Economic Valuation of Mangroves of the Safata District in Samoa

Vina Ram-Bidesi

Malama Siamomua-Momoemausu

Moira Faletutulu

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Vina Ram-Bidesi (Senior Lecturer, School of Marine Studies, University of the South Pacific and Project Leader)

Malama Siamomua-Momoemausu (MESCAL Samoa Project Coordintator & Facilitator)

Moira Faletutulu (MESCAL in-country Assistant and Coordinator Climate Change Adapation)

The Project Leader was supported by the following MNRE staff members and Assistants in field work:

Malama Siamomua-Momoemausu (MESCAL Samoa Project Country Coordinator)

Moira Faletutulu (Samoa PACC Project Coordinator)

Sebastian Fata (Terrestrial Conservation Officer)

Fini Male (Terrestrial Conservation Officer)

Samantha Kwan (Marine Conservation Officer)

Jeffrey Faitua (Marine Conservation Officer)

Vaatele Anoifale (Myna Bird Project Assistant)

Alaifata Levi (Myna Bird Project Assistant)

Ieru Solomona (Office Assistant)

Kuiniselani Leleisiuao (Assistant)

Ruta Tamate (Assistant)

Misao Uelese (Assistant)

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1. Summary

The objective of this study has been to carry out the economic valuation of the mangroves in the Safata District with the aim to assist towards developing an effective management plan in light of reducing vulnerability and risk and supporting adaptation to climate change efforts. This study was conducted through a combination of methods including literature review and use of government and technical reports; conducting a series of formal and informal interviews with government officials, key village informants; and seeking other expert opinion. A comprehensive socio-economic survey was also conducted in 5 out of the 9 villages in the Safata District.

The direct uses of the mangrove ecosystem services such as provisioning services through the supply of fish and other invertebrates, timber and firewood, and medicines were estimated to be about ST$7,848 per hectare per year to ST$16,331 per hectare per year or US$ 3,139.29 to US$6,532.30 hectare per year. The indirect values such as coastal protection, carbon sequestration, water purification and sediment trap were estimated to hold higher value due to the higher replacement costs. These values however reflect on the replacement costs associated with destruction of mangroves. The mean Total Economic Value (TEV) of the Safata District was estimated as ST$41.51 million. Thus the average gross value per hectare of mangrove was estimated to have a value of ST$140,419.74 or US$56,167.90. Carbon Sequestration value presents as a potential value that could be realized given that Samoa is a Developing Country. The TEV however still can be argued as under-estimated because they do not take into consideration the intrinsic values such as existence and options value of mangroves in Samoa. The latter values are considered to be very high in the case of Samoa and thus extra caution should be used when making subjective assessments. In terms of the flow of benefits over 20 years with a discount rate of 5%, and excluding the benefit flows from carbon sequestration, there is still a high gross present value equivalent to ST$85.76 million.

The preliminary assessment of the study suggests that if current practice continues, with loss of mangrove at an annual rate of 4%, then in thirteen years time, there will be a loss of almost 25.2% of the value of mangroves with a discount rate at 5% or a loss of 22.8% of value with a 15% discount rate. On the other hand, if there is no harvesting or extraction of mangroves and they are allowed to grow at a rate of 1%, then there could potentially be an increase in value by 2.8% in 20 years at a discount rate of 5%. Additionally, if environmental conditions are not changed drastically, then the likely flow of real benefits would be much higher than those estimated.

The main findings of the study suggest that while mangrove management plans do exist for the Safata District, there is a need to further strengthen the existing frameworks. This will require an integrated approach that will in turn require advocacy work and legislative and institutional strengthening together with a thorough cost benefit analysis of any project to protect and preserve the mangroves. The study should reflect on the opportunity costs of actions and inaction inclusive of all stakeholders to achieve a win-win situation for communities and the nation as a whole. This report therefore provides the rationale for articulating the desired policy approach.

