

**Occasional Papers of IUCN Sri Lanka
No. 4, January 2003**

**Assessment of the Economic Value
of Muthurajawela Wetland**

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and
IUCN - The World Conservation Union, Sri Lanka Country Office

This publication has been prepared by IUCN - Sri Lanka
with financial assistance from the Royal Netherlands Government

Published by : IUCN - Sri Lanka



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Citation : Lucy Emerton & L. D. C. B. Kekulandala 2003. Assessment of the Economic Value of Muthurajawela Wetland. *Occ. Pap. IUCN, Sri Lanka.*, 4:iv + 28pp.

ISBN : 955-8177-19-9

Text : Lucy Emerton, L. D. C. B. Kekulandala

Cover photograph : Muthurajawela marsh (Photograph by Channa Bambaradeniya)

Produced by : IUCN Sri Lanka.

Printed by : Karunaratne & Sons Ltd. 67, UDA Industrial Estate, Katuwana Road, Homagama, Sri Lanka.

Available from : IUCN - Sri Lanka
No. 53, Horton Place, Colombo 7, Sri Lanka.

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* At the time of the study, the exchange rate was US\$1: Rs 90.

I. Introduction

Background to the Study

1.1 Study area and rationale

Muthurajawela Marsh covers an area of 3,068 ha. It is located between 10-30 km north of Colombo, in Gampaha District. Together with Negombo Lagoon (3,164 ha), Muthurajawela forms an integrated coastal wetland system of high biodiversity and ecological significance. The ecosystem is listed as one of 12 priority wetlands in Sri Lanka, and in 1996 an area of some 1,777 ha in the northern section of Muthurajawela was declared a Wetland Sanctuary.

Yet, despite its protected status, Muthurajawela is subject to intense and growing pressures. Areas within and surrounding the wetland have since 1991 been zoned for urban, residential, recreational and industrial development. Wetland species are harvested at high and often unsustainable levels, land is being rapidly reclaimed and modified for agricultural, commercial and residential purposes, and heavy loads of industrial and domestic wastes are discharged untreated into the marsh. The wetland area has been seriously degraded over time, and these threats continue to intensify.

Although the Muthurajawela-Negombo area has long been seen as having prime potential for industrial and urban development, there has to date been little appreciation either of the economic value attached to its conservation or of the high and far-reaching economic costs arising from its degradation and loss. Land and resource use decisions have been based on a development imperative that favours the modification of the wetland for short-term economic gain. The economic value of wetland goods and services are rarely factored into these decisions, which tend to focus only on the direct financial benefit of wetland conversion and reclamation. The area's biodiversity and natural ecosystems continue to be reclaimed, degraded and lost because they are seen to have little or no value as compared to other "developments" which yield more immediate and obvious profits.

1.2 Study aims and links to work already carried out

This study aims to generate information, which can contribute to an understanding of the economic benefits of wetland conservation and economic costs of wetland degradation and loss in Muthurajawela.

A partial economic valuation of wetland goods and services was carried out as part of the development of the Conservation Management Plan for Muthurajawela Marsh and Negombo Lagoon (CEA 1994). This useful exercise considered the value of Negombo Lagoon as a sink for industrial, domestic and municipal waste disposal; a source of land for housing on inter-tidal sand shoals; a location for lagoon fisheries, coastal shrimp and small pelagic fisheries; and as an anchorage for marine fishing craft. It also assessed the value of Muthurajawela Marsh for

recreation, and for housing land. The current study aims to build on this earlier valuation exercise by looking specifically at the economic values associated with the conservation and sustainable use of Muthurajawela Wetland Sanctuary.

A biodiversity assessment was also carried out in Muthurajawela by IUCN, between November 1999 and April 2000 (IUCN 2001). The current study aims to complement the biodiversity assessment, and to document ways in which economic concerns can be integrated into biodiversity assessment procedures and used within the context of wetland conservation.

The current assessment of the economic value of Muthurajawela Wetland Sanctuary was carried out in late 2001 and early 2002 as a joint exercise between IUCN Sri Lanka Biodiversity Programme (Channa Bambaradeniya and L. D. C. B. Kekulandala) and Asia Regional Environmental Economics Programme (Lucy Emerton). It gratefully acknowledges the assistance of officials of the Integrated Resources Management Programme in Wetlands (Dr. Jayampathy Samarakoon, Mr. Ajith Rodrigo, Ms. Shashikala, Mr. Tissa Ariyaratne, Mr. Akram and Mr. Sumedha Devapriya) implemented by the Central Environmental Authority and Arcadis/Euroconsult, Mr. Keerthi Jayewardena of the Sri Lanka Land Reclamation and Drainage Corporation, Staff of the Divisional Secretariat sub-office in Nugape, the librarian of the Central Environmental Authority of Sri Lanka, and the Negombo Lagoon Co-operative Fishing Society. We also wish to acknowledge, The Country Representative, Mr. Shamen Vidanage and other Staff of IUCN Sri Lanka for valuable comments and suggestions during several meetings held to discuss the study.

