ENVIRONMENTAL ECONOMIC VALUATION REVIEW

THE BIODIVERSITY FINANACE INITIATIVE

PREPARED BY

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## Chapter 1: Introduction

Biodiversity refers to the variety of life that can be found (i.e. plants, animals, fungi, and microorganisms), as well as to the communities that they form and the habitats in which they live. Biodiversity supports human well-being and economic development through the provisioning of food, clean water, disease and pest management, climate regulation, spiritual fulfilment, and aesthetic enjoyment. The rapid pace of development, has increased pressures on and the overall health of biodiversity and the services they provide. Economic values of biodiversity could lead to a set of potential financial solutions aimed at achieving key environmental sustainability and biodiversity goals and objectives of the country.

### 1.1 The need

“Quantifying the value of biodiversity remains one of the most challenging areas of environmental economics” (UNDP 2016, p. 31). “Part of the value of biodiversity can be captured in the flows of ecosystem services it supports” (UNDP, 2016). The field of economic valuation of biodiversity and ecosystem services has become a powerful tool for demonstrating, in a language familiar to decision makers, their contribution to growth, employment creation and poverty reduction. It also helps policymakers understand why ecosystems remain undervalued, and identify dependencies on biodiversity and therefore the loss of economic productivity and worsening of poverty associated with ecosystem degradation. In addition, converting non-monetary values of nature into monetary figures provides a way to capture and compare the value of biodiversity in alternative policies, programmes, and investments.

Biodiversity is an asset that has distinct properties: it can continue to provide goods and services in perpetuity, as long as you allow for the flow nature of the asset’s stock (UNDP, 2016). Otherwise, it is non-renewable and irreplaceable. This creates the justification for proper investment on the assets which would provide both protection of the asset and the sustainable flow of benefits. Most countries are not investing adequately in preserving or expanding biodiversity assets. One reason for this is non availability of the actual value or worth of the country’s biodiversity.

Monetary values are often taken from market prices but many environmental goods and services are not traded in markets or adequately priced by markets, which contributes to market failure. Valuation methods are therefore needed to be applied explicitly in order to arrive at a correct value of biodiversity. Such economic arguments will help to make the case for adequate resources to be invested in biodiversity. “Economics can also help to improve our understanding on who is benefiting from what ecosystem services and who bears the costs of providing them” (UNDP 2016…). This is important for setting up the right incentives for effectively protect biodiversity.

Sri Lanka’s National Biodiversity Strategies and Action Plan (NBSAP) recognises the importance of environmental valuation which is in line with the AICHI targets. Among the 12 National Targets of the NBSAP, the 5thindicates that ‘By 2022, the valuation of biodiversity is mainstreamed’.

According to the NBSAP, there has been a steady increase in studies of valuing Sri Lanka’s ecosystems. Yet, ecosystem valuation (the value of biodiversity and ecosystem services — BES) has to be mainstreamed into planning, implementation and decision-making .The actions of Target 5 are designed to increase awareness about biodiversity and ecosystems (BES); undertake valuation of key ecosystems; integrate BES to national accounting; and integrate BES to regional and national financing mechanisms (ref NBSAP?).

Review of relevant economic valuation studies could shed light on economic drivers of change and present information on the main economic sectors in terms of contributions to GDP and jobs which can then be compared with a sector’s dependencies and impacts on biodiversity. Market-related economic evidence includes assessments of the sectors’ impacts and dependencies on the environment. These analyses often consider how changes in the natural environment result in changes to ecosystem services and in turn the benefits to people from ecosystems.

Monetary valuation of the environment can be considered a three-step process of qualitative assessment, quantitative assessment and valuation in monetary terms. Valuation results can be reported, accompanied by discussion of the underlying assumptions and caveats, to provide additional understanding of the interactions between the prioritized economic sectors and biodiversity. For example, economic valuation evidence can help to assess trade-offs and priorities, between alternative uses of biodiversity containing land.

Economic valuation evidence for the country, subdivided by sectors, ecosystems and households/communities/businesses whose value are affected could provide additional arguments for investing in biodiversity, using appraisal tools such as cost-benefit analysis.

### 1.2 Total economic value

The study adopts ‘Total Economic Value’ framework for analyzing various value types associated with the complex ecosystems.

**1.2.1 Use Values**

This refers to economic value derived from using the ecosystem as a source of raw materials, medicinal products, aesthetic satisfaction, personally experienced vicarious adventure etc. Use value may be derived from present and expected future use. Use values are further divided into direct use values (DUV), indirect use values (IUV); and option values (OV). Direct use values can be further divided into consumptive, productive and non-consumptive use values. Direct use values are the values derived from directly consumable products of the forest or the products that can be used in improvements in production. Indirect use values refer to the ecological functions of the forests. For example, a forests role in a watershed would help to reduce impact of heavy rain fall on soil surface, sustain a dry season flow among other things. Therefore, removal of forest cover may result in water pollution, siltation, reduced water table etc.

**1.2.2 Option values**

These relate to the amount that an individual would be willing to pay to conserve a tropical forest for future use. In other words, it is similar to an insurance premium to ensure the supply of forest where the future supply is uncertain. For example, if an individual is sure to demand future use but unsure that the resource will be available then, he might pay something beyond future use value to secure an option guaranteeing the resource will be available for later use. Option value could be positive or negative. However, in the context of tropical forest, it is likely to be positive due both to increasing demand for its environmental qualities and to threatened supply due to deforestation.

**1.2.3 Non-use Values**

Non-use values are slightly more problematic in definition and estimation, but are usually divided into bequest values (BV) and existence values (EV). Bequest value measures the benefit accruing to any individual from the knowledge that others might benefit from a resource in the future. Existence values are unrelated to current use or option vales, and it is the value derived from the knowledge that any particular asset exists. For example, an individual’s concern to protect, the blue whale although he or she has never seen one and is never likely to, could be an example of existence value.

Thus total economic value could be expressed as,

TEV = UV + NUV = (DUV + IUV + OV) + (BV + EV)

Both use and non-use values can reside in the host nation or globally (all nations other than the host nation). Therefore the above equation can be rewritten as

TEV = DUVn + DUVg + IUVn + IUVg + OVn + OVg + BVn + BVg + EVn + EVg

Here, n denotes national and g denotes global.

### 1.3 Objectives

The main objective of the study is to compile and review exiting environmental valuation studies on biodiversity of Sri Lanka with a view to guide investments on biodiversity.

This main objective is fulfilled through the following sub objectives:

1. Collecting the available environmental valuation studies
2. Reporting estimated values of biodiversity of Sri Lanka under each economic sector
3. Review of the studies for their coverage and gaps
4. Comparing the values with the actual investments to provide policy guidance on investments on biodiversity

## Chapter 2: Economic Valuation of Biodiversity

### 2.1 Methods for Environmental valuation

To help policy-makers make more informed decisions about activities with significant environmental impacts, economists have developed methods for valuing non-market benefits in monetary terms. All of the methods attempt to express consumer demand, i.e. the willingness-to-pay (WTP) of consumers for a particular non-marketed benefit in monetary terms, or their willingness-to-accept (WTA) monetary compensation for the loss of the same. In short, these valuation methods attempt to express the utility derived from non-market goods and services in the metric of the market, which is considered to provide an accurate reflection of the relative preferences of producers and consumers for different goods and services.

Techniques for estimating non-market or non-timber forest values vary in their theoretical validity and acceptance among economists, their data requirements and ease of use, and the extent to which they have been applied in (and perhaps their relevance to) different countries. Different techniques available are divided into three broad groups (Box 1).

**BOX 1. Environmental valuation techniques**

1. **Market Based Techniques**

 Market price method

Production function approaches, which focus on bio-physical relationships between forest functions and market activities;

Cost-based approaches, including replacement cost method and defensive expenditure method.

 Human capital approach

 Opportunity Cost Method

2. **Hypothetical Market Based Techniques**

 Contingent valuation method

 Constructed markets

 Contingent ranking

 Choice modeling

 Delphi techniques

3. **Surrogate Market Techniques**

 Wage Differential Method

 Property Value Approach

 Travel Cost Method

**Use of existing value estimates**

Benefit Transfer Approach

**Estimation of economic value of medicinal plants - Pearce Equation**

The following section describes each method in detail.

**(?) Valuation Using Market Prices:** This is the simplest method of valuation. Many goods and services from tropical forest land uses are traded, either in local markets or internationally, including wood products (timber and fuel), non-wood forest products (food, medicine and utensils), crops and livestock products, wildlife (meat and fish) and recreation.

### 2.2 Market Based Techniques

**2.2.1 Use of direct market prices**

For those products that are commercially traded, market prices can be used. In some cases, it may be necessary to adjust market prices to account for market or policy failures. Prices are derived within the market place through interaction between consumers and producers over the demand and supply of goods and services. In an efficient market, goods and services will be priced at their marginal value product and reflect the full opportunity costs of resource use.

**2.2.2 Production Function Approaches**

This is also called the change-in-production technique or the input-output or dose response method. This method involves relating human well-being (or more narrowly, the incremental output of a marketed good or service) to a measurable change in the quality or quantity of a natural resource (Maler 1992). The production function approach may be used to estimate the indirect use value of ecological functions of forests, through their contribution to market activities. The approach is referred to as the production function method because many studies estimate impacts on economic production. However, the same approach can be used to estimate consumption losses directly, e.g. siltation of bathing areas.

Use of this approach involves a two-step procedure. Firstly, the physical effects of changes in the environment on economic activity are determined. This may be done through laboratory or field research, observation or controlled experiments, or statistical techniques. The second step consists of valuing the resulting changes in production or consumption, usually using market prices. In this way the monetary value of the ecological function is derived indirectly.

**2.2.3 Cost-based Valuation**

These methods focus on the costs of maintaining non-market forest benefits, or trade-offs with market values. Three alternative methods focus on the costs of providing, maintaining or restoring environmental goods and services. The most common methods are:

 **Replacement cost method -** measures environmental values by examining the costs of reproducing the original level of benefits

 **Preventive expenditure method -** estimate the cost of preventing or defending against degradation of the environment

 **Opportunity cost approach -** use estimated production costs as a rough proxy for the value of non-market benefits.

**2.2.3.1 Replacement Cost method**

The replacement cost technique generates a value for the benefits of an environmental good or service by estimating the cost of replacing the benefits with an alternative good or service.28 For example, where logging or road construction in upland forest areas leads to increased runoff and sedimentation, some studies use information on the costs of dredging or flood control as a rough estimate of the non-market benefit of watershed protection. The technique rests on the availability of such an alternative, which should - as nearly as possible - produce the same type and level of benefits as supplied by the resource or environmental function being valued.

**2.2.3.2 Preventive Expenditure method**

The preventive expenditure approach (also sometimes called ―mitigation‖ or ―defensive‖ expenditure) places a value on environmental goods and services by estimating the costs of preventing a reduction in the level of those benefits derived from a particular area. This approach may be most applicable for assessing the indirect use values of forests.