2. Abbreviations

MESCAL - Mangrove Ecosystems for Climate Change Adaptation and Livelihoods

IUCN – International Union for the Conservation of Nature

TEV – Total economic value

CEO – Chief Executive Officer

ha – hectare

SPREP – Secretariat of the Pacific Islands Regional Environment Programme

Currency

US$1 ~ ST$2.50

3. Acknowledgements

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4. Study Terms of Reference

The following outlines the specific responsibilities and tasks of this study:

Responsibilities:

Under the direction of the Water and Wetlands Programme Coordinator at IUCN ORO and with the support of the MESCAL Samoa Coordinator, the Consultant will conduct economics assessment for MESCAL Samoa demonstration site, Le Asaga Bay, Safata District, in partnership with the in-country REE assistant. To this end:

1. Liaise with the MESCAL Project Management Unit (PMU) and Samoa National Coordinator (NC) to help develop and implement the economics valuation of the demonstration site in Samoa;

2. Work with the in-country REE assistant in the implementation of the economics subcomponent of the Samoa MESCAL project, including field work, data collection, analysis and write up and in the production of knowledge products; and

3. To provide hands on training to in-country technical economics assistant in economic valuation of mangrove ecosystem, including the design of surveys, survey implementation, data collection, analysis and report writing.

Specific Tasks:

1. To conduct field surveys to determine direct traditional/cultural and commercial uses of mangrove resources (subsistence and/or commercial /artisanal fisheries, firewood, timber, medicine, etc) and assess their economic values

2. To conduct a desktop review on indirect uses of mangrove ecosystems (coastal protection, water treatment, carbon sequestration, sediment trap and biodiversity credits) and assess their economic values

3. Conduct a Total Economic Value (TEV) analysis, Cost Benefit Analysis (CBA) and Cost Assessment.

4. To conduct field surveys to determine non-use (existence) values of mangroves in Le Asaga Bay.

5. Why value mangroves?

Mangrove ecosystems are rapidly declining due to reclamation, urban and tourism development, and land based activities such as agriculture, aquaculture and pollution. Consequently, there is increased loss of important environmental and economic goods and services such as forest products, flood mitigation and habitat for fish. Table 1 provides a simple outline of the various ecosystem services provided by mangroves.

Table 1: Typical Ecosystem Services provided by Mangroves

Ecosystem Services	Goods and Services
Regulating	Reduction of beach and soil erosion
	Stabilizing of land by trapping sediments
	Coastal protection from strong waves and storm surges
	Water quality regulation
	Climate regulation
Supporting	Nutrient cycling
	Nursery and spawning habitats
Provisioning	Subsistence fisheries
	Commercial fisheries
	Firewood
	Timber
	Medicine
Cultural	Tourism and recreation
	Spiritual
	Education and research

Source: adapted from UNEP-WCMC (2006)

It is often argued that insufficient knowledge of values of goods and services supplied by the mangroves prompts the decision to convert them. Several studies in which the environmental functions of mangroves have been analyzed and valued indicate the necessity to internalize these functions into environmental management (Costanza, et al., 1997; Barbier E. B., 1994; Lal, 2003; Janssen & Padilla, 1998). It is also argued that only when all relevant costs and benefits of using a resource are fully considered that socially appropriate decisions can be made about allocating it to the activity that will generate the highest economic value. Economic information is therefore valuable to decision makers to support efficient and sustainable use of mangroves.

Economic measures and indicators have a strong influence on how trade-offs in coastal development are conceptualised and decisions are made, and are an important factor when choices are made about how to use and allocate funds and resources (Emerton, 2006).

Economic valuation can provide a powerful tool for placing coastal ecosystems on the agenda of planners and decision makers. The aim is to determine people's preferences, whether they are better off or worse off as a result of changes in the supply of ecosystem good and services. By expressing their preferences, and relating them to measures of human well-being, valuation aims to make natural ecosystems directly comparable with other sectors of the economy when investments are appraised, activities are planned, policies are formulated, or land and resource use decisions are made (Emerton, 2006).

As a result, this study aims to contribute towards strengthening mangrove resource management in Samoa as part of a Climate Change Adaptation measure. Effective management of their mangrove ecosystems will help build resilience to the potential consequences of climate change and variability on coastal areas as well as support/enhance livelihoods.

