

Mahausakande Tropical Rainforest Regeneration Initiative

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VALUATION OF ECOSYSTEM SERVICES AND OPTIONS FOR SUSTAINABLE FINANCING OF MAHAUSAKANDE: A REGENERATING RAINFOREST IN SRI LANKA

Thushara Ranasinghe

Channa Bambaradeniya



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Author of correspondence:

Thushara Ranasinghe (Email: ranasinghe.ts@gmail.com)

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For more information about the Mahausakande Tropical Rainforest Regeneration Initiative, please visit <http://mahausakande.org>

ABBREVIATIONS AND ACRONYMS

CBA	Conservation Banking Agreement
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CO ₂	Carbon Dioxide
DNA	Designated National Authority
EFT	Ellawala Foundation Trust
EUETS	European Union Carbon Emission Trading Scheme
HSBC	Honk Kong & Shanghai Banking Corporation
MBI	Market-based Instrument
MRF	Mahausakande Regenerating Forest
NPK	Nitrogen, Phosphorus, and Potassium
NTFPs	Non-timber Forest Products
REDD+	Reducing Emissions from Deforestation and Forest Degradation, Conservation and Enhancement of Forest Carbon Stocks, and Sustainable Management of Forest
TEV	Total Economic Value
UNFCC	United Nations Framework Convention on Climate Change

EXECUTIVE SUMMARY

Natural ecosystems provide invaluable ecosystem services for human well-being. A multitude of ecosystem services can be considered under provisioning, supporting, regulating, and cultural service categories. However, there tends to be a substantial under investment on ecosystem conservation because ecosystem services are generally undervalued. Private sector involvement and investment on ecosystem restoration and conservation management is scarce, as it is not an attractive investment as other economic activities, because the return on investment cannot be converted into monetary terms easily. Furthermore, most of the benefits are positive externalities in nature and used by the local, regional and global communities and the value cannot be captured, and it takes a considerable time to reap the actual benefits.

The Mahausakande tropical rainforest regeneration program is a pioneering conservation effort initiated by the Ellawala Foundation Trust (EFT) in 2003. Recognizing the significance of this program, the Hong Kong & Shanghai Banking Corporation (HSBC) in Sri Lanka joined with EFT in 2007 to further enhance the promotion of conservation and sustainable livelihoods in Mahausakande. The Mahausakande regenerating forest (MRF) located in Kiriella provides a unique opportunity to study the ecosystem services generated from a regenerating forest. A valuation study was conducted in MRF to estimate the monetary value of selected ecosystem goods and services generated at present, and the potential value that can be generated from sustainable management of forest resources. The financial requirement to operate the Mahausakande programme, and viable options for sustainable financing were also evaluated.

The value of the selected provisioning services under the present condition was estimated at Rs.147,281 (US\$ 1,292) per hectare per year, supporting services Rs. 53,694 (US\$ 471) per hectare per year, regulating services Rs. 56,053 (US\$ 495) per hectare per year and cultural services Rs. 54,902 (US\$ 482) per hectare per year. Under the current scenario, MRF generate a minimum of Rs. 312,379 (US\$.2,740) worth of provisioning, supporting, regulating and cultural ecosystem services per hectare per year. According to the estimates predicted for MRF under the scenario of adopting the proposed sustainable management options, the average value of ecosystem services, including the provisioning, supporting, regulating and cultural services considered would be around Rs. 1,268,383 (US\$ 11,126) per hectare per year at its maturity stage. It should be noted that these per hectare values are the minimum values as many of the services are not captured in the analysis due to valuation constraints and limitations.

The annual financial requirement for MRF, which includes expenses related to management, training and awareness programmes, and restoration work, was estimated at Rs. 5,884,000 (US\$ 51,614). EFT in collaboration with HSBC should pursue on biodiversity-based market opportunities to generate sustainable finances for the maintenance of MRF and its associated ecosystem services.

Key words: Ecosystem services, economic value, sustainable financing

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1. INTRODUCTION

The natural ecosystems provide ecosystem services which are worth many millions of rupees per year to the local, regional, national and global communities. However, the demands on natural resources related to an increasing human population has led to the unsustainable exploitation of natural resources, leading towards degradation of ecosystems. The vast array of ecosystem services that are provided by the forests can be considered under four broad categories; provisioning, supporting, regulating, and cultural servicesⁱ. The provisioning services include the various forest products that benefit humans, including food, timber, fibers, and medicines etc. The supporting services include watershed protection, regeneration of soils, providing habitats for the sustenance of fauna and flora, and prevention of erosion and siltation. The regulating services include decomposition of wastes, nutrient cycling, maintenance of the water cycle, maintenance of local and regional climate, reduction of wind damage, prevention of desertification and flooding, maintenance of renewable natural resources, and regulation of ambient air composition on earth. Without these ecosystem services life would not be possible.ⁱⁱ Replacement of these ecosystem services by artificial means would be highly expensive, while such methods will not be able to provide the multiple benefits related to natural ecosystems. These replacements, often deleterious, would require large amounts of energy as well. Overall, such methods would have a very high ecological footprint, and hence be counterproductive in terms of environmental sustainability.

There tends to be a considerable under-investment on ecosystem conservation because ecosystem services and their associated biodiversity are generally under-valued by decision-makers. Although it is mandatory for development projects and industries to consider the harmful impacts on natural ecosystems and take necessary actions to mitigate, restore or offset them in an acceptable manner, such requirements have been neglected by the project proponents, and owners of industries. The negligence of the required environmental restoration, conservation or offsetting is mostly due to the undervaluation of ecosystems and lack of knowledge and expertise on scientific restoration, conservation and offsetting mechanisms. Another reason is that ecosystems, biodiversity and their services are not considered on equal footing with the other sectors of the economy such as agriculture, industries, and services, since the contribution of the latter sectors to the national economy is tangible and can be valued in monetary terms easily. The monetary value of ecosystems to the national economy cannot be easily valued and stated in terms of currency due to the complexity of the direct and indirect uses of ecosystem services. As a result the ecosystems and associated services provided to ensure the sustainability of the other economic sectors of the country are neglected and omitted from the Gross Domestic Product (GDP).