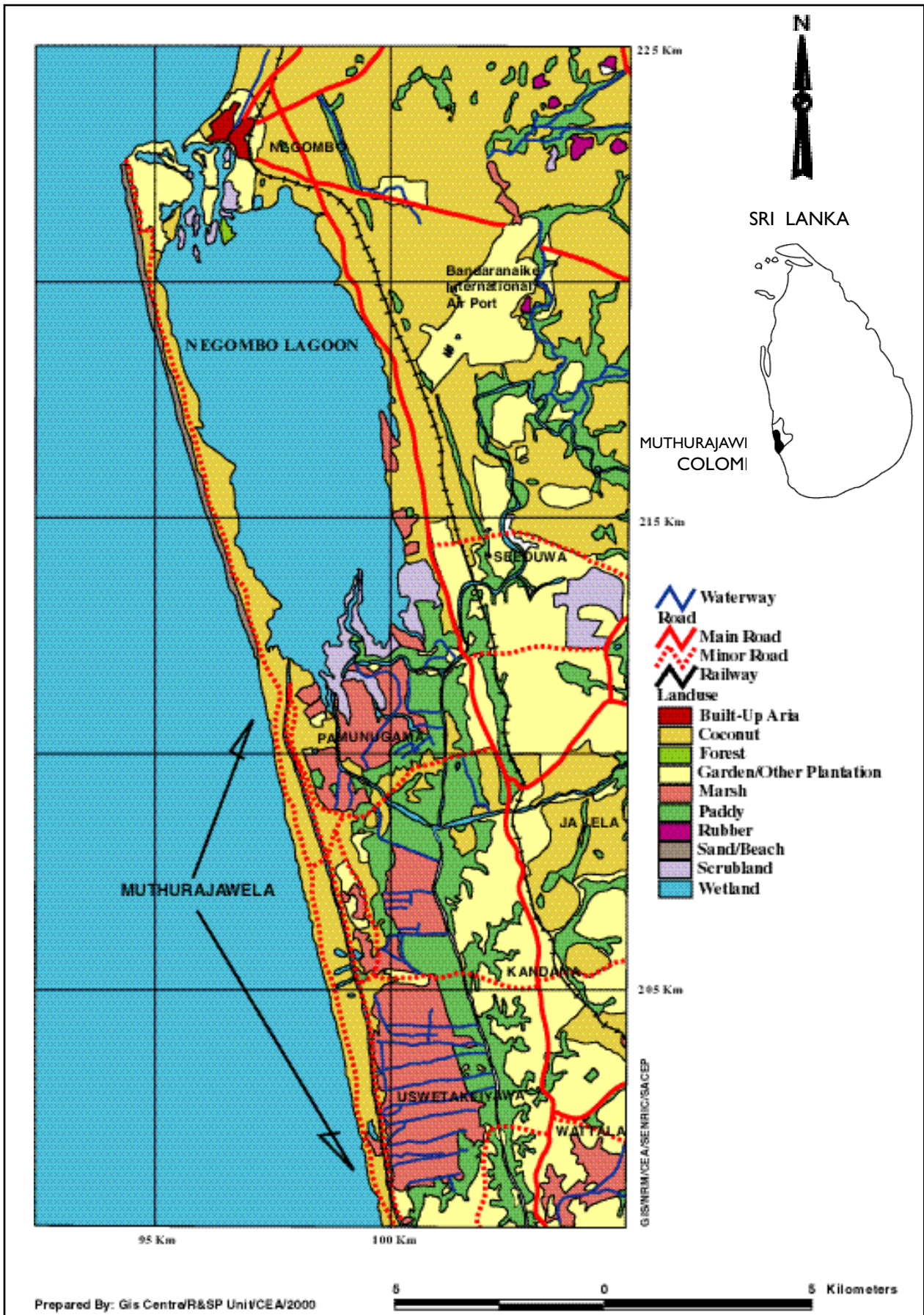


Figure 1.
Location of Muthurajawela wetland sanctuary

2. Methodology

Steps in the Economic Assessment of Muthurajawela

2.1 The role and aims of wetland economic assessment

Economics forms an important, but often neglected, component of wetland assessment. Whereas biological, ecological and hydrological methods are relatively well-established, little work has been carried out on developing and applying economic assessment techniques to wetlands. An understanding of the economic status of wetlands is however critical for planning for their sustainable management and wise use. Wetlands typically have a high economic value, economic forces underlie wetland degradation and loss, and wetland conservation often requires a range of economic management responses.

The aim of economic assessment is therefore to investigate the economic status and value of wetlands, with a view to highlighting economic concerns in wetland management. To these ends, the economic assessment of wetlands asks the following questions:

- How is wetland ecology, hydrology and biodiversity linked to economic output and production in surrounding areas? (discussed in **Chapter 3** of this report for Muthurajawela).
- What is the economic value of wetland benefits, and how are they distributed between different groups? (discussed in **Chapter 4** of this report for Muthurajawela).
- What kind of economic management responses are required to address threats to wetlands, and to support wetland conservation? (discussed in Chapter 5 of this report for Muthurajawela).

2.2 Steps in the economic assessment of Muthurajawela

The current economic study was designed specifically to complement the methodology and findings of the biodiversity assessment already carried out by IUCN (IUCN 2001). The biodiversity assessment used Muthurajawela Wetland Sanctuary as a demonstration site to develop and apply a set of general criteria for the identification of critical habitats in wetland ecosystems. Likewise, a major aim of the economics study was to develop, apply and document methods for the integration of economic concerns into biodiversity assessment procedures, which would then be generally replicable within the context of wetland conservation. Each stage of the economic assessment thus corresponds to an equivalent step in the biodiversity assessment process applied in Muthurajawela (Table 1). IUCN intends to further use and develop these integrated biodiversity-economics methods in future assessments of other ecosystems, areas and conservation management issues in Sri Lanka.

Table 1
Stages in economic and biodiversity assessment of wetlands

| Economic Assessment | Biodiversity Assessment |
|--|--|
| 1. Collation and review of published economics information on the study area. | 1. Review of existing published information on the study area and gathering of base maps. |
| 2. Initial reconnaissance survey of the study area to identify economic benefits, costs, beneficiaries and cost-bearers; Definition of aims, parameters and methodologies for the economic assessment. | 2. Initial reconnaissance survey of the study area to identify habitats and vegetation types, selection of representative sampling sites, planning out sampling schedule and also to verify and confirm the pre-planned sampling methods to document animals and plants. |
| 3. Cross-check and update of published data. | 3. Ground-truthing of vegetation maps, facilitated with a GPS monitor to obtain co-ordinates of vegetation types and sampling sites. Subsequently, develop a grid map of the study area. |
| 4. Selection of techniques and methods for the wetland valuation. | 4. Development of criteria and specific indicators to identify critical habitats. |
| 5. Site assessment of economic benefits and beneficiaries; Collection of valuation data. | 5. Site-specific inventorying of fauna and flora; Site-specific assessment of water quality; Assessment of site-specific threats to biodiversity. |
| 6. Analysis of economic data and valuation of wetland benefits and costs. | 6. Analysis of site-specific data and identification of critical habitats. |
| 7. Reporting on economic status, findings and management responses. | 7. Preparation of digitised maps (on ecological zones, and threat zones), using GIS techniques. |

This Chapter describes the methodology for wetland economic assessment as it was applied to the case of Muthurajawela.

2.3 Aims and scope of the economic assessment

The economic assessment of Muthurajawela wetland had four main objectives:

1. To generate information which could contribute to an understanding of the economic benefits of wetland conservation and economic costs of wetland degradation and loss in Muthurajawela within the context of ongoing efforts at wise use and sustainable management.
2. To complement and integrate with biodiversity assessment work already carried out by IUCN.
3. To provide baseline data that would be useful for biodiversity conservation and monitoring in Muthurajawela Wetland Sanctuary.
4. To develop, test, demonstrate and document practical biodiversity economics valuation tools which could be replicated in other sites in Sri Lanka.

The scope and parameters of the economic assessment of Muthurajawela were defined after an initial review of existing literature and reconnaissance of the wetland area. They were determined primarily by the aims of the study, and by available time and resources:

- **Study area:** the assessment focuses on Muthurajawela wetland, as it aims to provide information related to the management of this conservation area. It however also includes some economic linkages and effects extending beyond the boundaries of Muthurajawela itself, such as effects on neighbouring Negombo Lagoon.
- **Time frame:** The study provides a “snapshot” of the economic status and value of Muthurajawela under current management arrangements. Due to its short time frame and limited resources, and because of data constraints, it was beyond the scope of the study to make any detailed extrapolation of valuation data either to a “pristine wetland” scenario or to a situation of continuing degradation or modification.
- **Economic values:** Due to the short time frame of the study, and because of data constraints, it was decided that the study would express wetland economic benefits as gross (not net) values. It looks at the incremental economic value of conserving the wetland. In effect, the study compares “with wetland” and “without wetland” scenarios, indicating what wetland conservation adds to economic output and welfare as compared to the next most likely alternative land use (reclamation for settlement and industry).
- **Sustainability considerations:** As the main focus of the study is on the economic value of conservation, it considers only wetland benefits that are thought to be sustainable. Within the context of wise use principles, wetland conservation is considered to include the use of wetland land and resources to generate economic benefits. Limited information is however available as to the sustainability of current resource uses, and the ability of the wetland to process existing waste loads. For the purposes of this study, firewood collection, fisheries and limited agricultural production were considered to be within sustainable levels, and it is assumed that the wetland is currently able to process existing waste loads and effectively attenuate flooding.
- **Limitations:** The study is a rapid assessment, and is based primarily on published literature (it involved only limited collection of original field data. The results yielded are therefore broad estimates of wetland values, generated for management rather than research purposes. Few data exist on the economic value of the Muthurajawela, and it was beyond the resources available for this study to collect the information required to make an in-depth assessment of economic values. The study constitutes a first attempt to estimate the economic value of conserving Muthurajawela Wetland Sanctuary, and provides a base upon which data and values can be further refined in the future.

2.4 *Defining wetland economic values*

The total economic value of wetland species and ecosystems comprises the sum of:

- **Direct benefits:** economic values yielded by the physical use of wetland resources and ecosystems for production and consumption (for example fish, tourism, firewood, etc).
- **Indirect benefits:** economic values yielded by wetland environmental services and ecosystem functions (for example nutrient retention, microclimate regulation, flood attenuation, etc).

- **Option benefits:** the premium placed on maintaining wetland species and ecosystems for future possible economic uses, some of which may not be known now (for example development for pharmaceutical, industrial, agricultural, etc applications).
- **Existence benefits:** intrinsic values attached to the existence of wetland species and ecosystems, regardless of actual use (for example cultural, aesthetic, heritage, etc significance).

