

ASCLME Island States

COST AND BENEFIT ANALYSIS
PRELIMINARY REPORT

Rakotobe Andriamanganiaina T.
Consultant

CBA Preliminary Report

Table of contents

	Pages
1. Introduction	3
2. Identification of marine and coastal ecosystem services	3
2.1. Marine and coastal ecosystems	4
2.2. Typology of ecosystem services	4
2.3. Link between ecosystems and type of services	5
3. An overview of economic valuation of goods and services produced by ecosystems	6
3.1. The total economic value of goods and services	6
3.2. Methodology for willingness to pay estimation	7
3.3. Link between ecosystem services and use value of ecosystems	7
4. Country economic valuation of goods and services	8
4.1. Comoros	8
4.2. Madagascar	12
4.3. Mauritius	15
4.4. Seychelles	18
5. Total economic value for the island states	21
5.1. Countries synopsis	21
5.2. Economic value of provisioning services	21
5.3. Economic value of regulating services	22
5.4. Economic value of cultural services	22
5.5. Economic value of supporting services	23
5.6. Total economic value	23
6. Conclusion	24
References	25

1. Introduction

Marine and coastal ecosystems are characterized by their biodiversity richness and have crucial ecosystem goods and services that highly contribute to livelihood of people and economic development of a nation. Various sectors that link to marine and coastal ecosystems services such as fisheries, tourism, marine transportation, oil production,... are important for economic development for a given country. Unfortunately marine resources are threatened by various human pressures and natural catastrophe such as overfishing, pollution, and climate change.

Policies, strategies and international conventions such as Nairobi Convention have been developed within each nation and region to mitigate the impacts of these pressures and to better manage these marine resources. For example, Madagascar has been implemented its National policy for marine and coastal sustainable management. To enhance the implementation of these strategies and policies, the knowledge of marine ecosystem economic value should be improved. Having this crucial information is strongly support decision making in terms of the maintenance of the health of marine ecosystem and for sustainable development

The Agulhas and Somali Current Large Marine Ecosystem (ASCLME) project has approach phase to “build progressively the knowledge base and strengthens technical, managerial and decision making capabilities at the national and regional scales so as to address environmental concerns and transboundary development; build political will to undertake threat abatement activities; and leverages finances proportionate to management and governance needs”. Building a national Marine Ecosystem Diagnostic Analyses that would feed to national policy and governance and regional transboundary diagnostic is the main objectify of this data collection and synthesis of coastal and offshore data and information and capacity building.

Then this study consist of assessing cost benefit of marine and coastal resources in the island States of the western Indian Ocean-Comoros, Madagascar, Mauritius and Seychelles. Having information on the contribution of coastal and marine ecosystem goods and services into the economy of the ASCLME country would be useful to promote sustainable use of these resources. To have this information, the following activities have conducted: a) collate and measure economic values of ASCLME's key ecosystem goods and services (fishing, fish farming, tourism,...), b) measure the incomes and other benefits generated by these good and services and theirs distribution among stakeholder and between countries, c) Undertake an economic risk and assessment on marine and coastal resources in these country, and d) provide economic analysis of major policy issues related to the coastal and marine ecosystem management of the ASCLME.

This preliminary report of the Part one is focused on the economic valuation of marine and coastal ecosystem.

2. Identification of marine and coastal ecosystem services

Ecosystem describes as “a dynamic complex of plant, animal and microorganism communities and their non-living environment, interacting as a system” (EPA, 2009). Ecosystem services are defined as “the direct and indirect contributions that ecosystem makes to the well-being of human population” (EPA, 2009).

2.1. Marine and coastal ecosystems

2.1.1. Open ocean or pelagic zone

It is define as “any water in the sea that is not close to the bottom or near to the shore and it is the pelagic zone”. The pelagic ecosystem is composed by the primary producers on the foodchain such as the phytoplankton. Biodiversity in pelagic zone decreased with increasing depth because of progressive reduction of light intensity, temperature, dissolved oxygen, and food sources and increased of the water pressure (Walker & Wood, 2005).

2.1.2. Estuaries

An estuary is the wide part of rivers or streams with free connection to the open sea, fresh and salt water mix (Pritchard, 1967). Its ecosystem is more productive because of nutrients from rivers and serves as habitat and breeding area for many biodiversity species such as fish and reptiles. Economically, it is important for building infrastructures such as for tourism or port.

2.1.3. Coral reefs

They are made us by hard rocks formed by coral and found in warm sea (Temperature $\geq 16^{\circ}\text{C}$) that is not very deep. There are 2 main types of reefs: granite reefs (growing over large granite boulders), and carbonate reefs which are further divided into fringing reefs, atolls and platform reefs (Stoddart, 1984; Bijoux et al, 2008). Coral reefs serve as habitat of numerous biodiversity and support a high level of biomass such as fish mollusks, crustaceans and seaweed (Whittingham et al, 2002). This ecosystem is highly contributed to the economic development for different sectors such as fisheries and tourism.

2.1.4. Mangroves

In tropical and subtropical areas, along the interface between land and sea, bays, estuaries, lagoons, backwaters, and in the rivers, there are woody plants growing in these areas that are called Mangroves or ‘tidal forests’, ‘coastal woodlands’ or ‘oceanic rainforests. (Qasim, 1998).

Mangrove ecosystems are habitat of different group of aquatic and terrestrial biodiversity. Ecologically, mangroves protect littoral areas against marine erosion, floods, high waves through woody plants and protect also the coral reefs against pollution from land areas. Because of its high productivity, biodiversity richness, it is more valuable for human needs. Foods, energy, medicine, fertilizer, fuel and many other industrial products are from these ecosystems. (Kathiresan & Bingham, 2001).

2.2. Typology of ecosystem services

Typology of ecosystem services is based on the Millennium Ecosystem Assessment 2005 frame, which highlights a view of ecosystem services in reference to human well-being.

2.2.1. Provisioning services

Provisioning services are services from products obtained from ecosystems. These products include food, fuel, fiber, biochemical, genetic resources and fresh water. Many of these products are traded in markets, and have market value.

2.2.2. Regulating services

Regulating services are services received from the regulation of ecosystem processes. Ecosystem processes are the characteristic physical, chemical and biological activities that influence the flows, storage and transformation of materials and energy within and through ecosystems.

Regulating services includes services that improve human well-being by regulating the environment in which people live. These services are non-material benefits obtained from ecosystems, and include flood protection, water purification, air quality maintenance and climate control. These services are not generally marketed, but many have clear value to society.

2.2.3. Cultural services

Cultural services are services that contribute to the cultural, spiritual and aesthetic dimensions of people’s well-being. They contribute to establish a sense of a place. Some of cultural services have market value, through tourism and recreation.