The United Nations Millennium Ecosystem Assessment has stated that “if current trends continue, ecosystem services that are freely available today will cease to be available or become

more costly in the near future. The higher costs that primary users may face will be passed down to secondary and tertiary industries and will transform the operating environment of all businesses.”ⁱⁱⁱ

The private sector involvement and investment on ecosystem restoration and conservation management is generally low, due to several reasons. For example, it is not an attractive investment option compared to other economic activities, because the return on investment cannot be converted into monetary terms easily, while most of the benefits are positive externalities in nature and used by the local, regional and global communities and the value cannot be captured. There is a huge time gap between the time of investment and time taken to reap the actual benefits. Such investments also need a considerable effort in terms of resources and time. Other deterrents include the fact that investments on ecosystems are not a prioritized area in the economy, while no economic incentives such as tax exemptions and/or subsidies are provided to encourage investment on ecosystems.

Many ecosystem goods and services are not part of market transactions, as such have no price and/or value. This stems from a lack of understanding of the economic benefits arising from them and the economic costs that are incurred due to their loss. Lately, concerns over diminishing ecosystem services such as water supplies and deteriorating water quality have led to a renewed interest in conserving natural ecosystems and increased recognition of the critical role that a well-managed natural environment plays in securing vital benefits.^{iv}

Although there are private sector involvements in ecosystems restoration and conservation in developed countries, such examples are rare in developing countries. This makes the Mahausakande tropical rainforest regeneration project a pioneering initiative in Sri Lanka. The restoration of a 40-acre degraded rubber plantation into a tropical rainforest was initiated in 2004, by the Ellawala Foundation Trust (EFT). Over 6,000 saplings of native tree species have been introduced during the past six years in a systematic manner, and the area is gradually being converted to a tropical rainforest.

A multidisciplinary research program was initiated at the beginning of 2011 to study the ecological and socio-economic aspects related to the Mahausakande regenerating rainforest (MRF). One of the five studies carried out was an economic valuation of ecosystem services related to MRF. The objectives of the study included the following:

- To estimate the monetary value of ecosystem goods and services generated by the MRF;
- To estimate the potential economic value that can be generated if natural resources in MRF are used in sustainable manner; and
- To assess the financial needs for operation of MRF, and identify suitable sustainable financing mechanisms.

2. METHODOLOGY

Economic valuation of MRF would involve estimation of the value of provisioning, supporting, regulating and cultural services (in other words direct, indirect and other uses of ecosystem services) and understanding their significance. Initially, a list of ecosystem services related to MRF was compiled, following the categorization of ecosystem services by the United Nations Millennium Ecosystem Assessment. Each ecosystem good and service offered by MRF was assessed in a qualitative manner, using values of such goods and services related to tropical rainforests derived from previous valuation studies as a proxy for comparison purposes. The values of ecosystems goods and services derived from previous valuation studies are summarized in Table 2. 1 below:

Table 2. 1 : Estimated maximum values of ecosystem services from previous studies

Ecosystem Services	Estimated maximum values (US\$ per hectare)	Source
<i>Provisioning</i>		
Food, fodder, spices, rubber latex, medicinal herbs etc.	8,509	Rudolf 2000 ^v
Fresh water	875	Rudolf 2000
Timber and fiber	4,400	Tompson et al 2009 ^{vi}
Fuel wood	40	Pearce 2001 ^{vii}
<i>Supporting</i>		
Nutrient recycling	1,067	Rudolf 2000
Soil formation	3,480	Uhl et al 1993
Primary production		
Water cycle	3,000	Andersen 1997
<i>Regulating</i>		
Micro climate stabilization	4,400	Pearce 1998
Flood regulation		
Disease prevention		
Water purification	150	Holmes 1988
Slope stabilization	170	Rudolf 2000
Carbon sequestration	238	Torras 2000
Pest regulation		
Pollination	99	Rudolf 2000
Natural hazard regulation		
<i>Cultural</i>		
Aesthetic		
Spiritual	194	Tompson et al 2009
Educational		
Recreational & ecotourism	1,426	Rudolf 2000

Subsequently, the ecosystem goods and services of MRF that can be valued using suitable environmental economic tools and methods (see Table 2.2) were selected to collect primary and secondary data for valuation. Emphasis was placed on the goods and services that are currently being extracted and/or utilized by the Mahausakande program management, and/or local communities. The type of data gathered in the field included the following:

- The amount of products harvested per month or year;
- Current market price per unit of specific goods and services;
- The uses of goods and services – subsistence and/or commercial; and
- The number of trees belonging to a specific species with a production significance.

Table 2. 2: The methods used to value different categories of ecosystem services

Ecosystem Service	Valuation Method & Concept	Reference
Provisioning Services		
Rubber latex, Kitul treacle, Spices, Rattan, Bee honey, Areca nuts and other vegetables etc.	<i>Market price method:</i> The price of the goods and services that are commercially traded	Christiana 2006 ^{viii} ; Bann 2003 ^{ix} ; Emerton 1996 ^x
Potable/Bottled Water	<i>Market price / Substitute price method:</i> The market price of the substitute for a particular good or a service	Aylward et al 2010 ^{xi}
Supporting Services		
Nutrient recycling, Soil formation	<i>Benefit transfer method:</i> A proxy for the value of the same good or service function in another site	Uhl et al. 1993, Costanza et al 1993
Regulating Services		
Micro climate stabilization, Crop pollination	<i>Benefit transfer method:</i> A proxy for the value of the same good or service function in another site	Constanza et al 1997 ^{xii} ; Gallai et al 2008 ^{xiii} ; Torras 2000
Water purification and Soil erosion prevention	<i>Benefit transfer method:</i> A proxy for the value of the same good or service function in another site	Holmes 1988; Torras 2000
Carbon sequestration	<i>Market price method:</i> The price of the goods and services that are commercially traded	EUETS 2007; Andersen 1997 ^{xiv}
Cultural Services		
Ecotourism	<i>Travel cost method:</i> The value of an ecosystem based on the amount of money spent to reach the particular destination	Douglas 2001 ^{xv}
Educational	<i>Substitute cost method:</i> The cost of providing a substitute for the service	