**2.2.3.3 Opportunity cost method**

**Opportunity Cost of Labour**

This approach focuses on the employment opportunities foregone in order to secure or protect a particular non-market benefit. As with other cost-based approaches, the focus is on the costs of providing a nonmarket benefit, rather than the magnitude of the benefit *per se*. The basic idea is that a non-market benefit is worth at least as much as the return that could be obtained by private producers if they were to devote the same effort (i.e. the labour used to secure the non-market benefit) in some alternative use.

The opportunity cost approach is most often used to value the subsistence benefits of NTFP collection, where labour is the main input and prices are not available because all or most output is consumed directly by producers. In such cases, the implicit assumption is that a producer‘s decision to spend time collecting non-timber forest products is weighed against alternative uses of household labour. The opportunity cost of time spent harvesting NTFPs is thus taken as a proxy for the value of the product(s) in question

### 2.3 Stated Preference Approaches

Price-based, surrogate market and production function approaches all rely on the use of market prices (revealed preference) to estimate the value of forest goods and services. An alternative is to ask consumers to state their preferences directly, in terms of hypothetical markets or payments. In this approach, information on the value of an environmental benefit is obtained by posing direct questions to consumers about their willingness to pay for it or, alternatively, their willingness to accept cash compensation for losing the benefit.

The most widely used and well-developed stated preference technique is the contingent valuation method (CV or CVM). Less widely used stated preference methods include choice experiments (CE).

**2.3.1Contingent Valuation**

CV elicits individual expressions of value from respondents for specified increases or decreases in the quantity or quality of a non-market good. Most CV studies use data from interviews or postal surveys. Valuations produced by CVM are ―contingent‖ because value estimates are derived from a hypothetical situation that is presented by the researcher to the respondent. The two main variants of CV are open-ended and dichotomous choice (DC) formats. The former involves letting respondents determine their ―bids‖ freely, while the latter format presents respondents with two alternatives among which they are asked to choose. Open-ended CVM formats typically generate lower estimates of willingness to pay (WTP) than DC designs.

**2.3.2 Choice Experiments**

This approach involves asking individual respondents to choose mong alternative bundles of non-market goods, which are described in terms of their attributes, including an hypothetical price (Hanley et al. 1998; Adamowicz et al. 1998a). In the case of forests, for example, a CE survey may present respondents with alternative landscapes (in the form of images), which vary by species mix, age diversity, percentage of open area, the presence of roads and the hypothetical price (given a particular payment vehicle) to the individual. CE shares many features with Dichotomous Choice CV models and the results should be directly comparable with estimates based on DC/CV models. A particular strength of CE is the ability to estimate characteristic values for environmental goods.

Participatory Methods CVM and CE rely on interviews or questionnaire surveys to collect data on individual WTP for environmental benefits. Contingent ranking may also involve individual interviews. Survey design and administration has been a major focus of concern in all of these methods, with the aim of minimizing biased or strategic responses (Hanemann 1996). Some researchers argue that the use of participatory or ―focus group‖ techniques in both data collection and analysis can reduce bias and generate more accurate information. These and related concerns have led researchers to develop variants of CVM which use participatory survey techniques.

### 2.4 Surrogate Market Approaches

This group of methods relies on the fact that certain non-market values may be reflected indirectly in consumer expenditure, in the prices of marketed goods and services, or in the level of productivity of certain market activities. These techniques are statistically sophisticated methods, such as travel cost models and hedonic pricing, as well as simpler techniques such as the substitute goods method. The theoretical basis for all of these approaches is the household production function, which describes how households attempt to maximize their well-being by allocating time and resources to different activities.

**2.4.1 Travel Cost Method**

The travel cost method (TCM) is based on the assumption that consumers value the experience of a particular forest site at no less than the cost of getting there, including all direct transport costs as well as the opportunity cost of time spent traveling to the site (i.e. foregone earnings). This survey-based method has been used to estimate environmental benefits at recreational sites (including wildlife reserves, special trekking areas and beaches). Three basic steps are involved in travel cost models. First, a survey of a sample of individuals visiting the site to determine their costs incurred in visiting the site. These costs include travel time, any financial expenditure involved in getting to and from the site, along with entrance (or parking) fees. In addition, information on the place of origin for the journey, and basic socio-economic factors such as income and education of the individual is required.

The resulting data is manipulated to derive a demand equation for the site. This relates the number of visits to the site to the costs per visit. The third step is to derive the value of a *change* in environmental conditions. For this, it is necessary to determine how willingness to pay for what the site has to offer alters with changes in the features of the site. By comparing the willingness to pay for sites with different facilities it is possible to determine how the total benefits derived from the site change as the facilities of the site change.

**2.4.2 Hedonic Pricing**

This method attempts to isolate the specific influence of an environmental amenity or risk on the market price of a good or service. The most common applications of this technique are the *property value* approach and the *wage differential* approach, which are used to value environmental amenities and dis-amenities. Hedonic pricing is based on the assumption that the market value of land or labour is related to the stream of net benefits derived from it. This stream of net benefits includes a range of factors, including environmental amenities. Therefore, the value of the environmental amenity can be imputed from the observed land or labour market.

**2.4.3 Property value approach**

Application of the hedonic pricing approach to property values involves observing systematic differences in the value of properties between locations and isolating the effect of environmental quality on these values. The market value of a residential property, for example, is affected by many variables including its size, location, construction materials, and also the quality of the surrounding environment. With sufficient data on property values and characteristics it may be possible to control for size, location, construction materials and other factors, such that any residual price differential may be imputed to differences in environmental quality. The hedonic pricing method requires large data sets, in order to account for and eliminate the influence of all other variables which affect market prices. The approach also assumes that markets for land are competitive, and that both buyers and sellers are fully informed of the environmental amenity or hazard.

### 2.5 Other Approaches

**2.5.1 Benefit transfer method**

Benefit transfer is an application of monetary values obtained from a particular valuation study to an alternative or secondary policy decision setting, often in another geographical area than the one in which the original study was performed. Thus, the basic goal of benefit transfer is to estimate benefits for one context by adapting an estimate of benefits from some other context. Benefit transfer is often used when it is too expensive and/or there is too little time available to conduct an original valuation study, yet some measure of benefits is needed. It is important to note that benefit transfers can only be as accurate as the initial study.

Benefit transfer can be applied to extrapolate values of different non-market valuation techniques such as Hedonic pricing, Travel cost method, Contingent valuation, Choice modelling. The types of benefit transfer applications can range from simple and pragmatic applications through to more technical and complex operations.

**2.6 Challenges to economic valuation**

An economic valuation exercise in the developing country context is itself a challenge due to financial and other constraints. The estimated values are often constrained by the lower income levels. All valuation methods are subjected to this bias. Errors of statistical methods and the negligence of full range of values are the other issues. Estimated values always reflect the preferences of current generation. Valuation exercises assumes linearity between the quantity of goods and services and the value. However, ecosystems often behaves with non-linearity and the valuation methods are not capable of capturing such facets.

## Chapter 3: Methodology of the study

### 3.1 The approach

There are several approaches under which values of biodiversity can be reported, including the sectoral approach, value based/ecosystem services based approach, values estimated under each valuation method, and values estimated for each ecosystem/genetic or species diversity.

The initial discussions held with the stakeholders indicated that the sectoral approach provides better inputs.

The values of biodiversity will therefore be collected under the following sectors.

1. Forestry
2. Tourism
3. Fisheries
4. Energy (biomass and Hydropower)
5. Agriculture
6. Health
7. Water
8. Disaster mitigation

This approach is able to highlight interlinkages between sectors and to illustrate economic sectors which are having the highest contribution from biodiversity. However, it may not capture non-use values and future values. The Total economic value (TEV) framework which disintegrates values into use values and non-use values will also be adopted in the data collection process. It is assumed that TEV approach is capable of capturing every aspect of value of a complex environmental asset. It is extremely useful in decisions on comparison of worth of alternative land uses.

### 3.2 Sources of data

The following Sources will be explored for data on valuation studies:

 Published sources – journals, books, reports, web publications on conferences etc.

 Unpublished sources (dissertations, reports)

 Universities

 Research institutes and other institutions

Due to the time constraints, the data will be collected mainly from the available web sources, personal contacts among the environmental valuation practitioners and membership of the Sri Lanka Agricultural Economics Association. In addition, the existing reviews of environmental valuation studies that have been carried out (for example, forest sector green accounting study and Estimates of Environmental Unit Values in Sri Lanka) will be used as data sources.

**a. The review will consist of the following**:

1. Values of biodiversity reported under each sector

2. Review of the studies for their coverage and methodological aspects

3. Identification of gaps and issues related to valuation studies

4. The need to present environmental valuation review results in an easy to access form like a database has been identified - this has to be done in a subsequent stage due to resource and time constraints.

**b. Guidance for policy - information on the justification of further investments:** It is intended to compare the estimated value for each sector/ecosystem and the expenditure/investments and to provide recommendations on additional investments.

## Chapter 4: Results

### 4.1 Diversity of different value types and valuation methods in Sri Lanka

The following table provides details on different valuation methods adopted in assessing different value types associated with different ecosystem types of Sri Lanka.

**Table 4.1: Valuation methods adopted in valuing different ecosystem types in Sri Lanka**

|  |  |  |
| --- | --- | --- |
| **Ecosystem types/ resource**  | **Types of values estimated**  | **Valuation methods used**  |
| Tropical rain forests  | Direct use values  | Market prices |
|  | Indirect use values  | (Replacement cost approach) RC |
|  |  | Market prices (global) |
|  | Option values  | Pearce equation  |
|  | Non-use values  | Contingent valuation method (CVM) |
| Parks /protected areas  | Direct non consumptive use values  | Travel cost method (TCM) |
| Botanical gardens | Direct non consumptive use values | Travel cost method |
| Home gardens in the wet zone  | Direct consumptive uses  | Market price method |
| Mangroves  | Direct consumptive uses | Market prices |
|  | Indirect use values  |  |
|  | Non-use values  | CVM |
| Wetlands  | Direct consumptive uses | Market prices |
| Wild life (elephant) | Direct non consumptive use values | CVM |
|  | Non-use values  | CVM |
| Wild life (leopard) | Direct non consumptive use values | TCM |
|  | Non-use values  | CVM |
| Wild life orphanages | Direct non consumptive use values | TCM |
| Forest plantations | Direct consumptive use values (NTFP) | Market prices  |
| Coconut plantations | Direct consumptive use values (animal rearing grounds) | Market prices |
|  | Indirect use values | Replacement cost  |
|  |  |  |
| Rubber plantations  | Direct consumptive use values (intercropping) | Market prices |
|  |  |  |
|  | Indirect use values  | Avoided global damage cost  |
| Wetlands  | Direct non consumptive use values | CVM |
|  | Indirect use values  | CVM |
| Coastal wetlands | Direct non consumptive use values | TCM |
| Water falls  | Direct non consumptive use values | TCM |
|  |  | Market prices  |
| Forest landscapes  | Direct non consumptive use values | CVM |
| Medicinal plants  | Direct consumptive use values | Market prices |
| Forests containing medicinal plants  | Option values  | Pearce equation  |
| Land containing Crop wild relatives  | Option values  | Choice modelling  |
| Watersheds | Indirect values  | Replacement cost  |
| River basins  | Direct consumptive use values | Market prices  |
|  | Direct non consumptive use values | Market prices  |
|  | Indirect use values  | Avoided damage cost method  |
| Secondary forests  | Direct consumptive use values | Market prices  |
|  | Indirect use values  | Avoided damage cost method |
| River ecosystems  | Direct consumptive use values | Market prices  |
|  | Direct non consumptive use values | Market prices  |
|  | Indirect use values | Damage costs avoided  |
|  |  |  |

It is evident that CVM and TCM has been the most commonly adopted valuation method in valuing ecosystems in Sri Lanka. The most commonly adopted value type for valuation has been direct non consumptive use values.