2.2.4. Supporting services

Supporting services are services that maintain basic ecosystem processes and functions. These services affect human well-being indirectly by maintaining processes necessary for provisioning, regulating and cultural services.

2.3. Link between ecosystems and type of services

The table below classifies the different ecosystem services produced by main marine and coastal ecosystems by category of services. Each of them will be valued within this study, for each island state to establish the total economic value of ecosystems goods and services.

Table 1: Link between ecosystems and type of services (Based on Costanza et al., 1997; and Millennium Ecosystem Assessment, 2005)

	Provisioning services	Regulating services	Cultural services	Supporting services
Open ocean	Food production from fisheries		Scenery	Nutrient cycling

Estuaries	Food production from fisheries		- Scenery - Tourism	Nutrient cycling
Coral reefs	- Food production from fisheries - Raw materials extraction - Ornamental resources	- Climate regulation - Shoreline protection	- Recreation - Tourism - Education	Maintenance of genetic diversity
Mangroves	- Food production from fisheries - Raw material extraction from forestry (timber, fuelwood, non timber forest products)	- Climate regulation - Shoreline protection - Disturbance protection	- Recreation - Tourism - Education	Nutrient cycling Maintenance of genetic diversity

3. An overview of economic valuation of goods and services produced by ecosystems

3.1. The total economic value of goods and services

The total economic value of goods and services produced by an ecosystem consists of its use value and non-use value (EPA, 2009). Non use value is actual value of existence of goods and services without their use, and value for future generation as a bequest. Use value has two components: the direct use value and the indirect use value.

3.1.1. Direct use value

The direct use value is the value of direct consumption of goods and services from ecosystems. For marketed goods and services, the market price gives the less controversy direct use value.

3.1.2. Indirect use value

The indirect use value is the value of services and secondary goods produced by ecosystems. These services are not marketed, and their valuation is controversial. It is an approximated value, often obtained by contingent valuation

Table 2: Total economic value frame

Total economic value			
Use value		Non use value	
Direct use value	Indirect use value	Bequest value	Existence value
Direct benefits from use of primary goods	Benefits from secondary goods and services	Value for future generation	Value of existence without use of goods

			and services
--	--	--	--------------

3.2. Methodology for willingness to pay estimation

The value given by people to a good or a service is the amount of price they will pay to keep the service or to get the good. This is their willingness to pay. Two valuation methods of willingness to pay will be used in this study: the market price and the benefit transfer value.

3.2.1. Estimation with market prices

Some goods produced by ecosystems have market prices. Market prices are revealed willingness to pay. In a country level, the aggregation of goods price is given by their contribution to the gross domestic product (GDP). This aggregate is not the economic value: the cost of the production of the goods is not within the GDP. So an adjustment of sector GDP contribution is necessary.

The sectorial contribution to the GDP gives the value of the production. To calculate the benefit amount, it is necessary to decrease this production value by the salaries and the other operating costs. The formula above is a synthesis of this approach:

$$[\text{BENEFITS}] = [\text{PRODUCTION VALUE}] - [\text{SALARIES}] - [\text{OTHER OPERATING COSTS}]$$

3.2.2. Estimation with benefit transfer

For non-marketed services, contingent valuation is the main approach which is in use to put a value to the service. This method is complex and costly, so it is issued only on same place of the world, for same services. A meta-analysis of these evaluations was undertaken to establish a reference value. It is an approximation of willingness to pay for the service.

The benefit transfer method aims to transfer the value of an ecosystem service measured in a place of the world to another place. If the people's wealth has not the same level, a correction of the first willingness to pay is necessary to take in consideration the ability to pay for people in the second place. This correction is given by a transfer function. In case of lack of data and information, the gross national income per capita rate is used as transfer function. The following formula expresses this benefit valuation:

$$[\text{BENEFIT}] = [\text{REFERENCE BENEFIT}] \times [\text{TRANSFER RATE}]$$

3.3. Link between ecosystem services and use value of ecosystems

To undertake a classified valuation of goods and services produced by ecosystems, two approaches are necessary: the approach by typology of ecosystems services, and the approach by use of ecosystems services. The table below gives a synthesis of these two approaches.

This frame will be used for the valuation of ecosystem services for each ASCLME island country and for an aggregated value.

Table 3: Link between ecosystem services and use value of ecosystems

	Direct use value	Indirect use value
Provisioning services	- Food production - Raw material production - Ornamental resources	
Regulating services		- Climate regulation - Disturbance regulation - Shoreline protection
Cultural services	- Tourism - Recreation	
Supporting services		- Nutrient cycling - Maintenance of genetic diversity

4. Country economic valuation of goods and services

4.1. Comoros

4.1.1. Country summary

The Comoros Archipelago (The Comoros) is composed by three islands: Mwali (Moheli), Ndjouani (Anjouan) and Ngazidja (La Grande Comore). The archipelago is situated at 300 km from eastern Africa coast, at latitude 12°10' S and longitude 44°15' E. The Comoros have a total area of 1,660 km², 469 km of coastline, a 12,684 km² territorial sea, and a 161,996 km² economic exclusive zone. The main coastal and marine ecosystems are seagrasses, lagoons, mangroves (1.08 km²) and coral reefs (430 km²).

The archipelago has 644,000 inhabitants. The life expectancy for Comorians people is 63, the GNI per capita is 750 US\$, and the Human Development Index (HDI) for the Comoros is 0.576. The majority of populations (80%) are in coastal zone. (Earth Trends, 2003; Ministère de l'Agriculture de la Pêche et de l'Environnement, 2008)

4.1.2. Economic valuation of provisioning services

a) Food production from fisheries

Comoros fisheries have two major components: inshore fisheries and off shore fisheries. Inshore fisheries are undertaken within the territorial sea by local fisherman, in a traditional or artisanal way. Offshore fisheries are undertaken by international seiners or longliners within the economical exclusive zone. The mean intake from the inshore fisheries is 16,200 tons/yr and the mean intake from the economical exclusive zone is 4,670 tons/yr (Youssef, 2010).

The fisheries sector contribution to GDP is 8% and the Comorian GDP amount is 386Mus\$. So, the annual gross income from fisheries is 30,88Mus\$. Annually, the European Union give a 0,46Mus\$ financial compensation for the offshore intake(Youssouf, 2010). Direct employment for the sector is about 8,500, and indirect employment is about 24,000. Salary for employees is 800 us\$ per year per person, and the annual amount of salaries for the people employed in the sector is 26 Mus\$. The other operating costs are estimated about 10% of gross income.

Given these parameters, the annual net value for the fisheries sector is 2,252 Mus\$. The net present value for a thirty-year period, with a 3% discount rate is 44.14Mus\$.

b) Raw materials extraction

Mangroves produce raw materials such as fuelwood and fiber. The Comoros have a 26 km² mangrove area. Given the lack of specific survey for quantification of raw material extraction, we will use the benefit transfer method for the valuation of these goods. Costanza (1997) has established a reference value for raw material extraction: 162 us\$/ha/yr.

