ECONOMIC VALUATION OF THE TERRESTRIAL AND MARINE RESOURCES OF SAMOA

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Acronyms and Abbreviations

CVM	Contingent valuation method
DEC	Division of Environment and Conservation
GDP	Gross Domestic Product
NBSAP	National Biodiversity Strategy and Action Plan
PPP	Purchasing power parity
TEV	Total economic value
WTA	Willingness to accept
WTP	Willingness to pay
WWF	World Wide Fund for Nature (formerly World Widelife Fund)

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Executive Summary

The Gross Domestic Product (GDP) provides an indicator of the growth of the economy of a nation. The GDP for Samoa in 1999 was estimated to be ST$718.4 million at current market prices, of which agriculture, fishing and indirectly tourism are the main sectors of the economy. These sectors are directly and indirectly dependent on the natural resources. Yet, the essential role played by these resources to the economy is not explicitly known since many of their services are not transacted through formal markets and in some cases markets do not exist to permit payments for their utilisation. The Samoan national government has identified the need to incorporate the economic values of these natural resources into the National Bio-diversity Strategy and Action Plan (NBSAP) with the aim of integrating bio-diversity conservation with policy planning. With this in mind, research on the economic valuation of the marine and terrestrial resources, particularly forests, of Samoa was conducted from October 10 to November 24, 2000 and the findings are provided in this report.

This report is divided into three sections. The first section elaborates on the linkage between the natural resources and the economy, for which economic valuation is a tool used to explicitly monetised the various functions played by these resources. A detailed presentation is made of the basic principles of economic values, kinds of economic values and methods available to conduct the economic valuation exercise. The second section provides the case study results on the economic values of various functions played by these resources. These value estimates are aggregated to obtain the total economic values of Samoa's natural resources. These aggregated values are then compared to the GDP to provide an indication of their significance in enhancing a sustainable economic growth for the country. The last section provides for the lessons learned from this economic valuation exercise and how other South Pacific islands could benefit from it. Guidance is provided as to embark on similar exercises in other South Pacific Island countries.

Several case studies on the assessing the economic values of forest and marine resources were conducted. The economic values of these resources as a producer of fish, timber and materials for handicrafts involve the assessment of the resource rents contributions. The economic valuation technique adopted was the price-based residual valuation method of allocating appropriate opportunity costs to various scarce inputs used in production and assigning a fair profit margin to the resource user. The residual value was assigned as the resource rent contributed by the resources. The economic values of the recreational services provided by the resources were obtained using Mount Vaea Forest Researve Trail and Palolo Marine Reserve as study sites. The contingent valuation method (CVM) was used which involves surveying both domestic and international visitors to elicit their willingness to pay (WTP) a hypothetical entrance fee to enjoy the recreational benefits provided by these sites. Owing to the limitation of time, budget and research on basic bio-physical relationships between natural resource conservation and environmental stability, economic valuation of individual ecological functions could not be attempted. Instead

the economic values of the overall ecological functions of the forest and marine resources were ascertained by conducting another CVM study on respondents from various categories of profession. These respondents were limited to Samoan citizens. The CVM survey elicit the WTP to a hypothetical conservation trust fund for the purpose of ensuring the indirect use and option values of sustaining the ecological services generated by these resources.

To obtain an estimate of the total economic value (TEV) of the forest and marine resources of Samoa, values of various goods and services have to be aggregated. Original estimations of the economic value of the environmental goods and services from the above case studies were added with the values of other goods and services obtained using the technique of benefit transfers of values from the rest of the world. The dependence upon the latter source is motivated by the limitations of time, budget and local environmental impact studies. A wide range of value estimates was available in the literature. The approach was to adopt conservative value estimates after adjusting for purchasing power parity differences between Samoa and the country where the values were adopted.

Two estimates of the total economic value (TEV) of the goods and environmental services of the forest and marine resources were computed. The first estimate of ST$21.0 million per annum that is about 2.7% of the GDP refers to the TEV based on the perspective of the citizens of Samoa, by excluding the values generated for the benefit of the rest of the world. This contribution is significant given that these resources are either the primary input in the production of fishery (ST$15.6 million), timber (ST$0.48 million) and non-timber materials (ST$1.29 million) and the critical attractions to the tourism industry (ST$1.74 million) without which the multiplier from the tourism earnings could not have been generated. The life support ecological function of these resources need not have to be further justified contributing ST$0.6 million. The cultural values of these resources contributed another ST$1.3 million.

Including the value of global benefits or values generated by these resources for the benefit of the rest of the world, particularly on climate regulation services, nutrient cycling and biological control, the TEV was raised to ST$232.5 million per annum which is about 29.9% of the GDP of Samoa. This large value is mainly contributed by the large area of the marine resources of Samoa relative to its land area. The high value when including global benefits is suggestive of the essential role played by Samoa in providing ecological services to mankind. The large global benefits provide evidence for Samoa to seek international supports to conserve its terrestrial and marine resources to sustain the global benefits for mankind. There are various economic instruments available for the country to seek such supports from both internal and international sources.

The lessons learned from undertaking the economic valuation of the terrestrial and marine resources of Samoa is that it is possible to conduct such an exercise in other South Pacific islands given sufficient commitment on the part of the research team, adequate research budget and proper planning. The experience suggests that focusing on an in depth economic valuation research in specific sites having a dominant natural resource may be beneficial as a means of overcoming some of these limitations. To facilitate the valuation exercise, an inventory of the terrestrial and marine resources is an important information base for many economic valuation efforts. The inventory should be done using accountable sampling techniques, such as random or systematic random, so that the information could be used to obtain flows of goods and services on a per hectare and per year basis. This is necessary when aggregating the information for the whole area.

A major constraint is the lacking local scientific investigations on physical impacts of development upon terrestrial and marine resources that could hamper investigations on the indirect use values of ecological functions of these resources. Basic research on bio-physical environmental impacts is the foundation for good change in productivity economic valuation exercises. Hence, such basic research should be given equal priority by Governments of the South Pacific islands.

To encourage similar economic valuation research in the other South Pacific islands, a list is provided of goods and services provided by the terrestrial and marine resources that are potential targets for economic valuation exercise. This list also provides appropriate valuation methods for adoption.

1.0 Background of the Study

The Gross Domestic Product (GDP) provides an indicator of the growth of the economy of a nation. The GDP for Samoa in 1999 was estimated at ST$718.4 million at current market prices (Treasury Department 2000). Agriculture, fishing and indirectly tourism are the main sectors of the economy. Agriculture and fishing contributed 8.2% and 7.8% of the GDP respectively. While tourism earnings from international tourists were estimated to contribute 18.8% of the GDP (Samoa Visitors Bureau Research & Statistics Division 2000).

It is interesting to note that all these sectors are directly and indirectly dependent on the natural resources of the country. Agriculture is a land-based sector while fishing is a marine-based sector. Tourism is linked to the environment through the attraction of the natural resource to holiday international tourists. To enhance the continual growth of these sectors to the economy, these natural resources would have to be managed.

However, the essential role played by these resources to the economy is not explicit to the general public. The services provided by the terrestrial and marine resources are not directly accounted for in the GDP. The services are not transacted through formal markets and in some cases markets do not exist to permit payments for their utilisation. In other cases, the values of these services have been misallocated as returns to labour and entrepreneurship making wages and profits excessive. Hence, these natural resources tend to be treated as a 'free good'. This mis-interpretation has to be corrected to obtain general support for the conservation of these resources. The essential role and contribution of the natural resources to nation building has to be explicitly enumerated and acknowledged. This calls for efforts to placing monetary tags to the various bio-physical and ecological functions played by these resources.

The Samoan national government has identified the need to conduct an economic valuation of these natural resources. The results from the study will be used to develop a strategy on integrating biodiversity conservation with policy planning, such as land–use and coastal development, and incorporating environmental impact assessments of policies on natural resources.

With this in mind, research on the economic valuation of the marine and terrestrial resources, particularly forests, of Samoa was conducted from October 10 to November 24, 2000 and the findings are provided in this report.

This report is divided into three sections. The first section elaborates on the linkage between the natural resources and the economy, for which economic valuation is a tool used to explicitly monetised the various functions played by these resources. A detailed presentation is made of the basic principles of economic values, kinds of economic values and methods available to conduct the economic valuation exercise.

The second section provides the case study results on the economic values of various functions played by these resources. These value estimates are aggregated to obtain the total economic values of Samoa's natural resources. These aggregated values are then compared to the GDP to provide an indication of their significance in enhancing a sustainable economic growth for the country.

The last section provides for the lessons learned from this economic valuation exercise and how other South Pacific islands could benefit from it. Guidance is provided as to embark on similar exercises in other Pacific Island countries.

2 Natural Resources, Economic Development and Economic Valuation

2.1 Role of Natural Resource and Environment in Sustaining the Economy

Natural resources, in a sense, is a capital stock that generates flows of environmental goods and services that may be used to transform materials to enhance human welfare. In the process, this form of capital stock may or may not remain intact. This capital stock can take the following identifiable forms, physical natural capital, such as trees, fish and coral; and an intangible form, such as information stored in the natural capital stock,. These two forms of natural capital, in combination with other forms of capital, in particular man-made machinery and human capital resources can transform materials into products that can satisfy human welfare.

Environmental goods and services are partially captured in markets or not adequately quantified in terms comparable with those that are transacted in the market. Hence, they are often given little emphasis in the policy and decision making process. This neglect may compromise the sustainability of the economies of developing nations.

As an illustration, consider the coral reefs that provide habitats for fish. One aspect of their value is to increase and concentrate fish stocks. One effect of changes in coral reef quality or quantity would be observed in commercial fisheries markets, or recreational fisheries. But other aspects of the value of coral reefs, such as recreational diving and biodiversity conservation, do not show up completely in markets. Also consider the forests that provide timber through well established markets, but the associated habitat values of forests are also felt through recreational activities where there are no market transactions. Further, forest holds soils and moisture, and create microclimates, all of which contribute to human welfare in complex, and generally non-marketed ways.

The economic goods and services provided by natural resources and the environment represent the benefits human populations derive, directly or indirectly. They can be classified into goods and services that can be considered as commodities owing to their being transacted in the market, and ecosystem functions that are not transacted in the market. Non-transacted ecosystem functions refer to the habitat, biological or processes of the ecosystem such as, in nutrient cycling and in assimilation of waste. The list of environmental goods and services from terrestrial and marine resources is large. Following Costanza *et al*. (1997) and for the purpose of this report, the environmental goods and services can be classified as follows (Table 2.1):

2.2 Measurement of Economic Values

In economic analysis, any action that increases welfare is a benefit and any action that decreases welfare is a cost. A benefit is the value that people assign to goods and services, including those provided by the terrestrial and marine resource system. Such values are revealed by an individual's willingness to pay (WTP) to obtain those goods and services or willingness to accept (WTA) compensation for a loss of goods or services. A cost is the income forgone in other potential uses of environmental resources. Opportunity cost is the measure of the economic cost of the loss of options for using resources that results from making a particular choice. This includes financial costs since spending money in one way precludes the same money from being spent in a different way.

In an economic sense, value is used as a measure of a change in welfare and valuation is used to mean the process of valuing or estimating these values (Anon. 1995). Measurement of the above change in welfare can be categorized between consumers and producers:

2.2.1 Consumers

Economists can obtain the measure of WTP by consumers from the demand or marginal benefit curve of a typical marketed good. The area below the demand curve is the WTP or gross benefits society would receive from consuming a good. But in obtaining the good, payments would have to be made for purchasing it. This is the amount that would show up in national income indicators, such gross domestic product (GDP) which is the market price P_1 multiplied by the quantity Q_1 consumed. Net benefits from the consumption of the good are the gross benefits measured by the area below the demand curve ($OABQ_1$) less payments (OP_1BQ_1) (Figure 2.1). This net benefit measure (AP_1B) is termed consumer's surplus.

Table 2.1: Environmental goods and services from terrestrial and marine resources

	Goods and services	Functions	Examples
1	Gas regulation	Regulation of atmospheric chemical composition	CO_2/ balance. O_3 For UVB protection, and SO_x levels
2	Microclimate regulation	Regulation of global temperature, precipitation, and other biologically mediated climatic processes at global or local levels.	Greenhouse gas regulation, DMS production affecting cloud formation.
3	Disturbance regulation	Capacitance, damping and integrity of ecosystem response to environmental fluctuations.	Storm protection, flood control, drought recovery and other aspects of habitat response to environmental variability mainly controlled by vegetation structure.
4	Water regulation	Regulation of hydrological flows.	Provisioning of water for agricultural (such as irrigation) or industrial (such as milling) processes or transportation
5	Water supply	Storage and retention of water	Provisioning of water by watersheds, reservoirs and aquifers
6	Erosion control and sediment retention	Retention of soil within an ecosystem	Prevention of loss of soil by wind, runoff, or other removal processes, storage of silt in lakes and wetlands.
7	Soil formation	Soil formation processes	Weathering of rock, and the accumulation of organic material.
8	Nutrient cycling	Storage, internal cycling, processing and acquisition of nutrients.	Nitrogen fixation, N, P and other elemental nutrient cycle.
9	Waste treatment	Recovery of mobile nutrients and removal or breakdown of excess or xenic nutrients and compounds.	Waste treatment, pollution control, detoxication.
10	Pollination	Movement of floral gametes	Provisioning of pollinators for the reproduction of plant populations.
11	Biological control	Trophic-dynamic regulations of populations.	Keystone predator control of prey species, reduction of herbivours by top predators
12	Refugia	Habitat for resident and transient populations.	Nurseries, habitat for migratory species, regional habitats for locally harvested species, or over wintering grounds
13	Food production	That portion of gross primary production extractable as food.	Production of fish, game, crops, nuts, fruits by hunting, gathering, subsistence farming or fishing.
14	Raw materials	That portion of gross primary production extractable as raw materials.	The production of lumber, fuel or fodder.
15	Genetic resources	Sources of unique biological materials and products.	Medicine, products for material science, genes for resistence to plant pathogens and crop pests, ornamental species (pets and horticultural varieties of plants)
16	Recreation	Providing opportunities for recreational activities.	Eco-tourism, sport fishing, and other outdoor recreational activities.
17	Cultural	Providing opportunities for non-commercial uses	Aesthetic, artistic, educational, spiritual, and/or scientific values of ecosystems.

*Adapted from Costanza et al. (1997)

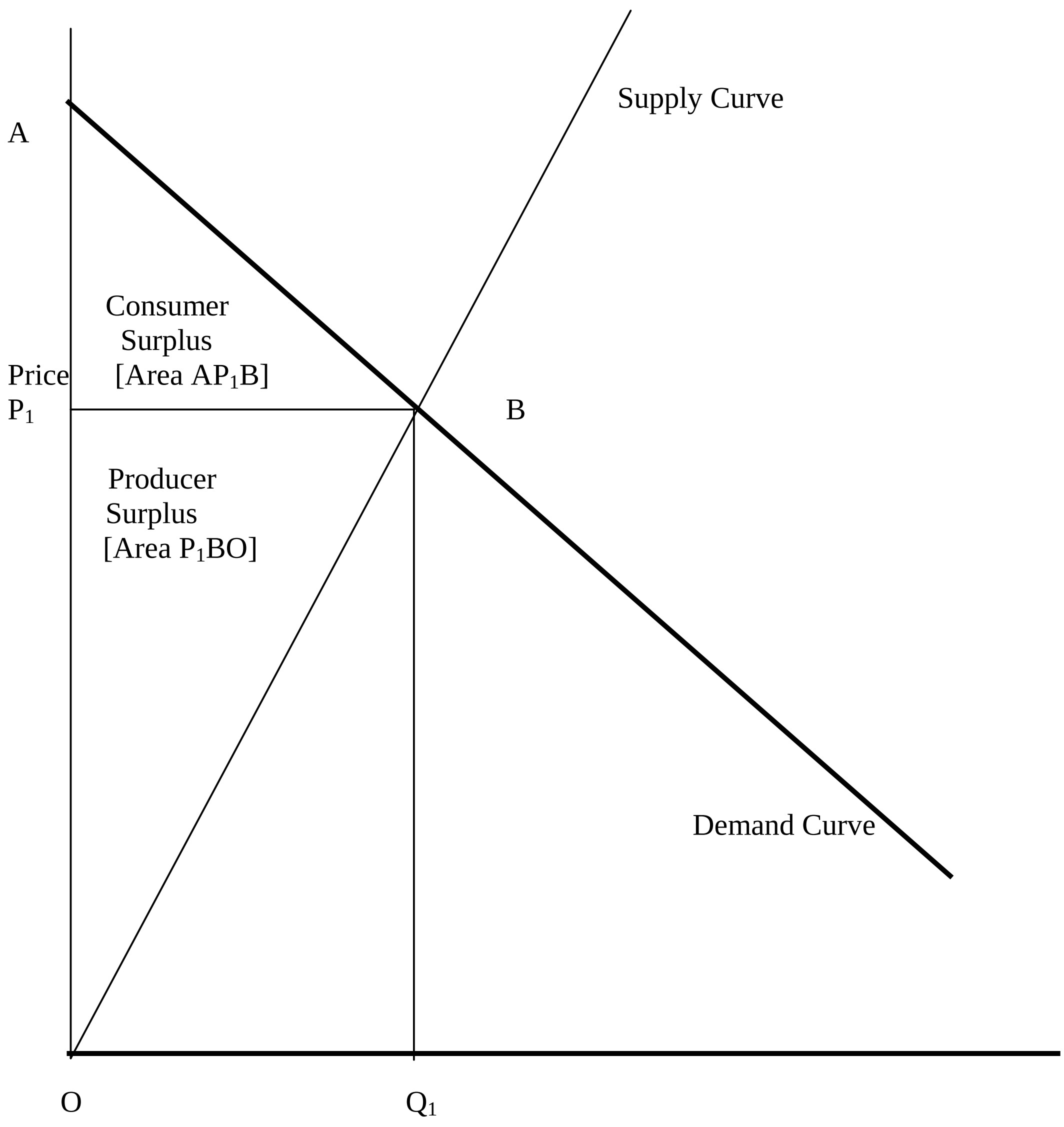


Figure 2.1: Measure of consumer's and producer's surpluses

2.2.1 Producers

Producer's welfare can be measured directly and is observable from the output market where a firm sells its production. Economists are concerned with the value obtained by the producer which is the total gross revenue (OP_1BQ_1) derived by the producer minus the total variable cost involved in production which is the area below the supply curve where Q_1 quantity of the good is produced [Area OBQ_1]. This value obtained [Area OP_1B] is termed producer's surplus. This producer's surplus measures the economic rent accruing to the producer from the ownership of fixed factors. This surplus is the returns to factors above the marginal cost because their supply is limited in the short run.