### 4.2 Examples under each ecosystem

Review of the existing studies on the ecosystem values reveals values available under the individual examples and their value types. This covers forest, fisheries, water, tourism, health, energy and agriculture sectors.

**Table 4.2 Individual examples of valuation and their value types**

|  |  |  |
| --- | --- | --- |
| **Category**  | **Example**  | **Value type**  |
| 1.1 Natural forests Tropical rain forests: | Sinharaja Forest Reserve Knuckles Forest Hurulu FR | Use values and non-use values  |
| 1.2 Parks and protected areas  | Hortain Plains NP, Udawalawa NPWasgomuwa NP, Yala NPMinneriya NP, Kaudulla NPUdawathekele RNPWilpattu NP, Kumana NP Pigeon Island NPYala | Use values Non-use  |
| 1.3Botanical gardens  | HakgallePeradeniyaSeethawaka | Use values  |
| 1.4 Home gardens  | Kandyan home gardens Lowland home gardens | Use values and lost values  |
| 1.5 Mangroves  | RekawaPuttlamHambanthota | Use values and non-use values  |
| 1.6 Valuation of species  | Elephants LeopardsTurtles  | Use values and non-use values  |
| 1.7 Wetlands  | Small tanks in Hambanthota, Bolgoda lake | Use values  |
| 1.8 Coastal wetlands | Muthurajawela Marsh, Madu Ganga, KalametiyaNegambo lagoon Paraviwella Beach | Use values  |
| 1.9 Water falls  | Dunhinda, Bopath Ella  | Use values  |
| 1.10 River basins  | Kalaoya | Use and non-use values  |
| 1.11 River ecosystems  | MahaOya | Use values Costs of degradation  |
| 1.12 Dry zone forests  |  | Non-use values  |
| 1.13 Valuation of forest plantations | Jak Mahogany mixed plantation  | Non timber forest products |
| 1.14 Valuation of rubber plantations  |  | Carbon benefits  |
| 1.15 Valuation of coconut plantations  |  | Watershed conservation  |
| 1.16 Valuation of forest landscapes | Kadugannawa scenic view  |  |
| 1.17 Valuation of mountains  | Sri Pada | trekking |
| 1.18 Valuation of sea grass  |  |  |
| 1.19 Valuation of habitats of crop wild relatives  | Puttlam wetlands  |  |
| 1.20 Value of pollinators  | Forests of the country  | Crop value  |
| 1.21 Value of land containing medicinal plants  | Low land rain forests SinharajaKnuckles  | Pharmaceutical prospecting value  |
| 1.22 Value of carbon sequestered in forests  | Total forest extent  | Ecosystem service  |
| 1.23 Value of montane forests for hydropower  |  |  |
| 1.24 Value of rivers for white water rafting  | Kithulgala | Use values  |

According to the above table, Parks and protected areas have received the highest attention of valuation experts.

### 4.3 Details on estimates available for each value type

The following table provides a description of different value types of the total economic value in relation to the Sri Lankan ecosystems.

**Table 4.3: Description of different value types**

|  |  |
| --- | --- |
| **Value type**  | **Description**  |
| Consumptive use values  | Non timber forest products from wet zone and dry zone home gardens and from forests  |
| Non consumptive use values (recreational values) | Consumer surplus estimates of National Parks, Botanical gardens species viewing etc. |
| Option values  | Pharmaceutical prospecting values of forests containing medicinal plants  |
| Indirect use values  | Value of carbon storage of forests  |
|  | Flood protection values of mangroves Watershed protection Pollination services Provision of fodder for livestock |
| Non-use values (Local) | Sinharaja rain forest Elephants Yala National Park Dry zone forests Leopards  |

The following section provides details on each value type.

**4.3.1 Consumptive Use Values**

Fuel wood and non-timber forest produce (NTFP) comprise a very significant part of the household incomes of communities living closed to the forests. The following four types of estimates are available.

1. NTFP value of Wet Zone home gardens
2. NTFP value of Wet Zone forests
3. NTFP value of Dry Zone home gardens
4. NTFP value of Dry Zone forests

The following section elaborates on each item.

**4.3.1.1 NTFP value of Wet Zone home gardens Western province**

**Table 4.4: Values of different NTFP products from Wet Zone home gardens**

|  |  |
| --- | --- |
| **Product**  | **Annual Value Per Household (Rs)** |
| Green leaves | 2852.92 |
| Yams | 590.98 |
| Vegetables  | 4912.17 |
| Fruits  | 19525.85 |
| Spices | 3396.03 |
| Economic crops | 37166.77 |
| Medicinal plants  | 950.82 |
| Ornamental plants | 1276.86 |

Source :Priyadharshika and Gunawardena, 2007

**4.3.1.2 NTFP value of Wet Zone forests**

**Table 4.5: Value of different NTFP products from Wet Zone forests**

|  |  |
| --- | --- |
| **Item category** | **Net value per ha of the forest (Rs)** |
| Mushrooms | 11.81 |
| Leafy vegetables | 3 |
| Other vegetables  | 0.55 |
| Yams | 1.69 |
| Spices | 4.3 |
| Fruits | 0.14 |
| Fish | 4.03 |
| Roofing materials | 3.66 |
| Tying materials | 6.73 |

Source: Gunawardena, 1997

**4.3.2 Non Consumptive use values – recreation values**

Eco-tourism is recently expanding area in tourism industry and accordingly, it has to be treated differently for the valuation. For estimating non consumptive use values of forests, the most often used methods have been the travel cost method. For majority of the Sri Lankan parks and protected areas, consumer surpluses have already been estimated.

**Table 4.6: Recreational values of Parks, Protected areas, Botanical gardens, wetlands** **and waterfalls**

|  |  |  |
| --- | --- | --- |
| **Reference** | **Site** | **Consumer surplus Rsmn** |
| Rathnayake and Gunawardena (2007) | Hortain Plains National Park | 51.68 |
| De Silva and Kotagama (1997) | Udawalawa National Park | 2.18 |
| Rathnayake and Gunawardena (2002) | Wasgomuwa National Park | 2.38 |
| Marasinghe (2002) | Yala National Park | 54.4 |
| Rathnayake and Kariyawasam (2002) | Peradeniya Botanic Garden | 240 |
| Weerakoon (2002) | Muthurajewela Wetland System | 119.4 |
| Herath and Nissanka (2003) | Udawathekele Royal National Park | 7.9 |
| Jayaratne and Gunawardena (2004) | Hakgalle Botanic Garden | 221 |
| Gunatilake and Vieth (1998) | Pinnawela elephant Orphanage | 12.20 |
| Rathnayake and Gunawardena (2007) | Kaudulla National Park  | 1.92 |
| Piyadasa and Thiruchelvam (2005) | Bopathella | 120.00 |
| Sooriyabandara (2002) | Minneriya national park | 3.90 |
| Rathnayake (2012) | Dunhinda falls | 345.65 |
| Rathnayake (2012) | Sri Pada mountain trekking  | 101.58 |
| Rathnayake (2012) | Belilena | 0.24 |
| Wickramarachchi and Gunawardena (2012) | Leopard viewing  | 1027.64 |
| Gunawardena (2012) | Wilpattu National Park | 24.00 |
| Gunawardena (2012) | Kumana National Park | 0.62 |

**4.3.2.1 Non Consumptive use values – recreation values of Botanical Gardens managed by Department of Botanic Gardens**

**Table 4.7: Comparison of consumer surplus estimates of Botanic Gardens**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Author** | **Site** | **Visitor type** | **Recreational value****(LKR million)** | **Recreational value (2017)****(LKR million)** |
| Jayarathne (2004) | Hakgala Botanical Garden | Local | 228.49 | 686.13 |
| Rathnayake and Kariyawasam (2002) | Peradeniya Botanical Garden | Local | 240.00 | 824.47 |
| Maduwanthika and Gunawardena (2017) | Seethawaka Wet Zone Botanic Garden | Local | 182.00 | 182.00 |

The comparison demonstrates that the value shows higher values for well-established gardens such as Hakgala botanical Garden and Peradeniya Botanical Garden and much lower value for recently established Seethawaka Wet Zone Botanic Garden.

**4.3.2.2 Non Consumptive use values – recreation values of National parks managed by Department of Wild Life Conservation**

**Table 4.8: Consumer surplus estimates of National parks managed by Department of Wild Life Conservation**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Author** | **Site** | **Survey sample** | **Visitor type** | **Consumer Surplus in the study year (Rs Mn)** | **Consumer Surplus 2017 prices (Rs Mn)** |
| De Silva & Kottagama (1996) | Hortain plains | 200 | Local | 2.181 | 12.54 |
| De Silva &. Kottagama (1996) | Udawalawa | 66 | Local | 2.18 | 12.53 |
| Sooriyabandara (2002) | Minneriya | 82 | Local | 3.9 | 13.40 |
| Rathnadeera (2002) | Coral Reef Hikkaduwa | 72 | Foreign | 6135 | 21,035 |
| Rathnayaka (2002) | Wasgamuwa | 100 | Local | 2.38 | 8.18 |
| Rathnayaka & Gunawardena (2011) | Horton plains | 200 | Local | 51.68 | 77.81 |
| Marasinghe (2001) | Yala Park/Block 1 | 115 | Local | 54.4 | 202.49 |
| **Total**  |  |  |  |  | **21,361.95** |

**4.3.2.3 Non Consumptive use values – recreation values of Sanctuaries under Department of Wild Life Conservation**

**Table 4.9: Consumer surplus estimates of Sanctuaries under Department of Wild Life Conservation**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Author** | **Site** | **Survey sample** | **Visitor type** | **Consumer Surplus in the study year (Rs mn)** | **Consumer Surplus 2017 prices (Rs Mn)** |
| Weerakoon (2000) | Muthurajawela | 75 | Local | 119.4 | 507.27 |

**4.3.2.4 Non Consumptive use values – recreation values of Beach Park managed by Coast Conservation Department**

**Table 4.10: Consumer surplus estimates of Beach Park managed by Coast Conservation Department**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Author** | **Site** | **Survey sample** | **Visitor type** | **Consumer Surplus in the study year (Rs mn)** | **Consumer Surplus 2017 prices (Rs Mn)** |
| Rathnayaka (2015) | Paraviwella Beach Park | 220 | Local | 8.14 | 8.80 |

**4.3.2.5 Non Consumptive use values – recreation values of Ramsar Wetlands**

 **Table 4.11: Consumer surplus estimates of Ramsar Wetlands**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Author** | **Site** | **Survey sample** | **Visitor type** | **Consumer Surplus in the study year (Rs mn)** | **Consumer Surplus 2017 prices (Rs Mn)** |
| Rathnayaka (2015) | Maduganga Ramsar Wetland | 400 | Local | 8.14 | 21.58 |

**4.3.3 Indirect use values**

**4.3.4 Option values of forests containing potential medicinal plants**

Almost all new pharmaceutical drugs and remedies are discovered in forests and then replicated by industrial processes. The pharmaceutical value of "hot spot" land areas in Sri Lanka have been estimated by various authors mainly with the use of ‘Pearce equation’. This model involved partitioning the information on total species found in forests into different leads (a species which has a chance of yielding valuable drug) of varying quality. Here each and every forest type is assumed to have species of different quality. The next step is to compute the probability of a potential drug in proportion to the quality of the lead. The probability is assumed to be directly proportional to the density of species in that forest. Setting the search program to be optimal and random, and using financial parameters such as the cost of discovering a species and revenues obtained by different pharmaceutical companies which use this species, it will be possible to estimate the option value of pharmaceuticals as a component of the value of the bio-diversity of Sri Lanka’s forests.