The estimates of different ecosystem services made by recent valuation studies (see Table 2.1) were used for the valuation of ecosystem goods and services related to MRF. The following assumptions were made during the process of valuing different ecosystem goods and services, and also for future predictions:

- About 45% of the drinking water production is attributed to the MRF;
- Ecosystem goods such as Kitul sap, bee honey, pepper, leafy vegetables, fruits and rattan etc., will be collected and sold by the Mahausakande program management;
- Some of the introduced species will begin to yield products after five years;
- The forest will reach its maturity after 30 years since initiation of restoration;
- Investments for restoration of MRF will not be necessary after 2035, and the only expenses after this period would be the cost of operation and management; and
- The exchange rate considered for the study is 1US\$=114 SL Rupees

Constraints of the Study

Most previous studies on ecosystem valuations have focused on areas where the ecosystems are publicly owned or community owned with open access. Hence the number of beneficiaries was higher and spread across different spatial scales ranging from local to global. However, since MRF is a privately owned property, local community access to forest resources such as fuel wood, non-timber forest products (NTFPs) such as leafy vegetables, fruits, herbs, and construction materials is very limited. Being a privately-owned property, MRF has the characteristics of pure private properties such as enforceability, transferability, divisibility, excludability and universality.^{xvi} Since most of the ecosystem services and related benefits generated by the MRF are not fully utilized by surrounding communities, and the present owners extract only limited types and amounts of forest products, estimating the Total Economic Value (TEV) of ecosystem services related to MRF is constrained.

3. ECONOMIC VALUATION

A qualitative evaluation of ecosystem services generated from MRF is presented in Table 3. 1. The significance of the economic value of different ecosystem services generated from MRF is highlighted for its current status, as well as for its future.

Table 3. 1: A qualitative evaluation of ecosystem services generated from MRF

Ecosystem Services	Current Value	Future Potential Value
<i>Provisioning</i>		
Food, fodder, spices, rubber latex, medicinal herbs etc.	△△△	△△△
Fresh water	△△	△△△
Timber and fiber	△△	△△△
Fuel wood	△△	△△△
<i>Supporting</i>		
Nutrient recycling	△△	△△△
Soil formation	△△	△△△
Primary production	△△	△△△
Water cycle	△	△△△
<i>Regulating</i>		
Micro climate stabilization	△△	△△△
Flood regulation	△	△△
Disease prevention	△△	△△
Water purification	△△	△△△
Slope stabilization	△△	△△△
Carbon sequestration	△△△	△△△
Pest regulation	△△	△△
Pollination	△△	△△△
Natural hazard regulation	△△	△△
<i>Cultural</i>		
Aesthetic	△△	△△△
Spiritual	△△	△△△
Educational	△△△	△△△
Recreational & ecotourism	△	△△△
△- Low value; △△- Medium value; △△△-High value		

According to the qualitative evaluation, most of the ecosystem services classified for MRF have medium values at present, seven years since the initiation of forest restoration activities. It is expected that most of the services will reach maximum capacity and generate a high value by 2035.



Photo 1: Preparation of Kitul Treacle



Photo 2: Bee Colony (Pollinators)