Figure 2.1 refers to a man-made substitutable good. Many environmental goods and services are only substitutable up to a point. Under this circumstance, the demand curve approaches infinity as the quantity available advances toward zero or a minimum threshold level of services, making the consumer's surplus to approach infinity. In this sense, demand curves for environmental goods and services are difficult to estimate. Another departure from Figure 2.1 is that the supply curves of environmental goods and services are more nearly vertical. This occurs due to the fact that environmental goods and services cannot be raised or reduced by economic system.

Human impacts upon the terrestrial and marine resources can affect both the consumers and producers of the goods and services offered by this forest. Consumers would include recreation visitors and the local community relying on the riverine and marine ecosystem as habitat for fishery. Producers would include private forest owner or State Governments entrusted as stewards of public forest land and territorial water who provide and generate goods and services from the forest and marine resources. Depending upon who is affected by the human impacts on the terrestrial and marine resource whether the consumer or producer, the relevant value measure is either consumer surplus or producer surplus respectively.

2.3 Categories of Terrestrial and Marine Resource Value

Following the taxonomy adopted by economists, the terrestrial and marine resource values can be categorized as:

2.3.1 Direct Use Values

These are values that accrue from the direct human use of terrestrial and marine resource, i.e. whose value is enhanced by the characteristics of the natural systems.

2.3.2 Indirect Use Values

Terrestrial and marine resource has an important role in the maintenance of ecological and environmental functions. Humans do not obtained any direct use in this capacity. But with these functions uninterrupted, various related uses and services can continuously be supplied such as regulated water flow into farmland. These benefits that accrued, as a result of the ecological and environmental functions are termed indirect use values.

2.3.3 Option Value

Some resources are not consumed currently but might be consumed in the future, hence the need for their reservation. This resulted in a category of value derived from preserving the option of maintaining terrestrial and marine resource for possible consumption in future time periods. It arises because of the uncertainty of future supplies of terrestrial and marine resource benefits, which apply, to both future direct and indirect use values. The value involves the benefit of risk-averting behavior in the face of uncertainties. This value can be considered as a payment of insurance premium now to ensure sufficient reserve is made of the terrestrial and marine resource for potential consumption.

2.3.4 Non-use (Existence and Bequest) Values

The above three measure the value of a terrestrial and marine resource that is being utilized or has potential of being use sometime in the future. But what happen when individuals do not derive any current or have any intention of obtaining future uses from the terrestrial and marine resource. Yet, these individuals have comfort in the thoughts that this resource exists now and in the future. Values that individuals derive from simply knowing that terrestrial and marine resources are conserved, for this and future generations are termed existence and bequest values.

The categorization of the goods and environmental services from terrestrial and marine resource in accordance to the economic value taxonomy is shown in Table 2.2

Table 2.2: Environmental goods and services of terrestrial and marine resource categorized according to economic valuation taxanomy

Direct Use Values		Indirect Use Values Of Ecosystem Functions	Option Value	Non-Use (Existence And Bequest) Values
Commercial Use Values: -Biomedical resources -Commercial fishing -Commercial forest products -Eco-tourism	Subsistent Use Values: -Fuel wood and building materials -Subsistence dependence: .Traditional medicines . Food (fish, game & edible plants)	-Nutrient retention and maintenance of nutrient cycles -Sediment retention -Shoreline stabilization -Flood control -Maintenance of water cycles -Regulation of climate -Absorption / decomposition of pollutants	All direct and indirect uses in the future, which involve some uncertainty.	All values not associated with direct or indirect human uses.

The classification of the valuation methods is given in Table 2.3 and described below:

2.3.5 Price-Based Valuation Methods

The price-based valuation methods, either the direct market prices or their shadow price versions are best adopted when the goods and environmental services are readily transacted in formal markets. The purchasing price of a good reflects the WTP at the margin and can be used directly in project evaluation. However, when market prices do not reflect their true opportunity costs, such as when there exist government subsidies as in agricultural production, then these prices would have to be adjusted back. This process is known as shadow pricing in order to obtain the true market prices. But many of the goods and services from terrestrial and marine resources are not sold and purchased in these formal markets. Hence other market valuation methods would have to be relied upon when evaluating them.

2.3.6 Surrogate Market Valuation Methods

The surrogate market valuation category is relied upon when there is no formal market to obtain a measure of value of the goods and services of interest and when there exist a related good and service which is transacted in the market. This method relies on the use of information about the marketed good to infer the value of the related good and services not transacted in the market. This category of methods is also termed revealed preference or observed market behaviour since value is inferred using data from observed behaviour in markets related to the environmental goods and services provided by the natural resource. Included in this category of valuation methods are the travel cost method (TCM) and the production function approach when one of the inputs is the non-marketed environmental goods and services.

In the case of the TCM, the recreational value of the environmental quality at a location in the terrestrial and marine resource is obtained from revealed information of the costs people incur to go there. The underlying assumption, other things being equal, is that an individual will not travel farther than required in order obtaining satisfactory recreation. The cost of travel of the marginal visitor (i.e. the one located at the farthest distance) whose travel cost can be computed is used as a basis of the maximum gross benefit or willingness to pay (WTP) of a visit to the recreational site. The value to each individual visit is then imputed as the difference between this WTP and his actual cost of travel.

Table 2.3: Categories of economic valuation methods

Price-Based Valuation	Surrogate Market Valuation	Constructed Market Valuation	Cost-Based Valuation
• Market Prices • Shadow Prices • Related or Substitute Good <u>For Evaluating</u> • Timber and • Non-wood Products (food, medicine, handicrafts) • Fisheries	• Hedonic Prices • Travel Cost • Production Function • Change in Productivity <u>For Evaluating</u> • Environmental Amenities • Recreation and Eco-tourism • Regulatory Ecological and Environmental Functions (flood • Control, nutrient cycling, carbon sink, micro-climate regulator)	• Contingent Valuation • Choice Modeling <u>For Evaluating</u> • Recreation and Eco-tourism • Ecological and Environmental Functions • Protected areas • Cultural and Religious Values	• Opportunity Cost • Restoration Cost • Replacement Cost • Relocation Cost • Preventive /Defensive Expenditure • Damage Costs Avoided • Dose Response Function <u>For Evaluating</u> • Damages to protected areas • Losses of ecological and environmental functions • Health impacts

2.3.7 Constructed or Hypothetical Market Approach

These valuation methods elicit consumer preferences of goods and environmental services that are not traded in markets directly from the consumers. For example people's willingness to pay (WTP) to obtain the object being valued or willingness to accept (WTA) to forego the benefits are obtained directly from respondents via a personal interview or mail questionnaire by posting relevant questions.

2.3.8 Cost-based Approaches

An alternative valuation method is the cost-based approach. This group of methods assesses either the costs of mitigating measures to raise the quality of the resource back to the features prior to the degradation or the costs of different preventive measures that would ensure the maintenance of the benefits provided by the resource.

Actual costs incurred as a result of environmental degradation to the terrestrial and marine resource can be used as a measure of the minimum benefits of avoiding environmental impacts. For example, the expenditures made to restore an environmental resource once it has been damaged by cyclones can also be used as a proxy monetary measure of economic value.

However, in most circumstances cost underestimates WTP, but not always. In principle, the costs incurred voluntarily in a free-market situation to mitigate or reverse an environmental impact will be equal to or less than the value of the impact. For example the costs of medical treatment would only reflect a lower-bound measure of the value of avoiding an adverse health effect of air and water pollution. This value has not taken into account the WTP to avoid the inconvenience of pain and sufferings. However, the costs of restoring a damaged environmental resource may sometimes exceed the benefits or value of restoration.

Table 2.4 provides a glossary of evaluation methods that can be used to evaluate the values of goods and environmental services from terrestrial and marine resources.

Table 2-4: Glossary of evaluation methods

Valuation Methods	General Description of Methods
Change in Productivity	A technique that evaluates the change in net revenue incurred by a firm from a change in the quality of an environmental input used in production.
Choice Modeling	A valuation technique of eliciting WTP involving a hypothetical market with a designed combinations of multi-attributes of the environmental resource. This technique can decompose the values of the individual attribute of the resource.
Contingent Valuation	A technique involving the construction of a hypothetical market in order to elicit the WTP or WTA as compensation involving the gain or loss of an environmental services respectively.
Damaged Costs Avoided	A technique based on the assumption that the costs of environmental degradation can provide a proxy measure of environmental benefits when the resource is intact.
Dose Response Function	A technique using the coefficient from a function linking physical damages to the level of environmental degradation.
Hedonic Pricing	A technique that uses the differential value of properties and wages to impute the value of a change in environmental amenities.
Market prices	Prices derived from buying and selling of goods and services in the market.
Opportunity Cost Method	A technique relying on the opportunity cost of time used in harvesting and collection of goods as a basis of valuation.
Preventive/Defensive Expenditure Method	A technique of valuing the environmental goods and services by measuring up-front payments to prevent degradation of the environment.
Production Function Approach	A technique to value the indirect use of regulatory ecological functions of a natural resource through their contributions to economic activities.
Related Or Substitute Goods Approach	A technique using information on the price of a related/substitute marketed goods to infer the value of goods that are not transacted in the market.
Relocation Cost Method	A technique involving the estimation of cost to relocate communities such that they obtain a similar level of benefits in their new location as derived at their original location.
Replacement Cost Method	A valuation technique relying on the cost of replacing specific natural ecosystem functions or assets with man-made production activity.
Restoration Cost Method	A technique of valuing intact ecosystem by measuring the cost to re-create the original ecosystem.
Shadow prices	Market prices adjusted to correct for any market and policy failures to reflect the full opportunity costs of resource use to society.
Travel Cost Method	A technique of estimating the recreational services of a site using information on the amount of money and time people spends getting to the site.

2.4 Application Of Economic Valuation In Policy Decision Making

Economic valuation of natural resources has applications in policy decision making on land use management. According to Barbier (1994), three applications are in:

- an impact analysis of project development and natural catastrophe upon the environment.
- a partial analysis comparing the viability of alternative development project options where natural resources are affected.
- a total economic valuation of the environmental goods and services of a natural resource system.

2.4.1 Impact Analysis

This is an extension of environmental impact assessment (EIA) whereby the physical impacts are monetarily appraised. It involves evaluating the changes that occurred to the environment as a result of a project or activity and a natural disaster. An example of impacts from an economic activity would be the bio-physical changes upon villages and fishing grounds located downstream from the establishment of an industrial project upstream. Not only bio-diverse resources are possibly displaced or degraded on site when development projects are improperly planned, there are also potential off-site repercussions that have to be accounted as well. Environmental effluents will be released affecting the streams flowing downstream affecting domestic clean water supply, and aquatic lives. Destructive costs would include reducing domestic water usage and declining fish catch over time. The industrial impact to the environment is equal to the foregone net benefits comprising of declining revenue from fishing and rising cost of acquiring water supply. This affects the livelihood of downstream users.

An example of impacts from natural disasters in the South Pacific islands would be evaluating the damages upon the natural resources of an island caused by natural disasters such as cyclones. Much potential goods and services provided by nature are destroyed or at least degraded and the monetary loss can be evaluated. An interesting case study of an economic impact assessment is that of the evaluation of the effects of the forest fires in Indonesia of 1997 that also causes trans-boundary haze to the South East Asian region (Glover and Jessup 1999).

2.4.2 Partial Analysis

This is related to an analysis of alternative development project options involving different levels of natural resource utilisation. An example involves a comparison of the feasibility of two project options between permitting timber harvesting and total protection of a forest catchment area. A case study in Malaysia is provided in Mohd Shahwahid *et al.* (1999). Timber harvesting could raise timber revenues but would inadvertently also raise the level of erosion and sedimentation of downstream water supply. This in turn raises the cost of water treatment plant and reduces the net return of the plant. The analysis involves comparing the returns from an option of timber harvesting from the forest to its opportunity cost, the reduced net return experienced by the water treatment plant. This is one loss and there are many more. Any benefit reduction or rising external cost to downstream users ought to be included as a component of total production cost to the timber harvesting project option.

2.4.3 Total Economic Valuation

This involves appraising the total economic value of a natural resource ecosystem. An example is the appraising of all the environmental goods and services in the peat swamp forest catchment conducted in Malaysia by Kumari (1995). Thie total value estimate can provide a measure of economic contribution of the peat swamp forest to the welfare of society. This measure is sometimes used as a basis to lobby for the establishment of protected areas but allowing restricted use by local communities.

If we let DUV be direct use value, IUV be indirect use value, OV be option value and EV be existence value then total economic value is

$$TEV = DUV+IUV+OV+EV \quad (2.1)$$

If DC is the direct cost of protection, and (NBF_x) foregone net benefit of alternative uses if the peat swamp forest is not protected, then total economic cost (TEC) is

$$TEC = DC+NBF_x \quad (2.2)$$

The criterion often used to ascribe for protected areas is for TEV to exceed the TEC of protection.

2.5 Economic Instruments: The Means to Capturing the Economic Values of Natural Resources

Natural resources are well known to provide various environmental goods and services, yet resource owners are only able to capture partially or none at all, these benefits provided to society. The problem remains as a mismatch between who pays for the cost of conservation and who receives its benefits. This stems from the public good nature of natural resource conservation which gives rise to the free rider problem, where people outside the conserved areas secure economic benefits without having to pay the full price for them (McNally and Mabey 1999). Resource owners who could either be the Government or local communities as the case would be in the South Pacific islands, would generally bear the brunt of the costs, in terms of indirect costs and / or foregone economic opportunities.

Economic valuation can help establish the monetary benefits of the terrestrial and marine resources. Mechanisms do exist to enhance resource owners' ability to capture these lost revenues with the lowest transaction costs. These mechanisms can be established locally or regionally and even at the international level. In some cases, community resource owners can take the lead in charging for the utilisation of these benefits while in other cases individual and regional Governments can take the initiatives. There are also international mechanisms that can be tapped to capture the global benefits provided by the terrestrial and marine resources of the South Pacific islands. Tables 2.5 and 2.6 provide a list of economic instruments that can be used to capture the economic values of forest and marine resources respectively.

Table 2.5: Economic instruments to capture economic values of forest resources.

Action	Mechanism
Increasing benefits from the suitable use of the forest	• Improved natural resource management. • Production of non-timber forest products. • Eco-tourism • Certified timber
Appropriating local values of forestry protection	• Visitor entrance fees. • Watershed fees. • Airport taxes.
Appropriating global values of forestry protection	• International donor contribution. • Carbon offsets. • Debt-for-nature swaps. • Bio prospecting. • Forest conservation trust. • Transferable development rights.
Forest use by timber companies	• Higher stumpage fees. • Environmental performance bonds. • Reforestation fund. • Fiscal measures in forestry.
Property rights	• Open access. • State ownership. • Private ownership. • Common property ownership.

Source: McNally and Mabey 1999

Table 2.6: Economic instruments to capture economic values of marine resources.

Action	Mechanism
Property rights and fisheries	• Quota based fisheries management. • Landing tax. • Input restriction. • Private fisheries: aqua culture. • Community management.
Increasing the benefits from the sustainable use of fisheries	• Responding to the international demand for fish. • Certified fisheries. • Promoting marine-tourism. • Processing the fish.
The loss of marine bio diversity	• Subsidising alternative fishing techniques. • Detection and fines for damage. • Effluent charges. • Fines and non-compliance fees. • Environmental liability. • Environmental bonds.
Appropriating external values from marine resources to owners	• Visitor entrance fees. • Watershed fees. • Airport taxes. • International donor contributions. • Debt-for-nature swaps • Bioprospecting • Marine conservation trust • Transferable development rights

Source: McNally and Mabey 1999

3.0 Case Studies of Valuing Samoan Terrestrial and Marine Resources

3.1 Introduction

The economic goods and services provided by these forest and marine resources and the environment represent the benefits human populations derive, directly or indirectly. These goods and services may not on their own have been transacted in the market but an end product produced from using them as inputs, or a related product may have a market. In cases when a related good and service is transacted in the market, we can then rely on the expenditures involved in producing this related good to obtain a value of the natural resource and environmental goods and services that are transacted in the market. In this report the environmental impacts of cyclones on timber production of forest was evaluated by the replacement cost method while the coastline protection function of mangroves was assessed by using the cost avoided method.

In cases when an end product has a market price and when we know the production cost structure, such as for saw milling and fishing, we can rely upon this information to work backwards to derive the resource rent that is the value of the flow of the resource stock. This has been illustrated in the case of forest stand and the role of the marine resource in food production by providing a habitat for fish.

Under certain circumstances, markets for environmental goods and services do not exist or are not well develop and there may not be markets for related goods and services. It is not possible to value these goods and services using market prices, prices of related goods and services, and expenditure approaches. A viable alternative may be the use of constructed or hypothetical market approaches such as contingent valuation method (CVM). The CVM elicits consumer preferences of goods and environmental services that are not traded in markets directly from the consumers. Monetary value for environmental goods and services is established through the setting up of a “hypothetical” market. What is implied by hypothetical market is that a consumer is given a description including using illustration, of the attributes of an environmental good and services and his or her preference is elicited. This method assumes that individuals have true, but hidden, preferences for the environmental good and service that can be expressed by their willingness to pay (WTP) or willingness to accept (WTA). People’s WTP to obtain the object being valued or WTA to forego the benefits are obtained directly from respondents via a personal interview or mail questionnaire by posting relevant questions. The CVM is one of only two techniques available to measure non-use values. For example the CVM can be used to place values that individuals derive from simply knowing that the rainforest is conserved for current and future generations, even though they have no intention of getting any use from it.

3.2 Price-based Evaluation Methods for Appraising Use Value of Commodity Production from Terrestrial and Marine Resources

3.2.1 Economic Value of the Marine Resources in Fish Production.

The fish landings are often classified into subsistence, artisanal small-scale fishing to meet the local market needs, and an industrial sector involving large-scale fishing for canneries and export. Analysis on resource rent estimation is conducted for the three classifications above.