Rausser and Small (2000) considering 18 sites (the same as those considered by Simpson et al., 1996) and using the information on the density of endemic species as prior information, estimated the present value of WTP of pharmaceutical prospecting. The estimated WTP for pharmaceutical prospecting for forest in southwestern Sri Lanka is US$ 7,463 /ha (Rs. 567,188 /ha), which is the world’s second highest among the estimates. The highest WTP (US$ 9,177 /ha) is for western Ecuador and the third highest present value (US$ 5,473 /ha) is for New Caledonia. The lowest non-zero value reported is US$ 231 /ha for Central Chile.

**4.3.5 Non-use values**

Non-use value estimates are available for Sinharaja forest, Yala protected area, dry zone forests, elephant conservation and for leopards. The following table provides the details.

**Table 4.12: Non-use values of Parks, Protected areas and Botanical gardens**

|  |  |  |
| --- | --- | --- |
| **Reference** | **Site** | **Non-use value Rs** |
| Gunawardena (1997) | Sinharaja forest  | Village 0.18Rural 0.26Urban 0.22 (% of annual income) |
| Bandara, 2005 | Elephant  | Rs. 82.96 per hh per yr |
| Weligamage, 2011 | Yala National Park  | Rsmn 1897.07per yr |
| Wickramarachchi and Gunawardena, 2012 | Leopard  | Rsmn 1615.902 per yr |
| Weligamage, 2012 | Dry Zone forests of Sri Lanka  | Rsmn 915.66 per yr |

### 4.4 Economic values of individual Ecosystems

The following table provides details.

**Table 4.13 : Economic values of individual ecosystems**

|  |  |  |  |
| --- | --- | --- | --- |
| **Resource**  | **Value type** | **Estimated value (Rs)** | **Reference**  |
| **Ecosystems**  |
| **Sinharaja rain forest reserve**  | **Direct consumptive use values** |  |  |
|  | Non-timber forest product | Use value of NTFP 952.72 Rs/ha/yr, WTP for reserve non-use 56689000 Rs/ha/yr, non-use value of NTFP 8444010 Rs/ha/yr | Weerahewa and Abeygunawardena (1993) |
|  |  | 307.2 Rs per ha (1994 prices) | Gunawardena (1997) |
|  |  | Periphery of Sinharaja 575 Rp/ha/yr | Gunatilake, *et al* (1993) |
|  | Option values  | Peripheral communities: 54.7 Rs/ha/yr, Urban communities: 204.50 Rs/ha/yr | Abeygunawardena (1992) |
|  | Option value (pharmaceutical prospecting) | US$ 77.00 /ha/yr(Rs. 5,900 /ha/yr)(Pearce Equation)  | Thushantha and Kotagama (1995), and Kotagama (1996)  |
|  | **Indirect use values**  |  |  |
|  | Soil protection and infiltration benefit  | Rs 2513 per ha /yr | Subasinghe and Gunwardena |
|  | Benefit of carbon storage  | $ 40 million (total) | Subasinghe and Gunwardena |
|  | **Non-use values**  |  |  |
|  | Existence values  | Peripheral communities: 41.30 Rp/ha/yr, Urban communities: 171.60 Rp/ha/yr | Abeygunawardena (1992) |
|  |  | Village 0.18Rural 0.26Urban 0.22UK0.12 (% of ann income) | Gunawardena (1997) |
|  | Bequest values  | Peripheral communities: 72.30 Rp/ha/yr,Urban communities: 271.20 Rp/ha/yr | Abeygunawardena (1992) |
|  |  | Village 0.42Rural 0.16Urban 0.23UK0.13 (% of an income) | Gunawardena (1997) |
|  | Total economic value of conservation | 663.64 Rp/ha/yr | Ekanayake and Abeygunawardena (1994) |
| **Knuckles forest range**  | **Use value** of non-timber forest product | 575 Rp/ha/yr | Abeygunawardena and Wickramasinghe (1991) |
|  |  | Periphery of Knuckles 4095 Rp/ha/yr,  | Gunatilake, *et al* (1993) |
|  | **Option value** (pharmaceutical prospecting) | US$ 19.67 /ha/yrRs. 1,495 /ha/yr(Pearce Equation) | Karaluvinne (2001)  |
|  | Option value (pharmaceutical prospecting) | US$ 49 – 98 (Pearce Equation)US$ 785 - based on patents on medicinal plants of Sri Lanka  | Pushpakumara et al (2002) |
| **Horton plains**  | Heritage interpretation and environmental services value | 256.47 Rp/ha/yr | Perera, Jayatilleke and Wanigasundara (1995) |
| **Udawalawe National Park**  | Direct non consumptive use values | 2.18 Rs million  | De Silva & Kotagama (1997)  |
| **Wasgomuwa National Park**  | Direct non consumptive use values | 2.38 Rs million  | Rathnayake & Gunawardena (2002)  |
| **Kaudulla National Park**  | Direct non consumptive use values | 1.92 Rs million | Rathnayake & Gunawardena (2009) |
| **Horton Plains National Park**  | Direct non consumptive use values | 51.68 Rs million | Rathnayake & Gunawardena (2009) |
| **Yala National Park**  | Direct non consumptive use values | 54.4 Rs million | Marasinghe (2002)  |
| **Minneriya National Park**  | Direct non consumptive use values | 3.9 Rs million | Sooriyabandara (2002)  |
| **Peradeniya botanic Garden**  | Direct non consumptive use values | 240.0 Rs million | Rathnayake & Kariyawasam  |
| **Hakgala Botanic Garden**  | Direct non consumptive use values | 221.0 Rs million | Jayarathne and Gunawardene (2004)  |
| **Pinnawala Elephant Orphanage** | Direct non consumptive use values | 12.2 (for locals) 2,364.9 (foreigners) Rs million | Gunethilleke&Vieth (1998)  |
|  |  |  |  |
| **Diyawanna Oya** | Direct non consumptive use values | 3890 Rs million | Marawila& Thibbotuwawa (2010)  |
| **Wetlands**  |  |  |  |
|  | Wetland Product  | Economic Value per ha  | IUCN |
|  | Paddy | 15,916 |
|  | Domestic Use | 145,454 |
|  | Livestock | 32,593  |
|  | Industrial use | 1227  |
|  | Fishery | 34,790 |
|  | Lotus Flowers | 7,136 |
|  | Lotus Roots | 10,590 |
|  |  |  |  |
|  | Recreational benefits of small tanks  | Rs 1,020 per yrperhh | Dayananda and Gunawardena, 2005 |
|  | (indirect use value) Avoided flood damage benefit  | 6.7 million per yr in Kelaniya area  | Dehiwala and Gunawardena, 2006 |
| **Mangroves**  |  | Value(Rs/ha/year) | Gunawardena and Rowan (2005) |
|  | Forestry net benefits | 1,500 |
|  | Lagoon fishery netbenefits (at a subsistence level) | 18,750 |
|  | Coastal fishery net benefits | 34,500 |
|  | Erosion control and buffer againstdamage from storms | 21,000 |
|  | Existence, bequest and option values tolocal community | 181.2 |
| **Species**  |
| **Elephant**  | Use value  | Rs 137.38 | Bandara, 2005 |
|  | Non use value  | Rs. 82.96 |
| **Leopard**  | Use value  | Rs million 1,027.64 per yr | Wickramarachchi and Gunawardena, 2012 |
|  | Non use value  | Rs million 1,615.902 per yr |

### 4.5 Review of valuation studies for coverage, methods and issues

**4.5.1 Valuation studies that have used Contingent valuation method (CVM) in Sri Lanka**

1. **Shantha, A. A., & Ali, B. (n.d.). Economic Value of Irrigation water: A case of Major Irrigation Scheme in Sri Lanka.**

Type of Assessment and main findings: This study attempts to determine the economic value of irrigation-water in a government properly managed irrigation project (GPMIP)

Empirical Data: Stratified random sample techniques has been used to select the sample under several stages. At the first stage farmers were clustered as head, middle and tail based proximity of water sources to the irrigable land.

Valuation techniques used: contingent valuation method followed by single bounded dichotomous choices

Socio economic groups: authorized paddy farmers in selected schemes

Comments:

This study attempts to determine the economic value of irrigation-water in a government properly managed irrigation project (GPMIP) by eliciting farmer’s willingness to pay (WTP) using contingent valuation method followed by single bounded dichotomous choices.

The target groups of the field survey have been authorized paddy farmers in selected schemes. Total sample population was 1,440 settler households in Nagadeepa irrigation scheme. Stratified random sample techniques have been used to select the sample under several stages. At the first stage farmers were clustered as head, middle and tail based proximity of water sources to the irrigable land. Because,

in practice, farmers whose fields are furthest from the water sources frequently have least secure water supply, while the farmers whose fields are closer to water source receive an unduly large share of channel water. The irrigation engineers and technical officers are involved in the development of head, middle and tail regions of each scheme. In the second stage sample size is determined under the Bartlet (2001) approach. In principle willing to pay for irrigation water is depicted in the following table.

**Table 4.14 : Willingness to pay for irrigation water**

|  |  |  |  |
| --- | --- | --- | --- |
| **Type of Farmers by water source** | **Sample Size** | **Agreed %** | **Disagreed %** |
| Head enders | 133 | 68% | 32% |
| Middle enders | 123 | 87% | 13% |
| Tail enders | 121 | 95% | 5% |
| Total | 367 | 82% | 18% |

A stepwise backward binary multivariate logistic regression model has been used to measure WTP and to determine the factors that influence the variation in WTP. Primary data has been obtained from 367 farmer households in Nagadeepa irrigation schemes in dry zone. The estimated value of irrigation water was Rs. 5,275 ($40) per hectare per season which is 8.6 percent of net income in paddy farming per hectare at present in selected irrigation scheme. Mean willingness to pay and related values are depicted in the following table.