Review of existing literature, consultation with experts and initial reconnaissance suggested that the following economic benefits and linkages are associated with Muthurajawela Wetland Sanctuary (Figure 2):

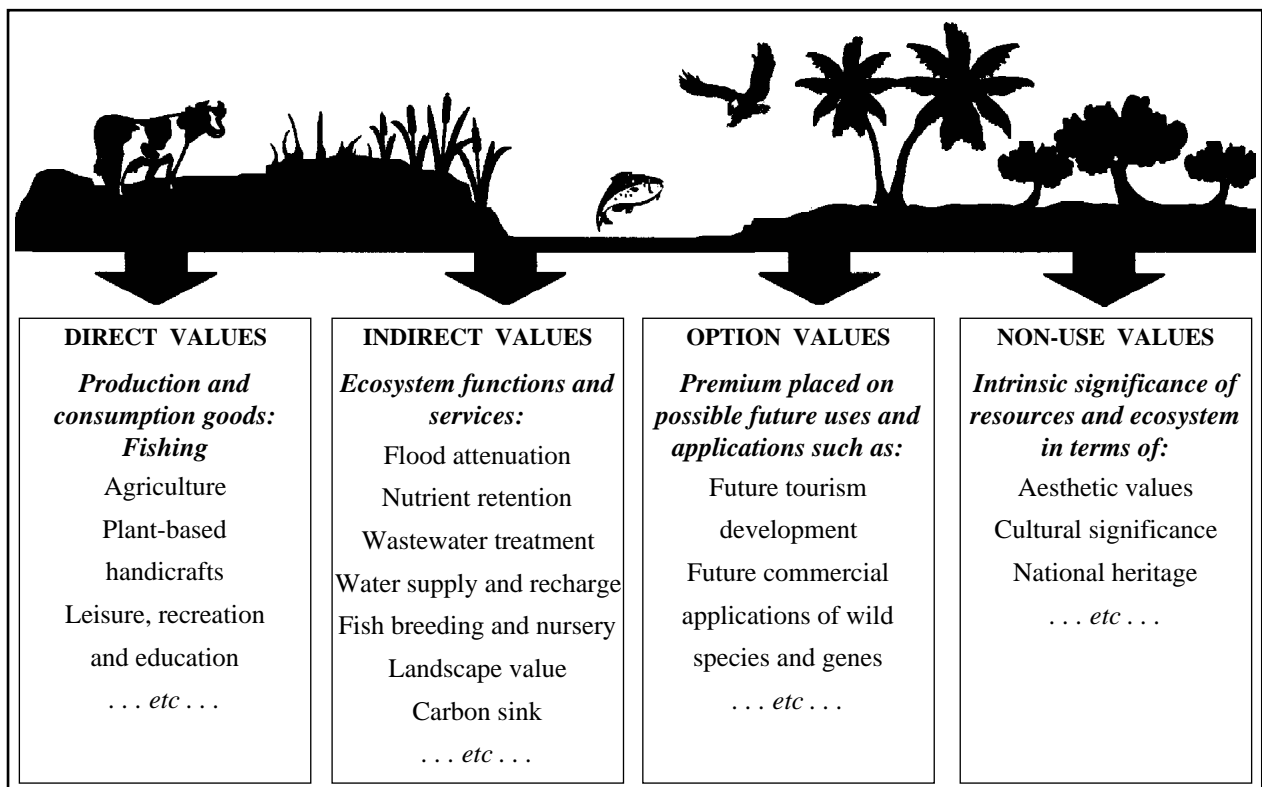


Figure 2.
Economic benefits of Muthurajawela Wetland Sanctuary

The economic benefits and linkages for Muthurajawela Wetland Sanctuary are described below, Chapter 3.

2.5 Techniques for valuing wetland benefits

Having identified the range of economic benefits associated with Muthurajawela, techniques were selected which could be used to value these benefits. A wide range of methods are available with which to value wetland economic benefits, each requiring different data and analysis.

- The simplest and most straightforward way of valuing wetland goods and services is to look at their **market prices** - what they cost to buy or what they are worth to sell.

For the case of Muthurajawela, market price-based valuation techniques could be applied to the economic benefits associated with fishing, agricultural and plant-based handicraft production activities in the marsh area.

However, as is often the case with environmental goods and services, many of the economic benefits associated with Muthurajawela wetland have no market price, or are subject to prices that are highly distorted. In these cases a range of alternative valuation techniques could, in principle, be applied:

- **Effects on production:** Other economic processes often rely on wetland resources as inputs, or on the essential life support provided by wetland services. Where they have a market, it is possible to value wetland goods and services in terms of their contribution to the output or income of these other production and consumption opportunities.

For the case of Muthurajawela, effects on production techniques could be used to assess the economic value of wetland wastewater treatment services and provision of fish breeding and nursery habitat functions in terms of their contribution to downstream fisheries in Negombo lagoon.

- **Replacement costs:** Even where wetland goods and services have no market themselves, they often have alternatives or substitutes that can be bought and sold. These replacement costs can be used as a proxy for the value of wetland goods and services, although usually represent only partial estimates, or under-estimates.

For the case of Muthurajawela, replacement costs could be used to assess the value of flood attenuation benefits in terms of infrastructure required to provide a similar level of services.

- **Damage costs avoided:** The reduction or loss of wetland goods and services frequently incurs costs in terms of damage to, or reduction of, other economic activities. These damage costs avoided can be taken to represent the economic losses foregone by conserving wetland resources.

For the case of Muthurajawela, damage costs avoided could be used to assess the value of carbon sequestration in terms of climate change-related damage costs avoided.

- **Mitigative or avertive expenditures:** It is almost always necessary to take action to mitigate or avert the negative effects of the loss of wetland goods and services, so as to avoid economic costs. These mitigative or avertive costs can be used as indicators of the value of conserving wetland resources in terms of expenditures avoided.

For the case of Muthurajawela, mitigative/avertive expenditures could be used to assess the value of wastewater treatment and water recharge services in terms of alternative expenditures avoided.

- **Travel costs:** Natural ecosystems typically hold a high value as a recreational resource or destination. Although in many cases no charge is made to view or enjoy natural ecosystems and species, people still spend time and money to reach them. This spending - such as on transport, food, equipment, accommodation, time, etc. - can be calculated, and a demand function constructed relating visitation rates to expenditures made. These travel costs reflect the value that people place on leisure, recreational or tourism aspects of wetland resources.

For the case of Muthurajawela, travel costs could be used to assess the value of recreation and tourism in terms of expenditures made on visiting the wetland.

- **Contingent valuation:** Even where wetland goods and services have no market price, and no close replacements or substitutes, they frequently have a high value to people. Contingent valuation techniques infer the value that people place on wetland goods and services by asking them their willingness to pay for them (or willingness to accept compensation for their loss) under the hypothetical scenario that they would be available for purchase. Contingent valuation techniques are one of the few methods that can be used to assess option and existence values.

For the case of Muthurajawela, contingent valuation could be used to assess the value of option and existence value in terms of willingness to pay for wetland conservations

- **Human capital:** By establishing a dose-response relationship between environmental loss and decreased human productivity, the human capital approach to valuation adds up the loss of earnings, and other (such as medical) costs in order to calculate costs associated with the degradation or loss of wetland goods and services.

For the case of Muthurajawela, human capital methods could be used to assess the value of wastewater treatment in terms of effects on on-site and downstream income and employment.

- **Hedonic methods:** Hedonic methods look at the differentials in property prices and wages between locations, and isolates the proportion of this difference that can be ascribed to the quality and provision of environmental goods and services.

For the case of Muthurajawela, hedonic methods could be used to assess the landscape values in terms of effects on housing and property prices.