The large alias are used in fishing tuna for exporting and include the large catamarans and mono hulls with length of 12 m to 24 m employing 6 sets of fishing gear per trip with 1,450 hooks per set. The trip length for the larger alias is at least 5 days. Medium size catamarans from 10 m to 12 m long employing 2 sets of fishing gear per trip with 325 hooks per set are also used in long line tuna fishing. The trip length is shorter normally 3 days. Because of the larger fishing boats, longer trip length and the adoption of long line fishing which requires the purchasing of baits, their direct and indirect cost are higher than that incurred by artisanal fishing which uses smaller canoes mainly (4m -4.5m long). The cost of subsistence fishing is very low owing to its short nightly fishing trip, the use of small canoes, some of which are home-made, and the use of various fishing gears including spear fishing, gill nets, cast nets and hand lines. Often no ice coolers are brought along.
The cost of production of each size of boats is given in Table 3.1 below. The direct or running cost of fishing dominates the total cost. But the larger monohulls had relatively large fixed costs owing to the larger investments. Fuel, bait and labour wages were the main running cost elements. In subsistence

fishing, only wages played an important role since the manual paddling canoe (paopao) was used and that other fishes caught were being used as baits when required. From the profitability indicators of Table 3.2, it is suggestive that fishing is a lucrative industry. An important factor for this is related to the issue of treating the fishery resource as a 'free good', and any surplus from effort being treated as the full return of fishing.

Table 3.1: The average production cost according to fishing categories (ST$/trip)

Categories of fishing vessel	Large Monohulls		Large Catamarans		Extended Alias		Alias		4-4.5m Canoe		2 m Aliar	
Cost Items	ST$/ trip	%	ST$/ trip	%	ST$/ trip	%	ST$/ Trip	%	ST$/ trip	%	ST$/ trip	%
Fuel, oil, hydraulic fluid for each trip	4,500	13.78	800	18.20	300	22.51	300	26.13	50	14.61	0	0.00
Bait	4,125	12.63	963	21.89	293	22.01	275	23.95	0	0.00	0	0.00
Ice	1,143	3.50	286	6.51	73	5.46	55	4.75	8	2.38	0	0.00
Food purchased for trip	600	1.84	125	2.84	70	5.25	50	4.35	10	2.92	5	16.72
Crew wages	9,331	28.57	1,361	30.95	346	25.93	259	22.58	135	39.33	23	77.57
Direct	19,700	60.32	3,535	80.40	1,082	81.15	939	81.76	203	59.25	28	94.29
Loan repayments	5670	17.36	380	8.64	101	7.60	84	7.35	45	13.26	0	0.00
Depreciation of vessel	4200	12.86	281	6.40	75	5.63	63	5.44	50	14.73	2	5.71
Insurance of vessel	1680	5.14	113	2.56	53	3.94	44	3.81	34	9.82	0	0.00
Boat repairs and maintenance	1260	3.86	84	1.92	23	1.69	19	1.63	10	2.95	0	0.00
Registration fees	150	0.46	4	0.09	0	0.00	0	0.00	0	0.00	0	0.00
Indirect	12960	39.68	862	19.60	251	18.85	209	18.24	139	40.75	2	5.71
Total	32,660	100.00	4,396	100.00	1,333	100.00	1,148	100.00	342	100.00	30	100.00

Table 3.2: Profitability indicators by fishing enterprises (%)

Profit rates	Large Monohulls	Large Catamarans	Extended Alias	Alias	4-4.5m Canoe	2 m Canoe
Over cost	74.41	88.95	58.27	37.81	57.34	158.56
Over sales	42.66	47.08	36.82	27.44	36.44	61.32

The assessment of the economic value of marine resource as a source food is important for a number of reasons:

- Valuation helps explicitly determine the direct contribution of this marine resource in the fishing activity.

The statistics on production, export and domestic consumption, provided the gross value of the flow of the fish commodity that has been harvested from the marine resources. The selling price of a commodity is made up of the sum of compensations for the use of various inputs in the production process. Inputs are used during fishing, which can be classified into running or direct cost inputs and fixed cost inputs. Running cost inputs include payments for fuel, bait, ice, labour man-hours and maintenance of fishing gear. Fixed inputs include man-made fixed assets like the boat and fishing gear.

In many cases, the important natural asset that serve as the habitat and feeding grounds, i.e. the marine resource itself, has been ignored or treated as a free asset.

The use of each of the above inputs, except the natural asset, is compensated. Compensations are made for the use of fuel, bait, ice, and labour (which may include the labour of the boat and fishing gear owner). The owner of the fishing gear and boat is being compensated by receiving in full the residual of the value of the fish caught net of the compensations for the other man-made inputs used. It is argued that a portion of the residual value ought to be allocated to natural asset as a return for providing services particularly as the habitat and feeding ground of the fish stocks. This portion is being argued as the economic value of the marine resource for the food production service.

- The loss or degradation of the marine resource constitutes an economic loss

When development projects are established, local communities are provided with new job opportunities, infra-structural facilities and social services. Not all projects are well planned and implemented. Under these circumstances the environment may receive the brunt from problems, such as poor sanitation and waste outlets. The marine resource being a drainage receptacle would be affected when the pollution exceed the threshold level. The health of the marine resources may decline and may affect the habitat and nursery grounds of fisheries. The economic loss cannot be associated with a total loss of the value of the fish landing which include among others the returns to labour and man-made assets. The affected labour has already gained employment from the new development projects, either because of better salaries or work environment. The fishing gear and boats may have resale or salvage values and could have been utilised in other fishing villages. Hence, in many cases the economic loss is only for the residual value associated to the marine resources that is termed as resource rent by economists. It is this change in productivity of the marine resources that require evaluation and not the whole loss in the value of the catch.

3.2.1.1 Basic Model

An approach of computing the resource rent from fishing is to calculate the difference between the selling price and the direct cost of production and other returns to fixed assets. Only a portion of the total profit margin is imputed and allocated to the fishermen for his effort and entrepreneurial skill, the rest is to be allocated as the rent from the marine resource for producing the stock of fish that is caught. This resource rent can be written as

$$R = FP - ALC - ARFC - APM \qquad (3.1)$$

where
R is the resource rent per unit of fish caught,
FP is the price per unit of fish sold to the middlemen,
ADC is the average direct cost of fishing, and transporting (not inclusive of a normal profit margin for the fishermen),
ARFC is the average rate of return to fixed capital investment by the fisherman
APM is the equitable profit margin allocated to the fishermen for the effort and risks taken up.

3.2.1.2 Computation Procedure

Rent valuation requires several sets of information including, prices, quantities of fish stocks caught and a breakdown of the cost elements. The formula for calculating the resource rent from the fish stock caught is adapted from the formula for stumpage timber value of Davis (1977), and Mohd Shahwahid and Awang Noor (1998) and is given below:

$$R = \sum_{i=1}^{n} \sum_{j=1}^{k} Q_{ij} \{ (FP_{ij} - ADC_j - ARFC_j - APM_j) \} \qquad (3.2)$$

where
R is the rent from the stock of fish caught per unit,

FP_{ij} is the selling price of fish species i and grade class j to the middlemen,
Q_{ij} is the quantity of fish caught by species group i and fishing boat/gear j,
ADC_j is the average direct fishing cost using fishing boat/gear j (not inclusive of the fisherman's equitable profit margin),
ARFC is the average return on investment estimated by $r\ FA_j$ (3.3)
and
APM_j which is the equitable profit margin allocated to the fishing boat/gear owner j which can be estimated by

$$\pi \sum_{i=1}^{n} Q_{ij}\, FP_{ij} \qquad (3.4)$$

where
r is average rate of return on investment
FA_j is the value of the fishing boat and gear
π is the average profit margin obtained by the entrepreneur for taking the business risk

From the above equations, it is expected that the variation in rents from a marine resource will result mainly from the differences in the stock of fish caught, fish prices that vary across species and grade classes, the direct fishing cost of each fishing boat/gear, the returns to fixed capital invested and the profit margin to be allocated to the entrepreneur who may be the boat and gear owner as well.

3.2.1.3 Economic Rent of Marine Fishery Resource

Data compiled from the Division of Fishery (2000), Passfield (2000), Passfield and King (2000), Passfield and Mulipola (1999) and further discussions with King, Passfield and Mulipola enabled the computations of the marine fishery resource rent. From Table 3.3, it is clear that the value of the marine resource for the production of fish is influenced by what profit margin is assigned to the different fishing enterprise. The higher the assigned profit margin, smaller is the resource rent. Also the resource rent per trip is higher for the large monohulls and catamarans owing to their larger catch. These boats conduct longer fishing days per trip and use more sophisticated fishing gears.

Table 3.3: Distribution of conversion return between the profit margin for the fishing enterprise and resource rent per trip basis by category of fishing vessel

Categories of fishing vessel	Large Monohulls		Large Catamarans		Extended Alias		Alias		4-4.5m Canoe		2 m Canoe	
Division of conversion return	ST$	%	ST$	%	ST$	%	ST$	%	ST$	%	ST$	%
Profit margin over sales (10%)	5696	23.30	831	21.22	211	27.16	158	36.45	54	27.44	8	16.31
Resource rent	18754	76.70	3084	78.78	566	72.84	276	63.55	142	72.56	40	83.69
Profit margin over sales (15%)	8544	34.94	1246	31.83	316	40.74	237	54.67	81	41.16	12	24.46
Resource rent	15906	65.06	2668	68.17	460	59.26	197	45.33	115	58.84	36	75.54
Profit margin over sales (20%)	11392	46.59	1661	42.44	422	54.32	316	72.90	108	54.88	15	32.61
Resource rent	13058	53.41	2253	57.56	355	45.68	118	27.10	89	45.12	32	67.39

The above analysis was based on a per trip basis. The frequency of fishing trips varied among the fishing categories. More frequent fishing efforts were being made by the monohulls, larger catamarans and alias owing to their larger investments and greater demand of the export tuna market. Artisanal and subsistence fishermen made less frequent trips. Summing up the resource rents over the year yields Table 3.4. Larger rents were generated by the larger boats with subsistence fishing providing the least.

Table 3.4: Distribution of conversion return between the profit margin for the fishing enterprise and resource rent per year 1999/2000

Categories of fishing vessel	Large Monohulls		Large Catamarans		Extended Alias		Alias		4-4.5m Canoe		2 m Canoe	
Division of conversion return	ST$	%	ST$	%	ST$	%	ST$	%	ST$	%	ST$	%
Profit margin over sales (10%)	189867	23.30	44302	21.22	16877	27.16	12658	36.45	2692	27.44	387	16.31
Resource rent	625148	76.70	164456	78.78	45261	72.84	22071	63.55	7118	72.56	1984	83.69
Profit margin over sales (15%)	284801	34.94	66453	31.83	25316	40.74	18987	54.67	4038	41.16	580	24.46
Resource rent	530215	65.06	142304	68.17	36822	59.26	15742	45.33	5772	58.84	1791	75.54
Profit margin over sales (20%)	379734	46.59	88605	42.44	33754	54.32	25316	72.90	5384	54.88	773	32.61
Resource rent	435281	53.41	120153	57.56	28384	45.68	9413	27.10	4426	45.12	1597	67.39

Table 3.5: Distribution of conversion return between the profit margin for the fishing enterprise and resource rent per year 1999/2000

Categories of fishing activity	Exports		Domestic		Subsistence		Total	
Division of conversion return	ST$	%	ST$	%	ST$	%	ST$	%
Profit margin over sales (10%)	2323463	29.10	145709	27.25	2907912	16.31	5377084	20.41
Resource rent	5660571	70.90	388997	72.75	14924528	83.69	20974096	79.59
Profit margin over sales (15%)	3485195	43.65	218563	40.88	4361868	24.46	8065626	30.61
Resource rent	4498839	56.35	316143	59.12	13470572	75.54	18285554	69.39
Profit margin over sales (20%)	4646927	58.20	291417	54.50	5815824	32.61	10754168	40.81
Resource rent	3337107	41.80	243289	45.50	12016616	67.39	15597012	59.19

The fishery production of Samoa was 9,159 mt valued at more than ST$51 million in 1999/2000. In terms of quantity, the main channel of distribution went to the export market involving some 4,480 mt or 49% with only 275 mt or 3% sold in the domestic market. A substantial quantity 4,400 mt (47.5%) were caught mainly for own consumption. Using this information, it was possible to compute the total resource rents that can be attributable to fishing in the marine resources.

Aggregating the various fishing categories into export and domestic markets and subsistence fishing and using the above ranges of resource rent by categories, the total economic values generated by the marine resources for the production of fish were computed (Table 3.5). For illustration, when the entrepreneur and vessel owner was assigned a profit rate over sales of 20%, then it can be concluded that the value of the marine resource rent for fish production was ST$15.6 million or 59.2 % of the conversion return. Conversion return is the total returns net of all accounted costs (except for the profit margin to the boat operator for risk taking). A greater proportion of rent was contributed by subsistence fishing due to a large number of subsistence fishermen, low production cost and high prices fetched by reef fishes.

3.2.1.4 Status of Rent Capture of Fishing, Possible Role for Economic Instruments

It is interesting to investigate the level of rent capture in marine resource for the purpose of food production in Samoa. Currently, there is no royalty and income taxes being imposed on the returns from primary production, particularly from the common marine resources. A license fee is being charged upon fishing vessels to limit and monitor the fishing fleet. The rates are as reported in Table 3.6. But the number of compliance has been very low. The fee is highest with an amount of ST$5,000 for vessels of length 15m and above and lowest with an amount ST$200 for vessels less than 12 m in length. This fee can also be treated as a source of revenue to the Government. Hence its collection can be considered as a source of state revenue and its collection is considered as an attempt to capture the resource rent.

Table 3.6: Vessel Categories with allocated fees and number of licensed fishing vessels

Vessel size	Fee	Number licensed	
< 12 m	200	16	
12m<15m	500	2	
≥15 m	5000	3	

An indicator of rent capture was computed to determine the proportion of the rent accounted by the licensing fee. The proportion of the fee over the computed average annual resource rent suggests that a small amount was being captured (Table 3.7).

Table 3.7: Indicator of rent capture by the Government from fishing

Categories of fishing vessel	Large Monohulls	Large Catamarans	Extended Alias	Alias	4-4.5m Canoe	2 m Canoe
Profit margin scenario	%	%	%	%		%
10%	0.80	0.12	0.00	0.01	0.03	0
15%	0.94	0.14	0.01	0.01	0.03	0
20%	1.15	0.17	0.01	0.02	0.05	0

This analysis is not intended to suggest that the Government should impose any resource utilisation levy upon subsistence fishermen. The inshore fishing is the main source of protein for many households and it would be counter-productive to discourage them from being involved in the productive economic activity. Fishing is one form of activity utilising their economic labour resources. Without an alternative to this source of low cost protein, regulations on rent capture would likely be broken. The main issue on subsistence and inshore fishing is more one of relieving the pressure upon the inshore resources. The instrument adopted by the Fishery Division is to encourage villagers to fish in areas outside the reefs. The instrument was the introduction of low cost boats capable of fishing over the reef slope and up to five miles beyond where the depths are 100m. This will enable fishermen not only to target reef fishes, but also pelagic fishes through trolling. Inadvertently, the fishermen could be raised from subsistence to artisanal and commercial fishermen

There is merit however, to introducing economic instruments to raise rent capture among commercial fishing, particularly upon the larger enterprises whose landings are meant for exports.

3.2.2 Economic Value of the Forest Resources in Timber Production.

To assess the economic value of forest as a producer of timber requires the estimation of the resource rent from logging activities. With knowledge of this value, concerned parties can better appreciate the economic significance of the resource and implement better resource planning and management. An important spin-off is to observe what proportions of rent was captured by relevant parties, state government and customary owners of the forest, and the concessionaires.

3.2.2.1 Basic Model

The resource rent that can be derived from allocating a logging concession is basically the value of the standing timber. Two approaches to estimate the resource rent from a concession are the market evidence method and residual value method. The market evidence method estimates the resource rent of a timber stand by comparing prices of standing timber recently sold from stands with similar characteristics as the subject stand. This method is a good first estimate of the resource rent. But in certain countries, there is no market transaction for the standing timber in forest concessions. Further, even if transactions exist no two concessions are exactly similar in terms of species, volume and wood quality composition, accessibility and terrain, resulting in erroneous estimates.

The residual value method calculates the resource rent as the difference between the selling price of the nearest end-product made from standing timber and the stump-to-market processing costs. The nearest product made from standing timber that has a market price is saw logs. Thus, the average resource rent of the standing timber equals the difference between the price a buyer will pay for the logs and the average total costs of harvesting (not inclusive of a fair or equitable profit margin for the concessionaire) and transportation from the forest to the buyer. Only a portion of the total profit margin is imputed and allocated to the concessionaire while the rest is to be allocated to the resource owner for both State owned and community forests.

The residual value method was used to estimate the resource rent of the logging concessions in Samoa. To determine the ability of resource owners of capturing this forest rent, the total value of forest taxes (royalty) chargeable upon the annual log production from the concession will be compared to the computed resource rent.

3.2.2.2 Computation Procedure

The resource rent refers to the value of standing trees with diameters of 30 cm and above. This diameter limit reflects that logs are marketable for diameter sizes larger than 30 cm diameter breast height (dbh). The formula for calculating resource rent for a logging concession was modified from Davis (1977), and Mohd Shahwahid and Awang Noor (1998):

$$SV = \sum_{i=1}^{n} \sum_{j=1}^{k} V_{ij} \{ LP_{ij} - ALC - APML_{ij} \} \qquad (3.5)$$

where
LP_{ij} is the log price of species group i and diameter class j,
ALC is the average harvesting cost per unit volume
$APML_{ij}$ which is the equitable profit margin allocated to the logging concessionaire for harvesting logs of species group i and diameter class j,
SV is the resource rent per hectare
V_{ij} is the volume of timber in species group i and diameter class j

A complication in the computation, is the absence of a formal market for saw logs. Hence the computation, begin from the price of rough sawn timber. This requires obtaining the breakdown of production costs from logging to saw milling. An interview of a saw miller was conducted to obtain this information. However, the lack of published data and the reluctance of the industry to provide detailed breakdown of their sawn timber production by species and grades disallowed detailed investigation. Equation 2.1 was modified in accordance to available data.

SV = V{[(STP - ASMC - APMSM) / CF] – ALC – APML } (3.6)

where

SV is the resource rent per concession per annum
V is the total volume of logs (m^3) harvested from each concession per year
STP is the rough sawn timber price per m^3
ASMC is the average saw milling cost per m^3
APMSM is the average profit margin for saw milling operations (ST/m^3 sawn timber)
CF is the conversion factor of logs into sawn timber
ALC is average harvesting cost per m^3
APML is the average equitable profit margin allocated to the forest concessionaire and logging contractor for undertaking logging operations.