The worldwide mean GNI per capita is 9,875 us\$ in 2007, and the Comorian GNI per capita is 750 us\$ for the same year, so the benefit transfer rate is 0.08. The annual benefit from raw material extraction is 0.03 Mus\$. The net present value for a thirty year period with a 3% discount rate is 0.63 Mus\$.

c) Ornamental resources harvesting

Ornamental resources are produced by coral reefs. There is no specific study about the amount of ornamental resources harvesting, so the benefit transfer will be used. Sukhdev (2009) has established a reference value for ornamental resources from coral reefs: 264 us\$/ha/yr. The Comoros have a 430 km² coral reef area. We will use the same benefit transfer rate, 0.08, as for raw material extraction. Based on these data, the annual benefit from ornamental resources harvesting of Comoros is 0.86Mus\$, and the net present value for a thirty year period, with a 3% discount rate is 16.90 Mus\$.

d) Total economic value of provisioning services

The total economic value for provisioning services is given by the sum of fisheries production, raw material extraction, and ornamental resource harvesting. The net present value for these goods, for a thirty year period and with the same discount rate (3%) is 61.67 Mus\$.

4.1.3. Economic valuation of regulation services

a) Shoreline protection by coral reefs

Coral reefs give a protection service for shoreline. There is no unique value for this service because it depends on coastal land use. A good estimation of shoreline protection value is given by Cesar (2002) for Indonesia, where a distinction is made between the economic value for agriculture protection (820 us\$/km) and human settlement protection (50,000 us\$/km) or touristic installation protection (1,000,000 us\$/km). The benefit transfer rate for Comoros' shoreline protection is estimated based on the comparison of Comorian GDI per capita to that of Indonesian and its value is 0.37.

For the coastal land use, it is assumed that agriculture occupied about 10% to 30% of the coast and human settlement (including roads and habitation) is about 10% to 30% of the coast. The length of Comorian coastal coral reef is 281 km. It is assumed that the replacement will be realized once during the study period, and the actual value (without discount) is considered as the net present value.

Given these parameters, the benefit value for agriculture protection is from 0.009 to 0.026 Mus\$, and the benefit value for settlement protection is from 0.524 to 1.05 Mus\$. The total value for shoreline protection is from 0.53 to 1.07 Mus\$.

b) Disturbance regulation by mangroves

Mangroves give a regulation service against disturbance: floods, erosion and high waves. We refer to Costanza (1997) for the standard value: 1,839 us\$/yr/ha. The mangrove extent for the Comoros is 26 km², and the benefit transfer rate is 0.08.

Based on these data, the value of annual benefit from the disturbance regulation is 0.36 Mus\$ and the net present value for thirty years at 3% discount rate is 7.12 Mus\$.

c) Climate regulation

Climate regulation services are given by coral reefs and mangroves. The economic valuation for coral reefs services will be based on benefit transfer. For mangroves climate regulation services, the economic valuation will take in consideration the carbon market and carbon sequestration by mangroves.

The reference value for benefit transfer is given by Sukhdev (2009), who established it at 648 us\$/ha/yr. The climate regulation is a global service, so a transfer rate is not necessary. Based on these data, the annual benefits for climate regulation is 27.86 Mus\$, and the net present value for a thirty year period at 3% discount rate is 534.67 Mus\$.

The carbon market takes in consideration credits generation by avoided deforestation, including mangroves. The deforestation rate in Comoros is very high (7.4% per year), so it is assumed that all the mangroves area (26 km²) will disappear in few years. We assume in this study that efforts will be done to avoid the mangrove deforestation, and the carbon sequestered in biomass is marketed.

For Comoros, the above ground mangrove biomass is 141.6 t/ha, and the below ground biomass is 171.8 t/ha. So the total volume of biomass loose avoided is 814,840 tons, and the avoided emission is 1.5 MteCO₂. Actually, the market price is 10 us\$/teCO₂, and the cost for avoided deforestation is 2.51 us\$/teCO₂. Based on these data, the net value for climate regulation by mangroves (carbon sequestration) is 11.189 Mus\$.

d) Total economic value of regulation services

The total economic valuation of regulation services is given by the sum of shoreline protection, the disturbance regulation, and the climate regulation. For the Comoros, this value is from 553.51 Mus\$ to 554.05 Mus\$.

4.1.4. Economic valuation of cultural services

Economic valuation of cultural services is estimated through tourism sector. For the Comoros, the mean annual arrivals for the last five years is about 15,400 (Attoumani & Picard, 2010). The sectorial contribution to the GDP is 4% and the gross tourism income is 15.44 Mus\$. The total number of employees in the sector is 500, and the mean annual salary per person is 800 us\$. It is assumed that operating costs level is at 20% of gross income.

Based on these parameters, the net annual value for cultural services is 11.95 Mus\$, and the net present value for thirty years at 3% discount rate is 234.26 Mus\$

4.1.5. Economic valuation of supporting services

a) Maintenance of genetic diversity

Maintenance of genetic diversity is a global service given by coral reefs, so a benefit transfer may be used for its valuation, without a transfer rate. The reference is Sukhdev (2009) who gives a standard value at 13,541 us\$/ha/yr. The Comoros have a 430 km² coral reefs extent, so the annual benefit is 582.26 Mus\$. The net present value for thirty years at 3% discount rate is 11,172.73 Mus\$.

b) Nutrient cycling

Nutrient cycling is another global service, so we can take the standard value of benefit without a transfer rate. The standard value (Costanza) is 118 us\$/ha/year. The Comoros have 12,684 km² of territorial sea. Given these parameters, the annual value for nutrient cycling is 149.67 Mus\$, and the net present value for a thirty year period at 3% discount rate is 2,933.62 Mus\$.

c) Total economic value of supporting services

The total economic valuation of supporting services is given by the sum of maintenance of genetic diversity and the nutrient cycling service. For the Comoros, this value is 14,106.35 Mus\$.