2.6 Selection of economic benefits for valuation

Although a relatively large body of literature exists which deals with ecological, hydrological, management and socio-economic aspects of the Muthurajawela-Negombo area, little reference is made to environmental economic characteristics and information. There are little or no detailed environmental economics data on Muthurajawela, except for the broad estimates of economic values presented in the Conservation Management Plan for Muthurajawela Marsh and Negombo Lagoon (CEA 1994). Because of information, time and resource constraints, it was

impossible to obtain sufficient data to value all of the economic benefits associated with Muthurajawela, or to apply all of the potential valuation techniques that are identified above. It was therefore necessary to identify which valuation techniques could realistically be applied to Muthurajawela in the context of this study. The benefits that were selected for valuation were chosen according to their perceived importance to the surrounding economy, and the extent to which data were readily available at the time of the study (Table 2):

Table 2
Valuation of Muthurajawela wetland benefits

| Economic Benefit | Valuation technique | Data required | Included/excluded in study |
|---|---|--|---|
| Fisheries | Marsh fisheries: Market prices of output | Fishing population, catch and prices | <input checked="" type="checkbox"/> Yes |
| Agriculture | Marsh farming: Market prices of output | Farming population, area, yield and prices | <input checked="" type="checkbox"/> Yes |
| Plant-based handicrafts | Marsh species: Market prices of output | Artisan population, production and prices | <input checked="" type="checkbox"/> No - insufficient data |
| Leisure and recreation | Marsh recreation: Visitor travel costs | Visitor numbers, type and expenditures | <input checked="" type="checkbox"/> Yes |
| Flood attenuation | Surrounding area: Service replacement costs | Required infrastructure and costs | <input checked="" type="checkbox"/> Yes |
| Nutrient retention and wastewater treatment | Waste treatment: Mitigative expenditures | Required infrastructure and costs | <input checked="" type="checkbox"/> Yes |
| | Local population: Health status | Medical expenditures; relationship between pollution and health | <input checked="" type="checkbox"/> No - insufficient data |
| Fish breeding and nursery | Downstream fisheries: Negombo fishery income | Fishing population, catch and prices; relationship between marsh degradation and catch | <input checked="" type="checkbox"/> No - insufficient data |
| | On-site fisheries: Marsh fishery income | | <input checked="" type="checkbox"/> Yes - reflected in direct value |
| Water supply and recharge | Local water users: Avertive expenditures | Required infrastructure and costs | <input checked="" type="checkbox"/> Yes |
| Landscape values | Adjacent property: Hedonic methods | Comparative property prices | <input checked="" type="checkbox"/> No - insufficient data |
| Carbon sink | Global climate change: Damage costs avoided | Carbon sequestration capacity and associated costs avoided | <input checked="" type="checkbox"/> Yes |
| Option values Existence values | Potential users: Contingent valuation | Willingness to pay | <input checked="" type="checkbox"/> No - insufficient data |

The results and findings of the valuation of Muthurajawela Wetland Sanctuary are presented below, Chapter 4.

2.7 Drawing conclusions from the economic assessment

Economic assessment goes beyond merely calculating the monetary value of wetland goods and services: it also aims to relate these values to on-the-ground wetland management issues.

The overall objective of this study is to generate information which can contribute to an understanding of the economic benefits of wetland conservation and economic costs of wetland degradation and loss in Muthurajawela, within the context of on-going efforts to use the wetland wisely and manage it sustainably.

A key part of the economic assessment of Muthurajawela was to generate information that can be used, and to identify economic issues that need to be addressed, in support of wetland conservation. Information on the economic value of Muthurajawela was thus analysed, and used to point to:

- The economic rationale and justification for conserving Muthurajawela, and managing as a Wetland Sanctuary.
- The economic threats and pressures that need to be addressed in the management of Muthurajawela as a conservation area.
- The economic tools and measures that can be used to assist in the conservation of Muthurajawela, in particular those that support the recommendations made by the biodiversity assessment (IUCN 2001).

The conclusions of the economic assessment of Muthurajawela Wetland Sanctuary are presented below, Chapter 5.

3. Assessment

Wetland-Economic Linkages in the Muthurajawela Area

3.1 Population and livelihoods

Almost 300,000 people live in the Muthurajawela-Negombo area¹, of which just under 5,000 live in or directly adjacent to Muthurajawela marsh². The number of households living in the Conservation Zone of the marsh has increased substantially over time, from only 52 households in 1952 (Mahanama 1998) to 700 households today (Table 3). Most of this human population migrated from nearby locations of Gampaha District into the Muthurajawela area after the mid-1970s, attracted by the relatively low price of land and the lack of enforcement against moving onto state-owned land in the Conservation Zone. Today, just over half of the marsh population are squatters, and about three quarters of landholdings are unauthorised.

Table 3
Squatter population in the Muthurajawela Conservation Zone 2002

| Name of settlement | Households | Persons |
|--------------------|------------|--------------|
| Kadola | 53 | 206 |
| Heen Ela | 9 | 34 |
| Tharakuliya | 32 | 124 |
| Lenus Wella | 61 | 236 |
| Tummodara | 10 | 39 |
| Suduwella | 2 | 9 |
| Farmwatta | 44 | 171 |
| Kaleliya | 18 | 69 |
| Uswatta | 44 | 171 |
| Kajugasgodella | 13 | 51 |
| Swarnahansawila | 51 | 197 |
| Ja Ela Bunt | 121 | 471 |
| Kunjawatta | 4 | 17 |
| Sebastain Mawatha | 4 | 17 |
| Pubudugama | 156 | 604 |
| Indivitiya | 17 | 64 |
| Nilsirigama | 55 | 214 |
| Ambavitiya | 3 | 13 |
| Total | 698 | 2,709 |

From data presented in Mahanama 1998, updated to 2002 levels using 2.5% growth rate specified in Hettiarachchi and Samarawickrama 2000

1. Based on data presented in GCEC 1991, extrapolated to 2002 levels using population growth rates specified in Hettiarachchi and Samarawickrama 2000.
2. Based on data presented in CEA 1994, extrapolated to 2002 levels using population growth rates specified in Hettiarachchi and Samarawickrama 2000.

Livelihoods in the Muthurajawela-Negombo area are based mainly on fishing, farming and natural resource harvesting, with a minority of residents earning income from employment and small-scale trade. The area is characterised by high levels of poverty, and the majority of the marsh and lagoon-adjacent population belong to the lowest income category (CEA 1994). In 1998, nearly 80% of households living around the wetland earned less than Rs 5,000/month, and a third earned less than Rs 3,000 (Mahanama 1998). More than 60% of labour force is unemployed (CGEC 1991), and the majority of those with paid work are engaged in low-paying manual labour activities such as gardeners, home helps and cleaners (Mahanama 1998).

3.2 Direct economic uses of wetland resources

It is against this background of limited livelihoods, low access to income and employment, and widespread poverty that wetland resources underpin a wide range of economic activities for the approximately 1,200 households or 5,000 people who live within and beside Muthurajawela Marsh. Due to its proximity to Colombo, Muthurajawela also provides a popular recreational destination for urban dwellers and foreign tourists. Economic benefits associated with the direct use of wetland resources in Muthurajawela include:

- **Fishing:** Between 13% (Mahanama 1998) and 14% (GCEC 1991) of local households are involved in fishing activities in the marsh area, including both fresh and brackish water parts. A wide variety of fishing methods are used, including rod and hook, drift and cast nets and brush piles. Although commercial fisheries are well-developed in nearby Negombo Lagoon, fishing in the marsh area is primarily for household consumption.
- **Use of wetland plants and trees:** Most of timber species once found in the marsh area have now been exploited, and only small bushy plants are left (Wijeyaratne 2000), these plants are harvested for a variety of purposes. About 60% of houses are constructed of timber plank walls, cadjan roof and cement floor (Mahanama 1998), and make some use of wetland species. The vast majority of households (an estimated 94% (utilise woodfuel for cooking, and 60% of these obtain firewood from the marsh area (Mahanama 1998). Reeds and sedges obtained from the marsh are also used for the construction of fish traps, mats and handicrafts (Wijeyaratne 2000). It is estimated that up to 75 ha of the northern part of Muthurajawela Marsh is under mangroves³. As well as providing a range of ecological services (see below), mangroves are used to construct brush piles for fishing activities.
- **Agriculture:** Due to the salinity, acidity and low natural fertility of its predominantly peat soils, the marsh area is unsuitable for cultivating all but a very few crops (GCEC 1991). It is estimated that approximately 60 ha is planted with coconuts, 20 ha with bananas, and 14 ha with vegetables (Agricultural Instructor, Ja-Ela Divisional Secretariat pers comm.).