The CF is to reflect that the volume of log inputs required in the production of 1 m^3 of sawn timber is more than the volume of the sawn timber produced. In fact the log volume is a reciprocal of the CF. This factor is dependent on the saw milling technology to recover as much output from the log input. The higher the CF, the less is the volume of log input utilised in production and the lower is the cost of log input. The multiplication of the cost of log input by CF provides us with a good estimate of the imputed price of one m^3 of log. The challenge is the appropriation of an equitable profit margin for the concessionaire (who is also the saw miller) and the logging contractor. The profit margin is the returns due to these two parties for undertaking the risk in the logging operations. We used three percentages for profit margin to provide an indicator of how sensitive the computation of resource rent would be to different assigned APML.

3.2.2.3 Economic Rent of Natural Forest Timber Resource

The average price ex-mill of Tava (*Pometia pinnata*) sawn timber is ST\$590/m^3. Based on a mill interview, a breakdown of the cost elements of this price was ascertained as reported in Table 3.8. Wage component was low in the saw milling industry of Samoa, probably due to low industrial job opportunities. Fuel, lubrication, electricity usage and mill maintenance also took up a small proportion of total cost. In many countries saw milling is quite a competitive industry with profit rates close to the national average returns on investment. Hence, we have allocated a profit rate over cost of 15% that was computed to be 12.79% over selling price. This procedure has enabled us to appropriate the residual as the cost of log procurement.

The cost of procuring the saw log inputs took a large component of saw milling cost since the production of every m^3 of sawn timber requires 2 m^3 of log inputs. This is due to the low recovery rate of 50% in the saw milling operation in Samoa. High log procurement cost was also due to the logging operations on difficult terrain.

Table 3.8: The average production cost and price of saw milling

Cost elements	ST \$/m^3	%
Cost of procuring saw logs***	348.31	71.32
Wages and salaries	68.40	14.01
Fuel, lubrication, electric, mill maintenance	53.77	11.01
Indirect cost*	17.88	3.66
Average total cost	488.36	100.00
Profit margin**	71.64	12.79
Average sawntimber price	560.00	100.00

* includes depreciation, insurance and interest charges
** includes profit margin for saw milling operation
***inclusive of profit margin for the concessionaire and the logging contractor.

The information on the costs of log procurement was further disaggregated into direct and indirect cost of logging, and a residual termed conversion return. The term conversion return was introduced by Davis (1979) to depict the surplus of prices from the production cost. The latter is not inclusive yet of a fair profit margin to be allocated to the concessionaire for taking the risk in the logging business. The conversion return is to highlight the fact that the surplus is comprised of two components, the profit margin to the concessionaire and a residual to be accounted as the value of standing timber for the resource owner. Currently, the conversion return included the profits share for the concessionaire (who happens to be the saw miller) and the logging contractor, and the royalty payment made to the Government and resource owners.

Table 3.9 provides the estimated cost structure of the logging operations under three different scenarios of overall profitability of the logging operation: low (30% of total sales), medium (43%) and high (50%). A conversion return of ST$50.20/$m^3$ was obtained for the low profitability scenario, ST$87.79 /$m^3$ for medium scenario and ST$106.20m^3 for the high scenario.

Table 3.9: Estimated breakdown of logging costs (ST$/$m^3$)

	ST/m3 log	Proportion
Direct logging cost	40.72	55.87
Indirect logging cost	32.16	44.13
Average total cost	72.87	100.00
Conversion return	101.28	58.16
Average log price	174.16	100.00

The value of stumpage from the forest resource is dependent on how much we allocate as fair profit margin to the concessionaire and logging contractor for undertaking logging business risk. In tropical log producing countries like Malaysia, a range of between 20 to 30% of sales were used given that logging can be a risky business. Three scenarios were provided 20%, 30% and 40% of selling price. Table 3.10 provides the resource rents estimated under the three scenarios of overall profitability assumed for the concessionaire and logging contractor.

Table 3.10: Distribution of conversion return between the profit margin for the concessionaire and resource rent.

Scenario for fair profit margin to the concessionaire		Division of conversion return	ST $	%
20%	Per volume basis (/m^3)	Profit margin for concessionaire and logging contractor	34.83	34.39
		Resource rent	66.45	65.61
	Per ha of forest land	Profit margin for concessionaire and logging contractor	731	34.39
		Resource rent	1395	65.61
30%	Per volume basis (/m^3)	Profit margin for concessionaire and logging contractor	52.25	51.59
		Resource rent	49.04	48.41

	Per ha of forest land	Profit margin for concessionaire and logging contractor	1097	51.59
		Resource rent	1030	48.41
40%	Per volume basis (/m^3)	Profit margin for concessionaire and logging contractor	69.66	68.78
		Resource rent	31.62	31.22
	Per ha of forest land	Profit margin for concessionaire and logging contractor	1463	68.78
		Resource rent	664	31.22

The estimated resource rents decline from ST$66.45/m^3 or ST$1395/ha to ST$31.62/m^3 or ST$664/ha as the profit margin for the concessionaire and logging contractor is raised from 20% to 40% of sales.

From the above results, it is clear that the value of the natural forest for timber production is influenced by what profit margin we are willing to assign to the integrated logging and saw milling operations and to the logging contractor. Using the annual production figure of 1997 (Table 3.11) as a basis, it was possible to compute the economic value of the natural forest as a producer of timber material (Table 3.12). When we assigned a low profit margin to the concessionaire and logging contractor, the annual economic value of the forest was estimated as ST$ 1,012,185. If a higher profit margin was assigned, the value declined to ST$481,636.

Table 3.11: Log production according to concessionaire, 1997

Name of company	Log concession area (ha)	Log production (m3)	Estimated (ha)	Remaining years
	(ha)	(m3)	Harvesting area	of harvesting
Samoa Forest Corporation	1,290	5707	190	7
Bluebird Company A	1,540	5,019	186	8
Bluebird Company B	490	2,970	149	3
Sava'i Sawmillers Ltd	555	692	69	8
Strickland Brothers	605	844	47	13
Total	4480	15232	641	7

Source: Iakopo (1998)

Table 3.12: Estimated annual economic value of the natural forest in timber production.

Scenario for fair profit margin to the concess-ionaire and logging contractor	Division of conversion return	ST $
20%	Resource rent	1012185
30%	Resource rent	746910
40%	Resource rent	481636

3.2.2.4 Status of Rent Capture of Timber Resource: Possible Role for Economic Instruments

The literature has alluded to the fact that the logging allocation system in the tropical region has failed to capture the potential forest resource rents that are due to governments as custodians of natural tropical forests (Sulaiman, 1977; Boado, 1988; Gillis, 1988a; Vincent, 1990; Vincent et al., 1993; Awang Noor et al. 1992). Estimates of the percentage rent capture by forest royalties vary from 11.4% for the Philippines (Boado, 1988) through 33.2% in Indonesia (Gillis, 1988a) and 12.1% in Peninsular Malaysia (including forest premium payments as computed from Vincent, 1990) to 82.8% in Sabah, Malaysia (Gillis, 1988b). As early as 1977, Sulaiman pointed out that a high proportion of the resource rent arising from logging (about five times the share for standing timber value that the State Government as stewards of the forest resource actually received) was extracted by the licensees and logging contractors. Almost similar observation was made by Vincent (1990). But further investigation in the late nineties, suggests that this problem can be overcame by tendering out the logging concessions (Mohd Shahwahid and Awang Noor 1998) .

It is interesting to investigate the level of rent capture in Samoa. A royalty rate ST$0.22/boardfoot or ST$7.77/m^3 is being charged upon every m^3 of timber extracted. When the concession falls on a community forest, the community would receive two-thirds of the royalty collected while the rest would go to the Government. Table 3.13 provides an index of the proportion of royalty collected to the estimated resource rents. A low index suggests that the resource rent has been inequitably extracted by the concessionaire. This implies that the resource owners have not been capturing the full rent due for the extraction of their natural resources by the concessionaire. Opportunities exist to capture a higher proportion.

Table 3.13: Indicator of rent capture by resource owners from the annual coupes of the forest concessions

Scenario for fair profit margin to the concessionaire	% Rent capture
20%	11.69
30%	15.85
40%	24.57

Other countries in the tropical region have resorted to introducing various kinds of instrument to capture a higher proportion of this resource rent. Malaysia imposes three instruments. A royalty charge similar to that applied in Samoa is updated from time to time to keep track with changing prices of logs. The royalty rates that go to the State treasury, vary according to the species of logs extracted. A lump sump area-based forest premium is charged as a compensation for surrendering the rights of the stumpage to the concessionaire. Finally, a volume-based silvicultural cess is charged for every m^3 of logs extracted to finance future forest rehabilitation activity. Further, to raise the efficiency of rent capture, a tender is increasingly being imposed to concessionaires and this system has proven to be successful. In the conventional practice, saw millers purchase logs from logging licensees who have the experiences and access to obtaining logging rights. With the tender system, logging rights are being allocated to the highest bidder. Saw millers have directly gone into the tendering process and at times paying a fee equal in value to the resource rents (Mohd Shahwahid and Awang Noor 1998). Saw millers are satisfied to attain a normal profit or even a slight loss. Log procurement activity is being treated as a cost center while the saw milling is being treated as the profit centre enhanced by the security of log supply.

3.2.3 Economic Value of the Forest Resources in Handicraft Production

Subsistence employment has traditionally formed the basis of Samoan economic and social structure. A high proportion of the people's livelihood in Samoa, particularly in the rural areas, is still derived from subsistence activities. If we define subsistence activity as non-monetary sectors in the Gross Domestic Product (GDP), the proportion of imputed non-monetary component of the Gross Domestic Product (GDP) is still substantial, albeit declining from 22% in 1994 to 17% in 1999. In 1994, non-monetary agriculture was 4.71 times that of the amount of market transactions of agricultural produce. Similarly, in fishing and handicraft, the non-monetary proportions were 4.61 and 2 times respectively of the value of the transactions in the market. With the exception of handicrafts, these proportions have declined somewhat by 1998 to 2.52 (agriculture), 0.51 (fishing) and 2 (handicraft).

Despite the importance of subsistence activities, we observed that even in the remote areas of Uofato village, the role of the market economy has increasingly been accepted by households with much handicrafts like kava bowls, Samoan weapons and mats getting into the market every week.

3.2.3.1 Valuing Resources from the Forests as Inputs to Household Production

To estimate the value of resources collected from the forest as inputs to household production, a study was conducted at the village of Uofato. The village is renowned for its carvers and the high quality products they produce (Lockwood 1971). The researcher accompanied by four officers (Faraimo Tiitii, Talie Foliga, Afele Faiilagi and Christine Ainuu) from the Department of Environment and Conservation (DEC) interviewed 7 households or 41% of the total number of households in the village for the main handicraft activities conducted mainly wood carvings, mat making, collection and drying of 'ava herbs and boat making.

The aim of the interview using a prepared questionnaire as a guide was to acquire data on the non-timber forest products (NTFPs) being collected and utilised for further processing and to determine the extent of their marketability. NTFPs serve important economic and subsistence functions to rural communities (Arvidsson 1996). The objective was to assess the economic values of the forest resources as inputs to the household production system. Resource rents were computed for products transacted in the market. The selling value of the products was deducted for costs of all direct inputs and imputed value or shadow wages of the labor of the individual collector and processor. The latter was assessed using the opportunity cost concept of time spent. In this case the imputed net return from subsistence fishing. The questionnaire used to solicit this information is provided in the Appendix I.

The result of the investigation on the cost and earning of wood carving and the associated resource rent due for the Ifelele tree is reported in Table 3.14 below. Working on an assumption of the carvers earning a fair profit margin for undertaking business risk and uncertainty of 30% over sales, it was possible to extract the proportion of resource rent to be allocated to the Ifelele tree in providing the wood material in use by the carvers. The proportion was estimated to be around 24.5% of the sales of various kava bowls and Samoan weapons. As a preliminary investigation on the value of the forest resources as inputs for the handicraft, the resource rent proportion of Ifelele over sale value of carving products was used as a basis for obtaining the resource rents on NTFP resources at the national level.

Table 3.14: Cost and earning structure of handicraft activity from 1 Ifilele tree and 1m3 of Ifelele log

	Per 1 Ifelele tree		Per 1 m3 Ifelele log	
	ST	%	ST	%
Sales	6860	100.00	6075	100
Value of Ifelele tree	1680	24.48	1487	24.48
Wood extraction cost	220	3.21	195	3.21
Processing cost	2902	42.30	2570	42.30
Total production cost	4802	70.00	4253	70.00
Fair Profit*	2058	30.00	1823	30.00

* assuming that a fair profit for risk undertaken is 30% over sales

The historical growth rate for the handicraft sector was computed as 0.8% per annum. Using this rate of growth to project over its 1998 contribution into the GDP, the sectoral GDP was estimated as ST 2.2 million for the year 2000. The component of resource rent in the sectoral GDP can be estimated by taking into account the proportion for resource rent over the wholesale price and deducting profit margin for the handicraft retailers. Out of the final sales value in the sectoral GDP, it was estimated that the resource rent component for the NTFP resources was ST432,447 for the year 2000.

3.3 Constructed Market Approach of Appraising Use Value of Recreational Services Provided by Forest and Marine Resources: Using The Contingent Valuation Method (CVM)

The forest and marine resources provide habitats for timber trees and fish. In the case of coral reefs, one aspect of their value is to increase and concentrate fish stocks. One effect of changes in coral reef quality or quantity would be observed in commercial fisheries markets. But other aspects of the value of coral reefs, such as recreational snorkelling and biodiversity conservation, do not show up completely in markets. Also consider the forests that provide timber through well established markets, but the associated habitat values of forests are also felt through unmarketed recreational activities. Further, forest holds soils and moisture, and create microclimates, all of which contribute to human welfare in complex, and generally non-marketed ways.

In the following case studies, the CVM is used for valuing the recreational services offered by forest and marine reserves and valuing the ecological functions offered by these resources. Both these services are being provided as a public good. A feature of a public good is non-rival consumption whereby an individual consumption does not jeopardise the amount available to another individual, up to a certain threshold level or carrying capacity. The significant characteristic of a public good is that once provided, there is zero incremental cost of an additional use of the good by another individual. Hence adding up each individual's WTP would provide an estimate of aggregate WTP of society for the resource.

A clear and realistic "hypothetical" market for the recreational service at Mount Veae Forest Reserve and Palolo Deep Marine Reserve were prepared to allow visitors to express their willingness to pay (WTP). These reserves provided recreational opportunities as well as other ecological functions. Hence, the questionnaire highlighted all these benefits provided by the resources and then reminded the visitors that only the recreational benefits are being evaluated (Appendixes II and III). To maintain the quality of this service, the reserves would have to be managed and this set up a reason for payment for the services where no direct payment is currently extracted at Mount Vaea and an additional payment is being sought for Palolo Deep.

To elicit the WTP the payment vehicle selected was the entrance fee that is a user fee instrument. The advantage of this payment vehicle is that the respondent can easily relate to it and is being use currently at Palolo Deep. An entrance fee per entry is deemed appropriate since a fee is hypothetically sought directly from the user.

To ensure that the WTP responses are valid, standard socio-economic questions on age, income, gender and education of respondents were collected. The intention is to isolate the influences of these variables on WTP by running a multiple regression of WTP on these variables. To ensure that no pro-environment behavior is swaying the WTP bids, information on membership of environmental groups was also asked.

The payment card approach was used to elicit visitor's WTP. The respondent was given a series of values to choose from to best represent his maximum WTP. The advantage of this approach is that the respondent has to only bid once from the range provided.

Prior to implementing the CV survey, the questionnaire was assessed by several staffs of the Unit of Conservation within the DEC. An informal focus group brain-storming inquiry was also conducted on other staff members of the Division as a means of verifying whether all the relevant issues relating to the valuation exercise have been covered and whether the use of the entrance fee payment vehicle is appropriate? A pilot test on sample respondents was conducted at the sites and further adjustments were done on the questionnaire. Owing to the short time period of the study, all respondents visiting the sites during the surveys were interviewed. However, when visitors came in a group, only one respondent was randomly selected. Several staff of the DEC helped in conducting the survey including Faraimo Tiitii, Talie Foliga, Cordelia Toto'a Ale and Christine Ainuu.

During the data analysis, it was found that the rate of non-responses, protest responses, zero or extremely high responses was low not exceeding 10%. Further inquiries suggested that the zero WTP responses were a combination of zero worth or income constraints with a small proportion expressing that natural resource recreational services should be a free good and to be provided by the Government.

The mean and median WTP bids were computed. A multiple regression between the WTP bids and selected socio-economic variables were run and the statistical goodness of fit tested. The sample mean WTP was multiplied by the number of total visitors to obtain the total value.

3.3.1 Mount Vaea Forest Reserve Trail

Mount Vaea Scenic Forest Reserve Trail is an interesting outdoor recreational opportunity being offered by a tropical rainforest resource. In this national park a botanical garden has been established with the plantings of many forest tree species interspersed among existing matured trees at the foot of Mount Vaea Scenic Reserve. A trail to the summit of Mount Vaea leads to the tomb of Robert Louis Stevenson, the renowned author tomb. The trail is a steep climb providing a view of the beautiful forest, birdlife and great views of Apia. There are two paths to choose from, the long trail which is about 45 minutes, meanders gently up through the forest, whereas the 30 minute short trail goes straight up with numerous steps cut into the hillside.

The scenic reserve trail is located 4 kilometres from Apia up along the Cross Island Road. Walking to trail will take up about an hour. Currently there is no entrance fee being charged. The trail is being maintained by the DEC of the Department of Lands, Surveys and Environment.

3.3.2 Palolo Deep Marine Reserve

Palolo Deep Marine Reserve is a fringing reef encompassing a lagoon comprising a total area of 137.5 ha (Toloa 1999). It was formalised as a marine reserve in 1974, under the National Parks and Reserve Act and remains the only recognised national marine reserve in Samoa. This reserve offers an excellent swimming site with a snorkelling opportunity. The best snorkelling site is about 100 metres off-shore where a deep chasm in the lagoon is filled with colourful corals and marine fishes.

The marine reserve is located a kilometre north east of Apia's town centre around the corner from the wharf towards Vaiala Beach. Walking to the reserve will only take a few minutes. Currently, the reserve is being managed by a private party under the supervision of the DEC. There is an entrance fee of ST$2 per entry collected by a private entrepreneur who manages the site.