Photo 3: Rubber Tapping

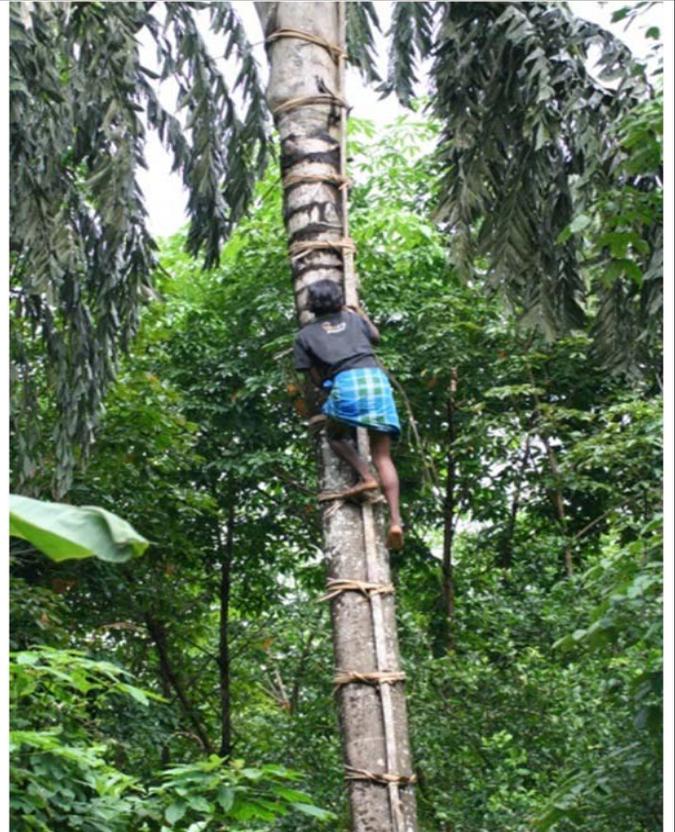


Photo 4: Kitul Sap Extraction



Photo 5: Rattan



Photo 6: Cinnamon



Photo 7: Pepper



Photo 8: Freshwater Stream



Photo 9: Conservation Awareness Programme

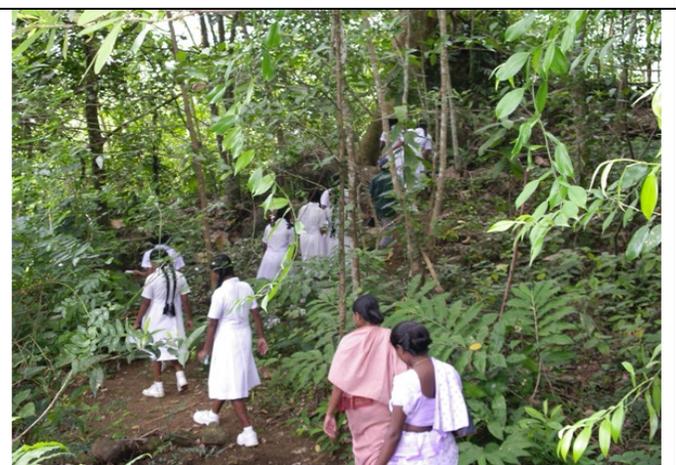


Photo 10: School Students on Nature Trail

3.1 Current Value of Ecosystem Services from MRF

3.1.1 Value of provisioning services

The natural resources which are generated and sustainably extracted from MRF were selected to estimate the economic value. The selected natural resources include rubber (*Hevea brasiliensis*) latex, treacle production from the sap of 'Kitul' palm (Fishtail Palm- *Caryota urens*), dried pepper (*Piper nigrum*) fruit, and potable spring water. Although there are other natural resources such as leafy vegetables, Areca palm (*Areca catechu*) nuts, wild fruits, and rattan etc. in MRF, these resources are not extracted at present. The total estimated value of provisioning services generated from MRF is summarized in Table 3.2.

Rubber latex extraction

Extraction of rubber latex is currently being carried out by the forest management in a mature rubber plot of approximately 4 hectares. In year 2008, the rubber latex production was recorded as 4,134kg, and in 2010 it had increased up to 5,235kg. The average market price per kilogram of rubber was Rs. 171 in 2008, and Rs. 368 in 2010. Accordingly the value of rubber production in MRF was Rs. 704,472 and Rs. 1,927,253 in 2008 and 2010, respectively.

Kitul treacle production

Kitul is one of the valuable native palm tree crops grown in MRF. Kitul treacle or jaggery (a local sweet that is used as a substitute for sugar) production through the process of Kitul flower sap extraction is one of the sustainable revenue generation mechanisms established at Mahausakande. Kitul treacle production was started in 2006. According to the available records, from May 2007 to May 2008 the treacle production was 270 bottles. The average market price per bottle of Kitul treacle is Rs.300, and the total value generated from the Kitul treacle production is estimated at Rs. 81,000 per year.

Pepper production

Pepper is one of spice crops cultivated in MRF in a small scale. The production of dried pepper in 2009 was 3kg, and 5kg in 2010. The value of pepper production in 2010 can be estimated at Rs. 9,500 under the market price Rs. 1,900 per kilogram of dried pepper. The pepper cultivation is not well grown at present, and in future the yield will be much higher, resulting in an increase in revenue.

Potable water supply

The natural springs in MRF provide potable water for the management center as well as for 30 households in the Hindurangala village located downstream. In 2008 about 72 households in the

Hindurangala village had received potable water from MRF¹, but due to mismanagement of the water distribution, it has been reduced up to 30 households. If potable water is provided to the households by the Water Board, the average cost for a four-member household would be approximately Rs. 450 per month. Using this value as a baseline, the total value of water provisioning services from MRF would be around Rs. 13,500 per month. Assuming that MRF has contributed to 45% of the water generated, the total value of water provisioning services can be calculated as Rs.72,900 per annum. In addition, the time saved to fetch water for domestic use due to the availability of potable water is also a benefit for the poor households, as they can allocate that time for some other productive work. There are several springs within the MRF and there is a high potential to generate more revenue by utilizing water for consumption and production requirements. The item Nos.5-13 in the table below are extracted and used only for subsistence purposes by the Mahausakande forest management.

Table 3. 2: Estimated total value of provisioning services per year

No.	Provisioning Services	Amount per Year	Value per Year (SL Rs.)	Value per Year (US\$)	Percentage Contribution
1	Rubber latex	5,235kg	1,927,253	16,906	85.50%
2	Kitul treacle	270 bottles	81,000	711	3.59%
3	Pepper fruits (dried)	5kg	9,500	83	0.42%
4	Potable spring water	7,290m ³	72,900 ²	639	3.23%
5	Ash plantain	200kg	24,000	211	1.06%
6	Banana	600kg	108,000	947	4.79%
7	Breadfruit	150 fruits	10,500	92	0.47%
8	Jackfruit	10 fruits	4,800	42	0.21%
9	Green Chili	12kg	6,000	53	0.27%
10	Kohila (<i>Lasia spinosa</i>)	5kg	800	7	0.04%
11	Vegetables	22kg	2,340	21	0.10%
12	Green leaves	130 bundles	3,900	34	0.17%
13	Coconut	60 nuts	2,400	21	0.11%
Total Value			2,253,393	19,767	100%

The value of provisioning services under the present condition is Rs.147,281 (US\$ 1,292) per hectare per year. There are many other non-timber forest products in MRF that are not harvested

¹ Discussion with the villagers

² This value is only for 45% of the total potable spring water supply

at present. These non-timber forest products can be harvested for commercial and/or subsistence purposes in the future, and increase the value of provisioning services.

3.1.2 Value of supporting services

The supporting services related to MRF considered for valuation includes nutrient recycling, and soil formation. The total estimated value of supporting services related to MRF is summarized in Table 3.3.

Nutrient recycling

Nutrient recycling is described as the recycle of biological and chemical elements and compounds in specific patterns through substance in an ecosystem; use, release and storage of nutrients by plants and their environments.^{xvii} According to Costanza et al., the nutrient recycling value of rainforests has been estimated at US\$922 per hectare per year. Assuming that MRF under the present condition of regeneration provide 50% of nutrient recycling services when compared to a mature rainforest, the annual value would be around Rs. 804,076 (US\$ 7,053) for 15.3 hectares of forest.

Soil formation

According to Costanza et al.,^{xvi} the value of soil formation of rainforests has been estimated at US\$10 per hectare per year. Uhl et al.^{xviii} estimated the value of soil nutrients removed by forest clearance at US\$ 3,480 per ha according to the market prices of Nitrogen, Phosphorus, and Potassium (NPK) fertilizers. Based on the estimates of Costanza et al., the value of soil formation of MRF can be estimated as Rs.17,442 (US\$ 153) per year.

Table 3. 3: Estimated total value of supporting services per year

No.	Supporting services	Value per Year (SLRs.)	Value per Year (US\$)	Percentage
1	Nutrient recycling	804,076	7,053	99.0%
2	Soil formation	17,442	153	1.0%
Total Value		821,518	7,206	100%

The total value of supporting services generated from MRF is estimated at Rs. 53,694 (US\$ 471) per hectare per year. This should be considered as the minimum annual value, because there are many other supporting services which were not considered for valuation under this study.