3. Estimated based on land use maps prepared by Central Environment Authority, also see IUCN 2001.

- **Recreation and tourism:** The marsh area is popular recreational destination, primarily attracting educational or school trips and day visitors from nearby Colombo. The Muthurajawela visitor centre attracted nearly 15,000 visitors in 2000, three quarters of whom also took a boat trip into the marsh area. It is also estimated that up to 1,500 people are employed in the hotel and restaurant sector in the area (CEA 1994).

3.3 *Indirect economic benefits of wetland ecosystem services*

Whereas the direct benefits of Muthurajawela marsh accrue primarily to the poor local households who live on its fringes, indirect economic benefits are spread over a much larger area and population. The marsh is surrounded by a large, and rapidly increasing, urban population and industrial zone. Up to 75,000 households or 300,000 people live in the Muthurajawela-Negombo area, of which an estimated 3,000 families depend on fishing in the Negombo Lagoon and a large proportion are employed in local industries and businesses or work in Colombo. Many industries are also located around, and upstream of, Muthurajawela, including more than 100 industrial units in the area directly adjacent to the Marsh (GCEC 1991). This urban and industrial population demand a variety of basic services and support to production: existing infrastructure is unable to provide many of these services adequately. The Muthurajawela wetland system generates important indirect functions that support and underpin industrial production and urban settlement in the area, including:

- **Flood attenuation:** Muthurajawela receives water from rainfall, runoff from surrounding higher grounds, and absorbs flows from the Dandugam Oya, Kalu Oya and Kelani Oya. During the rainy season, large volumes of water enter the wetland system. The marsh plays an important floodwater retention and buffering function by receiving and discharging these waters to the Negombo Lagoon and the sea by way of the Hamilton Canal. The maximum water storage capacity of the marsh has been estimated at 11 million cubic metres, with a maximum discharge of 12.5 cubic metres per second and a retention period of more than 10 days (Mahanama 2000).

As Muthurajawela has been degraded and reclaimed, hydrological linkages to appropriate discharge points have been cut off, meaning that excess water and peak flows cannot flow easily to Negombo Lagoon. Over recent years the intensity and frequency of flooding has increased dramatically in low-lying fringes of the marsh (CEA 1994). In severe rain, the Hamilton Canal and other watercourses overflow, and inundate surrounding areas. Today, floods occur in adjacent settlements at least two times a year during the wet seasons (van Agthoven and Gijssbers 1992), and during every rainfall period more than 1,000 households in the marsh area are affected by flooding (CGEC 1991).

- **Freshwater recharge and supplies:** Water is supplied to the wetland system through the Kelani Ganga to the south of the marsh, and the Dandugam Oya and Ja-Ela, flowing through the northern part of the marsh to into the lagoon. Muthurajawela acts as an important source of freshwater storage, with an estimated capacity of 11 million cubic metres (Mahanama 2000).

By maintaining surface, near-surface and possibly groundwater⁴ levels, the marsh plays a major important role in local freshwater supplies. These functions are particularly important for local households, many of whom lack a piped water supply and rely on shallow-dug wells. About 9% of Marsh households depend on well water for drinking and 70% use canals for bathing and washing (Mahanama 1998), and up to a quarter of the households living beside Negombo Lagoon rely on wells for their drinking water needs (Dangalle 1999). The marsh also acts as a source of freshwater to the tidal delta, and is critical in moderating salinity levels and upholding fisheries activities in Negombo Lagoon.

- **Sediment and nutrient retention and wastewater purification:** The marsh receives high loads of domestic refuse, sewage and industrial wastes, and sediment and silt loads, from both surrounding and upstream areas. It physically, chemically and biologically eliminates pollution from these wastewaters. While wetland plants trap sediments and remove nutrients and suspended solids, pollutants and pathogenic organisms accumulate and decompose in the wetland's bottom sediments, and effluents are diluted. Mangroves at the northern end of the marsh area also facilitate sediment deposition, before water enters Negombo Lagoon. They act as a filter for through-flowing waters, and assist in the removal of nutrients and toxic substances. These functions play an important role in assuring local water quality, and maintaining the quality of water entering the lagoon and sea.

Wastes enter the marsh from multiple sources, including adjacent households, fishing boats, tourist facilities, agriculture and industries (CEA & Arcadis 2000). It is known that in 1991 there were 100 industrial units in and around Muthurajawela marsh and Negombo Lagoon, including vehicle and electrical goods repair and garment makers (CGEC 1991). Today this number has undoubtedly increased, as much of the southern part of Muthurajawela has been turned into an industrial area. The fringes of the marsh are used as solid waste dumping grounds, and untreated wastewaters are also discharged directly into the wetland both from surrounding industries from the upstream towns lying along the Ja-Ela and Dandugam Oya (Mahanama 2000, Wijeyaratne 2000).

A high proportion of surrounding human settlements have no proper sewerage or sanitation system, and discharge raw effluents directly into the marsh. More than 40% of Marsh households have no latrine and 25% have only temporary latrines (Mahanama 1998), almost half of households living around Negombo Lagoon have no latrine (CEA1999), and it is estimated that the marsh and lagoon area receive raw or partially-treated sewage from a population equivalent to 200,000 people (CEA undated).

Land filling and reclamation in the marsh area for industry, infrastructure and settlement has increased local erosion and siltation dramatically (van Agthoven and Gijsbers 1992).

4. Little is known about the quality of groundwater in and under the marsh and lagoon, although layers of rain-fed freshwater are supposed to exist in the dunes and in the sandy area around Bopitiya (CEA & Arcadis 2000).

By 1999, annual sediment loads entering the marsh were estimated at 147,000 tonnes a year from the Dandugam Oya and Ja-Ela, and 62,000 tonnes a year from the Hamilton Canal (Kragtwijk and van Nood 1999).

- **Fish breeding and nursery:** About 28 fish species have been observed in Muthurajawela, of which about 24 are food fish (Mahanama 2000), and it is estimated that almost 100 households are involved in subsistence-level fishing. Negombo Lagoon has a high productivity for fisheries of an estimated 150 kg/ha/year (GCEC 1991), involving more than 3,000 families from 26 villages (CEA 1994, GCEC 1991, Hettiarachchi & Samarawickrama 2000). Catch includes, in the marsh, tilapia and snakehead, and in both the marsh and lagoon shrimp, crabs and a wide variety of saltwater fish.

The Muthurajawela wetland system provides indirect support to both marsh and lagoon fish production. Its sheltered waters, flooded vegetation and mangrove areas all constitute important breeding grounds and nurseries for freshwater and marine species of fish and crustaceans.

4. Findings

The Economic Value of Muthurajawela

4.1 Economic values

Estimating the monetary worth of some of these wetland benefits shows that Muthurajawela has a high direct and indirect economic value of Rs 726.5 million a year, or Rs 0.24 million/ha (Table 4). As is typical for the case of urban wetlands, ecosystem services contribute the main part (90%) of this value, and fisheries (36% of total resource use values) and agriculture (41%) are the most economically valuable resource uses (Figure 3).