4.1.6. Total economic value

The total economic value for goods and services produced by marine and coastal ecosystems is about 14,956 Mus\$ (cf. table4)

Table 4: The total economic value for goods and services produced by marine and coastal ecosystems

	Direct use value (Mus\$)	Indirect use value (Mus\$)	Total (Mus\$)
Provisioning services	Food production : 44 Raw material extraction : 1 Ornamental resources : 17		62
Regulating services		Climate regulation : 546 Disturbance regulation : 7 Shoreline protection: 1	554
Cultural services	Tourism & recreation : 235		235
Supporting services		Nutrient cycling : 2,934 Maintenance of genetic diversity: 11,173	14,106
Total	295.8	14,660	14,956

4.2. Madagascar

4.2.1. Country summary

Madagascar is classified among the world's big islands (the fourth biggest island worldwide, and the second for tropical islands). The island is located at latitude 20°00'S and longitude 47°00'E. The total area for Madagascar is 589,712 km², with 5,600 km of coastline, 117,000 km² of continental shelf, a 124,900 km² territorial sea, and a 1,888,000 km² economic exclusive zone. The main marine and coastal ecosystems are seagrasses, lagoons (60,000 km²), mangroves (3,097 km²), coastal forests (422 km²) and coral reefs (1,350 km²)

Madagascar is the poorest island state within the ASCLME region: the life expectancy for Malagasy is 59, the GNI per capita is 410 US\$, and the HDI for Madagascar is 0.543. The half (55%) of the 19 million inhabitants are in coastal zones. (Earth Trends, 2003)

4.2.2. Economic valuation of provisioning services

a) Food production

Fisheries in Madagascar have three components: inshore fisheries, mariculture, and offshore fisheries. Inshore fisheries are undertaken within the territorial sea by local fisherman, in a traditional or artisanal way. Mariculture is undertaken by industrial units, aiming a high quality added value. Offshore fisheries are undertaken by international seiners or longliners within the economical exclusive zone.

The total production of artisanal and traditional fisheries is 72,422 tons/yr and the mariculture production is 6,994.2 tons/yr. For offshore fisheries, the total intake is about 22,885.4 tons (Andrianaivojaona, 2010; Shipton, 2010).

The fisheries contribution to GDP is 7% and the Malagasy GDP is 5,410Mus\$. The annual gross income from fisheries is 378.7Mus\$. It is estimated that direct employment for the sector is 62,000, and indirect employment is 194,000. Then a total of 256,000 people depend on fisheries sector. Annual salary for employees is 500 us\$ per person, and the annual cost of salaries for all the people depending to the sector is 128Mus\$. It is assumed that operating costs are at 10% of gross income (Andrianaivojaona, 2010).

Given these parameters, the annual net value for the fisheries sector is 212.83Mus\$ and the net present value for a thirty-year period, with a 3% discount rate is 4,171.56Mus\$.

b) Raw materials

As for Comoros, we will use benefit transfer for the valuation of raw material extraction from mangroves, with reference to the Costanza value (162 us\$/ha/yr). The transfer rate is 0.04 and the Malagasy mangrove area is 3,097 km². So, the annual benefit from raw material extraction is 2.08Mus\$ and the net present value for a thirty year period with a 3% discount rate is 40.83Mus\$.

c) Ornamental resources

Benefit transfer will be used for this valuation, referring to Sukhdev (2009). The standard value is 264 us\$/ha/yr, and the benefit transfer rate is 0.04. Madagascar have a 2,230 km² area of coral reefs. Based on these data, the annual benefit from ornamental resources harvesting is 2.44Mus\$, and the net present value for a thirty year period, with a 3% discount rate is 47.91Mus\$.

d) Total economic value of provisioning services

The sum of economic value for ornamental resources, raw materials, and food production is the total economic value for provisioning services. Its value is about 4,260.30 Mus\$.

4.2.3. Economic valuation of regulation services

a) Shoreline protection

For shoreline protection valuation, we will use the Cesar's values as reference for benefit transfer. The benefit transfer rate is 0.04 and is assumed that agricultural use of coast is from 10% to 30%, and the human settlement use is from 20% to 30%. The length of Malagasy coral reefs is 2,700 km. Based on these data, the benefit value for agriculture protection is from 0.045 to 0.135Mus\$, and the benefit value for settlement protection is from 5.51 to 8.26Mus\$. Then the total value for shoreline protection is from 5.55 to 8.40Mus\$.

b) Disturbance regulation

For disturbance regulation, we will refer to Costanza's value for benefit reference (1,839 us\$/yr/ha) and the transfer rate is 0.04. The mangrove area for Madagascar is 3,097 km². Based on these data, the value of annual benefit for disturbance regulation is about 23.65Mus\$ and the net present value for thirty years at 3% discount rate is about 463.48Mus\$.

c) Climate regulation

Two ecosystems produce climate regulation services: coral reefs and mangroves. As for Comoros, benefits from coral reefs regulation will be estimated based on benefit transfer method and benefits from mangroves regulation by market prices.

Climate regulation by coral reefs have a 648 us\$/ha/yr value (Sukhdev, 2009). This value may be transferred without adjustment, given the nature of benefit. Madagascar has a 2,230 km² area of coral reefs. So the total amount of annual benefits for climate regulation is 144.5Mus\$, and the net present value for a thirty year period at 3% of discount rate is about 2,772.81Mus\$.

For carbon sequestration by avoided mangrove deforestation, it is assumed that the loss of 309.7 km² of mangroves is avoided, and the biomass rate is 292.8 t/ha. The total volume of not emitted CO₂ is 16.625 MteCO₂. The market price is 10us\$/teCO₂, and the cost for avoided deforestation is 2.51 us\$/teCO₂. Based on these data, the net value for climate regulation by mangroves (carbon sequestration) is 124.52Mus\$.

d) Total economic value of regulation services

The total economic value of regulation services is the sum of the three previous services: shoreline protection, disturbance regulation, and climate regulation. The total amount of this service is from 3,366.36 to 3,369.21 Mus\$

4.2.4. Economic valuation of cultural services

As for Comoros, the economic value of cultural services is estimated through the tourism sector. The mean arrivals for last five years is 282,100 and the contribution of tourism sector for GDP is

3.7%. The Malagasy GDP is 5,410 Mus\$, so this sector contribution is 200,17Mus\$. In the other hand, the total number of employees in the sector is 27,300, and the annual salary is 500 us\$ per person. It is assumed that other operating costs are at 30% of gross income (Rajeriarison & Picard, 2010).

Based on these parameters, the net annual value is 126.47 Mus\$, and the net present value for a thirty years period and at 3% discount rate is 2,478.85 Mus\$

4.2.5. Economic valuation of supporting services

a) Maintenance of genetic diversity

This is a global service produced by coral reefs, so we can use benefit transfer without adjustment (13,541us\$/ha/yr, Sukhdev). Madagascar has a 2,230 km² coral reefs area, so the annual benefit value is about 3,019.64Mus\$. The net present value for thirty years at 3% discount rate is 57,942.22Mus\$.

b) Nutrient cycling

Nutrient cycling by oceans is another global service. The reference value is Costanza's (118 us\$/ha/yr). Madagascar has 124,900 km² of territorial sea. Consequently, the annual value for nutrient cycling service is about 1,473.82 Mus\$, and the net present value for a thirty year period at 3% discount rate is 28,887.52 Mus\$.

c) Total economic value for supporting services

The sum of the economic value of the two former services is the supporting services value. This value is about 86,829.81 Mus\$.