3.1.3 Value of regulating services

The regulating services associated with the MRF considered for valuation includes microclimate stabilization, water purification, erosion prevention, carbon sequestration, and pollination. The total estimated value of regulating services related to MRF is summarized in Table 3.4.

Microclimate stabilization

The climate regulation value of rainforests has been calculated as US\$223 (Rs. 25,422) per hectare per year.ⁱⁱⁱ Assuming that the value of micro climate regulation related to MRF is half of the above value as it is still a regenerating rainforest, the annual climate regulation value of Mahauskande would be around Rs. 190,665 (US\$ 1,672.5).

Water purification

According to the estimates of Holmes^{xix} the benefit of forest cover for replacement of water purification costs may be in the range of US\$50 - US\$150 per hectare of forest. The existence of MRF forest also helps to avoid the cost of water purification, because the forest helps to naturally purify the water. Using the above figure as a proxy and considering 50% of minimum value as the value of water purification services related to MRF, the annual value of this particular service provided by Mahauskande can be estimated at Rs. 43,605 (US\$ 382.5).

Slope stabilization/Erosion prevention

The cost of on-site and off-site soil erosion prevention related to the Amazon rainforest has been estimated at US\$ 68 and US\$ 170 per ha per year, respectively, resulting in a total value of soil erosion prevention of US\$ 238 per ha per year.^{xx} Assuming that 50% of benefits related to erosion prevention can be attributed to MRF, the annual value of erosion prevention of Mahauskande is estimated at Rs.203,490 (US\$ 1,785).

Carbon sequestration

The average carbon stock per hectare of Asian tropical rainforest is estimated at 230 metric tons^{xxi} for a forest with 30% of canopy cover. A study conducted in Sinharaja rain forest, which is located in the same biogeographic zone as MRF, has estimated the forest carbon content as 357.9 metric tons.^{xxii} There are different values per ton of carbon sequestered, and the European Union Carbon Emission Trading Scheme (EUETS) has placed a value of US\$ 24.3 per ton of CO₂.^{xxiii} The value of total carbon stored in intact forests ranges between US\$ 750–10,000 per hectare.^{xxiv} The total above ground carbon stock of MRF is estimated at 1030.2 metric tons^{xxv} (in 15.3 hectares) and the value of the stock was estimated at Rs. 2,853,860 (US\$ 25,034) using the base value of US\$24.3 per ton established by the EUETS. Estimates calculated for Brazil shows that 4 to 12 years old secondary tropical forests accumulate about 9.1 metric tons of carbon per

hectare per year.^{xxvi} Using the same market price of US\$ 24.3 per ton of carbon the annual value attributed to MRF for carbon sequestration is Rs. 25,209 (US\$ 221.13) per hectare. The total value of MRF for annual carbon sequestration can be estimated at Rs. 385,695 (US\$ 3,383.28).

Pollination

Mahauskande forest provides habitat for pollinators such as bees, butterflies and bats etc., and these natural pollinators can facilitate increased crop production in the home gardens and other farmland around Mahauskande. For example, a study has highlighted that 100% of avocado production, 30% of lime, and 20% of lemon production^{xxvii} is dependent on the insect pollination and the same percentage of the value of such crops can be allocated to the pollination services provided by insect pollinators. Olschewski et al calculated that for a plantation in southern Manabí in Ecuador the average pollination value represents US\$ 49 per hectare per year.^{xxviii} Assuming that 50% of that value can be attributed to the pollination services provided by the pollinators in MRF, the total annual value of pollination services can be estimated at Rs. 41,895 (US\$ 367.5).

Table 3. 4: Estimated total value of regulating services per year

No.	Regulating services	Value per Year (SLRs.)	Value per Year (US\$)	Percentage
1	Micro climate stabilization	190,665	1,673	22%
2	Water purification	43,605	383	5%
3	Erosion prevention	203,490	1,785	23.5%
4	Carbon sequestration	385,695	3,383	44.6%
5	Pollination	41,895	368	4.8%
Total Value		864,495	7,583	100%

The total value of regulating services related to MRF is estimated as Rs. 56,503 (US\$ 495.64) per hectare per year. This value should be considered as the minimum value, because many other regulating services provided by MRF were not considered in this analysis.

3.1.4 Value of cultural services

Infrastructure for research, education and ecotourism is available within the premises of MRF. One of the key activities is a training programme on biodiversity conservation and healthy lifestyles conducted for school children. Schools were selected from the Ratnapura district for monthly training programs, and about 24 training programmes per year have been conducted in

2009-2010. Ten selected students and two teachers participated at each training programme that is conducted by 3-4 resource personnel. Based on the assumption that the total cost per training programme is equal to the minimum educational value under the present condition, the minimum value of education can be estimated. According to the available information Rs. 35,000 has been spent per training programme and using this figure as a surrogate, the minimum educational value can be calculated as Rs. 840,000 (US\$ 7,368.42) per year. This value can be much higher if the value of the forest as a resource for practical experience on nature is incorporated. The total estimated value of cultural services related to MRF is summarized in Table 3.5 below.

Table 3. 5: Estimated total value of cultural services per year

No.	Cultural services	Value per Year (SLRs.)	Value per Year (US\$)	Percentage (%)
1	Educational value	840,000	7,368	100%
Total Value		840,000	7,368	100%

Under the current scenario, the MRF generate a minimum of Rs. 312,379 (US\$ 2,740) worth of provisioning, supporting, regulating and cultural ecosystem services per hectare per year.

3.2 Expected value of the ecosystem services from sustainable practices

There is tremendous potential to enhance the value of ecosystem services related to MRF, through the introduction of new revenue generating opportunities, value addition of currently harvested products, pursuing in market opportunities for other products that are currently not being harvested, maximum utilization of resources in a sustainable manner, and the gradual progression of this regenerating forest into maturity. Specific examples for future enhancement of ecosystem services associated with MRF are elaborated below.