Table 4
The value of Muthurajawela Marsh direct and indirect economic benefits

| Economic benefit | Value (Rs million/year) |
|---|-------------------------|
| Flood attenuation | 485.51 |
| Industrial wastewater treatment | 162.31 |
| Agricultural production | 30.29 |
| Support to downstream fisheries | 20.00 |
| Firewood | 7.96 |
| Fishing | 6.26 |
| Leisure, recreation and recreation | 5.28 |
| Domestic sewage treatment | 4.32 |
| Freshwater supplies for local populations | 3.78 |
| Carbon sequestration | 0.78 |
| Total | 726.49 |

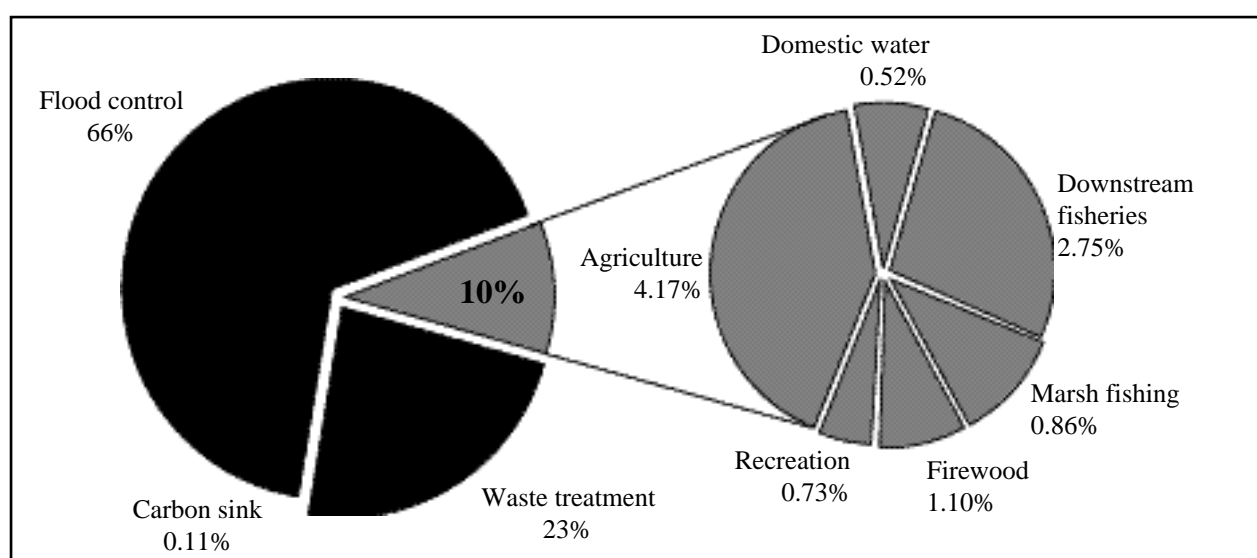


Figure 3
Components of the economic value of Muthurajawela

- **Use of marsh for fishing:** Between 13% (Mahanama 1998) and 14% (GCEC 1991) of the marsh population, or approximately 175 households, are involved in fishing activities in Muthurajawela. It is known that the average monthly value of fishing is approximately Rs 3,000 (updated to 2002 levels from data presented in CEA 1994), meaning that in total the marsh fishery may be worth some Rs 6.26 million a year for surrounding households.
- **Use of plants and trees:** The vast majority of the marsh population (an estimated 94%) utilise woodfuel for cooking, and 60% of these or 800 households obtain firewood from Muthurajawela (Mahanama 1998). With the purchase price of firewood some Rs 30/ household/day, the value of firewood obtained from Muthurajawela equates to a market price equivalent of Rs 7.96 million a year.
- **Use of marshland for agriculture:** Parts of Muthurajawela are used for crop production. Even though the soils are poor, the presence of abundant water and rich sediments enables the cultivation of small areas of coconuts, bananas and vegetables. The gross returns from this crop farming are some Rs 29.24 million a year.

Up to 30 families own pigs, which obtain the bulk of their food requirements from plant materials found in the marsh. With each household selling 3 to 4 pigs a year at a price of Rs 10,000, this translates into an annual value added to household production of around Rs 1.05 million.

- **Leisure, recreation and education:** Up to 15,000 residents of Colombo, tourists and school parties visit Muthurajawela each year for recreational purposes. They make a variety of expenditures on these visits, including paying for tours, transport, food, boat trips and souvenirs. The gross annual value of these expenditures is in excess of Rs 5.3 million, of which 48% accrues to Muthurajawela Visitor Centre 48%, 34% is paid to tour operators 34%, and 18% is spent on public and private transport to the marsh.
- **Flood attenuation:** In order to replicate the flood control functions provided naturally by Muthurajawela, it would be necessary to construct of a proper drainage system and pumping station. This would involve deepening and widening the channels of watercourses flowing between the wetland area and the lagoon (notably the Ja Ela, Kalani and Old Dutch Canal), installing infrastructure to divert floodwaters into a retention area, and pumping water out into the sea. Due to the flat topography of the marsh area, this would require significant engineering works.

Cost estimates for this type of flood control measures are available for Mudu Ela wetland, which lies along the Kalani River just to the south of Muthurajawela. Here, infrastructure has been installed to ensure that a total of 443 acres of land remain drained, in order to reclaim an area of 360 acres. The total construction costs required to including widen and deepen the channels of watercourses, and to retain and pump out water, is Rs 2.11 million per hectare per year, and annual maintenance costs are between 3-4% of this investment cost. Extrapolating these costs to the 3,068 ha Muthurajawela wetland gives expenditures of Rs 486 million a year to replace natural flood attenuation functions.

- **Freshwater supplies for local populations:** An estimated 9% of Marsh households depend on well water for drinking, and 70% use unpiped freshwater for bathing and washing (Mahanama 1998). Twenty four percent of Negombo fishing households depend on wells for their drinking water needs (Dangalle 1999). This equates to a total of 1,600 households who rely on surface and shallow water for domestic purposes.

Wetland water retention plays an important role in recharging these freshwater supplies, and maintaining them close to the surface. In the absence of this ecological service, it is likely that deeper wells would have to be dug to reach freshwater reserves, or that additional shallow wells would need to be dug in the dry season. With each well serving an average of 3 households, this equates to avertive expenditures avoided of an estimated Rs 3.78 million per year.

- **Domestic sewage treatment:** The majority of residents of the low-cost settlements around Muthurajawela currently use either unimproved pit latrines or have no sanitation facilities at all. Almost all of their domestic wastes enter directly into the wetland, carried in surface water or as seepage from latrine pits. Currently at least 67% or 900 households living around the marsh have no proper latrine facilities, and discharge untreated sewage into the marsh (Mahanama 1998). The marsh has an important function in treating these domestic wastes, assuring local water quality and purifying water before it enters the lagoon area.

The high water table and recurrent waterlogging in these residential areas, and their close proximity to the wetland, would require the construction of elevated pit latrines to prevent sewage from entering directly into the wetland. The costs avoided of constructing improved latrines for households who currently discharge sewage into the wetland work out at more than Rs 4.32 million a year.

- **Industrial wastewater treatment:** In 1991 there were 100 industrial units in and around Muthurajawela marsh and Negombo Lagoon, including vehicle and electrical goods repair and garment makers (CGEC 1991). Today, much of the southern portion of the wetland has also been turned into an industrial area, discharging polluted wastewater directly into the wetland, which acts as a buffer that treats these effluents before they flow into Negombo Lagoon. Of the 140 or so industries in Ja-Ela and Ekala, 64 generate effluent, 17 have high domestic loading of over 10 m³/day by water consumption, and only 13 have any kind of treatment facility (Ministry of Policy, Planning and Implementation 1993). Both treated and untreated discharges are pumped into Ja-Ela stream.

A feasibility study on industrial wastewater treatment for the Ja-Ela/Ekala area looks at the costs of establishing a joint treatment plant for nearly 60 textile, garment, food processing, chemical and other industries (Ministry of Policy, Planning and Implementation 1993). It calculates that such a treatment plant would have a capital cost of approximately US\$4.3 million, average annual operating and maintenance costs of US\$ 470,000, and a lifespan of 10 years. Applying the exchange rate at the time of this study gives an annualised cost of some Rs 81 million. Today it is estimated that between 100-150 industries, concentrated in two main zones, discharge untreated or partially treated wastes into

Muthurajawela Marsh. The costs avoided of constructing two major joint treatment plants for these industries thus equate to approximately Rs 162 million a year.

- **Support to downstream fisheries:** Muthurajawela provides a number of services that maintain and support downstream fisheries production, including sediment trapping, wastewater purification, freshwater supplies and fish breeding and habitat. The annual value of this fishery in Negombo Lagoon was estimated at Rs 100 million a year in 1991 (GCEC 1991), Rs 150 million in 1994 (CEA 1994), Rs 187 million a year in 1999 (Wijeyaratne 2000), and is assumed to be worth Rs 200 million in 2002.