3.3.3 Eco-tourism/Recreational Values

Tables 3.15 and 3.16 provide the results of the CV survey on the maximum WTP for visitors to the Mount Vaea Forest Reserve and Palolo Deep Marine Reserve. The mean WTP overall for both sites were ST$1.77 and ST$4.75 respectively suggesting that Samoa being an island and known for its marine attractions mainly for snorkelling, swimming and sunbathing, was perceived to have a higher value to the visitors. International visitors have placed higher WTP values in both attractions. But the disparity was more distinct in Mount Vaea than the Palolo Deep.

Table 3.15: Economic values of the eco-tourism/recreational services of the Mount Vaea Forest Reserve

WTP/entrance	Domestic Visitor	International Visitor	Overall Visitor
Mean (ST$)	0.67	4.25	1.77
Standard Error (ST$)	0.16	1.9	0.43
Median (ST$)	0.25	2.75	1
Range (ST$)	0 to 3.5	0 to 10	0 to 10

Table 3.16 : Economic values of the eco-tourism/recreational services of the Palolo Deep Marine Reserve

WTP/entrance	Domestic Visitor	International Visitor	Overall Visitor
Mean (ST$)	4.25	4.88	4.75
Standard Error (ST$)	0.56	0.51	0.40
Median (ST$)	4.50	4.00	4.00
Range (ST$)	2 – 6	2 – 17	2-17

A regression analysis was conducted to identify significant factors influencing the WTP values placed by visitors. Only the age was a statistically significant explanatory variable with a negative coefficient for the case of Mount Vaea (Table 3.17). This is not surprising since the climb up the summit makes this site more attractive to younger visitors. The independent variables used were not able to explain the behaviour of the WTP bids for the case of Palolo Deep (Table 3.18). The small sample size obtained at Palolo Deep was not able to show sufficient variability in the independent variables to explain the WTP bids of visitors. For a better statistical diagnostic, further data collection is suggested.

Table 3.17 : Regression analysis between WTP and selected independent variables for Mount Vaea Forest Reserve

Variable	Coefficients	t Stat
Intercept	1.86	1.38
Marital status	0.77	1.78
Age	-0.06	-3.13**
Sex	0.18	0.53
Educational level	0.02	0.19
Income	8.45E-06	1.34
NGO membership	0.54	0.79

**Statistically significant at the 5% level of significance
F statistic of 2.48 is statistically significant at the 5% level of significance
R^2 and adjusted R^2 are 0.36 and 0.22 respectively

Table 3.18 : Regression analysis between WTP and selected independent variables for Palolo Deep Marine Reserve

Variable	Coefficients	t Stat
Intercept	6.54	2.35**
Marital status	0.48	0.59
Age	-0.06	-1.42
Income	8.43E-06	0.90
Number of visit per year	-0.02	-0.63
Sex	-0.60	-0.82
Educational level	-0.05	-0.02

**Statistically significant at the 5% level of significance
F statistic of 0.93 was not statistically significant
R2 was 0.16

3.3.4 Total value of recreational opportunities

While all visitors may contribute to the development of tourism, the trend in holiday arrivals perhaps gives the best indication of what is happening in the tourism sector. Holiday arrivals reflected discretionary travellers (compared to business and those visiting relatives and friends) and are likely to make a more direct demand and to value the recreational services generated by forest and marine resources. In 1999, 26,323 or 30.9% of the total are holiday arrivals, compared to 39.0% visiting relatives and friends, 12.7% business travellers and 17.3% others.

According to the Tourism Council of the South Pacific (1992), the average length of stay of all visitors in 1990/91 was 7.1 nights. This has a bearing on the number of sights that an average visitor could visit. Pleasure visitors consider the natural scenery as the second most important attraction of Samoa followed by the suitable climates which is related to beach visits, reinforcing the general consensus within the industry of the visitor's preference upon scenic touring and beach related activities in Samoa. 61% of pleasure visitors took on organised tour excursion averaging 2.3 tours per person.

Assuming that an average pleasure visitor makes about 3 sites per tour, this implies that about 7 sites were visited. This is about the same number of sites mentioned by most visitors interviewed at, either Palolo Deep or the Mount Vaea Forest Reserve. An estimated 5 sites were related to the beach and marine resource-based activities with forest related resources taking up only 2 sites.

Obtaining the economic values of recreational services generated by these resources to domestic visitors is difficult as no complete records are kept of their arrivals. The number of domestic visitors to Mount Vaea and Palolo Deep can be estimated more easily being the sample site. Visitors often arrived either in the morning or late afternoon at Mount Vaea. An average daily weekday visits of 10 people and weekend of 15 can be made, This was after adjusting for occasional group visits at the site. A weekly visitation rate of 80 people per week is acceptable. Giving a ratio of 60% domestic visitors, this implies that over a year a number of 2300 visitors can be accounted for with the rest being international tourists. This implies that Mount Vaea Forest Reserve has generated an economic value of ST$ 1,544 per annum for domestic tourists and ST$ 6,515 per annum for international tourists. In the case of Palolo Deep, there were also no records of the number of visitors, especially for a breakdown between international and domestic visitors. Although, this information could be obtained from a record of entrance fees, but this information could not be accessed since the site is being operated by a private enterprise. But it can be ascertained from the survey exercise that an average count of about 15-20 daily visits is a good estimate. The lower visitation rates could be used as an average, taking into account declining visitations during rainy days. Domestic visitors accounted for less than 10% of the total. Using these assumptions, the economic values of the recreational services generated by Palolo Deep were estimated to be ST$22,136 per annum for international tourists and ST$2,142 per annum for domestic visitors.

It was not possible to estimate the total economic values of recreational services by the forest and marine resources for domestic visitors as no records of daily visits to all the sites in the country was available. It is recommended that the Division of Environment and Conservation make a systematic inventory of visitors to various forest and marine resource recreational sites. Accounting for the number of visitors and visit habits would form a basis of understanding the significant role being played by the environment in the leisure and hospitality industry. This would form a stronger case for management budget request from the Government.

Taking the international visitor's mean WTP to Palolo Deep as a proxy for the economic value of a visit to a marine-based resource, while the WTP to the Mount Vaea Forest Reserve for a visit to a forest-based resource, it was possible to estimate the total economic value of the recreational services provided by the marine and forest resources. Multiplying the number of holiday arrivals by the number of sites and the mean WTP for each kind of resource, provided an estimate of the economic value of the recreational services to international visitors of ST$346,545/year for forest resources and ST$1,390,329/year for marine resources (Table 3.19).

Table 3.19: The economic values of recreational services provided by the forest and marine resources

Resource	Consumed by International Visitors (ST$/year)	Consumed by Domestic Visitors* (ST$/year)
Forest	346,545	1,544
Marine	1,390,329	2,142
Total	1,736,874	

* For Mount Vaea Forest Reserve and Palolo Deep only. The national sum could be multiples of these depending on an inventory of domestic visits.

3.4 Constructed Market Approach of Appraising Indirect Use and Option Values of Ecological Functions of the Forest and Marine Resources: Using The Contingent Valuation Method (CVM)

As mentioned earlier the CVM takes the elicitation of the WTP bids for the ecological functions played by the terrestrial and marine resources in Samoa directly to the respondents. The CVM study was done specifically to elicit the WTP of Samoan citizen for the indirect use and option values generated by the ecological functions of these resources. Hence the study did not capture the value of these resources to the citizens of the rest of the world. Special attention was given in the interview to highlight the fact that the resources of interest are limited to the tropical rainforest, mangroves and marine resources.

Respondents were specifically requested to ponder upon a simplified but informative list of benefits or services generated by each of these resources. For instance, in the case of the rainforest, respondents were given a brief description of the functions of the tropical rainforest that included*:*

- The forest plays an essential role in regulating the composition of gases in the atmosphere. For instance, the forest absorbs carbon dioxide from the air, store the carbon and releases oxygen back to the air.
- It provides important climate regulation services both locally and globally. Forests contribute cooler temperature, and rain to areas located adjacent to them.
- It regulates hydrological flows. Rain is intercepted by the forest tree canopy, slowing down the speed of the rainfall and allowing time for the soil to absorb the water droplets. This prevents large surface flows into rivers and causing sudden floods. Instead water seeps slowly below the land surface, regulating river flows and preventing drought. Hence forests store and retain rainwater to augment our water supply needs.
- It plays an important role in erosion control by retaining soils in the uplands and avoiding siltation of dams, lakes and wetlands.
- It serves as the habitat, and refuge for wildlife. With their habitat intact, wildlife does not disturb our farms.
- It is rich with biological diversity comprising of birds, reptiles, large animals, trees, palms, orchids and climbers which are the source of gene pools for breeding programs to support future human needs for food, and medicine.

Only the indirect use functions and benefits were illustrated since the survey was intended to capture the indirect and option values of the ecological functions of the resource only. The direct use values, such as timber, and non-timber products and recreational services were evaluated by other valuation methods. To ensure that respondents were clear with this point, they were reminded again of the rain forest's role as a source for human needs for food, raw materials like timber, herbs and medicine, and also the place where we seek opportunities for recreation, spiritual tranquility and education. Similar descriptions were made of the other two resources. Then the respondents were asked to place their maximum WTP per annum to a conservation trust fund for use to manage these resources, not only for current generations but also for their children in the future.

The survey was conducted on local populations only at various locations in town. Where it is known that the general populace, including urban and rural, will be around such as the mall, market place and parks.

The questionnaire was translated into the Samoan language. The target was to obtain about 250 respondents to provide a sufficient variation in the socio-economic characteristics of the respondents within limits of time and budget. But, this sampling level was not met owing to the difficulties in obtaining qualified enumerators from the National University of Samoa who are the time sitting for their examinations. Nevertheless, we have the services of Cordelia Toto'a Ale and Christine Ainuu from DEC to supervise five high school students as enumerators, as well as conduct the survey themselves in the Samoan language.

3.4.1 Ecological and Environmental Values

The analysis was conducted on 100 samples. The mean annual economic values of the ecological functions of the natural forest and marine resources was estimated to be ST$4.75 per person with a median at ST$3.50 per person (Table 3.20). These flow of values were quite evenly distributed among the three resources considered with a slightly higher bids being placed upon the rainforest and the lowest to the mangrove which is very much misunderstood by the citizens of the developing nations as a waste land.

Table 3.20: Economic values (indirect use and non-use) of the ecological functions of the natural forest and marine resources

Annual WTP/person per annum	Rainforest	Marine	Mangrove	Natural Resource
Mean(ST$)*	1.90	1.63	1.22	4.75
Standard Error(ST$)	0.21	0.25	0.17	0.55
Median(ST$)	1.45	1.00	0.65	3.50
Range(ST$)	0 to 8	0 to 12	0 to 6	0 to 20
Total Value	323,106	277,242	207,152	807,500

*Round-numbered

Using a population size of 170,000 for Samoa, it can be suggested that the ecological function of the natural forest and marine resources are perceived to an provide economic value of ST$807,500 per annum. The breakdown by resources, suggests that the rainforest provided ST$323,106/year, marine resource contributed ST$277,242/year with the rest by the mangrove resource. It was found that the mean WTP bid did vary among employment status, particularly from home-makers and those working in the private sectors (Table 3.21).

Table 3.21 : Average economic values of the ecological functions of the forest and marine resources

Work Status	Mean WTP/person (ST$/year)
Government services	5.63
Private sector	7.64
Unemployed/looking for job	5.92
Retired	4.25
Full time student	2.83
Homemaker	6.67
Working family plantation	2.88
Others	1.00
Overall	4.75

A regression analysis was conducted running the WTP bids with selected socio-economic variables. Age and educational level were statistically significant variables explaining the bids. The positive coefficients suggest that more elderly and educated respondents tend to have positive perceptions on the ecological functions of these resources and tend to be more willing to contribute higher bids to the conservation fund.

Table 3.22 : Regression analysis between WTP and several independent variables

	Coefficients	t Stat
Intercept	-4.91	-1.91
Marital	-1.86	-1.59
Age	0.20	3.30**
Sex	-0.73	-0.71
Education level	0.37	2.35**
Income	4.02E-05	0.53
Resident	1.31	1.30

**Statistically significant at 5% level of significance

3.5 Cost-based Approach of Assessing the Value of Mangrove Forests in Reducing Coastal Erosion and Coastline Protection: Cost Avoided Method

Sometimes a resource generates benefits that are difficult to measure, such as improved environmental quality. Information on avoided expenditures to reconstruct or re-establish environmental quality that is loss with the degradation of the resource, can be used to help place the values in perspective. When protecting a mangrove forest maintains coastlines and avoids coastal erosion, then information on the cost avoided for the construction of rock seawall or on the acquisition of sand for beach replenishment, can be used. This information, although based on costs avoided, gives some indications of the minimum magnitude of benefits produced by avoiding adverse environmental impacts (Dixon and Sherman 1990).

Mangrove forest is known to support coastline protection by reducing coastal erosion. With mangrove forest intact, the Government could avoid constructing seawalls or conduct beach replenishment activities by dumping sand on the coastal land eroded. The latter alternative being more expensive owing to the need to dredge sand from lagoons when the Government does not have the proper plant (dredger) and equipments. Further, such an activity would have to be maintained on a regular basis. The construction of seawalls is the most practical approach when dealing with coastal erosion in Samoa owing to the availability of rocks domestically and the fact that a seawall requires very low maintenance (Phillips, pers comm). But given the clearance of mangrove forests for development has been controlled in Samoa, there is no seawall construction yet to mitigate this problem.

Nevertheless, the benefit derived from the coastline protection provided by the mangrove forests can be assessed by using the avoided cost approach. The expenditure avoided can be estimated on the construction of seawalls along the coast, currently still lined with mangroves.

A typical seawall in Samoa has three layers of substrates namely (i) a filter cloth, (ii) a gravel filter layer of 0.6m thickness, and (iii) 2 layer rip-rap of 1.2m thickness composed of two layers of rocks. The function of the seawall is to dissipate the energy of the waves as they come in contact with the rock layer. The filter cloth and gravel filter layer are to allow water to seep pass without eroding the soil while the rock layer is to ensure the coastal land remain intact. When the current of the waves is strong a wall with a slope of 1:3 is often constructed. For coastal areas where mangroves are typically placed, e.g. at bays, the current of the waves are slower. The design of the seawall is less demanding requiring a reduction in thickness or width of both the gravel filter layer and the layer rip-rap and with a more steeper slope of 1:2. These adjustments mean that the expenditure on the construction is reduced to not less than by half (Phillips pers com).

A typical construction cost of a seawall is ST$500 per linear meter (lm). The cost structure is comprised of roughly 20% on labour, 35% on rental of equipments, and 45% on material. Considering the lower specification of the seawall design needed if constructed in coastal areas currently with mangrove forests in Samoa, the construction cost would not be more than 50% i.e. less than ST$250/lm. The coastline covered with mangrove forests was estimated to 25.7 km by an FAO study (Anon. 1989). This suggests that the cost avoided on seawalls can be as large as ST$6,425,000. Like the seawalls, with the mangroves protected the shoreline is sustainably protected. Hence, the value estimated represent the capitalised value of this ecological function. The value of the annual flow of this service has to be divided by the number of years we believed that the mangrove resource can be protected from being cleared. The estimate obtained is a subset of the many ecological functions generated by the natural forest resource.

3.6 Assessing Economic Values of Other Goods and Services Using Benefit Transfers Technique

In determining the total economic value of Samoan terrestrial and marine resources we relied on both original estimations of environmental goods and services from the above case studies and benefit transfers of values available from the literature for the other goods and services not possible to obtain originally. The latter source is motivated by the limitations of time, budget and most of all for lack of scientifically investigated environmental input-output production and environmental damage functions for Samoa.

A comprehensive literature review was conducted on value estimates of various environmental goods and services not originally computed in this study. Information collected included the valuation methods adopted, location, date and stated value. Main guidance was obtained from Costanza *et al.* (1997) who in computing the value of the world's ecosystem services and natural capital, have compiled much of the values needed and converted them into 1994 US$ equivalent on a per ha per year basis. They did this by adjusting for purchasing power parity differences between the country of origin to that of the United States. This makes conversion to Samoan Tala (ST$) equivalents easier by using a single ratio of purchasing power GNP per capita for the United States to that of Samoa. These values were then inflated to the year 2000 by multiplying with the consumer price index of Samoa. This exercise is necessary to adjust for income effects. A wide range of value estimates was available in the literature. The approach was to adopt conservative value estimates and those obtained using methods that are in line with the definition outlined in this report. When recent research outputs were known, they were preferred over those used by Costanza *et al* (1997). An illustration of the procedures involved in the benefit transfer exercise is given in Table 3.23 below:

Table 3.23: An illustration of benefit transfer on carbon sequestration/fixation values of natural forests

Source	Adger *et al* (1992)	Formula
Method	Avoided damage cost	
Study site	Mexico	
Policy site	Samoa	
1994 Unit values (US$/ha/yr)	88	
1994 Unit values (ST$/ha/yr)	216.11	US$88 x (ST$2.46/US$1)
1994 adjusted purchasing power parity unit values (ST$/ha/yr)	10.81	ST$216.11 x 0.05*
2000 adjusted purchasing power parity unit values (ST$/ha/yr)	13.32	ST$10.81 x 1.23 #
2000 adjusted purchasing power parity total values (ST$/ha/yr)	2,298,940	13.32 x total forest area @

Note:* purchasing power parity = [Samoan GDP per capita / US GDP per capita]
[Consumer price index $_{2000}$]/[Consumer price index $_{1994}$]
@ 172,567 ha (source: Iakopo 1998)

Benefit transfer technique was used to obtain value estimates of the forest resources in ecological functions, provision of food and raw materials, and cultural values (Table3.24). The value of the ecological functions was transferred for two reasons. Firstly, to provide an alternative estimate to the CVM estimate obtained in this study and secondly to obtain a breakdown of the values of the ecological functions. The total value of the ecological function is ST$4.3 million which is higher that the value obtained directly from this study. This disparity in estimates will be discuss latter in this section. The values for food and raw materials collected from the forest resources were transferred because a full account was not conducted in this study owing to limitations of time. While the cultural values was not attempted at all in this study.