3.2.1 Provisioning Services

The production of Kitul related value added products have been carried out up to 2009. At present, there are 26 mature Kitul trees, and about 60 medium size trees. At least 10 of these trees can be tapped on a regular basis to extract sap, which could produce a minimum of 400 bottles of Kitul treacle per year. Under the current price of Rs. 400 per bottle, there is potential to earn a total of Rs. 160,000 per annum.

The surface and ground water resources of MRF are a good source of drinking water, that can be marketed as freshwater generated from a regenerating tropical rainforest. The water can be sold in a special market where the customers are nature lovers, and willing to pay for products that are harvested in a sustainable manner. Supermarkets, five star hotels, and private sector institutions can be the targeted market for bottled water from MRF. If Mahauskande can produce on average 1000 liters of drinking water per day, 365,000 liters of drinking water can be produced

annually. Assuming that the net price per liter of water is Rs.30, there is a potential to generate a revenue of Rs. 10,950,000 per annum.

Assuming that rubber tapping at Mahausakande will remain constant during next 10 years, there is a potential to produce at least 5,000kg of latex per year, enabling to generate an annual revenue of Rs. 2,000,000, at the current market price of Rs. 400 per Kg of latex. .

There are about 863 native rattan (*Calamus* Spp.) plants introduced at MRF, and at least 860 stems can be harvested from them. Each rattan plant has more than one stem. The market price per feet of native rattan is Rs. 50³. It will take about 12 years⁴ for a rattan sapling to mature into stems with a large diameter, and the rattan at Mahausakande can be harvested after seven years from now (since they were planted in 2005-2006). If we assume that the length of one stem is 100 feet the annual value of the revenue from sustainably harvested rattan can be estimated at a minimum of Rs. 614,286.

There are about 435 pepper plants introduced in MRF. Assuming that at least half a Kilogram of dried pepper fruits can be harvested from one plant, there is a potential to harvest 217kg of pepper fruits per annum. The value of the harvest can be calculated as at Rs. 413,250 per annum under the current market price Rs. 1,900 per Kg of dried pepper.

Malabar Tamarind or 'Goraka' (*Garcinia quaesita*) plants have been introduced in to MRF, and there are about 200 trees in the premises. At the moment they do not produce fruits, but production will occur in the near future, facilitating sustainable extraction. If one tree produces 2kg of dried Goraka fruits after two years from now, there is a potential to produce a minimum of 400kg of dried Goraka⁵ per year. There is a potential to generate Rs. 232,000 per annum, if the production is valued under the current market price of Rs. 580 per Kg.

There is a potential to promote beekeeping to produce bee honey in MRF. One honey bee colony can be introduced to each acre of forest. According to the available information a minimum harvest of 10 kg of honey per hive per year can be expected^{xxix} and there is a possibility to produce 400 kg of bee honey from the 40-acre land at Mahausakande, yielding an annual revenue of Rs. 400,000 per annum, at the current market price of Rs. 1000 per kilogram.

There are 300-400 trees of Areca nut in MRF, but the yield is not harvested. If the management initiates harvest there is a potential to obtain a minimum of 5000 nuts per year. At the current market price of Rs. 5 per raw nut, there is a potential to generate Rs. 25,000 per annum from the sale of Areca nuts.

³ The market price per feet of native rattan at Radawadunna village (cane furniture and other cane goods makers)

⁴ According to the experience of scientists

⁵ A mature Goraka tree can produce a large number of fruits, and yield much higher than two Kg per annum.

3.2.2 Supporting services

When the Mahausakande forest grows further the capacity to provide supporting services will also increase, and gradually reach an optimum level at maturity. On this assumption, the total value of each of the supporting services can be calculated using the estimated values (based on benefit transfer method) highlighted in the previous section (3.1). The nutrient recycling value of MRF will reach its optimal level and the total value of that service would be around Rs. 1,576,620⁶. The total value of soil formation can be estimated at Rs.17,442 at the optimum maturity of the forest⁷.

3.2.3 Regulating services

Based on the estimates of Costanza et al, when MRF reaches its optimum maturity level, it would have the capacity to provide climate regulation services which can be estimated at Rs. 381,338 per year⁸. Based on the replacement purification cost estimates of Holmes 1988, the value of water purification function of MRF can be estimated at approximately Rs. 85,500 under the lower limit of the estimates and this may be as high as Rs.256,500⁹. Based on the calculations of Torras, the value of soil erosion prevention by MRF can be estimated at Rs, 406,980 per annum.

Carbon sequestration is one of the key ecosystem services provide by the rainforests and at maturity MRF would have 5,475.87¹⁰ metric tons of carbon. Based on the market value of carbon, the per hectare carbon storage value of Mahausakande can be estimated at Rs. 991,455, and the total value of carbon stored at Mahausakande can be estimated at Rs. 15,169,255 after 30 years since initiation of restoration work. The annual value of carbon sequestration can be estimated at Rs. 250,066, based on the assumption that 5.9 metric tons of carbon is absorbed by a hectare of forest¹¹. This value may be changed depending on the use of other estimates of carbon values based on different methods adopted.

If bee keeping is introduced in MRF the pollination services will also be enhanced. Using the benefit transfer method, the minimum value of pollinator services provided by MRF can be estimated at Rs. 83,790 per year¹². This value may vary significantly based on the types of crops that have been cultivated around Mahausakande and their dependence on the pollinators for production.

⁶ Based on Costanza et al (1997), US\$ 922 per hectare per year

⁷ Based on the estimates of Costanza et al (1997), US\$10 per hectare per year

⁸ US\$223 (Rs. 25,422) per hectare per year

⁹ Avoided replacement purification costs may be in the range of US\$50 - US\$150 per hectare of forest

¹⁰ Based on carbon estimate for the Sinharaja tropical rainforest - 357.9 metric tons per hectare

¹¹ Based on estimates in Brazil 5.9 metric ton of annual carbon accumulation per hectare of 15-30 year old forest

¹² Based on average pollination value of US\$ 49 per hectare per year

3.2.4 Cultural services

The location of MRF, together with its infrastructure in place, offers tremendous potential to promote ecotourism. The local and foreign visitors to Mahausakande will have ample opportunities to experience nature, culture, and adventure in this serene landscape, located less than two hours away from the main commercial city of Colombo. At present, this opportunity to generate additional revenue has not been adequately explored. If the management implements a program to promote ecotourism to attract at least 100 groups (with an average of six individuals per group) annually, there is potential to generate Rs. 870,000, at the current per person rate of Rs. 7,500 per night and Rs. 200 entry fee.