Even taking a conservative estimate of the contribution of these ecological services to fisheries catch shows that they have a high value. Assuming that the loss of these multiple functions would impact on just 10% of fisheries value in Negombo Lagoon gives a value of at least Rs 20 million a year in terms of their effects on downstream production.

- **Carbon sequestration:** Mangroves act as a sink for carbon sequestration, thereby helping to mitigate against the effects of global warming. Carbon dioxide release, through its global warming effects, gives rise to a range of economic costs and losses - for example health costs, sea-level rise and consequent damage to infrastructure, agriculture, fisheries and other production, and needs for protective infrastructure and mitigation. From data calculated for Puttalam Lagoon, it is estimated that mangroves fix between 300-2,000 g of C/m²/year (Ranasinghe 2000). For the 75 ha of mangroves in Muthurajawela marsh, this equates to carbon sequestration of between 225-1,500 tonnes/year.

Although still approximate, estimates have been made of the economic benefits or costs avoided of carbon sequestration. Most studies calculate the benefits of carbon sequestration at between US\$5-25 a tonne (Shogren and Toman 2000), or an average global warming damage cost of US\$20 per tonne of C released (Fankhauser and Pearce 1994). Taking a mid-range estimate of 11.5 tonnes of carbon fixation per year, and applying a conservative value of \$10/tonne, this yields a value in terms of climate change damage avoided of some Rs 776,250 per year for mangrove areas of Muthurajawela.

4.2 Economic beneficiaries

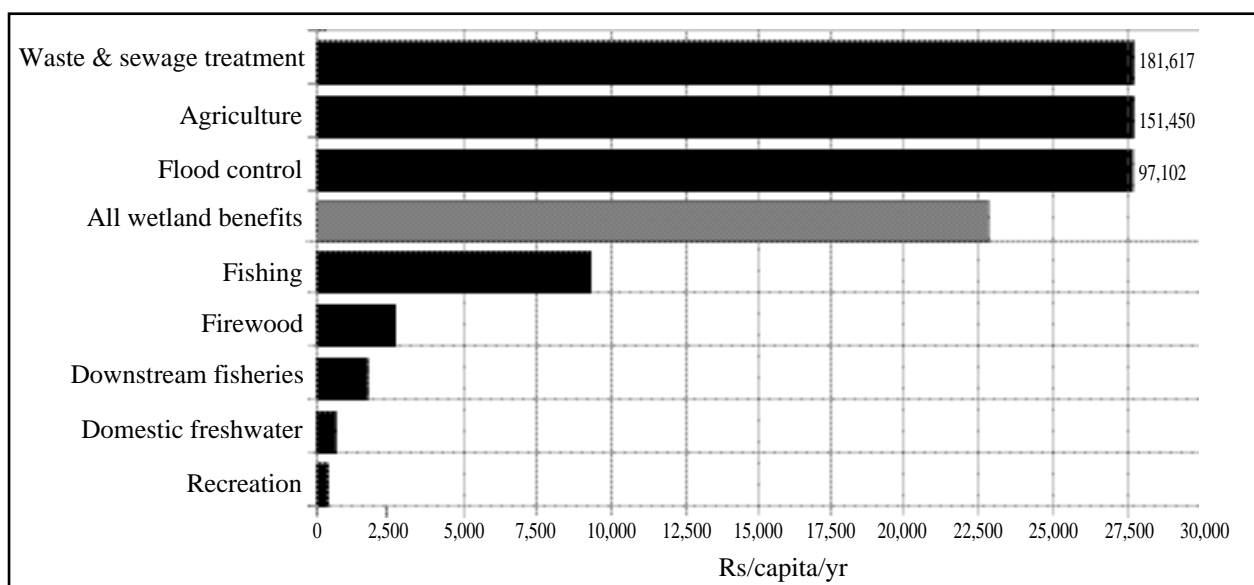
In total, the direct and indirect values that have been considered in this study benefit more than 30,000 people in the Muthurajawela area (Table 5). This includes nearly all of the population who live directly adjacent to the wetland, as well as many households and industries that are located upstream and downstream of Muthurajawela. Whereas direct economic values primarily accrue to the users of wetland plants and resources, who live beside Muthurajawela, wetland ecological services yield economic benefits for a much wider area, including fishing villages and industries around Negombo Lagoon, and upstream urban and industrial areas along the Ja-Ela, Dandugam Oya, Kalu Oya and Kelani Oya.

Table 5
Wetland beneficiaries *

| Economic benefit | Beneficiary population | Number of beneficiaries |
|------------------------------------|---|---|
| <i>Use of marsh resources</i> | | |
| Fishing | Marsh-adjacent dwellers | 675 people |
| Firewood | Marsh-adjacent dwellers | 3,000 people |
| Leisure, recreation and recreation | Colombo residents, foreign tourists, schools, tour operators and hoteliers | 15,000 people |
| Agricultural production | Marsh-adjacent dwellers | 200 people |
| <i>Marsh ecological services</i> | | |
| Flood attenuation | Adjacent industries, Marsh-adjacent dwellers | 5,000 people > 100 industries |
| Freshwater supplies | Marsh-adjacent dwellers and Negombo fishing households without piped water supplies | 6,300 people |
| Waste & sewage treatment | Marsh-adjacent dwellers without proper sewerage and sanitation | 3,400 people |
| | Upstream and adjacent industries | > 100 industries |
| Support to downstream fisheries | Negombo fishing households | 11,600 people |
| Total | | > 31,700 people > 100 industries |

* Excludes carbon sequestration, as accrues globally.

Muthurajawela is worth an average of almost Rs 23,000 a year to each of more than 30,000 beneficiaries (Figure 4). Wetland agriculture (more than Rs 150,000 per beneficiary per year), waste and sewage treatment (more than Rs 180,000) and flood control services (almost Rs 100,000) contribute by far the highest economic value on a per capita basis.



* Excludes carbon sequestration, as accrues globally.

Figure 4
Per capita value of wetland economic benefits*

5. Conclusions

Economic Aspects of the Management of Muthurajawela

5.1 The economic justification for Muthurajawela Wetland Sanctuary

The Muthurajawela-Negombo wetland system has a long history of human use and settlement, and has been subject to rapidly growing pressures and degradation over time. In recognition of its high environmental and commercial value, the Greater Colombo Economic Commission (now the Board of Investment) was in 1989 instructed to prepare a sustainable development plan for the area. The publication of the Masterplan for Muthurajawela Marsh and Negombo Lagoon in 1991 (GCEC 1991) led to a land use strategy being proposed for the future, which proposed that (Mahanama 2000):

- Two and a half percent or 160 ha of the wetland area be developed as a mixed urban zone.
- Four hundred hectares be designated a recreational buffer zone.
- The fringes of the marsh be earmarked for settlement development, including the resettlement of families evicted from the mixed urban development zone.
- Areas on either side of the Jayasuriya Road be allocated for housing development.
- The remaining area (85%) be zoned as an environmental conservation area.

The Master Plan was accepted by the government in 1992, and implementation commenced. The Department of Wildlife Conservation was charged with managing the conservation zone, the Department of Fisheries was made responsible for the fishery in Negombo Lagoon, and the Forest Department was mandated with the management of mangrove areas. A detailed plan for the conservation zone was prepared, and in 1996 an area of 1,777 ha of the northern part of the marsh was declared a Wetland Sanctuary under the Fauna and Flora Protection Ordinance. A management plan was also developed for Negombo Lagoon, which was declared as a Special Fishery Management Area under the Fisheries and Aquatic Resources Act 1996.

This study provides a strong — and much needed — economic argument for the continued conservation of Muthurajawela as a Wetland Sanctuary. Although many of the ecological, hydrological and biodiversity values associated with conserving the wetland are impossible to quantify on the basis of available data, even a partial valuation of wetland benefits shows that the presence of the Wetland Sanctuary makes sound economic sense:

- **The wetland has a high economic value, overall and relative to its area.** Wetland goods and services that have been considered in this study generate economic benefits worth more than Rs 726 million a year, or almost Rs 240,000 per hectare of wetland.
- **The wetland benefits a large, and diverse, human population.** More than 30,000 people gain direct and indirect economic benefits from the wetland, including local residents

of the marsh area, downstream fishing communities, and upstream and surrounding urban dwellers and industries.