Table 3.24: Economic values of selected functions of the forest resources obtained using benefit transfer techniques

Functions	Source of Value Estimates	Economic Valuation Technique	Research Site	Purchasing Power Parity Adjusted	
				Unit Value ST$/ha/yr	Benefit Transfer Value (ST$)
Climate regulation	Adger et al (1995)	Avoided damage cost	Mexico	13.32	2,298,940
Disturbance regulation	Ruiteenbeek (1989)	Change in productivity	Cameroon	0.30	52,249
Water regulation	Kumari (1995)	Change in productivity	Malaysia	3.78	653,108
Water supply	Kumari (1995)	Change in productivity	Malaysia	1.67	287,368
Erosion control	Mohd Shahwahid (1999)	Change in productivity	Malaysia	1.25	214,874
Genetic resources (Support for species & genetic diversity)	Adger et al (1992)	Option value	Mexico	4.84	835,978
Total Ecological Function					4,342,517
Total Food	Lampietti and Dixon (1995)	Net income	various countries	0.91	156,746
Total Raw Material	Lampietti and Dixon (1995)	Net income	various countries	9.39	1,619,708
Total Recreational Services	Lampietti and Dixon (1995)	Travel cost method	various countries	2.12	365,740
Total Cultural Values (Folklore & cultural support)	Adger et al (1992)	Contingent valuation method	Mexico	0.15	26,124
Total					6,510,835

Benefit transfer technique was used to obtain value estimates of the marine resources in ecological functions, provision of construction material and aquarium trade, and cultural values (Table 3.25). As in forest resources, a very large value was obtained for the ecological function of the marine resources. This value is ST$207.7 million per year many times more that that estimated using CVM in this study. A detailed explanation is given below for this disparity in values. A large part of this value is accounted by the role of the ocean as a receptacle for effluent sink and in nutrient cycling, climate regulation service and in biological control. The values transferred from other countries for the provision of construction materials such as sand and dead corals, and fish for the aquarium trade are relatively small.

Table 3.25: Economic values of selected functions of the marine resources obtained using benefit transfer techniques

Functions	Source of Value Estimates	Economic Valuation Technique	Research Site	Unit Value ST$/ha/yr	Benefit Transfer Value (ST$)		
					Coral Reefs	Open Seas	Overall Marine Resources
Climate regulation service	Costanza et al. (1997)	Economic activities	Global	5.80	40,007	75,335,349	75,375,356
Receptacle for effluent sink and nutrient cycling	Costanza et al. (1997)	Replacement cost	Global	9.40	64,868	122,149,483	122,214,351
Biological control	de Groot (1992) for coral reefs and Costanza et al. (1997) for open sea	Shadow price for coral reefs and replacement cost open seas	Galapagos for coral reefs and global for open seas	0.76 for Coral reefs and 0.74 for open seas	5,118	9,834,902	9,840,020
Disturbance regulation	Spurgeon (1992)	Replacement cost	Philippines	34.10	235,263		235,263
Waste treatment	de Groot (1992)	Replacement cost	Galapagos	8.78	60,585		60,585
Habitat/refugia	de Groot (1992)	Shadow price	Galapagos	0.06	418		418
Total Ecological Functions					406,258	207,319,734	207,725,993
Construction material	de Groot (1992)	Market value	Galapagos	0.79	5,432		5,432
Aquarium trade	McAllister (1980)	Market value	Philippines	0.44	3,029		3,029
Total Raw Material					8,461		8,461
Premium estate value	Costanza et al. (1997)	Change in real estate value	Global	9.84	669	1,258,867	1,259,536
Books/films	de Groot (1992)	Market value	Galapagos	0.003	21		21
Education / research	de Groot (1992)	Market value	Galapagos	0.11	731		731
Total Cultural Values					1,421	1,258,867	1,260,288
Total					416,140	208,578,602	208,994,742

3.6.1 Explanations for the High Estimated Values for Climate Regulation Services, Nutrient Cycling and Other Ecological Functions from Benefit Transfer Approach

The high estimated values obtained on ecological functions for both forest and marine resources from benefit transfer technique are best illustrated from observing the case of the marine resource. Samoa's sea area composes 100,000,000ha of territorial sea and 150,000,000 ha of exclusive economic zone, with a total of 250,000,000 ha. Costanza *et al.* (1997) disaggregated the value of the ecological functions of the seas into climate regulation services (carbon sink), effluent sink and nutrient cycling, biological control, coastal damage regulation, waste treatment and habitat/refugia for fisheries (Table 3.25). For instance, globally the marine resource is valued at US$38/ha/yr in 1994 for their climate regulation function. Converting this value into the currency of Samoa (ST$), adjusting this to reflect purchasing power parity (PPP) in Samoa, and inflating to year 2000 has provided a value of ST5.8/ha/yr giving a total of ST75,375,356/yr. Climate regulation by the marine resources surrounding Samoa is shared globally and not just by the citizen of Samoa. Arguably it can be valued in accordance to the WTP of world citizens, hence not requiring adjustment for PPP. Nevertheless, we maintain our convention to place a value in accordance to the perspective of Samoa. However, it should be noted that despite this adjustment, the value of the ecological functions obtained was an overestimation on at least two counts.

Embedded in the Costanza *et al.* (1997) estimate is the climate regulation services enjoyed by mankind. The adjustment for PPP only lowers down the benefits acquired by the citizens of the rest of the world proportional to the living standards of the citizens of Samoa. To obtain a more appropriate value to Samoa is to multiply this estimate by a fraction of the population of Samoa to the rest of the world.

Second, many of the estimated value of the ecological functions used the cost-based approach in particular the replacement cost, damage avoided cost and avoided costs of alternative controls. These methods reflect the total expenditure required to recreate the ecological functions by alternative control mechanisms, hence providing cost savings. Alternatively the approach is to look at the total cost avoided from the prevention of the occurrence of damages to society arising from the ability of the natural resources to continue with their ecological functions. While these approaches appear logical, they do not necessarily reflect the citizens' willingness to pay. As important as the ecological functions are but each member of society has individual priorities which may be dominated to meeting private needs first.

Nevertheless, reporting the above estimated values with global benefits from benefit transfer technique does have an advantage. This figure is interesting as it reveals that Samoa would stand to gain from any development of international trading in carbon emission/offset rights. Judging by the size of Samoa's open seas relative to its terrestrial area, the country could request substantial incremental international funding for its role in generating global climate regulation services.

The role of benefit transfer technique in generating values of other functions generated by the terrestrial and marine resources whose economic values were not assessed in this exercise is essential. For forest resources, these include the transfer of direct use values on food and other raw materials collected and cultural values as revealed by society. For marine resources, these include the transfer of values on construction material, aquarium fish trade, and cultural values derived from higher real estate values for land facing the ocean, and educational materials.

3.7 Total Economic Values of Samoa's Forest and Marine Resources

The Gross Domestic Product (GDP) provides an indicator of the growth of the economy of a nation. The GDP for Samoa in 1999 was estimated at ST$718.4 million at current market prices (Treasury Department 2000). Agriculture, fishing and handicraft can be classified as marine and terrestrial based sectors of the economy. The growth of tourism related industries such as hotels and restaurants and transport are partially dependent upon the marine and forest resources that provide eco-touristic attractions. Holiday tourists are attracted to Samoa for these natural attractions and cultural attributes. Agriculture, fishing and handicraft contributed 8.2%, 7.8% and 0.3% of the GDP respectively. While tourism earnings from international tourists were estimated to contribute 18.8% of the GDP (Samoa Visitors Bureau Research & Statistics Division 2000).

The goods and services provided by the terrestrial and marine resources though essential, have not been directly accounted for in the GDP for several reasons. These goods and services are not transacted through formal markets and in some cases markets do not exist to permit payments for their utilisation. In other cases, the values of these goods and services have been misallocated as returns to labour and entrepreneurship making wages and profits excessive. Hence, these natural resources tend to be treated as a ‘free good’.

The economic valuation exercise conducted above is aimed at reallocating the excessive wages and profits attributed to labour and entrepreneurship during the extraction and utilisation of the goods and services provided by the terrestrial and marine resources back as resource rents. This occurs particular so in the production of timber, non-timber forest products and in fishing. When no market exists for the utilisation of these resources such as for recreational services and the indirect benefits of the ecological functions of the terrestrial and marine resources, the values were elicited directly from society using the contingent valuation method. The estimated total economic value (TEV) of the goods and environmental services of the selected terrestrial and marine resources is provided in Table 3.26 and Table 3.27 below. Table 3.26 refers to the TEV based on the perspective of the citizens of Samoa, by excluding the values generated for the benefit of the rest of the world. While Table 3.27 refers to the TEV based not only on the perspective of the citizen of Samoa but including those values generated by these resources for the benefit of the rest of the world, particularly on climate regulation services, nutrient cycling, and biological control.

The total economic value accruing to the citizens of Samoa was assessed at ST$21.0 million per annum that is about 2.7% of the GDP. This contribution was significant given that these resources are either the primary input in the production of fishery, timber and non-timber materials and the critical attractions to the tourism industry without which the multiplier from the tourism earnings could not have been generated. The life support function of these resources need not have to be further justified. Including the value of global benefits into the computation of TEV raised the value to ST$232.5 million per annum which is about 29.9% of the GDP of Samoa. This huge value is mainly contributed by the large area of the marine resources of Samoa. The high value when including global benefits is suggestive of the essential role played by Samoa in providing ecological services to mankind.

There exists evidence for Samoa to seek international supports to conserve its terrestrial and marine resources to ensure the global benefits to mankind are sustainable. There are various economic instruments available for the country to seek such supports from both internal and international sources.

Table 3.26 : Total economic value of the forest and marine resources as accrued to the citizens of Samoa

Resources	Goods & Services	Kinds of Value	Economic Valuation Techniques		
				ST/year	Percentage
Forestry	Timber~	Direct Use	Economic Rent	481,636	2.29
	Raw Materials for Handicrafts	Direct Use	Economic Rent	432,447	2.06
	Other Raw Materials	Direct Use	Benefit Tranfer of Net Income Estimates	705,625	3.36
	Food	Direct Use	Benefit Tranfer of Net Income Estimates	156,746	0.75
	Recreational@	Direct Use	Contingent Valuation	346,545	1.65
	Ecological functions^	Indirect & Option	Benefit Tranfer of Avoided Damage Cost, Change in Productivity, and Option Value Estimates	323,106	1.54
	Cultural Values		Benefit Tranfer of Contingent Valuation Estimates	26,124	0.12
Sub-total				2,472,230	11.77
Marine	Fishery~	Direct Use	Economic Rent	15,597,012	74.25
	Raw Materials		Benefit Tranfer of Net Income Estimates	8,461	0.04
	Recreation@	Direct Use	Contingent Valuation	1,390,329	6.62
	Ecological functions^	Indirect & Option	Benefit Tranfer of Replacement Cost, Market Price and Shadow Price Estimates	277,242	1.32
	Cultural Values		Benefit Tranfer of Market Price Estimates	1,260,288	6.00
Sub-total				18,533,332	88.23
Total Forestry and Marine Resources				21,005,562	100.00

*may include values of resources collected from marine resources
@from international visitors only. Information on the number of domestic visitors is not available yet.
using a social discount rate of 4%
~ value varies as a sensitivity analysis of fair profit margin for business risk is conducted
^ Willingness to pay of citizens in Samoa only

Table 3.27 : Total economic value of the forest and marine resources of Samoa including global benefits accruing to the rest of the world

Resources	Goods & Services	Kinds of Value	Economic Valuation Techniques		
				ST/year	Percentage
Forestry	Timber~	Direct Use	Economic Rent	481,636	0.21
	Raw Materials for Handicrafts	Direct Use	Economic Rent	432,447	0.19
	Other Raw Materials	Direct Use	Benefit Tranfer of Net Income Estimates	705,625	0.30
	Food	Direct Use	Benefit Tranfer of Net Income Estimates	156,746	0.07
	Recreational@	Direct Use	Contingent Valuation	346,545	0.15
	Ecological functions^	Indirect & Option	Benefit Tranfer of Avoided Damage Cost, Change in Productivity, and Option Value Estimates	4,342,517	1.87
	Cultural Values	Direct Use & Option	Benefit Tranfer of Contingent Valuation Estimates	26,124	0.01
Sub-total				6,491,640	2.79
Marine	Fishery~	Direct Use	Economic Rent	15,597,012	6.71
	Raw Materials	Direct Use	Benefit Tranfer of Net Income Estimates	8,461	0.00
	Recreation@	Direct Use	Contingent Valuation	1,390,329	0.60
	Ecological functions^	Indirect & Option	Benefit Tranfer of Replacement Cost, Market Price and Shadow Price Estimates	207,725,993	89.35
	Cultural Values	Direct Use	Benefit Tranfer of Market Price Estimates	1,260,288	0.54
Sub-total				225,982,083	97.21
Total Forestry and Marine Resources				232,473,723	100.00

*may include values of resources collected from marine resources

@from international visitors only. Information on the number of domestic visitors is not available yet.

using a social discount rate of 4%

~ value varies as a sensitivity analysis of fair profit margin for business risk is conducted

^ These are the global benefits provided by resources of Samoa. Not restricted to the willingness to pay of citizens

3.8 Impact Analysis: An Illustration of the Effects of Cyclones Ofa and Val upon the Forest Resource

When cyclones destroyed a stand of forest for timber production, the costs of replanting can over time retain back the tree stand to provide the intended wood. The information on the replacement costs incurred, can provide a measure of benefit loss from the effect of the cyclones. This replacement cost gives some indications of the magnitude of benefits lost by adverse environmental impacts.

The replacement cost approach of analysing the value of adverse environmental effects examines human responses to these impacts. The response involves the investments that would be needed to offset or mitigate the environmental damage. The replacement cost approach looks at how much it would cost to replace productive assets that are damaged by an environmental impact. The case of the loss of quality timber stand caused by the cyclones of 1990 and 1991 can be valued using this replacement cost approach. The fact that a replanting programme is planned, implies that the forest stand is valuable and the cost of replanting can provide a measure of the property loss.

An analysis was conducted to determine the cost of reforestation in Samoa as a means of measuring the value of damages upon forest stands for timber production caused by the cyclones of 1990 and 1991. In the past, natural forests have supplied the majority of Samoa's sawn timber needs and export earnings. Samoa is rapidly exhausting its indigenous, merchantable forests. Cyclones Ofa and Val have prevented plantation forests from immediately replacing indigenous forests as a source of domestic wood supply. How much is this loss to the country?

The area of forest plantation was thought to be 4,392 ha by the end of 1989 (Oliver 1999). After the disastrous cyclones in 1990 and 1991 only 351 ha of fully stocked plantations or 8% of initial area were available (Table 3.28). An impressive campaign to replant these destroyed stands were undertaken. As of June 1999, the planted area was 3,205 ha. Before the cyclones, 80% of the plantations were of fast growing construction/utility species, mainly *Eucalyptus deglupta* and smaller amounts of *E. tereticornis, terminalia calamansanai* and *Toona australis* with 20% slow growing, high value species, mainly *Swietenia macrophylla* and smaller amounts of *Tectona grandis*. After the cyclones, the proportion of fast growing, construction species to slow-growing, high-value species was almost reversed.

The average age of the planted area has been reduced to 6 years, 85% planted since 1994 (Table 3.29). Thus, a severe timber shortage is likely after the indigenous resource is exhausted.

Table 3.28: Plantation area by 5 year age classes as of June 1999

Species	Area as of January 1990 (ha)	Loss to Ofa[1] 1990 (%)	Loss of balance to Val[1] 1991 (%)	Area remaining as of September 1995 (ha)		
				Pre 1990 planting	Planted since 1990	Total
Swietenia macrophylla	2,105	15	96	64	1,658	1,722
Eucalyptus deglupta	968	78	100	-	-	0
Mixtures	355	-	100	-	61	61
Toona australis	252	85	36	24	15	39
Tectona grandis[2]	161	56	19	57	36	93
Eucalyptus teriticornis	158	0	24	120	42	162
Terminalia sp.	128	9	69	36	33	69
Anthocephalus chinensis	91	100	-	-	-	0-
Flueggea flexuosa	60	22	38	29	122	151
Cordia alliodora.	35	<1	100	-	-	0
Paraseriant hes falcataria	**25**	**100**	**-**	-	-	0
Cedrela odorata	16	100	-	-	-	0
Euclayptus urophylla	16	28	44	6	43	49
Eucalyptus pellita	0	-	-	-	29	29
Intsia bijuga	15	-	-	-	6	6
Pometia pinnata	3	-	-	-	9	9
Acacia mangium	2	100	-	-	-	0
Pinus caribaea	1	100	-	-	-	0
Gmelina arborea	1	-	-	-	-	0
Others	-	-	-	14	48	62
Total	4,392	-	-	350	2,102	2,452

[1] Some stands were written off as a result of poor establishment, not just cyclone damage
[2] Area shown as planted pre 1990 is actually coppice regrowth since 1990.
Source: Oliver (1999)

Table 3.29: Plantation area by 5 year age classes as of June 1999 (ha)

Species	Plantation area by 5 year age classes			Total area
	1-5 years	6-10 years	11-15 years	
Swietenia macrophylla	2,228	1,072	32	2,526
Tectona grandis	78	20	-	98
Toona australis	24	15	-	39
Eucalyptus pellita	32	12	-	44
Eucalyptus urophylla	34	30	-	54
Eucalyptus tericornis	30	22	-	52
Flueggea flexuosa	109	31	-	151
Terminalia calamansanai	97	2	-	99
Terminalia superba	-	33	-	33
Acacia spp.	9	-	-	9
Intsia bijuga	7	-	-	7
Mixed spp.	40	21	-	61
Others	23	-	-	23
Total	2,711	1,258	32	3,991

Source: Oliver (1999)

To assess the replacement cost of forest plantation requires the identification of various planting activities, ascertaining of inputs utilised and costs incurred for each activity. Plantation activity began at the nursery to raise and hardened seedlings before being ready for transplanting onto the planting site. Site preparation in logged-over forests was by line-cutting rather than clear felling to reduce disturbance. Planting lines were cut 2m wide and the canopy opened. Spacing selected was 10m between lines and 2 m within lines to require the planting of 500 stems/ha. The wide spacing was done to reduce maintenance costs whereby no thinnings and pruning were contemplated. Repeated maintenance/weeding were conducted according to the following schedules of six times during the first year, four times in the second year, three times in the third year, two times in the fourth year and finally once in the fifth year.

Direct labour, administrative and supervision, and seedling cost for establishing and maintaining 1 ha of line-planted plantation is shown in Table 3.30. Using a discount rate of 10% yielded a discounted replacement cost of ST$1938.59/ha. Given that an estimated 4,041 ha of plantation forests were destroyed, then the value of the loss using the replacement cost method is ST$7,833,842.