4.2.6. Total economic value

The table below gives an overview of all ecosystem services value for Madagascar. The total economic value of these services is estimated from 96,935.36 to 96,938 Mus\$.

Table5: An overview of all ecosystem services value for Madagascar

	Direct use value (Mus\$)	Indirect use value (Mus\$)	Total (Mus\$)
Provisioning services	Food production: 4,172 Raw material production: 41 Ornamental resources: 48		4,260
Regulating services		Climate regulation: 2,897 Disturbance regulation: 463 Shoreline protection: 6-8	3,366-3,369
Cultural services	Tourism & recreation: 2,479		2,479
Supporting services		Nutrient cycling: 28,888 Maintenance of genetic diversity: 57,942	86,830
Total	6,739	90,196-90,199	96,935-96,938

4.3. Mauritius

4.3.1. Country summary

Mauritius (with The Rodrigues and Agalega) has a 2,045 km² total area and situated at 20°17'S and 57°33' E. It has a 496 km coastline, a 27,373 km² continental shelf, a 16,840 km² territorial sea, and a 1,900,000 km² economic exclusive zone (the largest among the island states in the region). The main coastal and marine ecosystems are seagrasses, lagoons (443 km²), mangroves (14 km²), and coral reefs (733 km²). (Ministry of Environment and NDU, 2007)

Mauritius has 1,269,000 inhabitants, with a huge majority (80%) in coastal zone. The life expectancy is 69 (the same as for Seychelles), and the GNI is the higher among the island states (8.1 billion US\$). The adult literacy is 87%, and the HDI is 0.804 (Ministry of Environment and NDU, 2007). Mauritius is often cited as an example of island state development.

4.3.2. Economic valuation of provisioning services

a) Food production

Fisheries in Mauritius have two components: inshore fisheries, and off shore fisheries. Inshore fisheries are undertaken within the territorial sea by local fisherman, in artisanal way. Offshore fisheries are undertaken by international seiners or longliners within the economical exclusive zone. The total production of artisanal fisheries is 3,577 tons/yr and offshore fisheries production is 7,966 tons/yr (Soondron, 2010). Then the total production is about 11, 5422.8 tons/yr.

The fisheries contribution to GDP is 1.5% and the Mauritian GDP is 6,362Mus\$. The annual gross income from fisheries is 95.43 Mus\$. Direct employment for the sector is 5,000, and indirect employment is 6,000. A total of 11,000 people depend on fisheries sector. Annual salary for employees is 7,000 us\$ per person, and the annual cost of salaries for all the people depending to the sector is 77 Mus\$ (Soondron, 2010). It is assumed that operating costs are at 10% of gross income. The compensation for offshore fishing is 0.487 Mus\$/yr.

Given these parameters, the annual net value for the fisheries sector 9.374 Mus\$ and the net present value for a thirty-year period, with a 3% discount rate is 183.73 Mus\$.

b) Raw materials

As for the two previous countries, we will use benefit transfer for the valuation of raw material extraction from mangroves, with reference to the Costanza value (162 us\$/ha/yr). The transfer rate is 0.65 and the Mauritian mangrove area is 14 km². From these data, we can calculate the annual benefit from raw material extraction: 0.147Mus\$ and the net present value for a thirty year period with a 3% discount rate is 2.882Mus\$.

c) Ornamental resources

Benefit transfer will be used for this valuation. Referring to Sukhdev (2009), the standard value is 264 us\$/ha/yr and the benefit transfer rate is 0.65. Mauritius has an 870 km² area of coral

reefs. Taking in account these data, the annual benefit from ornamental resources harvesting is 14.886 Mus\$, and the net present value for a thirty year period, with a 3% discount rate is 291.76 Mus\$.

d) Total economic value of provisioning services

The total economic value of provisioning services is the sum of fisheries, raw material extraction, and ornamental harvesting values. Then, it is about 478.38 Mus\$.

4.3.3. Economic valuation of regulation services

a) Shoreline protection

As for the two preceding countries, we will use the Cesar's values as reference for benefit transfer for shoreline protection valuation. The benefit transfer rate is 0.65 and it is assumed that agricultural use of coast is from 30% to 40%, and the human settlement use is from 30% to 50%. The length of Mauritian coral reefs is 496 km. Based on these data, the benefit value for agriculture protection is from 0.388 Mus\$ to 0.518 Mus\$, and the benefit value for settlement protection is from 23.690 Mus\$ to 39.483 Mus\$. Then the total value for shoreline protection is from 24.078 Mus\$ to 40 Mus\$.

b) Disturbance regulation

For disturbance regulation, we will again refer to Costanza's value for benefit reference (1,839 us\$/yr/ha) and the transfer rate is 0.65. The mangrove area for Mauritius is about 14 km². Based on these data, the value of annual benefit for disturbance regulation is 1.668 Mus\$ and the net present value for thirty years at 3% discount rate is 32.71 Mus\$.

c) Climate regulation

As for other islands states, two ecosystems produce climate regulation services: mangroves and coral reefs. Climate regulation by coral reefs have a 648 us\$/ha/yr value (Sukhdev, 2009). This value may be transferred without adjustment, given the global scale of benefit. Mauritius has an 870 km² area of coral reefs. Based on these data, the total amount of annual benefits for climate regulation is 56.38 Mus\$, and the net present value for a thirty year period at 3% of discount rate is about 1,081.77 Mus\$.

For carbon sequestration by avoided mangrove deforestation, it is assumed that the loss of 2.8 km² of mangroves is avoided, and the biomass rate is 291.8 t/ha. The total volume of not emitted CO₂ is 0.15 MteCO₂. The market price is 10 us\$/teCO₂, and the cost for avoided deforestation is 2.51 us\$/teCO₂. Based on these data, the net value for climate regulation by mangroves (carbon sequestration) is about 1.12 Mus\$.

d) Total economic value of regulation services

The total economic value of regulating services is obtained by summing the value of shoreline protection, disturbance regulation and climate regulation benefits. Its value is about 1,139.67 Mus\$ to 1,155.60 Mus\$.

4.3.4. Economic valuation of cultural services

As for other island states, the economic value of cultural services is based on tourism contribution to Mauritian GDP (6,362 Mus\$). The mean arrival during last years is 851,600 and

the contribution of tourism sector to the GDP is 8.32%. 22,840 people are working in the tourism sector, at 7,000 us\$/yr/pers (Picard, 2010), and it is assumed that operating costs are at 40% of the gross sectoral income. Then the net annual value of tourism sector calculated from these data is about 157.71Mus\$/yr. The net present value for thirty years using a 3% discount rate is about 3,091Mus\$.