MRF also provides a unique opportunity for students and scientists to study various aspects related to forest regeneration, and generate valuable knowledge. At present, there is sufficient infrastructure established within the premises to facilitate long-term research. The center should be popularized initially among local universities, and eventually among foreign research institutions as well. Attraction of students and research scientists to MRF would enable to significantly enhance its educational value. A summary of the potential value of ecosystem services that can be generated from MRF per annum is provided in Table 3.6, anticipating that the proposed interventions are implemented and managed properly.

Table 3. 6: Expected value of ecosystem services from Mahausakande by 2035

No.	Ecosystem services	Value per Year (SLRs.)	Value per Year (US\$)	Percentage (%)
Provisioning Services				
1	Rubber latex	2,000,000	17,544	10.31%
2	Kitul treacle	160,000	1,404	0.82%
3	Pepper	413,250	3,625	2.13%
4	Bottled Water	10,950,000	96,053	56.43%
5	Rattan	614,286	5,388	3.17%
6	<i>Garcinia</i> (Goraka)	232,000	2,035	1.20%
7	Bee honey	400,000	3,509	2.06%
8	Areca nuts	25,000	219	0.13%
Supporting Services				
9	Nutrient recycling	1,576,620	13,830	8.12%
10	Soil formation	17,442	153	0.09%
Regulating Services				
11	Micro climate stabilization	381,330	3,345	1.96%
12	Water purification	85,500	750	0.44%
13	Soil erosion prevention	406,980	3,570	2.10%

14	Carbon sequestration	250,066	2,194	1.29%
15	Crop pollination	83,790	735	0.43%
Cultural Services				
16	Ecotourism	970,000	8,509	5.00%
17	Educational	840,000	7,368	4.33%
Total Value		19,406,264	170,230	100.00%

Batagoda^{xxx} has estimated the value of trees, climbers, herbaceous plants in the Sinharaja rainforest at Rs. 70,908 (US\$ 622) per hectare per year. Costanza et al have estimated the total value per hectare of rainforest per year as Rs.228,797 (US\$2,007). According to the estimates predicted for MRF under the scenario of adopting the proposed sustainable management options, the average value of provisioning services would be around Rs. 966,963 per hectare per year, average value of supporting services is Rs. 104,187 per hectare per year, regulating services Rs.78,932 per hectare per year and cultural services Rs. 118,301 per hectare per year. The total value of ecosystem services, including the provisioning, supporting, regulating and cultural services considered would be around Rs. 1,268,383 (US\$ 11,126) per hectare per year at its maturity stage in 2035. It should be noted that approximately 56% of this estimate would depend on the production of bottled water.

4. SUSTAINABLE FINANCING OF MAHAUSAKANDE

4.1. What is sustainable financing?

Sustainable financing is defined as “*the ability to secure stable and sufficient long-term financial resources and to allocate them in a timely manner and appropriate form, to cover the full costs (direct and indirect) and to ensure that forest is managed effectively and efficiently.*”¹³

4.2. Why does Mahausakande need a sustainable financing mechanism?

Apart from forest restoration, several other programs are currently being implemented by the management of MRF. These include promotion of natural resources based sustainable livelihoods, promoting conservation education and awareness, promoting ecotourism and sharing the forest restoration experiences with other interested groups. The management also intends to expand the current area of MRF, in order to link it directly with the Bambarakande Forest Reserve. At present, the Ellawala Foundation Trust (EFT) and HSBC are funding the programs carried out at MRF. A diversified portfolio is necessary for the long term sustainability of conservation and community outreach related activities carried out Mahausakande.

4.3. Current financing requirement and future needs

The total investment on MRF from 2004 to 2011 is about Rs 22,576,853 (US\$ 198,042), which includes costs for restoration activities, research and education, and operation and management. Of the total investment to date, 58.2% has been borne by EFT, and 41.8% has been granted by HSBC.

The current cost of operation and management of MRF is about Rs. 1,884,000 (US\$ 16,526) per year which includes the salaries of staff, building and road maintenance and other related costs. In future it would require additional financial resources to cover capital expenses related to the purchase of a vital strip of land to establish a permanent link with the Bambarakanda Forest Reserve, and establish basic infrastructure for bee keeping and bottled water production. Therefore, exploration of other financing opportunities to ensure the long term sustainability of this initiative is a timely need. The future financial requirement for the Mahausakande tropical rainforest regeneration programme is summarized in Table 4.1 below.

¹³ <http://www.cbd.int/protected-old/sustainable.shtml>

Table 4. 1: Future financial requirements for Mahausakande Programme

No.	Activity	Requirement SLRs.	Requirement US\$
Annual Expenses			
1	Operation, management and maintenance	1,884,000	16,526
2	Research, education, monitoring and evaluation	2,000,000	17,544
3	Restoration of forest	2,000,000	17,544
Total Annual Expenditure		5,884,000	51,614
Capital Investments*			
4	Purchase an additional area of 25 hectares	20,000,000	175,439
5	Infrastructure for bottled water production and bee keeping	2,000,000	17,544
Total Capital Investments		22,000,000	192,983

*Approximate estimates

4.4. Potential sustainable financing mechanisms

The MRF can be used to pursue in biodiversity-based markets to generate sustainable finances to meet its future financial requirements. The EFT in collaboration with HSBC could pursue on three types of markets focusing on MRF and its resources:

- Markets for sustainably produced goods (e.g., Rubber latex; eco-labeled consumer products such as Kitul treacle and jaggery, bee honey, other agricultural produce, and bottled water);
- Consumer markets for non-consumptive uses of biodiversity (e.g., eco-tourism); and
- New markets for ecosystem services (e.g., Carbon Credits, Biodiversity Conservation Banking).