 **Table 4.15 : Mean Willingness to pay for irrigation water**

|  |  |
| --- | --- |
| Statistics | WTP for Irrigation Water (Rs/ha/season) |
| Mean WTP | 5,275 |
| Standard error | 1,468 |
| No of Observations  | 368 |

Further, Selected variables and estimated parameters of the final model are presented in the following table.

**Table 4.16: Selected variables and estimated parameters of the final model**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variables in the equation | β | Standard error | Wald | Sig | Exp (β) |
| Bid level (X1) | 0.003 | 0.001 | 36.265 | 0.000 | 1.003 |
| Location of paddy field (X2) | 2.573 | 0.775 | 11.038 | 0.001 | 13.111 |
| Irrigation scarcity (X3) | 1.375 | 0.552 | 6.209 | 0.013 | 3.956 |
| Ownership of paddy land (X4) | 1.973 | 0.677 | 8.494 | 0.004 | 7.190 |
| Main income source (X5) | 1.344 | 0.559 | 5.778 | 0.016 | 3.834 |
| Farm income (X6) | 0.001 | 0.000 | 6.582 | 0.010 | 1.001 |
| Extent cultivated of paddy (X7) | 1.171 | 0.359 | 10.648 | 0.001 | 3.225 |
| Knowledge on water management (X8) | 1.186 | 0.523 | 5.136 | 0.023 | 3.3274 |
| Constant (X9) | -15.826 | 2.193 | 52.085 | 0.0000 | 0.0000 |

Further, study has investigated if farmers can increase further their household farming income by 5.9%, it is possible to cover additional cost which would be driven due to pricing irrigation water and it is not an unreachable challenge with proper irrigation services. One of the most important policy implications of this study is the possibility of restructuring the existing irrigation pricing system by taking into account the economic value of irrigation water.

1. **Senarathne, A., Wickramasinghe, K., & Jayaratne, C. (2015, April ). Towards Sustainable Management of Bar Reef Marine Sanctuary.**

Type of Assessment: CVM based study to value the Ecosystem Services of Bar Reef Kalpitiya

Empirical Data: seven villages out of thirty one had been identified for the survey and 144 households had been selected randomly from these villages using a sample frame. The tourism industry survey had covered all registered tourism operators in the area that included 24 operators. In addition, 100 visitors had been randomly interviewed for the visitor survey both local and foreigners.

Valuation techniques used: CVM, open ended (OLS multiple linear regression)

Socio economic groups: Social communities, visitors from outsiders and tourism industry operators

Comments:

Senarathna et. al 2015 have done a CVM based study to value the Ecosystem Services of Bar Reef Kalpitiya. It is mentioned that despite efforts for conservation, the Bar Reef ecosystem is under the risk of degradation due to overexploitation of extractive uses and tourism. Provisioning and cultural services said to be creating a pressure on regulating and supporting services. Gross, lower-bound value for the conservation of ecosystem services of the Bar Reef has been estimated.

The study has taken perceptions of important users, namely local communities, visitors from outsiders and tourism industry operators into account. Perceptions of three types of users have been examined separately. In addition, willingness-to-pay (WTP) for conservation of the resource users has been elicited from the three user categories. For this a scenario of hypothetical resource governance scheme has been presented to them and the respondents had been asked to express their WTP in terms of cash and time inputs.

The assessment had been based on three surveys that covered local households, visitors (both local and foreign) and tourism operators, separately. Key informant discussions had been held in order to gather qualitative information with local users that included fishers, hotel owners, boat operators, aquarium fish collectors and local officers. Accordingly, seven villages out of thirty one had been identified for the survey and 144 households had been selected randomly from these villages using a sample frame. The tourism industry survey had covered all registered tourism operators in the area that included 24 operators. In addition, 100 visitors had been randomly interviewed for the visitor survey both local and foreigners. Willingness-to-pay included both cash and time contributions for participatory management. Significant independent variable had been the income. Households had been willing to contribute Rs. 367 per month on average for establishing a governance arrangement to minimize the negative impacts on the Bar Reef area. Visitor’s average donation amounts to Rs. 877. Households are willing to contribute more than Rs. 18 million per year, local visitors more than Rs. 26 million per year and foreign visitors is more than Rs. 9 million . Overall, Bar Reef conservation had a static, lower-bound value of Rs. 53 million per year, not taking 60,000 man hours of time contribution offered by visitors in to account. This study had been based on open ended willingness to pay questionnaire. Further, it has mention that Willingness to pay is much higher than the total income earned by the Department of Wildlife conservation by selling tickets at the entrance.

1. **Jayaratne, C. (2016). *Valuation of Ecosystem Services of Pigeion Island National Park Sri Lanka.* Master Dissertation, University of Colombo.**

Type of Assessment: Valuation of ecosystem services in Pigeon Island National Park Sri Lanka.

Empirical Data: random sampling 170 visitors, 150 villagers questionnaire survey. (ordered probit regression , maximum likelihood method)

Valuation method : CVM, Payment card

Socio economic groups: villagers, visitors, boat owners, tour operators.

Comments:

Jayaratne et al (2016) has done a research on valuing ecosystem services in Pigeon Island National Park Sri Lanka. According to that Pigeon Island national park faces similar threats to Bar Reef Kalpitiya. Main problem being the increase visitor pressure and over extraction of resources. Regulating and supporting services are degrading compared to provisioning and cultural services.

Study had been attempted to derive a gross lower bound value for the conservation of Pigeon Island based on Contingent Valuation method. Payment card method had been used to obtain the willingness to pay instead of open ended question. Set of values have been presented to visitors (170) and villagers (150) starting from Rs 1. Up to Rs. 1000. Key informative interviews with the experts in the field and focus group discussions with the hotel owners, boat operator and fishing community has been held. Average willingness to pay has been calculated using ordered probit regression method. Independent variables for the regression model of visitors had been income, whether respondent had obtained higher education and whether respondent was a foreigner. Independent variables for the regression model of Vilagers were income, whether respondents had observed non biodegradable matter on beach and whether they had valued existence of species. person and Villagers willingness to pay has been Rs. 12.11 and visitors has been Rs.39.03. Accordingly, conservation value as per the extrapolated average WTP for visitors was 34,872,212.16 and household was 1,236,091.92. These values together were much more than the revenue earned by the sale of tickets by the relevant authorities as stated in Senarathne et al (2015).

1. **Wattage, M. (2002). *An Estimation of Economic Value for Conservation of wetlands* CEMARE: University of Portsmouth**

Type of Assessment: CVM for systematically evaluate the conservation value of coastal wetlands in Muthurajawela Marsh and Negombo Lagoon area.

Empirical Data: In dichotomous choice procedure, the question was posed, if the program cost your household a total of Rs. 50, would you vote for the program or against it? To those who answered yes, the other part of the question was posed, what if the final cost estimates showed that the program would cost your household a total of Rs. 100, would you vote for or against the program. The procedure of WTP questioning stops there, if the answer is yes. The selection of one value out of the two values, Rs. 50 or Rs. 100 is purely a random choice. If Rs. 100 were the first pick, then the question was what if the final cost estimates showed that the program would cost your household a total of Rs. 100, would you vote for it or against it? If the answer is yes, the procedure stops at that point. If the answer is no, what if the final cost estimates showed that the program would cost your household a total of Rs. 50, would you vote for it or against it? This procedure continued on the same manner by changing the value pairs of (25,75), (50,100), (75, 125), (100, 150) and (125,175).Those who were not willing to pay any amount were questioned as to the reason they had for voting against the program,

Valuation techniques used: CVM (Dichotomous choice) The two main estimation methods are multiple linear regression and maximum likelihood estimation.

Socio economic groups: villagers

Comments:

Wattage 2002, has applied CVM for systematically evaluate the conservation value of coastal wetlands in Muthurajawela Marsh and Negombo Lagoon area. It had expected to contribute in resolving conflicts arising between wetland conversion for the development and conservation. A hypothetical conservation programme in the Muthurajawela Marsh and Negombo Lagoon area has been proposed as a mode to discuss the value of the conservation of wetland. Although this is a procedure of a hypothetical nature, stakeholders were informed that the value they would be willing to pay would actually pay at one point of time in the future. In dichotomous choice procedure, the question was posed, if the program cost your household a total of Rs. 50, would you vote for the program or against it? To those who answered yes, the other part of the question was posed, what if the final cost estimates showed that the program would cost your household a total of Rs. 100, would you vote for or against the program. The procedure of WTP questioning stops there, if the answer is yes. The selection of one value out of the two values, Rs. 50 or Rs. 100 is purely a random choice. If Rs. 100 were the first pick, then the question was what if the final cost estimates showed that the program would cost your household a total of Rs. 100, would you vote for it or against it? If the answer is yes, the procedure stops at that point. If the answer is no, what if the final cost estimates showed that the program would cost your household a total of Rs. 50, would you vote for it or against it? This procedure continued on the same manner by changing the value pairs of (25,75), (50,100), (75, 125), (100, 150) and (125,175).Those who were not willing to pay any amount were questioned as to the reason they had for voting against the program, The two main estimation methods are multiple linear regression and maximum likelihood estimation. In the multiple regression analysis independent significant variables were gross annual income, use for nature appreciation and use for bird watching and wildlife and willingness to pay was the dependent variable. R2 value was very low (0.11) indicating that most of the variation in WTP was not explained by the predictor variables.

There are two reasons for the poor relationship between the variables. The major reason is the large number of zero value returns attributed to the dependent variable. This indicates an unwillingness to pay anything for conservation of wetlands by a large proportion of respondents. The other reason is the estimation error. The existence of the disturbance term, coupled with the fact that its magnitude is unknown, makes calculation of these parameters impossible

The estimated average value of the individual WTP for conservation of wetlands under the open-ended format is Rs. 100.00 per month per household. Using the OOHB bid function, there is an expected WTP value of Rs. 264.27, which is somewhat larger than the WTP value obtained from the open-ended format.

Using the total household number in Colombo District (i.e. 500,000) this would indicate a gross figure of Rs. 50,000,000 – Rs. 1,32,135.000 per calendar month to affect conservation of wetland as defined above.

It should be noted that this does not include the broader surrounding districts, which might have an interest in conservation of the wetlands.

A novel aspect of this survey was the development of a methodology to separate total economic value (TEV) into use and non-use values. The method used for the decomposition of TEV is the Analytical Hierarchy Process (AHP).

1. **Senarathne, D.M.A.H., Abeygunawardena, P. & Kodituwakku, K.A.S.S. 1993. Factors influencing the Appreciation of Benefit Provided by Peradeniya Botanic Garden. Willingness to Pay Approach. *Tropical Agricultural Research*. 5:149-168.**

Type of Assessment: CVM

Empirical Data: from a Contingent valuation survey

Valuation techniques used: CVM (open ended and the iterative bidding approaches), Multiple regression analysis

Socio economic groups: visitors

Comments: Respondents' income and appreciation for benefits of botanic garden show a positive relationship however, with a very low co-efficient. Education and special interest on environment show a higher positive relationship with appreciation of botanic gardens. Marital status shows a positive and age shows a negative relationship with appreciation of botanic gardens. Regarding certain other factors, the outcomes of the constructed models are not very consistent and therefore are less reliable. Overall results suggest that measures are needed far improving people's knowledge and interest on environment rather than just considering environment as a market commodity for better appreciation of the botanic gardens policy.