A note is in order as to limitation of the replacement cost approach in assessing benefits loss. It derives a values from the expenditure to be incurred that is not necessarily tied to the benefits to be restored. There is no logical reason as to why total benefits to be restored will be equal to the cost incurred. In fact cost actually could go either way, being more or less than the benefit streams that will only occur in the distant future. The strength is that actual inputs and expenditure will have to be utilised and incurred making the total costs computed more tangible and easily grasp by society. This is especially more acceptable by society when they have confidence that the benefits to be restored will actually occur in the future. Growth and yield figures provided in Table 4 suggest that the plantation activity may actually generate timber to meet the future needs. But there is no guarantee that the plantation is financially viable.

Table 3.30: Per ha cost forest plantation in Samoa

Task	Year	Input	Cost/year (ST$)	Discounted cost/year (ST$)
Seedling	0	500 bags	750	750
Land preparation and planting (includes base line and planting line survey and planting)	0	32 man-days	358.40	358.4
Line weeding @ 5.5 days/ha	1 2 3 4 5	33 man-days 22 man-days 16.5 man-days 11 man-days 5.5 man-days	369.60 246.40 184.80 123.20 61.60	336 203.64 138.84 84.15 38.25
Beating up	1	2 man-days	11.40	10.36
Supervision and administrative costs				18.95
Total				1938.59

Adapted from Oliver (1999)

Table 3.31: Estimated growth, yields and rotation lengths for major plantation species in Samoa

Species	Stocking (stems/ha)	Rotation (years)	Mean Annual Increment (m^3/ha/yr)	Yield (m^3/ha)
Swietenia macrophylla	100-150	30	5	150
Terminalia calamansanai	100-150	20	7.5	150
Tectona grandis	100-150	35	4.3	150
Eucalyptus urophylla	100-150	20	9	180
Others	100-150	25	6	150

Source: Martel (1991)

4.0 Lessons Learned and Recommendations

4.1 Lessons Learned

Some of the main observations and lessons derived from undertaking the economic valuation of the terrestrial and marine resources of Samoa are:

1. It is possible to conduct such an exercise in other South Pacific islands given
   - sufficient commitment on the part of the research team, in particular support provided by local counterparts.
   - research budget
   - research time

2. Success is also subjected to the members of the research team having the knowledge of the subject research matter, in particular the theory and practical aspects of the economic valuation methods. Our experience in Samoa was to delay the training and capacity building until the end of the project time. This is a logical and meaningful approach when the participants include various government agency officers and members of non-governmental organisations with interest on the environment. With preliminary findings of the economic valuation exercise available, presentation on the various valuation methods is enriched with the exhibition of results. Participants can be made more interested and alert with the presentations of the values of the resources that they have a direct interest.

   Members of the research team however could have benefited more from an early exposure of the valuation methods and expected results. This will help members to be more aware of the purpose of the data collection and analysis activities. The lesson learned is that a small workshop for the research team should be conducted early in the project time. This is particularly more meaningful if the members are non-economists.

3. Owing to the limitation of time, the economic valuation exercise in Samoa is limited to valuing the role of the resources in the production of major goods and services, namely fish, timber, handicraft, recreational opportunities and overall ecological functions. Other values were obtained by way of benefit transfer technique of value estimates from research conducted in other countries. Given more time for planning, valuation of the wider roles of the resources could be attempted provided we have a larger research team membership and greater logistic supports.

4. Experience suggests that research budgets have in many cases been tight. This is especially so when involving international consultants. This may be unavoidable in many cases. Bearing this in mind, an alternative strategy is to focus economic valuation research in specific sites having a dominant natural resource. Retrospectively, in Samoa an in depth economic valuation exercise could be conducted in:

   - Sataoa and Sa'anapu for a mangrove resource site.
   - Uofato village for an evaluation of community dependency upon the natural forest and marine resource as a source of income and subsistence utilisation.
   - Afulilo Dam and Fagaloa Bay as a potential site for research on evaluating on-site and off-site economic impacts of development projects (hydro-electric power).

5. Lacking local scientific investigations on physical impacts of development upon terrestrial and marine resources has hampered the investigations on the indirect use values of ecological functions of these resources. Basic research on bio-physical environmental impacts is the base for good change in productivity economic valuation exercises. Hence, such basic research should be given equal priority by Governments.

4.2 Recommendations

The following are some recommendations useful for promoting research in economic valuation of the terrestrial and marine resources throughout the South Pacific islands:

1. A bio-physical inventory of the terrestrial and marine resources is an important information base for many economic valuation exercise. The inventory should be done using accountable sampling techniques, such as random or systematic random, so that the information could be used to obtain flows of goods and services on a per hectare per year basis. This is necessary when aggregating the information for the whole area. As an illustration, to evaluate the standing trees for its timber (stumpage) requires that information on tree diameters at breast height and tree merchantable heights by commercial species be collected for several hectares of forest area. This is necessary to compute the merchantable volume of stumpage on a per hectare basis.

   For non-timber forest products, the inventory would have to address the information needed to assess the value of the resource in producing raw materials for a certain product such as medicines, rattan canes and others. The information needs would vary.

   As an illustration, the information needs for valuing rattan stands is provided in Table 4.1 below.

Table 4.1: Information needs and their sources in valuation exercise of rattan stands.

INFORMATION NEEDS	**SOURCE OF INFORMATION**
Cost of rattan collecting and transporting to The processing workshop.	Market survey of rattan collectors & transporters
Product cost & selling price of processed Rattan canes by species and grade	Market survey of rattan processing firms
Number of rattan clumps per ha.	National Forest Inventory
Number of standing rattan canes per clump	Special limited scale forest inventory
Area of forest reserves	National Forest Inventory

Source: Mohd Shahwahid and Awang Noor (1999)

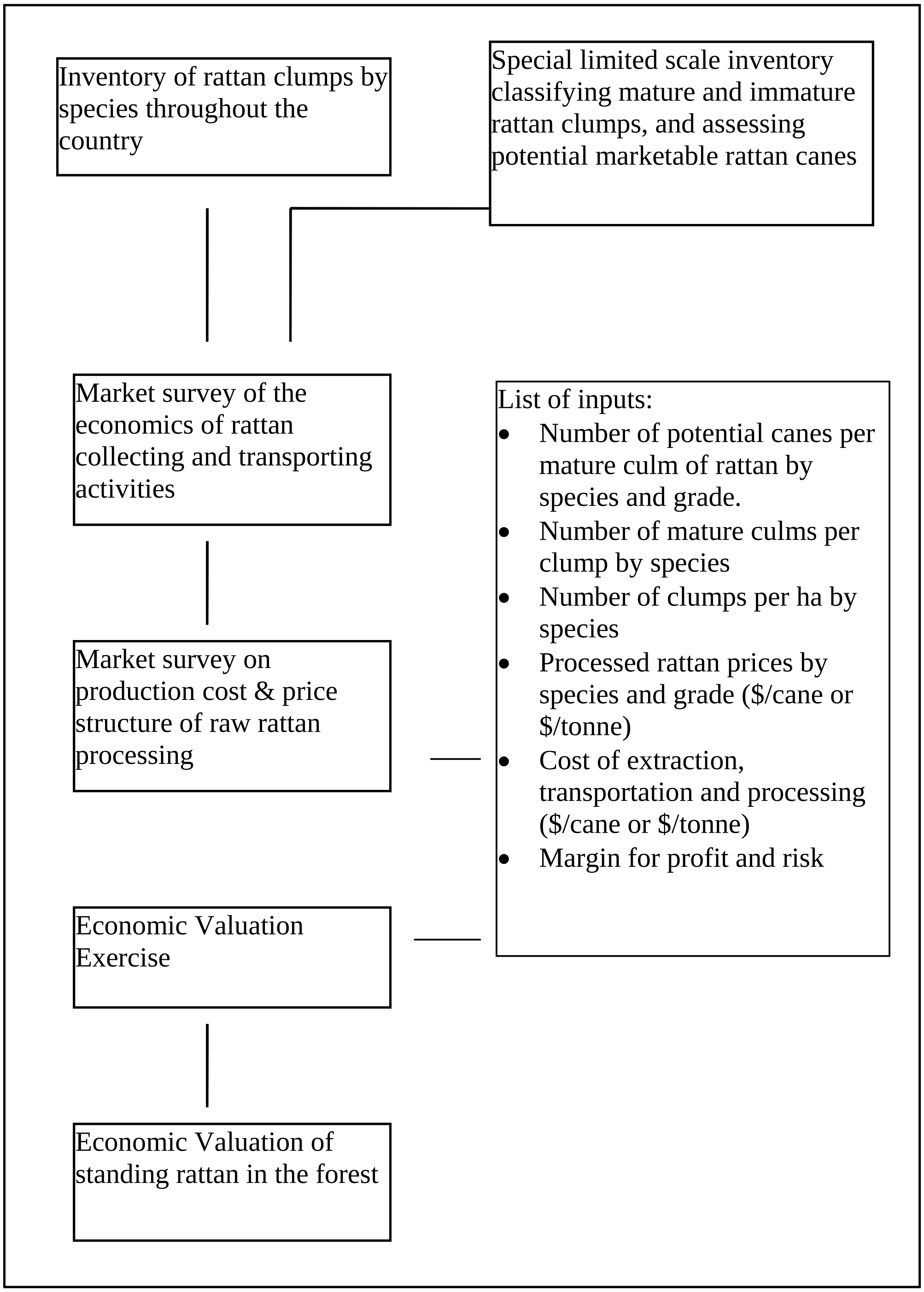
2. Economic valuation depends on the kinds of value to assess and the methods to adopt. Table 4.2 provides a list of goods and services provided by the terrestrial and marine resources of the South Pacific islands that are potential targets for economic valuation exercise.

In placing values upon resources that are producing marketable commodities such as wildlife for food, plant parts for medicine, beverage or as sources of fibres, potential techniques to adopt would be the market price-based valuation techniques. These techniques are appropriate since prices may exist. If not prices of substitute goods may be available or prices of an end product using the commodities in question as a raw material are available to work up the appropriate proportions to allocate as resource rent.

This approach may involve special inventory to assess the potential marketable quantity availability of the resource stocks. This will be followed by a market survey of prices and production cost and earning structure of relevant industries using the resource stock as raw materials. An illustration of the activities involve in assessing rattan stands as a producer of raw materials is provided in Figure 4.1.

Table 4.2: List of goods and services provided by terrestrial and marine resources of the South Pacific islands

Items From The Natural Resource To Assess	**Possible Economic Valuation Methods**	**Additional Comments**
Timber, fishery resource. Plant parts for medicine, beverage, fibres and raw materials in handicraft and construction. Wildlife body parts such as skins for handicrafts.	Market price-based approaches such as market prices, substitute prices and residual method to assess the economic rents	Require an inventory of the biological resources and a market survey of the market prices and production cost structure of marketable products that are using the plant parts or wildlife body parts as an input.
Recreational services	Travel cost method (TCM) and contingent valuation method	TCM may not be suitable in soliciting values from international tourists
Nutrient cycling	Replacement cost	Cost of alternative mechanism to recycling
Carbon sequestration	Damage or cost avoided	Involves assessing the physical carbon stock and placing a value for each ton of carbon sunk by the resource.
Catchment protection effects including on water supply and flood regulation	Change in productivity and damage or cost avoided	Involves assessing the bio-physical changes in the quantity and quality of water and identifying their impacts upon the economic activities downstream
Aesthetic	Contingent Valuation Method	Care must be given in setting the hypothetical market
Shoreline protection functions	Cost avoided	Involves assessing cost saving from not having to construct seawalls or coastal rehabilitation activity
Educational and cultural values	Various methods including market prices and contingent valuation methods	
Impacts of natural disasters	Replacement cost	Involves assessing the cost of re-establishing or reconstructing damaged properties
Impacts of air and water pollution upon health	Cost of illness (COI)	COI to measure impacts upon health from exposure to pollutants released into the environment



Source: Mohd Shahwahid and Awang Noor (1999)

Figure 4.1: A flow chart for deriving the value of a rattan stand

If the approach is to assess the willingness to pay directly, then a CVM questionnaire have to be developed, giving special attention to the hypothetical market. This involves an appropriate description of the situation that merit the good or service in question to be charged a fee for its utilisation and using appropriate payment vehicles for its collection. A payment vehicle can be in the form of an entrance fee for a recreational site or contribution into a conservation trust fund as a basis of assessing people's perception of the value of the resource. This would be the recommended technique to adopt to place values on the protection of endangered wildlife species or to assess appropriate community's willingness to pay for the introduction of conservation trust fund for the protection of a particular species or ecosystem.

In conducting a change in productivity approach and avoided damage or cost approaches at deriving the indirect values of catchment protection, appropriate bio-physical impacts have to be available first. This would include prior research on differential erosion and sedimentation rates and hydrological or water flows under different development scenarios relative to the base case of catchment protection. These bio-physical impacts have to be related to changing cost incurred or revenue loss suffered by downstream economic activities in order to assess the economic values.

When using the replacement cost method to assess the value shoreline protection or of the impacts of natural disasters, the appropriate activity to re-establish or re-construct the damaged properties has to be selected. Then the cost of the activity has to be assessed. The case studies on shoreline protection benefits of mangroves and on the economic impact of the cyclone on the forest resource are good illustrations on the application of the replacement cost method.

References

Adger, W.N., Brown, B., Cervigini, R. and Moran, D. 1995. Towards Estimating Total Economic Value of Forests in Mexico. Centre for Social and Economic Research on the Global Environment, University of East Anglia and University College London, Working Paper 94-21.

Anon. 1995. Techniques to Value Environmental Resources. An Introductory Handbook. Australian Government Publishing Service, Canberra.

Arvidsson, Mats 1996. Non-timber Forest Products, a Resource in Conservation of the Samoan Rainforests. A Minor Field Study. Swedish University of Agriculture Sciences, International Rural Development Centre. Working Paper 312. Uppsala. 67 p.

Awang Nor A. G., J. R. Vincent and Yusuf H. 1992. Comparative economic analysis of forest revenue system in Peninsular Malaysia. Osborn Center Forestry Policy Grants Program.

Barbier E.B. 1994. Valuing Environmental Functions: Tropical Wetlands. Land Economics 70(2):155-173.

Boado, E. L. 1988. Incentive policies and forest use in the Philippines. In Public Policies and the Misuse of Forest Resources. ed. R. Repetto and M. Gillis. Cambridge Universitù Press. Cambridge, pp165-198.

Costanza, R., d'Arge, R.. de Groot, R. Farber, S. Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R.V., Paruelo, J., Raskin, R.G., Sutton, P., van der Belt, M. 1997. The Value of the World's Ecosystem Services and Natural Capital. Nature 387: 253-265.

Davis, K. P. 1977. Forest Management. McGraw Hill Publication . N. Y. 500 p.

de Groot.R.S. 1992. Functions of nature: Evaluation of nature in environmental planning, management, and decision making. Wolters-Noorhoff, Groningen. 315 pp.

Division of Fishery 2000. Annual Fishery Report of the Division of Fishery.

Dixon, John A. and Paul B. Sherman 1990. Economics of Protected Areas, A New Look at Benefits and Costs. Earthscan Publications Ltd, London. 234 p.

Gillis, M. 1988a. Indonesia public policies, resource management and the tropicaì forest. In Public Policies and the Misuse of Forest Resources. ed. R. Repetto and M. Gillis. Cambridge University Press. Cambridge, pp 43-105.

Gillis, M. 1988b. Malaysia public policies, resource management and the tropical forest. In Public Policies and the Misuse of Forest Resources. ed. R Repetto and M. Gillis. Cambridge University Press. Cambridge, pp 115-153.

Glover, D. and Jessup, T. (ed.) 1999. Indonesia's Fires and Haze: The Cost of Catastrophe. Institute of South East Asian Studies (ISEAS) and Economy & Environment Program for Southeast Asia (EEPSEA)

Iakopo, Malaki. 1998. Country Report – Western Samoa. In Tang Hon Tat, Finiasi Louisa S., Teunissen, Edwin J.C. and Masianini Bernadette (eds.) Procs. Of Heads of Forestry Meeting "Setting the Baseline for Future Forests and Trees Activities" UNDP/FAO South Pacific Forestry Development Programme. Field Document No. 11 RAS/92/361. Pp139-149.

Kumari, K. 1995. An Environmnetal and Economic Assessment of Forest Management Options: A Case Study in Malaysia. The World Bank. Environmental Economics Series 026, Washington, D.C.

Lampietti, J.A. and J.A. Dixon 1995. To See the Forest for the Trees: a Guide to Non-Timber Forest Benefits. The World bank,. Environmental Economics Series 013, Washington, D.C.

Lockwood, Brian 1971. Samoan Village Economy. Melbourne, Oxford University Press, London. 232 p.

Martel, F. 1991. National Forest policy Review. Projection of Saw log Supply from Plantation Forests. Western Samoa.

McAllister, D.M. 1980. Evaluation in Environmental Planning: Assessing Environmental, Social, Economic and Political Trade-offs. The MIT Press.

McNally R. and Mabey N. 1999. Project Economics Handbook: Economic Instruments in the Design of Integrated Conservation and Development Projects. Draft WWF-UK Paper.

Mohd Shahwahid H.O. and Awang Noor A.G. 1998. Economic Rent from Hardwood Timber Extraction in the West Coast of Peninsular Malaysia. Malaysian Journal of Agricultural Economics (MJAE) Vol 12 :1-15.

Mohd Shahwahid H.O. and Awang Noor A.G. 1999. Estimating the Non Timber Values of Forest: Beginning with Natural Stands of Rattan. Tropical Biodiversity 6(3): 161-177.

Mohd Shahwahid H.O., Awang Noor A.G. Abdul Rahman M.D. and Shaharuddin A. 1999. Cost and Earning Structure of the Logging Industry in Peninsular Malaysia. The Malaysian Forester 62 (3):107-117.

Mohd Shahwahid H.O., Awang Noor A.G., Abdul Rahim N., Zulkifli Y. and Razani U. Trade-offs on Competing Uses of a Peninsular Malaysian Forested Catchment. Environment and Development Economics 4(4):281-314 1999.

Mulipola A. P. 1997. An Assessment of the Subsistence and Artisinal Inshore Fisheries on Savaii Island, Western Samoa. Master of Applied Science (Fisheries) Thesis. Australian Maritime College.

Oliver, W. 1999. An Update of Plantation Forestry in the South Pacific. RAS?97/330. Working Paper No. 7. Pacific Islands Forests & Trees Support Programme. SPC/UNDP?AusAID/FAO.

Passfield, K. 2000. Facts and Figures for the 1999 Samoan Longline Fisheries. Information Sheet 27. Fisheries Division, Ministry of Agriculture, Forests, Fisheries and Meteorology.