These biodiversity-based markets can also provide sustainable livelihood opportunities for local communities around MRF, and promote the local economy. The first and second types of markets were discussed in detail under section 3.2 of this paper. A short description of new markets for ecosystem services is provided below.

Biodiversity Conservation Banking is defined as “a site where habitat and/or other ecosystem resources are conserved and managed in perpetuity for listed species, specifically for the purpose of offsetting impacts occurring elsewhere to the same resource values^{xxx1}. Biodiversity banking is considered as in-kind offsite mitigation or offsetting of environmental impacts from economic activities. It is a tradable permit type Market-based Instrument (MBI), which has expanded rapidly in countries such as the United States, European Union, and Australia, and being introduced into other parts of the world as well. The unit traded is most often an area of habitat

(i.e., a perch, an acre, a hectare etc.). Depending on the ecology of a species concerned, the unit may be a breeding pair or combination of habitat and the actual species, or in the case of fish and aquatic species the unit may be a linear foot of riparian habitat. A "Conservation Banking Agreement" (CBA) is the most standardized mechanism for creating bankable credits. Under a CBA, the sale of these units, or credits, is based on species conservation outcome rather than simply management action. A bank must demonstrate that the species are being conserved, through its conservation actions implemented in accordance with a species recovery plan. The conservation outcome is measured through systematic monitoring of biodiversity as well as the valuation of ecosystem services. Sri Lanka, with its rich biodiversity and higher percentage of endemic species, has tremendous potential to set up biodiversity conservation banks. Hopefully, the government of Sri Lanka would establish relevant policies and guidelines to initiate biodiversity banking in the future. The present study, together with the other research studies initiated at MRF can be used to establish a biodiversity conservation bank focusing on this regenerating rainforest.

The Kyoto Protocol of the United Nations Framework Convention on Climate Change (UNFCCC) has established the Clean Development Mechanism (CDM)¹⁴, which allows developing countries to undertake afforestation and reforestation projects. Such projects can earn saleable certified emission reduction (CER) credits, each equivalent to one ton of CO₂. These CER credits (commonly referred to as carbon credits) can be traded and sold, and developed countries can use these credits to offset their greenhouse gas emissions. The government of Sri Lanka has already initiated several activities to promote CDM in Sri Lanka. These include the establishment of a Designated National Authority (DNA) for CDM project activities, preparation of a national framework policy on CDM, initiation of a national strategy for CDM in Sri Lanka, and establishment of two CDM study centers. The MRF provides an ideal opportunity for a pilot scale CDM project on carbon trading.

Reducing Emissions from Deforestation and Forest Degradation (REDD) is a programme initiated by the United Nations (UN) to create a financial value for the carbon stored in forests, offering incentives for developing countries to reduce emissions from forested lands and invest in low-carbon paths to sustainable development. The expanded concept "REDD+" goes beyond deforestation and forest degradation, and includes the role of conservation, sustainable management of forests and enhancement of forest carbon stocks. A recent evaluation of Sri Lanka's REDD+ potential has concluded as "maybe likely".^{xxxii} If REDD+ is initiated in Sri Lanka in the future, the Mahausakande tropical rainforest regeneration program has tremendous potential to benefit from it.

¹⁴ <http://cdm.unfccc.int/index.html>

5. CONCLUSIONS AND RECOMMENDATIONS

Since MRF is privately owned and managed, there is a possibility to generate higher economic benefits compared to the forests which have common property characteristics or communal property characteristics, because the managers of the privately owned forest can harvest the resources in a sustainable manner without harming the biodiversity of the forest.

According to the results of the analysis the economic value of ecosystem services of MRF under the business as usual scenario was estimated at Rs. 4.7 million (US\$ 41,228) per annum. Under the scenario of new initiatives to reap additional benefits, the potential future value of ecosystem services generated from MRF was estimated at Rs. 19.4 million (US\$ 170,230) per annum, which is around four times higher than the current ecosystem benefits. The estimated values for provisioning, supporting, regulating services should be considered as the minimum economic value of MRF.

There is a tremendous potential to generate high economic benefits from MRF through value added ecosystem services such as provisioning and cultural (e.g., ecotourism and education) services. At present around Rs. 2.25 million (US\$ 19,767) worth of provisioning services generated from MRF are being utilized by the management and surrounding communities, but there is a potential to increase these benefits at least up to Rs. 14.7 million (US\$ 129,776) which is about seven times higher than the currently captured value. Production of bottled water and bee keeping are two main activities which need some initial investment, but these activities will generate a higher return. Other types of ecosystem services will undergo a two-fold increase with the maturity of the forest.

Diversification of sustainable financing opportunities for MRF is essential in order to ensure the future sustenance of this nationally significant initiative. It is envisaged that the results of this study would help to promote further investments on conservation and restoration of natural ecosystems by the private sector in Sri Lanka. Based on the findings of this study, the following recommendations are proposed for the future sustenance of MRF and its associated activities for conservation and community well-being.

- The targeted customers for sustainable products related to MRF should be the upper middle class and the rich who have a higher purchasing capacity, and are willing to pay a premium for environmental conservation. In addition to the normal market price, a certain percentage can be added to the price as eco-friendly premium. Eco-labeling and certification should also be considered to capture the market share for consumer products generated from MRF.

- MRF should be promoted as an ecotourism destination among local and foreign visitors. Attempts should also be made to promote it as a tropical biodiversity conservation research and education center for local and foreign university students.
- EFT in collaboration with HSBC should pursue on innovative sustainable financing options such as Biodiversity Conservation Banking and Carbon Trading based on MRF. Discussions should be initiated with the relevant government agencies (e.g., Ministry of Environment, and Finance Ministry) to set up relevant policies, guidelines, and institutional mechanism to facilitate Biodiversity Conservation Banking in Sri Lanka.
- A project proposal for carbon trading should be developed and submitted to the Environmental Economics and Global Affairs Division of the Ministry of Environment – the Designated National Authority for the approval of CDM projects.
- Attempts should also be made to establish partnerships with current global initiatives such as the REDD+, to use MRF as a pilot location for these programmes. This would enable EFT to leverage additional financial resources to sustain MRF.

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