4.3.5. Economic valuation of supporting services

a) Maintenance of genetic diversity

As for other island states, maintenance of global diversity is a global service produced by coral reefs, so we can use benefit transfer without adjustment (13,541us\$/ha/yr, Sukhdev). Mauritius has an 870 km² coral reefs area, so the annual benefit value is about 1,178.07 Mus\$. In that case, the net present value for thirty years, with 3% discount rate is 22,605. Mus\$.

b) Nutrient cycling

As for Madagascar and The Comoros, nutrient cycling by oceans is another global service. The reference value is Costanza's (118 us\$/ha/year). Mauritius has 16,840 km² territorial sea. Consequently, the annual value for nutrient cycling service is 198.71Mus\$, and the net present value for a thirty year period at 3% discount rate is 3,895Mus\$.

c) Total economic value of supporting services

The total economic value for supporting service is given by the sum of maintenance of genetic diversity and nutrient cycling. Its value is about 26,500Mus\$.

4.3.6. Total economic value

The total economic value for goods and services produced by ecosystems for Mauritius is obtained by summing the values of provisioning services, regulating services, cultural services, and supporting services. This value is estimated from 31,209 Mus\$ to 31,225 us\$.

Table 6: The total economic value for goods and services produced by ecosystems for Mauritius (Mus\$)

	Direct use value (Mus\$)	Indirect use value (Mus\$)	Total (Mus\$)
Provisioning services	Food production:184 Raw material production: 3 Ornamental resources: 292		479
Regulating services		Climate regulation:1,083 Disturbance regulation: 33 Shoreline protection: 24-40Mus\$	1,140-1,156
Cultural services	Tourism & recreation:3,091		3,091
Supporting services		Nutrient cycling: 3,895 Maintenance of genetic diversity:22,605	26,500
Total	3,570	26,500	31,209-31,225

4.4. Seychelles

4.4.1. Country summary

The Seychelles archipelago (115 islands) is composed by two groups of islands: the granitic islands (41 islands in the North-East) and the coralline islands (74 islands in the South and the South-East). The south-western island of the archipelago is situated at 500 km from African east coast, and the extent of the archipelago is 1,200 km. The archipelago is situated at 4°35' S, and 55°40' E. The archipelago has a 445 km² total area (the smallest island states in ASCLME region), a 746 km of coastline, a 45,411 km² territorial sea, a 31,479 km² of continental shelf and a 1,288,643 km² of economic exclusive zone. The main coastal and marine ecosystems are seagrasses, mangroves (29 km²), and coral reefs (1,690 km²). (Earth Trends, 2003)

The Seychelles have 87,400 inhabitants, and all of them are in coastal zone. The life expectancy for Seychellois is 69, and they have the highest GNI per capita (10,290 US\$) and HDI (0.845) of the region.

4.4.2. Economic valuation of provisioning services

a) Food production

Fisheries in Mauritius have two components: inshore fisheries, and off shore fisheries. Inshore fisheries are undertaken within the territorial sea by local fisherman, in artisanal way. Offshore fisheries are undertaken by international seiners or longliners within the economical exclusive zone. The total production of artisanal fisheries is 4,600 tons/yr and offshore fisheries production is 95,912 tons/yr (Lucas V., 2010). Then, the total production is about 100, 512 tons/yr.

The fisheries contribution to GDP is 39% and the Seychellois GDP is 682Mus\$. The annual gross income from fisheries is 265,98Mus\$ (Lucas V., 2010). The annual compensation for offshore fishing is 5,33Mus\$. Direct employment for the sector is 1,800, and indirect employment is 6,000. Then a total of 7,800 people depend on fisheries sector. Annual salary for employees is 4,000 us\$ per person, and the annual cost of salaries for all the people depending to the sector is 31,2Mus\$. It is assumed that operating costs are at 10% of gross income.

Given these parameters, the annual net value for the fisheries sector is 213,512 Mus\$ and the net present value for a thirty-year period, with a 3% discount rate is 4,184.93 Mus\$.

b) Raw materials

As for the other countries, we will use benefit transfer for the valuation of raw material extraction from mangroves, with reference to the Costanza's value (162 us\$/ha/yr). The transfer rate is 1.04 and the Seychellois mangrove area is 29 km². From these data, we can calculate the annual benefit from raw material extraction which is 0.490 Mus\$ and the net present value for a thirty year period with a 3% discount rate is 9.595 Mus\$.

c) Ornamental resources

Benefit transfer will be used for this valuation. Referring to Sukhdev (2009), the standard value is 264 us\$/ha/yr and the benefit transfer rate is 1.04. The Seychelles has a 1,690 km² area of coral reefs. Taking in account these data, the annual benefit from ornamental resources harvesting is 46.491 Mus\$, and the net present value for a thirty year period, with a 3% discount rate is 911.244 Mus\$.

d) Total economic value of provisioning services

As for other countries, the total economic value of provisioning services is calculated by summing the fisheries, raw material extraction, and ornamental harvesting values. It is about 5,105.77 Mus\$.

4.4.3. Economic valuation of regulation services

a) Shoreline protection

As for other countries, we will use the Cesar's values as reference for benefit transfer for shoreline protection valuation. The benefit transfer rate is 1.04 and is assumed that agricultural use of coast is estimated from 10% to 20%, and the human settlement use is from 20% to 40%. The length of Seychellois coral reefs used in this valuation is 168 km, relating to the inner islands where is located more than 90% of population. Based on these data, the benefit value for agriculture protection is from 0.071Mus\$ to 0.141Mus\$, and the benefit value for settlement protection is about 12.90Mus\$. Then, the total value for shoreline protection is from 12.97Mus\$ to 13.04Mus\$.

b) Disturbance regulation

For disturbance regulation, we will refer to Costanza's value for benefit reference (1,839 us\$/yr/ha) and the transfer rate is 1.04. The mangrove area for The Seychelles is 29 km². Based on these data, the value of annual benefit for disturbance regulation is estimated as 5.557 Mus\$ and the net present value for thirty years at 3% discount rate is 108.92 Mus\$.

c) Climate regulation

As for other islands states, two ecosystems produce climate regulation services: mangroves and coral reefs.

Climate regulation by coral reefs have a 648 us\$/ha/yr value (Sukhdev, 2009). As for other countries, this value may be transferred without adjustment, given the global scale of benefit. The Seychelles have a 1.690 km² area of coral reefs. Based on these data, it is estimated that the total amount of annual benefits for climate regulation is 109,51Mus\$, and the net present value for a thirty year period at 3% of discount rate is 2,101.37 Mus\$.

For carbon sequestration by avoided mangrove deforestation, it is assumed that the loss of 5.8 km² of mangroves is avoided, and the biomass rate is 454.8 t/ha. The total volume of not emitted CO₂ is 0.48 MteCO₂. The market price is 10 us\$/teCO₂, and the cost for avoided deforestation is 2,51 us\$/teCO₂. Based on these data, it is estimated that the net value for climate regulation by mangroves (carbon sequestration) is 3.62Mus\$.

d) Total economic value of regulation services

The total economic value of regulating services is obtained by summing the value of shoreline protection, disturbance regulation and climate regulation benefits which is from 2,222.58 Mus\$ to 2,231.06 Mus\$.