6. Samoa – general

Samoa consists of two larger islands Upolu (1108 km^2) and Savaii (1695 km^2), as well as seven small islands. Samoa is located between latitudes 13 ° 25' S and 14° 05' S and longitude 171° 23' W and 172° 48'W. It has a tropical oceanic climate with a wet and dry season. The total population of Samoa in 2011 was 187,820 with an annual growth rate of 0.8% (Samoa Bureau of Statistics, 2012). The land area is estimated to be 2,785 km^2 and the coastline 383 km. The population is spread throughout 21, 424 households in 326 villages, most of which are located on the two main islands. About 70% of the villages are on the coast, which puts pressure on the coastal resources and their habitats.

Figure 1: Map of Samoa

7. Mangroves of Samoa

Approximately 70 percent of Samoa's population live in coastal communities and depend either directly or indirectly on the marine environment and resources as a source of food, livelihood and income, which underscores the importance of the marine environment. Mangroves are one of the main marine ecosystems that maintain the quality of the marine environment. Destruction of these areas is a concern as mangroves are associated with provisioning of marine resources and coastline protection.

Mangroves are a small but important part of the biota of Samoa. Their occurrence also marks the eastern limit of the Indo-Pacific mangrove distribution (Chapman 1976). Three mangrove communities have been identified in Samoa (Douglas et.al 1998). The most common mangrove communities typically occur adjacent to each other: The *Rhizophora samoensis* on the seaward fringe below the high water mark and *Bruguiera gymnorrhiza* on the landward side at about the high water mark (Iakopo 2006). The *Xylocarpus granatum* mangrove, which is considered rare in Samoa, is only present in a single small stand of less than 1 hectare, on white sand substrate at a stream mouth near Salailua on Savaii Island [Schuster, 1993]. The newly added, tidally adapted mangrove species, *Acrostichum aureum (Saato*) along with *Hibiscus tiliaceus (Fau*) flank the landward side.

In terms of mangrove cover, the Vaiusu-Mulinuu is the largest stand of about 86.41 hectares; the Saanapu-Sataoa is the second largest which is 82.63 hectares; and followed by Le Asaga Bay with an estimated 47.82 hectares. Le Asaga Bay is the largest of the four mangrove systems of Safata, with a total mangrove ecosystem area of 191.82 hectares. It also holds about 144 hectares of estuary, which is the biggest of all estuarine mangrove stands in the country.

The Vaiusu Bay mangrove stand is important but largely degraded because of its location in the main urban area. Mangrove forest is dominated by *Bruguiera gymnorrhiza* with some *Rhizophora (mangle) samoensis*. Other species present include the ferns *Acrostichum aureum* and *Humata heterophylla*, and *Barringtonia asiatica*. The nearby coastal forest is dominated by *Diospyros elliptica*, *D. samoensis* and *Syzygium* spp. The wetland and surrounding areas that are located below the high water mark are government-owned land however; there is also customary tenureship and management by the local communities who regard these as adjacent parts of their land properties even to the outer reef areas.

Mangroves are threatened as a result of increasing coastal population and settlements, unsustainable coastal development, and land-based activities. The combination of these with natural forces (e.g. cyclones and tsunamis) has more or less impelled climate change impacts and further eventuating coastal subsidence and erosion. Out of ignorance of their immeasurable values, mangroves are being filled (reclaimed) to make more land, and are also treated by some as waste reservoirs; the destructive impacts of which have been the gradual alterations of the rate and nature of their ecological functions. In a continual process of development, some stands in the vicinity of Apia which are privately owned are the most disturbed and are on the verge of disappearance.

In order to improve the status of biodiversity and take stock of the current status of mangrove ecosystems, the Ole Si'osiomaga Society Inc. (OLSSI) conducted a biodiversity audit to assist in designing a local area biodiversity action plan (Sa'ifaleupolu & Elisara, 2011). The report provides a detailed assessment of the biodiversity of the mangrove habitat and is a useful reference. The status of mangroves in Samoa, including an inventory of species of plants and animals found, is provided in (Iakopo, 2006) and Siamomua-Momoemausu (2013) respectively. Table 2 provides a list of commonly found fish and other marine species dependent on or associated with mangroves in Samoa. In addition, the physical and geographical characteristics of mangroves in Samoa are described in detail in Schuster (1993).

Community-based management and conservation programmes for mangroves have been initiated and implemented by government, non-government organizations, and local communities. Most of these prioritize education and awareness, and often involve communities in the planning and field implementation of activities. Some villages have developed village rules (and related infringements) for mangrove area management and control. These rules are further translated into bylaws which are recognized nationally in the statutory courts of law.