Passfield, K. and King M. 2000. The Samoan Tuna Longline Fishery. Information Sheet 27. Fisheries Division, Ministry of Agriculture, Forests, Fisheries and Meteorology.

Passfield, K. and Mulipola, A. 1999. Profile of the Commercial Tuna Fishery in Samoa. Samoa Fisheries Project by the Government of Samoa- AusAID.

Ruiteenbeek, H.J. 1988. Social Cost-Benefit Analysis of the Korup Project, Cameroon. WWF for Nature Publication, London.

Samoa Visitors Bureau Research & Statistics Division 2000. November Report Update. Government of Samoa.

Spurgeon,J.P.G. 1992. The Economic Valuation of coral reefs. Marine Pollution Bulletin 24(11):529-536.

Sulaiman H. N. 1977. A method of forest revenue assessment based on inventory data. Malaysian Forester 40(3):144-159.

Tourism Council of the South Pacific 1992. Samoa Tourism Development Plan 1992-2001.

Treasury Department 2000. Update of the Samoan Economy: Gross Domestic Product. Government of Samoa.

Vincent, R. V. 1990. Rent capture and the feasibility of tropical forest management. Land Economics 6 (2): 212-23.

Vincent, J. R., Awang Nor A. G., and Yusuf H. 1993. Economics of tropical timber fees and logging in tropical forest concessions. Unpublished report.

Appendix I: Survey questionnaire for valuing the role of forest resources in producing raw materials for the handicraft industry

SURVEY QUESTIONNAIRE

VALUING NATURAL RESOURCES AS INPUTS TO THE HOUSEHOLD PRODUCTION SYSTEM

October 2000

Division of Environment and Conservation,
Department of Lands, Surveys and Environment,
Government of Samoa, Apia

Enumerator’s name:
Respondent’s name:

Village: Date :
Age : Sex :

Who are the respondent : Husband Wife Son Daughter Grandfather/Grandmother Others

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1. List the species and quantities collected per month from the natural resources. If further processed, which parts of the species are utilised

Species	Parts of species/ plant / tree collected	Quantities collected per month (mention units used)	Direct use or further processed	Handicraft / other processed products	Proportion for own consumption and for sale

2. When are the season for species/tree/plant collection, and making of handicraft/processed products (months)

Species Collection	Seasons	Handicraft and other processing products	Seasons (which months)

3. Where are the species/tree/plant species collected from ? Location:_________________
Distance from your home/workshop :_______________km
Travel time from home/workshop:________________hr

4. If you know, can you list down the prices of the collected items from the forest/marine resource. If not, do you know of similar items that have a price.

Items collected	Prices/unit (mention units used)	Similar or substitute items	Prices / unit (mention units used)

5. Can you specify the monthly labour time, and other inputs that are needed in collecting the items from the forest.

	List of Items Collected from the Forest				
Inputs	1.________	2.________	3_________	4.________	5.________
Skilled labor man-days*					
Unskilled/semi-skilled man-days*					
Instruments (specify)_________________:					
Instruments (specify)_________________					

Instruments (specify)_________________					
Transportation (specify)_________________					
Fuel (mention units used)					
Imputed rental of workshop (Number of days needed)					
Other inputs, specify					
Other inputs, specify					

*8 hour man-day

6. Can you specify the cost per unit of labor time and of the other inputs

Inputs	ST/unit
Skilled labor man-days*	
Unskilled/semi-skilled man-days*	
Instruments (specify)_________________:	
Instruments (specify)_________________	
Instruments (specify)_________________	
Transportation (specify)_________________	
Fuel (mention units used)	
Imputed rental of workshop (Number of days needed)	
Other inputs, specify	
Other inputs, specify	

7. If you know, can you list down the prices and quantities made per month of each different kinds of handicraft and processed products. If not, do you know of similar items that have a price.

Handicraft / processed products	Prices/unit (units used)	Quantities produced / month (units used)	Similar or substitute items	Prices / unit (units used)

8. Can you specify how much labor time and other inputs that are needed to make <u>each</u> of the following handicraft and processed products .

	List of Handicraft and Processed Products				
Inputs	1._______	2._______	3________	4._______	5._______
Skilled labor man-days*					
Unskilled/semi-skilled man-days*					
Varnish (mention units used)					
Lacquer (mention units used)					
Paint(mention units used)					
Electricity (mention units used)					
Fuel (mention units used)					
Imputed rental of workshop					

(Number of days needed)					
Volume of wood material needed (mention units used)					
Other inputs, specify					
Other inputs, specify					

*8 hour man-day

9. Can you specify the cost per unit of labour time and of the other inputs

	ST/unit
Skilled labor man-days*	
Unskilled/semi-skilled man-days*	
Varnish (mention units used)	
Lacquer (mention units used)	
Paint(mention units used)	
Electricity (mention units used)	
Fuel (mention units used)	
Imputed rental of workshop (Number of days needed)	
Volume of wood material needed (mention units used)	
Other inputs, specify	
Other inputs, specify	

*8 hour man-day

10. Background information:

Household members	Age	Main economic activity #	Other supplementary economic activity	Monthly income @ (ST/month)	Income from collecting & processing activities

specify type of profession
@ total income from all sources

Do you have any comments about the availability of materials from the forest and what can be done to improve the situation.

Do you have any comments about the processed products? Markets, Technical assistance, etc. What can be done to improve the situation.

Appendix II: Contingent Valuation Questionnaire for Recreational Services of Mount Vaea Forest Reserve

SURVEY QUESTIONNAIRE

VALUING RECREATIONAL VALUES OF NATURAL RESOURCES

October 2000

Division of Environment and Conservation,
Department of Lands, Surveys and Environment,
Government of Samoa, Apia

In the first section, we would like to evaluate your preference of this recreational site?

The natural resources provide various benefits to humans. We would like you to ponder the following functions being played by a natural forest:

- ❑ Flood Mitigation, fresh water supply and regulation
- ❑ Micro-climate regulator of nearby areas
- ❑ Carbon sequestration and carbon sink
- ❑ Sources of timber and non-timber forest products
- ❑ Biological bio-diversity comprising of birds, reptiles, large animals, trees, palms, orchids and climbers
- ❑ Drugs and herbs. The forest is also a source of traditional medicines and of natural compounds with potential development into modern medicine.
- ❑ Recreation and eco-tourism

This section is about valuing the recreational benefits of the natural forest <u>only.</u>

The Mount Vaea Forest Reserve supports a stream, an aesthetic scenery and a cooling environment very suitable for recreational experiences like hiking, wilderness experience, swimming and be in a healthy surrounding. At the foot of Mount Vaea is located a botanical garden. Currently, the management of the botanical garden and the surrounding natural forest is funded by the Government. To ensure sustainable management of this site, additional funding is needed to complement existing budget.

1. Would you be willing to pay an entrance fee to enter the site and obtain the benefits generated by this botanical garden and natural forest?

Yes	1
No	2

Please do not agree to pay if:

- ❑ You cannot afford it; or
- ❑ If you are not sure about being prepared to pay

If your answer is yes, go to the next question, otherwise go to question 3.

2. The following table consists of a list of prices from ST0.50 to ST15. Ask yourself:

" What is the maximum price that you would be willing to pay (per entrance) to obtain the recreational benefits mentioned above. Tick one level.
(Note: Consider other expenses that you have already paid for this trip and remember that you could spend your money on other things)

<u>ST$ per Entrance</u>

0.50 ____________
1.00 ____________
1.50 ____________
2.00 ____________
2.50 ____________
3.00 ____________
3.50 ____________
4.00 ____________
4.50 ____________
5.00 ____________
6.00 ____________
7.00 ____________
8.00 ____________
9.00 ____________
10.00 ____________
12.50 ____________

15.00 ____________

3. Could you please explain the main reason for not wanting to pay for an entrance fee?

The Botanical garden and natural forest is a free good	1
The Botanical garden and natural forest should be funded by the Government	2
Cannot afford to pay	3
Others (Please explain ________________________)	4

4. Out of 100%, how do you allocate the benefits you derived from the attractions offered by this recreational site

	Attractions	%
1	Visiting the botanical garden	
2	Robert Louis Stevenson Tomb	
3	Hiking up the trails to Mt. Vaea Forest Reserve	
4	Wilderness experience and aesthetic scenic	
5	Others, please specify __________________________	
	Total	100%

5. How many times have you been here in the last 12 months? ______________

In this final section, we would like to ask you a few questions about you and your group to ensure that our sample is representative.

6. Which country are you from ___________

7. Are you married?

Yes	1
No	2

8. For each member of your group, please list their age and sex:

Group Member	Age (in years)	Sex (M/F)
Self	____________	____________

9. What is the highest level of education you personally have obtained?

Never went to school	1
Completed primary school only	2
Completed secondary school only	3
Completed Technical/University Degree	4
Completed post-graduate diploma (how many additional years_____)	5

10. What is your own current work status?

	Self	Spouse
Employed full time	1	1
Employed part-time	2	2
Unemployed/looking for work	3	3
Retired	4	4
Full-time student	5	5
Home duties	6	6
Other (please specify ____________________)	7	7

11. Please indicate your total income (before tax) earned last year?

If locals, the income brackets below are in ST, if internationals, Specify the currency (US$/NZ$/AUS$/______)

Annual Income	**Self**	Spouse
5,000 and below		
5,001 – 10,000		
10,001 - 15,000		
15,001 - 20,000		
20,001 - 25,000		
25,001 - 30,000		
30,001 - 35,000		
35,001 - 40,000		
40,001 - 45,000		
45,001 - 50,000		
More than 50,000		

12. Are you a member of any non-governmental organisation (NGO) with interest on the environment?
    Yes 1
    No 2

13. Do you have any comments to make about your trip and the site?

We would like to thank you for your co-operation in completing this questionnaire.

Appendix III: Contingent Valuation Questionnaire for Recreational Services of Palolo Deep

SURVEY QUESTIONNAIRE

VALUING RECREATIONAL VALUES OF NATURAL RESOURCES

October 2000

Division of Environment and Conservation,
Department of Lands, Surveys and Environment,
Government of Samoa, Apia

In the first section, we would like to evaluate your preference of this recreational site?

The marine resources provide various benefits to humans. We would like you to ponder the following functions being played by a marine resource such as the Palolo Deep:

- ❑ Habitat for fisheries.
- ❑ Mangroves, river estuaries and corals are spawning ground and nursery for some fisheries.
- ❑ Sources of fish and other fishery catch
- ❑ Climate regulation and carbon sink
- ❑ Coastline damage control. Mangroves protect the shoreline from surging tides and coral reefs reduce the impact of ocean waves on the coast.
- ❑ Nutrient cycling acquisition, storage and release of nutrients. Mangroves capture nutrients from land-based sources, and release them gradually in the aquatic environment, serving as the beginning of the food chain
- ❑ Biological diversity comprising of fishes, shellfishes, corals, and plankton. This contributes to ecosystem stability, source of genetic information for cross-breeding and genetic engineering
- ❑ Drugs and herbs. The marine resource is also a source of traditional medicines and of natural compounds with potential development into modern medicine.
- ❑ Beaches, lagoons and coral reefs have amenity value for recreation and eco-tourism.

This section is about valuing the eco-tourism benefits of the marine resource <u>only.</u>

The Palolo Deep and its natural marine ecosystem support a beach, an aesthetic view of the ocean and beautiful corals and a suitable environment for swimming opportunities. Currently, the entrance fee is insufficient for effective management of the Palolo Deep Marine Reserves. Additional funding is needed to ensure sustainable management of this site.

1. Would you be willing to make additional payment for a more effective management of the marine reserve to ensure that the eco-tourism benefits you obtained from this marine resources be sustained?

   Yes 1

   No 2

Please do not agree to pay if:

- ❑ You cannot afford it; or
- ❑ If you are not sure about being prepared to pay

If your answer is yes, go to the next question, otherwise go to question 3.

2. The following table consists of a list of prices from ST0.50 to ST15. Ask yourself:

" What is the maximum additional price that you would be willing to pay (per entrance) to obtain the recreational benefits mentioned above. Tick one level.

(Note: Consider other expenses that you have already paid for this trip and remember that you could spend your money on other things)

ST$ per Entrance	
0.50	____________
1.00	____________
1.50	____________
2.00	____________
2.50	____________
3.00	____________
3.50	____________
4.00	____________
4.50	____________
5.00	____________
6.00	____________
7.00	____________
8.00	____________
9.00	____________
10.00	____________

12.50 ___________
15.00 ___________

3 Could you please explain the main reason for not wanting to pay an additional entrance fee?

The Palolo Deep and marine resource is a free good	1
The Palolo Deep and marine resource should be funded by the Government	2
Cannot afford to pay	3
Others (Please explain ______________________)	4

3. Out of 100%, how do you allocate the benefits you derived from the attractions offered by this marine resource site

	Attractions	%
1	Swimming and sun-bathing opportunities	
2	Snorkelling watching corals	
3	Ocean scenic views	
4	Others, please specify________________________	
	Total	100%

4. How many times have you been here in the last 12 months? _____________

In this final section, we would like to ask you a few questions about you and your group to ensure that our sample is representative.

5. Which country are you from __________

6. Are you married?

Yes	1
No	2

7. For each member of your group, please list their age and sex:

Group Member	Age (in years)	Sex (M/F)
Self	___________	___________

8. What is the highest level of education you personally have obtained?

Never went to school	1
Completed primary school only	2
Completed secondary school only	3
Completed Technical/University Degree	4
Completed post-graduate diploma (how many additional years_____)	5

9.

What is your own current work status?	Self	Spouse
Employed full time	1	1
Employed part-time	2	2
Unemployed/looking for work	3	3
Retired	4	4
Full-time student	5	5
Home duties	6	6
Other (please specify __________________)	7	7

10. Please indicate your total income (before tax) earned last year?
If locals, the income brackets below are in ST, if internationals, Specify the currency (US$/NZ$/AUS$/______)

Annual Income	**Self**	Spouse
5,000 and below		
5,001 – 10,000		
10,001 - 15,000		
15,001 - 20,000		
20,001 - 25,000		
25,001 - 30,000		
30,001 - 35,000		
35,001 - 40,000		
40,001 - 45,000		
45,001 - 50,000		
More than 50,000		

11. Are you a member of any non-governmental organisation (NGO) with interest on the environment?
Yes 1
No 2

12. Do you have any comments to make about your trip and the site?

We would like to thank you for your co-operation in completing this questionnaire.

Appendix IV: Contingent Valuation Questionnaire for Ecological Functions of Forest and Marine Resources

SURVEY QUESTIONNAIRE

VALUING THE ECOLOGICAL & ENVIRONMENTAL VALUES OF NATURAL RESOURCES

October 2000

Division of Environment and Conservation,
Department of Lands, Surveys and Environment,
Government of Samoa, Apia

SECTION A

This questionnaire is to find out how much people know and value Samoa's Forests, Mangroves and Marine Resources

- All three Tropical Rainforests, Mangroves and Marine Resources make sure that there is enough oxygen in the air, keeps the temperature down and produce rain for us. These resources are the home and feeding grounds for many different animals, birds, fish, corals and plants and have potential uses for animal and plant breeding and medicines to control serious illnesses. With the presence of these resources, the world ecosystem is stable. There are probably many more uses that we don't know about yet.

Apart from that each of these three resources provides specialise functions.

- Tropical Rainforests help reduce erosion and regulate water flow preventing flooding and drought.
- River estuaries, coastal waters and open seas help recycle the nutrients from erosion while coral reefs reduces the impact of ocean waves on the coast.
- Mangroves absorbs excess river flows preventing floods, absorb and recycle nutrients by playing a waste treatment function and also prevent coastline damages

These are the ecological functions or services of the Tropical Rainforests, Mangroves and Marine Resources that directly and indirectly are our life-support system.

We want **to limit your interest to the ecological services** of these three natural resources only. As you know, these resources are constantly under threat from development, pollution and changing global climatic conditions. These resources need to be managed effectively in order to sustain them

We wish to set up a **NATURAL RESOURCE CONSERVATION TRUST FUND** for this purpose to complement the management programmes undertaken by the government.

1. Would you be willing to contribute to this natural resource conservation trust fund to ensure that these resources are protected and continue benefiting us and our children ?

Yes	1
No	2

Please do not agree to pay if you cannot afford it or if you are not sure about being prepared to pay. If your answer is **Yes**, go to the **next question**; **otherwise** go to question 3.

2. What would be the most you would pay per year to the fund to ensure the natural resources are protected. Tick one level.

SAT$ per year
0.50 ___________
1.00 ___________
1.50 ___________
2.00 ___________
2.50 ___________
3.00 ___________
3.50 ___________
4.00 ___________
4.50 ___________
5.00 ___________
6.00 ___________
7.00 ___________
8.00 ___________
9.00 ___________
State the amount if more than SAT$10.00 ___________

3. **If** you had only a total of ST$ 1 to contribute, how many sene would you give to each resource ?

	Contributions for conservation of resource		
1	Rain forest resources	_____	sene
2	Marine resources	_____	sene
3	Mangroves	_____	sene
	Total	100	sene

4. Could you please explain the main reason for not wanting to contribute to the conservation fund?

SECTION B

In this final section, we would like to ask a few questions about you to make our analysis more representative.

5. Are you married?

Yes	1
No	2

6. Age ______(in years)

7. Male 1
Female 2

8. What is the highest level of education you have obtained?

Never went to school	1
Completed primary school only	2
Completed secondary school only	3
Completed Technical/University Degree	4
Completed post-graduate diploma (how many additional years_____)	5

9. What is your own current work status?

Government officer	1
Private sector	2
Unemployed/looking for work	3
Retired	4
Full-time student	5
Home duties	6
Work on your/family plantation	7
Other (please specify __________________)	8

10. Please indicate your total income (before tax) earned last year?

Annual Income	**SAT $**
5,000 and below	
5,001 – 10,000	
10,001 - 15,000	
15,001 - 20,000	
20,001 - 25,000	
25,001 - 30,000	
30,001 - 35,000	
35,001 - 40,000	
40,001 - 45,000	
45,001 - 50,000	
More than 50,000	

11. Are you a member of any non-governmental organisation (NGO) in support of environmental conservation

Yes	1
No	2

12. Where is your place of residence

Apia Town	1
Upolu, out of Apia	2
Savai'i island	3
Apolima island	4
Manono island	5

13. Do you have any comments to make about this study on valuing the ecological services of the natural resources of Samoa?

We wish to thank you for your responses.