4.4.4. Economic valuation of cultural services

As for other island states, the economic value of cultural services is based on tourism contribution to Seychellois GDP (682 Mus\$). The mean arrival during last years is 152,800 and the contribution of tourism sector to the GDP is 25.6%. 7,000 people are working in the tourism sector, at 4,000 us\$/yr/pers (Dogley, 2010), and it is assumed that operating costs are at 30% of the gross sectoral income. The net annual value of tourism sector calculated from these data is about 94.21Mus\$/year and the net present value for thirty years using a 3% discount rate is about 1,846.64 Mus\$.

4.4.5. Economic valuation of supporting services

a) Maintenance of genetic diversity

As for other island states, maintenance of global diversity is a global service produced by coral reefs, so we can use benefit transfer without adjustment (13,541us\$/ha/yr, Sukhdev). The Seychelles have a 1690 km² coral reefs area, so the annual benefit value is 2,288.43 Mus\$. The net present value for thirty years, with 3% discount rate is 43,911.42 Mus\$.

b) Nutrient cycling

As for the other island states, nutrient cycling by oceans is global service. The reference value is Costanza's (118 us\$/ha/yr). The Seychelles have 45,411 km² of territorial sea. Consequently, the annual value for nutrient cycling service is estimated as 535.85Mus\$ and the net present value for a thirty year period at 3% discount rate is about 10,502.89Mus\$.

c) Total economic value of supporting services

The sum of maintenance of genetic diversity and nutrient cycling services gives the total economic value for supporting services. This value is at 54,414.31 Mus\$.

4.4.6. Total economic value

The total economic value of goods and services produced by ecosystems is given by the sum of the provisioning, regulating, cultural, and supporting services which is from 63,593.60Mus\$ to 63,593.68Mus\$.

Table 7: The total economic value of goods and services produced by ecosystems for the Seychelles

	Direct use value (Mus\$)	Indirect use value (Mus\$)	Total (Mus\$)
Provisioning services	Food production: 4,185 Raw material production: 10 Ornamental resources: 911		5,108
Regulating services		Climate regulation: 2,105 Disturbance regulation: 109 Shoreline protection: 13	2,227
Cultural services	Tourism & recreation:1,847		1,847
Supporting services		Nutrient cycling: 10,503 Maintenance of genetic diversity: 43,911	54,414
Total	6,952	56,641	63,594

5. Total economic value for the island states

5.1. Countries synopsis

The table below shows the main characteristics of the four island states, as developed in the previous section:

Table 8: The main characteristics of the four island states

	Comoros	Madagascar	Mauritius	Seychelles	Total
Total area (km2)	1,660	589,712	2,045	445	593,862
Coastlines (km)	469	5,600	496	746	7,311
EEZ (km2)	161,993	1,888,000	1,900,000	1,288.643	3,951,282
Continental shelf (km2)	1,416	117,000	27,373	31,479	177,268
Territorial sea (km2)	12,684	124,900	16,840	45,411	199,835
Population (hab)	644,000	19,000,000	1,269,000	87,400	21,000,400
Coastal population (hab)	515,200	3,900,000	1,015,200	87,400	5,517,800
GNI (Mus\$)	483	7,800	8,122	889	
GNI per capita (us\$)	750	410	6,400	10,290	
HDI	0.576	0.543	0.804	0.845	
Mangroves (km2)	26	3,097	14	29	
Coral reefs (km2)	430	1,350	733	1,690	

Based on these data, we can say that Madagascar has almost the totality of the surface area (99%). It also has the very large majority of population (90%) and population living in coastal area (71%). Because of its largest mangrove area (90%), Madagascar is classified among the countries that having the largest mangrove areas in the world: its rank is 14th after Mozambique, with 2% of the total surface.

Madagascar and Mauritius shared the majority of exclusive economic zone (36% each one). However, the exclusive economic zone for Seychelles is 2900 times of its surface area (three times more extend for Madagascar).

Seychelles have coral reefs 4 times larger than its surface area. In addition, no archipelago Par ailleurs, aucun point de l'archipel n'est distant de plus de 4 km des cotes, et toute sa population est considerée comme cotiere. In addition, no point of the archipelago is distant of more than 4 km from the coast and all its population is like coastal people.

The Comoros have the smallest surface areas for mangroves, coral reefs, continental land, and special economic zone. However, they have a GDI per capita and a HDI higher than Madagascar which has the highest surface area.

5.2. Economic value of provisioning services

The economic value of provisioning services is the value of goods from fisheries, ornamental resources harvesting, and raw materials extraction. The table below shows its repartition per country, and per service:

Table 9: Summary of provisioning services per country, in Mus\$

	Comoros	Madagascar	Mauritius	Seychelles	Total
Fisheries	44	4,172	184	4,185	8,584
Ornamental resources	17	48	292	911	1,268
Raw materials	1	41	3	10	54
Total	62	4,260	478	5,106	9,906

The total economic value of provisioning services is 9,906 Mus\$ in which 86.6% is from fisheries and 12.8% is from ornamental resources harvesting. The open sea and the coral reefs ecosystems produce more than 99% of the economic values of provisioning services. Mangroves ecosystem produce a few economic value through raw material production (0.6% of total provisioning services)

5.3. Economic value of regulating services

The economic value of regulation services is the value of benefits from shoreline protection, disturbance regulation, and climate regulation. The table below shows the repartition of this value per country and per environmental service:

Table 10: Economic values of regulation services per country and per environmental service: (Mus\$)

	Comoros	Madagascar	Mauritius	Seychelles	Total
Shoreline protection	1	6-8	24-40	13	43-63
Disturbance regulation	7	463	33	109	612
Climate regulation	546	2,897	1,083	2,105	6,632
Total	554	3,366-3,369	1,140-1,156	2,226	7,286-7,306

The total economic value of regulating services is varied from 7, 286 Mus\$ to 7,306 Mus\$. The main economic value for regulating services is obtained from climate regulation (91%). This benefit is mainly produced by coral reefs (89%). Disturbance regulation is ten times fewer (less than 1%) compared to the other environmental services.

Coral reefs produce the majority of regulation services, about 89.6% (climate regulation and shoreline protection). As for provisioning services, the contribution of mangroves for regulating services is very few, about 10% (climate regulation and disturbance regulation).

5.4. Economic value of cultural services

The tourism sector gives the main benefit for cultural services. Its total economic value is 7,651Mus\$. The table below shows the repartition of tourism value per country.