All mangrove species are known collectively as *Togo* in Samoan. Whistler (2006) recorded the red mangroves as *Togo tane* (male mangrove) and the oriental mangroves as *Togo fafine* (female mangrove) (Iakopo 2006). Mangroves are not very common, hence only found on the two large islands of Upolu and Savaii. The recent assessments of the total extent of mangrove ecosystems in Samoa have recorded an estimate of about 752 hectares (Momoemasau, 2010).

Table 2: List of commonly found fish species dependent on or associated with mangroves in Samoa

Species Common Name	Species Scientific Name	Samoan Name
Bartail Goatfish	*Upeneus vittatus*	Ulaoa
Dot-tail Goatfish	*Parupeneus indicus*	Tauleia
Goldline Goatfish	*Mulloidichthys samoensis*	Afulu
Cresent perch	*Terapon jarbua*	Avaava
Emperor	*Lethrinus harak*	Filoa-vai
Sea bream (redtail emperor)	*Lutjanus argentimaculatus*	Filoa patuamumu
Fringelip or warty-lipped mullet	*Crenimugil crenilabis*	Anae (>20cm)
Blue-spot mullet	*Valamugü seheli*	Popoto (15 – 20cm)
Engel's mullet	*Valamugil engeli*	Aua (8-12cm)
Mullet	*Liza melinoptera*	Poipoi (5-8cm)
Mullet		Matapona (12-20cm)
Trevally	*Carangidae*	Lupota (8-20cm)
Trevally	*Carangidae*	Lupo (<8cm)
Mojarras	*Gerres macrosoma*	Matu
Mojarras	*Gerres oblongus*	Matu-loa
Herring	*Sardinella articauda/melanura*	Poi/Nefu
Herring	*Sardinella albella*	Pelupelu
Surgeonfish	*Acanthurus xanthopterus*	Palagi
Snapper	*Lutjanus fulvus*	Tamala
Goby (mudskipper)	*Acentrogobius nebulosus*	Manoo
Pufferf1sh	*Arothron manilensis*	Sue
Milkfish	*Chanos chanos*	Ava, Avali'i
Longjawed Barracuda	*Sphyraena flavicauda*	Saosao
Blood spot squirrelfish	*Flammeo sammara*	Malau tui
Mountain bass	*Kuhilia rupestris*	Inato
Yellowtail	*Mugil sp.*	Afa/utualii
Cardinalfish	*Apogon lateralis*	Fo
Halfbeak	*Zenarchopterus dispar*	Ise
Eel catfish	*Plotosus anguillaris*	Apoa
Up-side-down Jellyfish	*Casseopea*	Alualu
Mangrove crab	*Scylla serrata*	Paalimago
Mangrove lobster		Ula togatogo
Red claw mangrove crab	*Sesarma erythrodactyla*	U'a
Venus shell/cockle	*Gafrarium tumidum*	Tugane
Sand cockle	*Asaphis deflorata*	Pipi

Source: Siamomua-Momoemasua 2013: 36

8. Threats to mangroves in Samoa

Mangrove areas have been used largely by coastal communities and the government as rubbish disposal areas in the past. The Vaitoloa Point of the Vaiusu Bay mangal used to be the main rubbish dump for the Apia municipal area until the landfill site was established in Samoa.

The major threats to mangroves in the Safata District which includes the Le Asaga Bay area include both human activities such as unsustainable fishing of mangrove crabs, poor land use practices, and clearing of vegetation. Coastal developments such as reclamation, road construction and hotel development are some of the activities that also contribute towards the destruction of mangroves. This is further exacerbated by coastal flooding and extreme high water tidal influences that cause coastal erosion.

9. Study Methodology

Given the geography of Samoan Mangrove and discussions with MESCAL project coordinator, the Sanaapu and Sataoa mangrove forest and Le Asaga Bay mangroves in the Safata District, which includes the Pilot Site for MESCAL Samoa Project, were used as case studies. However, three other villages in the Vaiusu Bay closer to Apia, namely Vailoa, Vaiusu and Sogi were also surveyed to look at some of the impacts on mangroves associated with urbanization. The village interviews and discussions with key informants, technical experts, government authorities, communities and other stakeholders were used as the basis to gather information for assessment and evaluation of the mangroves to formulate the policy pathway. A detailed socio-economic survey was also conducted in five of the nine villages. Questionnaires were translated into Samoan language. A copy of both the English and Samoan questionnaires are attached in the appendix.