1. **Weerakoon, W. R. W. M. A. P., N. R. Withana, U. K. Jayasinghe-Mudalige and J. M. M. Udugama, “Assessing the Willingness-To-Pay of Local and Foreign Visitors Towards Visitor Satisfaction and Sustainable Development of Hurulu Forest Reserve in Sri Lanka”, Economics and Environment Network Symposium, Australian National University, Canberra, Australia, 22 – 24 November 2010.**

Type of Assessment: Assessing the Willingness-To-Pay of Local and Foreign visitors towards Visitor satisfaction and Sustainable development of Hurulu Forest Reserve in Sri Lanka: An Application of Contingent Valuation Method

Empirical Data: questionnaire survey, local visitors (100), foreign visitors (100)

Valuation techniques used: An Application of Contingent Valuation Method, The Open Ended Method, Dichotomous Choice Method and Iterative Bidding Method.

Socio economic groups: local and foreign visitors

Comments: The results of the Contingent Valuation approach reveals that over 85% of the foreign visitors and over 80% of the local visitors were willing to pay an increased entrance fee towards improvement of ecotourism facilities and environment conservation proposed in Hurulu Forest Reserve. The average monthly income was a common factor which influenced the Willingness-To-Pay of both local and foreign visitors. Furthermore, the group size of local visitors where as the family size and education level of foreign visitors had a significant effect on Willingness-To-Pay. The analysis showed that the recreational benefits received by the visitors are much higher than the amount that they pay at present. Hence, the current entry fee systems do not capture the economic value of the park. Therefore, increasing the entrance fee up to Rs. 75 for a local visitor and to a fee ranges from Rs. 800 to 2,500 for a foreign visitor is recommended. The study proves that an increment of budget outlays for further developments is feasible while discriminate pricing and providing forums to communicate with regulatory bodies to maximize the revenue and visitor satisfaction**.**

1. **Sumanadasa, M. (2010). Economic Valuation of Wetalnds: The Case of Maduganga. *Journal of Humanities and Social Sciences, 6*, 85-109**

Type of Assessment: Economic Valuation of wetlands: The Case of Madu Ganga

Empirical Data: Purposive sampling technique was used in identifying the most important critical coastal wetland from the sampling frame consisting of identified lagoons and estuaries located along the wet zone coastal belt. Population frame consisted of 25 GramaNiladhari Divisions of the two divisional secretariats of Balapitiya and Karandeniya in the Galle district. A total of 400 households were randomly chosen from survey blocks of randomly selected sample of 20 villages. A two ways stratified cluster sampling procedure was used to select households to reflect agricultural (Karandeniya) fisheries and tourism activities (Balapitiya). Questionnaires were administered through a systematic sampling of households, employing a face to face survey methodology. The effective sample size of this household survey was 388.

Valuation techniques used: Contingent valuation method

Socio economic groups: Maduganga wetland associated residents

Comments:

Estimation of Willingness to pay, Dependent variable willingness to pay

**Table 4.17 Estimation of Willingness to pay, Dependent variable willingness to pay**

|  |  |  |  |
| --- | --- | --- | --- |
| **Variable** | **β** | **t** | **e** |
| Constant |  | 12.779 | 39.642 |
| House hold Income | 0.107 | 2.569 | 3.236 |
| Level of Education | 0.078 | 1.890 | 7.327 |
| Previous visits | 0.021 | 0.520 | 4.242 |
| Recreation Facilities | -0.218 | -5.298 | 7.765 |
| Future Value | -0.182 | -4.558 | 10.044 |
| Awareness of Wetland | -0.288 | -7.139 | 11.633 |
| New Mgt Program | -0.435 | -11.061 | 10.878 |
| R2 | 0.439 |  |  |

The variable Household Income, has a positive co efficient value of 0.107 implying that the monthly household income is positively related to the WTP of the respondents. Similarly, positive and significant co efficient vales of Education level (0.078) and previous visits (0.021) also emerged as key determinants of their WTP. The behavioral variable of new management programme (-0.435) however, indicates a negative impact of new institutional measures to protect the environment may lead to a reduction in the net benefits derived by target beneficiaries, leading to a reduction of their WTP.

The study has led to several key findings that are very important in quantifying the wetland benefits. Interestingly, the economic value of wetlands is understood by the resident community despite their lack of formal education and poverty. Further, they are aware of the importance of ensuring a sustainable supply of products. They also receive substantial economic benefits and environmental services that enhance their welfare. Almost 50 percent of the households did express their WTP to be a fixed amount ofRs300.00per month for the management of MW. The estimated total WTP value per household was Rs. 164.00 per month while the estimated total WTP value for the sample resident population was Rs. 14.5 million per year. The results support the proposition that contributions by residents could provide considerable financial resources for conservation. Of the respondents 53.3 percent opted for a private fund. Thus the establishment of a wetland management fund for the sustainable management of the wetland is considered feasible.

1. **Rathnayake R. M. W. (2015). Estimating Demand for Turtle Conservation at Rekawa Sanctuary in Sri Lanka. Working Paper No. 92-15. South Asian Network for the Development and Environmental Economics, Kathmandu, Nepal**

Type of Assessment: Estimating demand for turtle conservation at Rekawa Sanctuary Sri Lanka.

Valuation techniques used: CVM

Empirical Data: Primary and secondary data have been collected from visitor arrivals. Primary data collection was from on site and off site surveys of visitors. Rekawa has been considered as on site area and Yala and Bundala as off sites. This study included a tourist sample of 900 respondents who visited Rekawa sanctuary (onsite) and the Bundala and Yala National Parks (off-site), of whom 600 were locals and 300 were foreign visitors. The study adopted a systematic random sampling method, where every fifth visitor encountered was invited to participate in the survey. In case of a refusal, next visitor was interviewed. The sampling covered all turtle-nesting seasons and visitation seasons.

Socio economic groups: Local and Foreign visitors at Bundala and Yala.

Comments: Turtles at the Rekawa sanctuary in Sri Lanka are under threat due to ongoing illegal activities such as killing turtles for meat, egg collection for sale, and the use of turtle shells to make products for markets. This study estimates the entrance fee that can be charged to visitors for ‘turtle watching’ to ascertain whether revenues from such fees can be used to compensate fishermen and reduce such illegal activities. We carried out a contingent valuation study at the Rekawa sanctuary and Bundala and Yala national parks to examine the foreign and local visitors’ willingness to pay (WTP) for turtle conservation under two different management scenarios. Scenario 1 sought to ascertain visitor preferences if visitor services were improved, while Scenario 2 focused on both visitor services and potential conservation initiatives. The findings suggest that a majority (63%) of visitors are willing to pay an entrance fee, which can be used for protecting turtles and improving visitor facilities at Rekawa. The estimated mean WTP per visit for local visitors was LKR 93 (USD 0.73) and LKR 143 (USD 1.12) for Scenarios 1 and 2, respectively, while the mean WTP of foreign visitors was USD 15 and USD 19 for Scenarios 1 and 2, respectively. Further, if we implement scenarios 1 and 2, annual revenue would increase by LKR 70 million and LKR 50 million respectively. These results, which suggest potentially huge gains in revenue, can be used to re-design entry fees for the Rekawa sanctuary and secure the cooperation of low income fishermen in turtle conservation.

* Probit regression has been done, household monthly income, variable was positive and significant at 1% significance level. Years of education also positive and significant at 1%.
1. **Prasanthi Gunawardena, U.A.D., Edwards-Jones, G., McGregor, M.J. and P. Abeygunawardena. 1999. “A Contingent Valuation Approach for a Tropical Rainforest: A Case Study of Sinharaja Rainforest Reserve in Sri Lanka” in Roper, C.S. and A. Park (eds.) The Living Forest: Non-Market Benefits of Forestry. Proceedings of an International Symposium, Edinburgh 24-28 June 1996, Forestry Commission. H.M. Stationary Office: London, pp. 275-84.**

Type of assessment & main findings: The study presents estimates of use and non-use values associated with the Sinharaja Rainforest Reserve, covering about 9,000 hectares in the south-west lowlands of Sri Lanka. The authors conclude that the total economic value (TEV) of the Reserve depends critically on who participates in the survey.

Empirical data: A CV questionnaire was administered to three groups in 1994: rural and urban households (230 and 240 respectively), and people living near the Reserve (224 households). Open-ended willingness to pay (WTP) questions were posed with regards to both use values (collection of forest products, education, recreation) and non-use values (existence and bequest). Users were asked to express their WTP for both sets of values, while non-users were asked to state WTP for non-use values only. Socio-economic data was collected for econometric analyses linking household characteristics to WTP

Economic values considered: Both use values and non-use values are calculated in an effort to estimate the TEV of the Reserve. Use values include direct benefits from the extraction of forest goods, non-consumptive uses such as recreation, and indirect benefits from the Reserve’s environmental services, and were lumped together in a single WTP question. Existence and bequest values were treated separately. Option values were not considered explicitly, but may be part of individual’s WTP for existence values

Valuation techniques used: An open-ended CVM was used, consistent with guidelines given in Mitchell and Carson (1989) and Cummings et al. (1986).

Socio-economic groups affected: The distribution of benefits associated with the Reserve was not considered explicitly, although the authors note that WTP for different forest benefits varies among different groups. Local villagers (forest users) express the highest WTP, as a percentage of income, for the preservation of use values. Their estimated WTP is 0.52% of income, compared to 0.21% and 0.33% for rural communities and urban communities, respectively. Local villagers also express the highest WTP for bequest values, at 0.42% of their income, compared to 0.16% and 0.23% for rural and urban groups, respectively. WTP for existence values is similar for all three groups. Foreigners’ WTP for non-use values is not estimated, although the authors consider that it may be important.

* + 1. **Valuation studies that have used other valuation methods**
1. **IUCN, Case Studies in Wetland valuation. Muthurajawela Marsh, Sri Lanka: Safeguarding wetland protected areas in Cities.**

Type of Assessment and main findings: Attempt to assess the economic value of Muthurajawela Wetland sanctuary,

The biodiversity assessment specified five management actions that were required as a matter of urgency to address the current threats to the wetland. Dissemination of the findings of the valuation study met the first two aims: raising awareness on wetland values, and documenting the socio-economic status of Muthurajawela. The valuation study also specified a series of economic tools and measures that could lend support to the three other management actions specified −promoting sustainable revenue and income generating activities, encouraging ecosystem restoration activities and initiating prompt and punitive action against wetland-degrading practices.