Table 11: Economic values of cultural services per country, in Mus\$

	Comoros	Madagascar	Mauritius	Seychelles
Economic value of Cultural services (Mus\$)	234	2479	3091	1847

Mauritius has the highest value of cultural services; it is due to the development of tourism infrastructure.

5.5. Economic value of supporting services

The economic value of supporting services is obtained through nutrient cycling and maintenance of genetic diversity. The table below shows its repartition by country and by environmental service:

Table 12: Summary of economic values of supporting services per country, in Mus\$

	Comoros	Madagascar	Mauritius	Seychelles	Total
Nutrient cycling	2,934	28,888	3,895	10,503	46,219
Maintenance of genetic diversity	11,173	57,942	22,605	43,911	135,632
Total	14,106	86,830	26,500	54,414	181,851

The total economic value for supporting services is 181,851Mus\$. This value is essentially produced by the maintenance of genetic diversity by coral reefs (74.5%).

5.6. Total economic value

According to the Millennium Ecosystem Assessment approach, the table below shows the repartition of the economic value of ecosystem services per country:

Table 13: The total economic value of ecosystem services per country, in Mus\$

	Comoros	Madagascar	Mauritius	Seychelles	Total
Provisioning services	62	4,260	478	5,106	9,906
Regulating services	554	3,366-3,369	1,140-1,156	2,226	7,286-7,306

Cultural services	234	2,479	3,091	1,847	7,651
Supporting services	14,106	86,830	26,500	54,414	181,851
Total	14,956	96,935-96,938	31,209-31,225	63,593	206,694-206,713

The total economic value of ecosystem services for the island states is estimated from 206,694Mus\$ to 206,713 Mus\$. The mean value is 14,956 Mus\$ for Comoros, 96,936 Mus\$ for Madagascar, 31,217 Mus\$ and 63,593 Mus\$ for Seychelles. Supporting services have the most substantial value (88%), mainly produced by coral reefs through the maintenance of genetic diversity (65.6%).

An additional analysis is given by comparison of the amount of direct and indirect use of ecosystems. The table below shows this repartition per country:

Table 14: The total economic value by use of ecosystem per country, in Mus\$

	Comoros	Madagascar	Mauritius	Seychelles	Total
Direct use	296	6,739	3,560	6,952	17,557
Indirect use	14,660	90,196-90,199	27,640-27,656	56,641	189,137-189,156
Total	14,956	96,935-96,938	31,209-31,225	63,593	206,694-206,713

The majority of total economic value is produced by indirect use of ecosystems: 91.5%. The direct use (marketed goods) represents less than 10% of total economic value.

6. Conclusion

Results from this ASCLME analysis outline the values of ecosystem services that would be useful for decision- making in terms of promoting sustainable use of marine and coastal resources at national and regional levels. In case of lack of information, economic valuation of few ecosystem services are estimated based on existing data as references and methods.

The total of economic values of goods and services from ecosystem services for the island states is estimated as 207 Billion us\$. This value is enormous, compared to the entire amount of the GDP of the four countries which is about 13 Million us\$.

It shows three main points:

- Externalities are huge and significantly contribute to human well-being, without market regulation: the poor people can have access to these goods and services,
- Most of environmental goods and services are still free access, which is not guaranty for its sustainable use,
- Inappropriate market policies can be illustrated by the difference of economic value of environmental services and the market values of goods.

The analysis of ecosystem good and services benefit distribution in countries and stakeholders highlights the failures of the policies for benefit access. Then, we can say that the governance issue is the access management of resources.

The next parts of this preliminary report will describe 1) the ecosystem goods and services benefit sharing analysis among stakeholder and countries, 2) The economic risk assessment on

marine and coastal resources in these countries, and 3) the economic analysis of major policy issues related to the coastal and marine ecosystem management of the ASCLME.

REFERENCES

- Andrianaivojaona, C., 2010. Small-Scale Fisheries In Coastal Livelihoods in The Republic of Madagascar.
- Attoumani, S. and Picard D., 2010. Tourism In Coastal Livelihoods in The Republic of Comoros.
- Bijoux, J.P., Decomarmond, A. & Aumeeruddy, R., 2008. Seychelles Status of the Marine Environment Report. UNEP.
- Cesar H. Indonesian Coral reefs : A Precious but threatened resources - 2002
- Constanza et al ,The value of the world's ecosystem services and natural capital - 1997.
- Dogley, F. F., 2010. Tourism in Coastal Livelihoods in The Republic of Seychelles
- Earth Trends, 2003. Coastal and Marine Ecosystem <http://earthtrends.wri.org> (visited in Jan 2011)
- Environmental Protection Agency, US. 2009. Valuing the Protection of Ecological Systems and Services. A Report of the EPA Science Advisory Board.
- Kathiresan, K. and Bingham, B.L., 2001. Biology of mangrove and mangrove ecosystems. *Advances in Marine Biology*, **40** : 81-251.
- Lucas V., 2010, Small Scale Fisheries In Coastal Livelihoods in The Republic of Seychelles
- Ministère de l'Agriculture de la Pêche et de l'Environnement. Direction Nationale de l'Environnement et des Forêts, 2008. Rapport National sur l'Environnement Marin et Cotier. Convention de Nairobi. Union Comore.
- Ministry of Environment and NDU, 2007. A National Status Report on the Marine and Coastal Environment of the Republic of Mauritius. October 2007. Nairobi Convention.
- Picard, D, 2010. Tourism in Coastal Livelihoods. In The Republic of Mauritius.
- Pritchard, D. W., 1967. What is an estuary: physical viewpoint. p. 3–5 in: G. H. Lauf (ed.) *Estuaries*, A.A.A.S. Publ. No. 83, Washington, D.C.
- Qasim, S. Z. (1998). Mangroves, In: *Glimpses of the Indian Ocean*. University.Press, Hyderabad, pp. 123-129.
- Rajeriarison, P. & Picard D., 2010. Tourism In Coastal Livelihoods in The Republic of Madagascar.\
- Shipton, T.A., 2010. Mariculture In Coastal Livelihoods in The Republic of Madagascar.
- Stoddart, D. R. (1984). Coral reefs of the Seychelles and adjacent regions. In: *Biogeography and ecology of the Seychelles islands* (ed. D.R. Stoddart), pp. 63-81. The Hague: Dr W Junk.
- Soondron, S. 2010. Small-Scale Fisheries In Coastal Livelihoods in The Republic of Mauritius.
- Sukhdev – climate issues update – Millenium ecosystem Assessment - 2009
- Walker, P and Wood E., 2005. The Open Ocean. In *Life and Sea*.
- Whittingham, E., Campbell, J, and Townsley, P. 2002., *Poverty and Coral Reefs : A Global Overview*. DFID.
- Youssouf, A.M., 2010. Small-Scale Fisheries In Coastal Livelihoods in The Republic of Comoros.