The Millennium Ecosystem Assessment's (MEA) conceptual framework for ecosystem services was used as a basis to identify the categories of mangrove ecosystem services as presented in figure 2. The framework for the total economic value assessment used in the study is outlined in figure 3.

Mangroves provide pivotal support to offshore fisheries by acting as nursery, breeding, spawning, and hatching habitats (Barbier, 2007), exporting organic matter to the marine environment, and producing nutrients for fauna in both the mangroves themselves and in adjacent marine and estuarine ecosystems (Salem & Mercer, 2012). Mangroves also play a crucial role in shoreline protection by acting as natural barriers, dissipating the destructive energy of waves, and reducing the impact of hurricanes, cyclones, tsunamis and storm surges. A number of studies have documented that regions with intact mangroves were exposed to lower levels of devastation from cyclones than those with degraded or converted mangroves (Chong, 2005; Badola & Hussain, 2005). Mangroves also contribute to shoreline stabilization and erosion control.

Figure 2: Conceptual Framework for Ecosystem Services

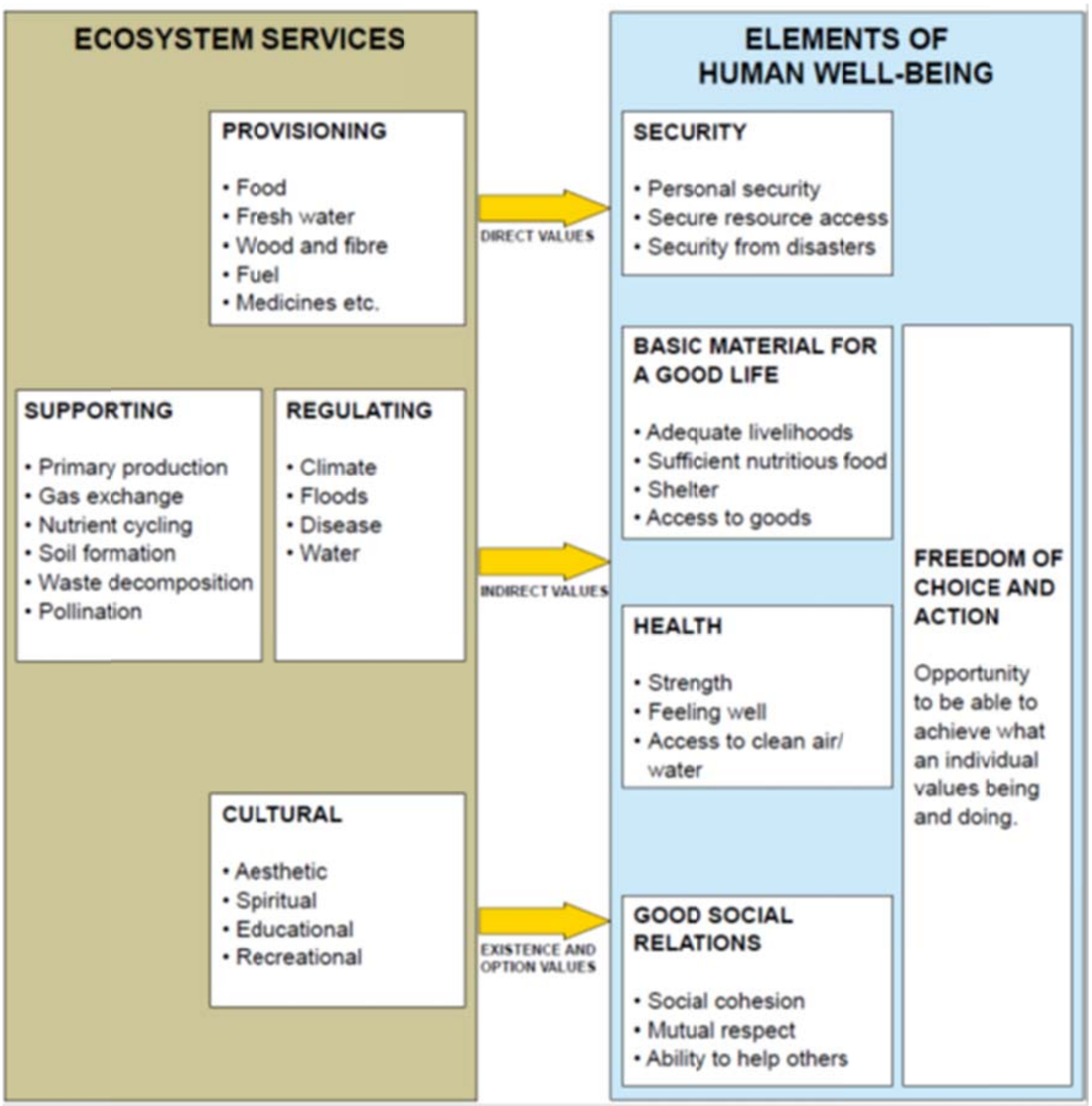
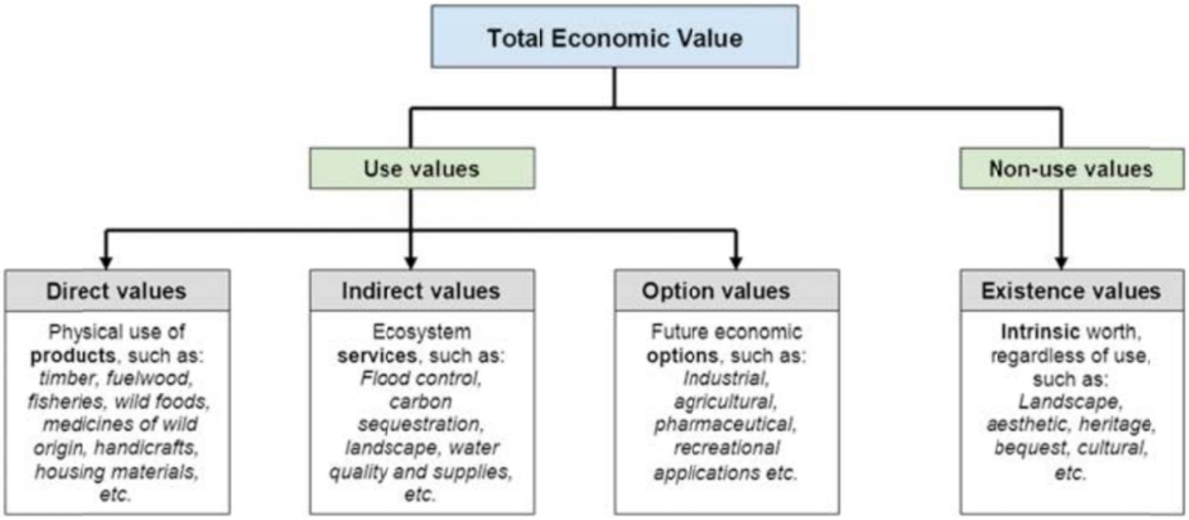


Figure 3: The Components of the Total Economic Value of Mangroves



Methods

Direct Use (extractive)– in Samoa, the direct use information was gathered by a household questionnaire on how much fish, shellfish, crabs and other marine products households catch/ collect and how much of this was sold and consumed. The questionnaire also ascertained the cost of fishing.

Fishery is largely subsistence and artisanal. Commercial fishers are mostly who do ocean fishing using *alias* but the artisanal fishers who sell all or some of their catch or subsistence fishers who have surplus catch and who sell were categorized as artisanal/commercial. Coastal commercial fishing using canoes was included while oceanic tuna was not included in the total calculation because fishers travelled long distances to the open ocean using alia catamarans. None of the villages in the study sites owned alias for oceanic fishing.

Market prices from Fisheries Reports and market survey interviews were determined. Replacement protein was determined by analyzing the consumption patterns of protein substitutes such as canned fish, canned meat and chicken at market prices for equivalent replacements.

Firewood, timber, and medicinal uses were also determined by questionnaires that inquired about amount and frequency. Replacement cost method was applied to determine the values.

Tourism –related uses were ascertained through interviews with resorts in the area on direct use of mangroves such as timber and construction materials and fisheries.