- **The wetland makes a substantial contribution in local livelihoods and urban poverty alleviation.** Many of the wetland beneficiaries, and residents of the wetland-adjacent area, belong to the poorest and most vulnerable sectors of the urban population. The wetland provides an important source of income, subsistence, employment and food security, and generates essential services, that are unavailable or unaffordable elsewhere for these households.
- **The wetland provides support to many economic sectors.** Wetland goods and services support production, consumption and economic output in key sectors that are critical both to the local economy and to Sri Lanka's development goals, including fisheries, industry, agriculture, urban settlement, water, sewerage and sanitation, pollution control, household production and consumption.
- **The wetland plays a critical role in assuring the provision of basic services and quality of life.** The wetland area supplies essential services which enable human settlement and ensure an acceptable quality of life, including flood control, maintenance of water supplies and quality, and treatment of wastes and pollution. Many of these basic services are not provided to an adequate level by existing infrastructure. The wetland helps to fill the gap between the level of basic goods and services that government is able to provide or afford, and that which a dense and rapidly increasing urban population requires.

5.2 Key economic concerns in wetland conservation

Despite its high economic value and protected status, Muthurajawela wetland continue to be threatened and degraded. Pressure on the wetland system arise almost entirely from human economic activities in the surrounding area, and includes:

- Habitat deterioration and degradation arising from land reclamation, clearance of vegetation, deliberate fire, dumping of garbage, discharge of agrochemicals, industrial wastes and organic pollution.
- Unsustainable exploitation of wild species, including tree-felling and use of destructive fishing techniques or over-fishing of certain species or in certain areas (such as to supply the ornamental fish industry.
- Introduction of alien invasive plant and animal species, including exotic fish, molluscs and common house rat; unmanaged domestic animals such as buffalo, cats, dogs, pigs and goats; and ornamental plants and shrubs.
- Interference with wetland hydrology and ecology through the construction of engineering works, water diversion, flood control measures and infrastructure developments such as roads and housing.

Critically threatened areas, species and habitats within the wetland system have already been identified, and a number of recommendations for the actions that are required to address these threats have been made. Proposed conservation actions include (from IUCN 2001):

1. According the Wetland Sanctuary status as a Ramsar site, upgrading the protected area status of the northern part of the wetland and incorporating additional areas.
2. Documenting the legal status of land within the Wetland Sanctuary, and the socio-economic status of communities within and around it.
3. Initiating prompt action against practices that degrade the wetland.
4. Initiating restoration activities to enhance degraded habitats.
5. Raising awareness on the importance of the Muthurajawela wetland.
6. Promoting ecotourism.

Economic tools and instruments provide a vital source of support to all of these proposed activities. As the majority of threats to Muthurajawela are economic in origin, economic actions are required to address them. Ultimately, unless it is demonstrated to make good economic sense to manage the wetland wisely and use it sustainably, it is unlikely that it will be conserved or that its continued (or extended) status as a protected area will prove acceptable — to urban planners and developers, to groups who currently engage in economic activities that degrade the wetland, or to poor local communities. At least five categories of economic measure can help to ensure the continued conservation of Muthurajawela Wetland Sanctuary:

- **Taking action to raise awareness on the economic value of wetland conservation.** There remains a perception that maintaining Muthurajawela as a natural or semi-natural wetland constitutes a waste of scarce land, funds and resources that could be more profitably allocated to industry, settlement, land reclamation, infrastructure and other “developments”. Generating information on the economic value of the wetland, and disseminating it in a form that is relevant to urban planners, decision-makers and policy-makers can provide a convincing argument for the wetland’s protected status.

A strong point has to be made that omitting environmental concerns from urban planning and development can give rise to untenable economic losses for some of the poorest sectors of the population. It also undermines industrial output, imposes high costs and expenditures for the public sector agencies who have the responsibility for providing basic services and assuring an acceptable standard of living, and may ultimately erode the very aims of urban development itself. It should be made clear that the continuing reclamation and degradation of Muthurajawela wetland gives rise to development losses and economic costs that neither the government nor the people of Sri Lanka can afford to bear over the long-term.

These measures can provide strong arguments in support of proposed Actions 1, 3 and 4 above.

- **Ensuring that wetland values are factored into development planning.** Economic analysis of the returns to development activities in the marsh area rarely takes account of impacts on the status and integrity of Muthurajawela, or see its degradation as an economic cost that must be factored into decisions alongside other project costs. Even though public sector projects, at least, are in theory subjected to detailed environmental impact assessment and economic cost-benefit analysis, these usually omit environmental economic values.

Estimates of the economic value of wetland goods and services should be a required component of EIAs and CBAs of public — and if possible also private — investments in infrastructure, engineering works and industrial developments, and these values should be reflected in project profitability and statements of economic desirability.

These measures form an essential component of proposed Action 5 above.

- **Ensure that economic penalties are set for wetland degrading activities at a level that reflects the economic costs they incur.** Penalties for illegal or destructive use of Muthurajawela, where they are enforced, tend to be unrealistically low. They often neither act as a convincing deterrent to degrading land and natural resources in the wetland, nor reflect the economic costs of the damage they cause. In many cases it still makes good economic sense to degrade wetlands, even after these fines or penalties are paid.

Information on the economic value of wetland goods and services can be used to ensure that penalties for illegal wetland degradation are realistic, and reflect the real costs of damage caused. Setting penalties at a full-cost levels should act as an additional disincentive against wetland degradation, or at least make sufficient funds available to mitigate or remedy its effects.

These measures reinforce, and support, proposed Action 3 above as a clear disincentive to wetland-degrading activities.

- **Ensuring that wetland conservation generates tangible economic benefits for surrounding, poor communities.** The economic activities of local residents threaten Muthurajawela. Although these threats are not as intense as those arising from large-scale and commercial developments, they exert critical pressure on the wetland. Yet, unlike commercial and industrial developers, many local residents are among the poorest sectors of the urban population and have few economic choices or alternative sources of income and subsistence. They can ill afford to bear the opportunity costs of (unsustainable) land and resource utilisation opportunities foregone, even though wetland degradation generates wider and longer-term economic losses.

Ensuring that wetland conservation generates tangible economic benefits to local populations is a necessary (although by itself is unlikely to be sufficient) condition for the continued existence of Muthurajawela Wetland Sanctuary. Unless the management of the wetland as a protected area yields clear economic benefits that can offset or compensate for unsustainable land and resource utilisation activities foregone, it is unlikely that local residents will be willing, or in many cases economically able, to support its conservation.

Proposed Action 6 is an example of these measures, which also provide economic incentives for proposed Actions 3 and 4 above.

- **Making efforts to capture wetland benefits as a means of financing conservation.** Extending the area and protection status accorded to Muthurajawela has cost implications. Substantial funds are required to manage the Wetland Sanctuary, to address threats and pressures, and to enforce controls on land and resource uses. Currently there are few funds available to undertake this work or to extend an adequate level of protection to the wetland.

Valuation indicates the magnitude of economic benefits that the wetland provides, and to whom they accrue. Many of the beneficiaries of Muthurajawela gain goods and services from the wetland at low or zero cost (and degrade wetland resources at low or zero private cost). Other benefits are currently not captured or realised in monetary terms. There is no reason why this should be the case (in many cases there are opportunities to develop and charge for sustainable wetland uses (for example ecotourism, as identified in action 6 above), or to ensure that the public sector agencies and private groups who profit from wetland goods and services and are able to pay for this use are charged fair prices (for example sharing in downstream fisheries taxes and licence fees collected by the Department of Fisheries, or imposing wastewater treatment and purification charges on polluting industries). If they are retained and allocated at the site level, such revenues can provide an important source of funding for the conservation of Muthurajawela in the future.

Proposed Action 6 is an example of these measures, which also provide financial support that will enable and strengthen the implementation of proposed Actions 1 and 4 above.

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