**Table 4.18 Empirical Data:**

|  |  |  |
| --- | --- | --- |
|  | Value ($ per year) | Vaue ($ per ha per year) |
| Flood attenuation | 5,394,556 | 1,758 |
| Industrial Waste water Treatment | 1,803,444 | 588 |
| Agricultural Production | 336,556 | 110 |
| Support to downstream fisheries | 222,222 | 72 |
| Firewood | 88,444 | 29 |
| Fishing | 69,556 | 23 |
| Leisure and Recreation | 58,667 | 19 |
| Domestic sewage treatment | 48,000 | 16 |
| Fresh water supplies | 42,000 | 14 |
| Total | **8,072,111** | **2,631** |

Valuation techniques/framework used: total economic value

Socio economic groups:

Comments: The valuation study’s findings underlined the high economic benefits that could accrue from

wetland restoration, but also indicated that any reduction in extractive wetland activities would constitute real economic losses to local households. A package of economic incentive measures, including value-added and income generating activities, was identified as essential to providing the necessary support to local landholders undertaking wetland restoration.

**2. De Mel, M., & Weerathunga, C. (2011). *Valuation of Ecosystem Services of the Maha Oya.* Environmental Foundation.**

**Valuation of Ecosystem services of the Maha Oya.**

Type of Assessment and main findings: Mining activities carried out both legally and illegally, have led to the degradation of the MahaOya and its associated ecosystems, impacting ecosystem services and affecting both on-site and off-site human populations. This study aimed to estimate the value of key ecosystem services generated by the MahaOya, so as to present the economic rationale and justification for ecosystem conservation and restoration in order to safeguard its hydrological, ecological and socio-economic benefits. The results of this study show that the stakeholder groups that are driving ecosystem degradation and loss – primarily the mining industries that operate in and around the river − are not bearing its costs. These accrue as externalities to society at large and the broader economy, mainly affecting government and local communities.

The study found that the current values associated with water use, fisheries, sand and clay extraction, and tourism in the study area are worth at least LKR 1.7 billion per year. The economic costs of ecosystem degradation, including those associated with land degradation, coastal protection, river rehabilitation and displacement of people, were estimated to be almost LKR 1.2 billion in the current year.

Empirical Data: Data was gathered by means of field surveys, and from a review of relevant literature.

Valuation techniques used: market prices, effect on production, replacement costs, damage costs, mitigative and aversive costs

Socio economic groups: government and local communities.

Comments: The economic impacts of ecosystem conservation and degradation to various stakeholders were assessed through modelling two different scenarios. These were ‘Business as Usual’ (BAU) – a situation where ecosystem degradation progressively worsens over time, and ‘Ecosystem Restoration and Sustainable Management’ (ERSM) – a situation where sufficient investments are made to improve and safeguard the integrity and health of the ecosystem. The study shows that overall; there is a clear economic gain from ERSM as compared to a continuation of BAU. Calculated over 25 years, it yields an incremental benefit of LKR 849 million: the net present value of ERSM (LKR 7.6 billion) exceeds that of BAU (LKR 6.8 billion). ERSM leads to a significant reduction in the damage costs associated with ecosystem degradation and loss, while maintaining (and even in some cases increasing) the economic values generated from the sustainable use of land and resources. Under BAU, costs are incurred to government and local communities as ecosystem service provision declines, undermining income and employment as well as giving rise to a range of physical expenditures and losses. Under the ERSM scenario, all stakeholders benefit.

The study recommends the preparation of a Management and Action Plan for the MahaOya and its associated ecosystems, focusing on ecosystem restoration and sustainable management. It calls for a multi-stakeholder approach to problem solving, including the effective coordination and cooperation between responsible government agencies such as the Geological Survey and Mines Bureau, Irrigation Department, Coast Conservation Department and local administrative bodies. The enforcement of existing laws and policies to minimise illegal activities that exacerbate the externalities of environmental degradation is also essential. It recommends the use of a variety of economic instruments which would internalise environmental externalities, and provide incentives for sustainable land and resource management. These basically aim to penalise those whose activities contribute to ecosystem degradation, so as to raise funds for restoration and compensate for the costs of environmental damage. It is also essential to prepare a compensation scheme for those in riverine and coastal areas that suffer from the impacts of environmental degradation. Additionally it is important to ensure that adequate economic incentives are provided to those who contribute towards ecosystem conservation and restoration, through the provision of funding, livelihood support and other rewards. These recommendations, if incorporated into policy and action plans, and if implemented effectively can help to ensure that the resources of the Maha Oya can be utilised in a sustainable manner, benefitting all stakeholders, minimising environmental degradation and preserving ecosystem services.

**3. Economic value of Irrigation water in paddy cultivation in Sri Lanka (H.M.S.J.H. Bandara and J. Weerahewa)**

Type of Assessment and main findings: The objective of this study is to estimate the value of irrigation water in the cultivation of paddy

Empirical Data: Secondary data on the cost of paddy cultivation in rain-fed and irrigated areas over a period of 20 years, published by the Department of Agriculture, were used for the analysis. The availability of irrigation water was represented by a dummy variable distinguishing irrigated areas and rainfed areas in the production function. The value of water was estimated to be Rs. 5,727.63 acre'1 season' suggesting that irrigation plays a major role in determining the profitability of paddy cultivation in Sri Lanka.

Valuation techniques used: Residual approach, with and without approach and production function approach were used as analytical tools.

Socio economic groups:

Comments: This study estimates the value of water using three methods: residual approach, with and without comparisons, and production function approach. The latter, which shows die marginal increment in yield due to the provision of irrigation water, provides the best approximation for the value of irrigation water. The results show some important policy implications. First, they indicate the importance of water in determining profitability of paddy cultivation. A large portion of profits (Rs. 5,727.63 acre'1) is attributable to returns to water, and any change in irrigation water may have a significant impact on the income of paddy farmers. Second, they show the marginal benefit of water when it is used in paddy cultivation. According to Shilpi (1995), operation and maintenance costs of irrigation were Rs. 5420.32 ha" in 1994 and it is equivalent to Rs. 2,168 acre/ season for that year. The value of irrigation water would be Rs. 3,614.13 acre/ season in 1994 according to the results of this study, if the price of paddy is considered to be Rs. 8.02 kg'1. These numbers indicate that the marginal cost of providing irrigation water does not exceed the marginal benefit of water when it is used in paddy cultivation, and in that regard it is not an inefficient allocation.

**4. Weerahewa, J., & Gunathilake, H. M. (2011). Impact of Potato trade liberalization on soil erosion: Multi Period Market Simulation Model. *Sri Lankan Journal of Agricultural Economics, 3* (1), 123-141.**

Type of Assessment and main findings: This study quantifies the welfare changes in potato trade liberalisation in Sri Lanka incorporating long-term social cost of soil erosion into a multiperiod market simulation model. Seven alternative crops were considered for studying long-term land use changes induced by potato trade liberalization

The results show that gain in consumer surplus is much higher than loss in producer surplus, government revenue and environmental cost. Thus, findings show that trade liberalisation is welfare improving. With regard to the impact of trade liberalisation on environment, the findings are however, non-conclusive.

Empirical Data:

Valuation techniques used: On-site cost of soil erosion was incorporated in the model through a dynamic soil depth crop yield function and cumulative off-site costs were deducted in calculating net welfare changes associated with land use changes induced by potato trade liberalization

Socio economic groups:

Comments: Depending on the empirical setting, trade liberalisation may induce environmentally friendly or unfriendly land use changes. Some environmental policies may be necessary in conjunction with trade liberalisation as it may not necessarily induce environmentally friendly land use changes.

**4.5.3 Valuation studies that have used Travel Cost Method in Sri Lanka**

Based on Paper accepted for Sri Lankan Journal of Agricultural Economics, U. A. D. P. Gunawardena and M. A. T. R. Kularatne 2015. Vol 17 (Issue 2), A Review of Application of Travel Cost method in Sri Lanka

The study selected twelve travel cost studies that have been carried out in Sri Lanka for the analysis. All studies were compared on their sampling methodology, estimation of travel cost, independent variables used in the travel cost function and statistical considerations. The preliminary analysis showed that the most common problems lies in the issues related to sample size, limited variables in the travel cost function, low R2 value, and different consumer surplus for same kind of recreational sites. Therefore, further detailed analysis was carried out using selected ten studies. Table 1 provides a summary of the selected TCM studies and their consumer surpluses in current prices.

**Table 4.19: Selected TCM studies for the study**

|  |  |  |  |
| --- | --- | --- | --- |
| **Reference**  | **Site**  | **Consumer surplus**  | **Consumer surplus (2015 prices)**  |
| Kariawasam (1992) | Sinharaja world Heritage site  | Rs 15770 | Rs 76,517 |
| Silva (1996) | Hortain Plains National Park  | Rsmn 2.181 | Rsmn 7.242 |
|  De Silva and Kotagama (1997) | Udawalawa National Park | Rsmn 2.18  | Rsmn6.64  |
| Rathnayake and Gunawardena (2002) | Wasgomuwa National Park | Rsmn 2.38 | Rsmn4.84  |
| Marasinghe (2002) | Yala National Park | Rsmn 54.4 | Rsmn110.56  |
| Ratnayake (2002)1 | Coral reef at Hikkaduwa | Rsmn 6135.488 | Rsmn12,469.40  |
| Rathnayake and Kariyawasam (2002) | Peradeniya Botanic Garden | Rsmn 240 | Rsmn487.76  |
| Weerakoon (2002) | Muthurajewela Wetland System  | Rsmn119.4 | Rsmn242.66  |
| Herath and Nissanka (2003) | Udawathekele Royal National Park  | Rsmn7.9 | Rsmn15.27  |
| Jayaratne and Gunawardena (2004) | Hakgalle Botanic Garden | Rsmn 221 | Rsmn392.60  |

1 – this study involves only the foreigners

The articles of the above studies were collected from the published and unpublished sources. Methodological issues considered in the review were, survey design issues, estimation of travel costs and statistical analysis. Under the survey design issues, data collection procedures, sample size, identification of visitor type (single purpose and pure visitors), zone definition, language used were considered. In relation to the estimation of travel costs, calculation of opportunity cost of time including the shadow prices of time and inclusion of other expenses were considered. In relation to the statistical analysis, emphasis was made on the correct configuration of the independent variables.

**Results and Discussion**

The methodological issues related to the survey design issues are discussed first and issues related to the travel cost estimations are discussed next. Issues related to statistical analysis and policy implications are discussed finally.

**Survey design issues**

**Timing of the survey**

Most of studies considered have been limited to a certain time period within a year and were not representative of the variation of seasons and off-seasons.Study in Hakkgala has been carried out in two weekends and weekdays in April and July. Sinharaja study has been carried out within one month. Survey of Udawalawe was done from November to December in 1996 and study in Royal Botanic garden was carried out within 30 days in March 2001. Muturajewela study has been done in September 2000 to January 2001.Only Wasgamuwa study has been carried out throughout the year inclusive of weekend and weekdays. Studies that limit their data collection period to a certain time period affect the results because number and type of visitors varies with the time period.

**Language used**

Language of most of the travel cost surveys has been either English or Sinhalese which resulted in omission of the visitors who speak other local languages. Study of Hikkaduwa, has managed to get the services of tourist guides to communicate with different nationalities especially foreigners.

**Definition of zones**

Majority of the studies had considered administrative districts as zones. Therefore, the two districts in a same distance will be categorized as two zones and it has an effect on the cost value estimated.

**Visitor types**

**(i) Local vs. foreign visitors**

Most of the studies have only considered local tourists and omitted foreigners and this is related partly to the language bias mentioned above and perhaps the multiple destination problems. Study conducted in Hikkaduwa Coral reefs is the only study that considered both local and foreign visitors. This can lead to under estimation of the benefits. For example, a TCM of Hikkaduwa which focused only on local visitors resulted in annual CS of 604.5 mn which is much less than the value derived from sample with foreigners (6135.488 mn per annum).

There are different ways of treating overseas visitors (Carr and Mendelsohn, 2003; Prayaga et al., 2006). However, non inclusion of foreigners may not be a serious issue, since use value for foreign tourists is not a social benefit to Sri Lanka but rather social benefits to their countries of origin. It is only the net economic value of the tourists’ expenditures within the country that can be considered a social benefit for Sri Lanka. The consumer surplus of overseas visitors would be important if it can be extracted through, for example, price discrimination or taxation.

**(ii) Single purpose visits vs. multiple visits**

Most of visitors to recreational sites had multiple visits, and it was difficult to obtain the exact travel expenditure incurred towards one destination. In such circumstances traveling expenditure had to be apportioned according to the distance they traveled to reach each and every destination as stated in Smith and Kopp (1980) and Sturgess (1999). Except Hakkgala study others have excluded multiple destination trips. Hakkgala study has differentiated the costs for different destinations and included only the cost component relevant to visit Hakkgala in the final analysis.

**(iii) Meanderers vs. pure visitors and travel benefits**

Except Hakgala study, other studies have not attempted either to identify pure visitors or to exclude meanderers from samples. Pure visitors are recognized from the fact that they do not derive benefits from the trip itself and meanderers are the ones who derive benefits out of the trip itself. In addition, traveling sometimes may yield benefits not costs. For example, traveling in a luxury vehicle is a prestige for majority of Sri Lankans and such benefits need to be excluded from the travel costs. However, none of the studies have made attempts to distinguish such ‘travel benefits’.

**Sample size**

Studies in consideration have used different sample sizes. In almost all survey situations, the sample is smaller relative to the target population. The sample size is an important aspect in the analysis and sample size need to be subjected to specific guidelines.

**Estimation of travel costs**

**Opportunity cost of time**

Both travel cost and opportunity cost of time must be incorporated in estimating total travel cost. However only the studies of Hakkgala, Udawattekele, Udawallawe, Royal Botanical Garden, Hikkaduwa Coral Reef and Muturajewela have considered total travel cost. Studies of Sinharaja, Yala and Hortain Plains have not included opportunity cost of time and have considered travel cost only.

**(i) Calculation of opportunity cost of time**

Estimation of the opportunity cost of time need estimation of shadow price of time. Based on transportation and urban community studies Cassario (1976) concluded scarcity value of time to be approximately 1/3 of the average wage rate. Out of the 7 studies, which included opportunity cost of time under the total travel cost, Muturajewela, Hikkaduwa and Hakkgala studies had followed this rule and other studies have included the total wage rate.

**(ii) Inclusion of leisure time**

In addition to the estimation of opportunity cost of time, inclusion of leisure time has not been a concern in most studies. Studies conducted in Hakkgala Botanical Garden and Royal Botanical Garden used 20 days as working days and others have used 30 days to estimate the opportunity cost of time. Use of 30 days to estimate the opportunity cost of time will lead to under estimation of leisure time.

**Inclusion of other expenses**

With regard to the travel cost Studies on Sinharaja, Udawalawe, Hortain Plains, Royal Botanical Garden and Muturajewela included other expenses incurred in a trip, but others did not give attention for such expenses.

**Statistical analysis**

**Testing for various models**

In the data analysis except the study carried out in Hakkgala, all other studies have not provided details of the statistical analysis. For example, R2 for equations with transformations, co-efficient of variation at 95% confidence interval to check standard error, residual distribution, and reality of the equation were not provided for most of the studies. The non inclusion of such details in the reports seems to be a common error thus eliminating the chances of testing the validity of the equations derived.

**Functional forms**

Almost all the studies have used linear functional forms. Choosing a linear form implies that as travel cost increase visits per year decrease by a constant amount. Other functional forms such as double log form are useful as it is capable of accounting for extreme values. A linear functional form could easily lead to overestimation of consumer surplus/use value if a loglinear form provides a better fit.

**Policy implications derived from the studies**

Results of TCM studies could provide useful information for natural resource management and a rationale to preserve unique ecosystems. Providing decision-makers with estimates of the value of recreational resources is essential for long-term policy and planning decisions. Justifying the use of public resources on recreational resources requires decision-makers to possess estimates of the value visitors place on such resources. Often it could be demonstrated that the CS is higher than the annual investment and operational costs of most of these parks. In addition, such values could be used for justifying compensation for the surrounding communities of their loss of traditional rights due to the declaration of the parks. This would be helpful to resolve the conflicts related to most of the parks. The studies considered have made emphasis on various such issues ranging from increasing park fees and improving facilities for the visitors.

**Discussion**

Almost all the parks and protected areas of the country have been subjected to travel cost valuation exercises. However, majority of these studies lacks proper emphasis on methodological aspects leading to questions on the validity of the provided estimates. The present paper attempted to review different applications of travel cost method in Sri Lanka with a view of improving the accuracy of the estimates.

Results of the study showed that most of studies have not considered issues and biases that are common in the information gathering (time period, language and visitor type), defining and estimation of total travel cost, opportunity cost of time. Statistical validities of the estimated equations have given only low priority. Majority of the studies failed to address the most common shortcomings of the method.

The review was based on the available reports of the studies, and majority of them are not published, or published locally. The details of the studies were sometimes not available in the documents available for the review. This sometimes may be due to the non inclusion of such details in the reports available.

The increasing demand for valuation results for designing, evaluating and implementing policies is also likely to explain a great interest in benefit transfers as a way of carrying out valuation that avoids the often substantial costs of collecting primary data. However, when environmental valuation increasingly is to be used in a policy context, it becomes of great importance that valuation results are reliable.

**Conclusions and Recommendations**

Most of travel cost studies carried out in Sri Lanka in different places have not given enough attention to biases that could arise in data collection time, language, visitor type in information gathering and had not given proper attention to multiple destination trips, substitute sites and issue of meanders from the traveling. Most of studies had taken incorrect estimates for total travel cost due to miscalculations of opportunity cost of time, indirect costs and biases in estimation in opportunity cost of time. Defining of districts as zones can lead to problems.

Further it need correct analysis of the data to get a best equation with variables. Studies that limit their data collection period to a certain time period affect the results because number of visitors varies with the time period.

Therefore it requires following a defined set of rules and steps for these issues when applying the travel cost method. The time and other resources spent on original economic evaluation studies would not be justified if they are not carried out according to the best practice. This issue has to be seriously considered by the researchers since the trend is now not to carry out the original studies but to use the existing primary studies for benefit transfer studies. If the travel cost estimates of Sri Lanka to be used in future benefit transfer studies or as guiding tools for policy regarding the parks and protected areas, the under and over estimations of their benefits that could result from the errors and flaws mentioned in this study have to be given proper consideration.

It is recommended therefore to include a sensitivity analysis, which includes the possible changes of the final estimates with regard to the variables mentioned above. However, it was obvious that errors could have been minimized if the proper sampling and usual guidelines of the travel cost method had been adopted.

### 4.6 A preliminary Analysis of data

**4.6.1 Understanding benefits of biodiversity from market value and economic value perspectives**

**Case of Botanical gardens**

The total revenue earned by Department of National Botanical Gardens from admission fees, plant sales etc., was Rs. 784.4 million in 2016 (revenue earned from visitors to the gardens was Rs.709.7Mn while plant sales and other sources yielded Rs.74. 7Mn.) Revenue of the Botanic Gardens shows a 36% increase compared to the last year (2015). Those details are given in tables1.2 and 1.3.

**Table 4.20:** Total Revenue of the Department of National Botanical Gardens as Units

|  |  |
| --- | --- |
| **Unit** |  **Total Revenue (Rs.)** |
| Royal Botanic Gardens, Peradeniya  | 642,796,438.28  |
| Botanic Gardens, Hakgala  | 90,409,862.61  |
| Botanic Gardens , Gampaha  | 23,844,169.00  |
| Medicinal Plant Gardens, Ganewatta  | 1,189,193.70  |
| Dry Zone Botanic Gardens ,Hambantota  | 6,677,339.10  |
| Wet Zone Botanic Gardens , Avissawella  | 19,184,166.00  |
| “Suwahas Mal Sevana” Plant Nursery, Battaramulla  | 170,305.00  |
| Meegalawa “Haritha Piyasa” Training Centre  | 115,925.00  |
| **Total** | **784,387,398.69** |

Source: Department of National Botanical Gardens

**Table 4.21:** Total revenue from visitors to the Department from 2012 to 2016

|  |  |
| --- | --- |
| Description | Year |
| 2012 | 2013 | 2014 | 2015 | 2016 |
| Revenue from local visitors (Rs. Mn.)  | 77.6 | 73.0 | 75.9 | 88.5 | 115.4 |
| Revenue from foreign visitors(Rs. Mn.) | 279.0 | 314.9 | 369.8 | 435.1 | 594.3 |
| **Total** **(Rs. Mn.)** | **356.6** | **387.9** | **445.7** | **523.6** | **709.7** |

The following table shows consumer surplus estimates calculated for three botanical gardens in Sri Lanka.

**Table 4.22:** Comparison of estimates of some TCM studies on botanic gardens

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Author** | **Site** | **Visitor type** | **Recreational value****(LKR million)** | **GDP deflator values** | **Recreational value (2017)****(LKR million)** |
| Jayarathne (2004) | Hakgala Botanical Garden | Local | 228.49 | 114.40(2004) | 686.13 |
| Rathnayake and Kariyawasam (2002) | Peradeniya Botanical Garden | Local | 240.00 | 100.00(2002) | 824.47 |
| Maduwanthika and Gunawardena (2017) | Seethawaka Wet Zone Botanic Garden | Local | 182.00 | 343.53(2017) | 182.00 |
| **Total**  |  |  |  |  | **1692.6** |

The economic estimate for the botanical gardens is more than double the market value. This provides a clear case for estimating the correct economic estimate for the biodiversity resources.

**Matching the gap between expenditure vs market values and economic values**

The above total values could be compared with the biodiversity expenditure and the gap could be matched with necessary economic or other policy instruments.

**The issue of replicating similar analysis for other biodiversity resources**

 Beneficiaries of biodiversity of many other ecosystems in Sri Lanka consist of wider socio economic groups. Benefits enjoyed by each and every group have to be meaningfully identified in order to arrive at a proper vale.