GIST
Green Indian States Trust

Mangroves Ecosystem Services Valuation Project Proposal

I. Identifying Socio-Environmental Benefits of Mangroves

Mangroves — trees and shrubs that grow in tropical estuaries — are among the world's most productive ecosystems, as they provide breeding and nursing grounds for marine and pelagic species, food, medicine, fuel, and building material for local communities. They also have an impressive capacity to sequester and store carbon at high rates. Mangroves are natural carbon-scrubbers, and can store up to on average 1,023 Mg carbon per hectare as compared to different types of terrestrial forest domains which, depending on their characteristics, can store between 250 and 350 Mg carbon per hectare only (Donato, et al., 2011).

A research estimated that the overall carbon stock of Mahanadi Mangrove Wetlands, on the East coast of India, is 1.6 times higher than that in terrestrial forests of Odisha (Sahu, et al., 2016). In addition to carbon sequestration, mangroves also serve as an important physical buffer, protecting coastal areas from storm surges and acting as "bioshields" against natural disasters. They perform a variety of useful ecological, bio-physical, and socio-economic functions, and are the source of a multitude of benefits to coastal populations.

Some of the key benefits provided by mangrove forests to the marine environment and to nearby communities are listed below:

a) **Fisheries:** Mangrove forests are home to a large variety of fish, crab, shrimp, and mollusc species. These fisheries form an essential source of food for thousands of coastal communities around the world. The forests also serve as nurseries for many fish species, including coral reef fish. In the Mesoamerican reef, there are 25 times more fish of some species on reefs close to mangroves than in areas where mangroves have been cut down (WWF, 2017). This makes mangrove forests vitally significant to coral reef and coastal communities, many of whom depend on it for their sustenance.

b) **Biodiversity:** Mangrove forests are crucial reservoirs of biodiversity. They are nesting and migratory sites for hundreds of bird species, as well as home to a wide array of reptile, amphibian, and mammal species. For instance, the Sundarbans mangroves of India and Bangladesh – the largest mangrove forest on Earth – are home to many rare and unique species such as the Bengal tiger, the water monitor lizard, the saltwater crocodile, fishing cats, and the Gangetic dolphin.

c) **Timber and plant products:** Mangrove wood is extremely valuable for it is resistant to rot and insects. Many coastal and indigenous communities rely on this wood for construction material as well as for fuel. These communities also collect medicinal plants from mangrove ecosystems and use mangrove leaves as animal fodder. Recently, the forests have also been commercially harvested for pulp, wood chip, and charcoal production.

d) **Coastal protection:** The dense root systems of mangroves trap sediments flowing down rivers and off the land. This helps stabilise the coastlines, prevent soil erosion from waves and increasingly violent storms, and create a physical barrier to shelter the land from rising seas as our climate changes. In areas where mangroves have

been cleared, coastal damage from hurricanes and typhoons is much more severe. During the 2004 Indian Ocean tsunami in Indonesia, coastal areas that were protected by mangrove forests were better able to withstand the devastating impacts of that disaster. Safeguarding wetlands can help protect vulnerable communities' coastal homes and provide sustainable livelihoods. By filtering out sediments, the forests also protects coral reefs and seagrass meadows from being smothered in sediments.

e) **Tourism:** Given the diversity of life inhabiting mangrove systems, and their proximity in many cases to touristic attractions such as coral reefs and sandy beaches, it is surprising that only a few countries have started to tap into the tourism potential of their mangrove forests. Snorkelling/kayaking expeditions in and around mangroves allow the explorer to witness a huge variety of sea life – baby fish, jellyfish, urchins in interwoven roots delving deep into the sandy substrate. Great potential lies in revenue generation from intact mangrove forests.

f) **Climate change mitigation and adaptation:** Mangroves play a key role in mitigating and adapting to the impacts of global climate change. The capacity of mangroves, sea grasses, and salt marshes to sequester carbon dioxide from the atmosphere is becoming increasingly recognized. Mangroves sequester carbon far more effectively – up to 100 times faster – and more permanently than terrestrial forests. Studies have shown that per hectare, mangrove forests store up to five times more carbon than most other tropical forests around the world (RECOFTC, 2017). Estimates suggest a range of between 150 million to 1 billion tonnes of CO_2 that is emitted annually due to the destruction of mangrove forests globally. Thus, at the global scale, coastal wetland destruction could account for 1-3% of industrial emissions; a number that is on the rise as more and more coastal wetlands are destroyed every year around the world. Thus, mangrove forests offer a unique and highly efficient approach to climate change mitigation and adaptation.

Despite these clear benefits, since 1980 the world has lost approximately 20 percent of its mangrove forests (Brooks, 2016). The fact that mangroves can store carbon at a much higher rate means that their destruction results in emissions of a much higher magnitude. According to Sahu et al., mangroves account for only 0.7% of tropical forest area, their destruction generates emissions up to 10% from total global deforestation (Sahu, et al., 2016).

Climate change mitigation work needs intact mangrove areas. The protection, restoration, and sustainable management of mangroves are seen as a pivotal element in addressing global climate change, reducing emissions from deforestation and forest degradation (REDD+), and the Sustainable Development Goals (SDGs), notably SDGs 1, 2, 3, 12, 13, 14, 15, and 16, respectively for reduction of poverty and hunger, increasing wellbeing, responsible consumption and production ways, climate action, life below water and life on land, and the promotion of peaceful and inclusive societies for sustainable development (UN, 2015). With this in mind, there is a growing need to recognise the importance of the socio-environmental benefits delivered by mangrove ecosystems, and to understand the factors, both biophysical and societal, that contribute to sustainable mangrove management.

II. Trend and Status of Mangrove Areas in India

Mangroves in India are unique in terms of their extent, variability and biodiversity. A total of 4011 species, including 920 plant (23%) and 3091 animal (77%) species have been recorded from Indian mangrove ecosystems, which is the highest in the world (Kathiresan & Rajendran, 2005). However, there has been an overall continuous decline in mangrove forests caused by conversion to agriculture, aquaculture, tourism and urban development. India lost 40% of its mangrove area during last century (Ministry of Environment & Forest, 2015). Predicted mangrove loss will reduce biodiversity, eliminate fish nursery habitat, adversely affecting adjacent coastal habitats and eliminate a major resource for human communities that traditionally rely on mangroves for numerous products and services.

Figure 1: Mangrove sites in India

India has a total mangrove cover of 4627.63 km^2, which represents 0.15% of the country's land area, 3% of the global mangrove area, and 8% of Asia's mangroves (Forest Survey of India, 2013).

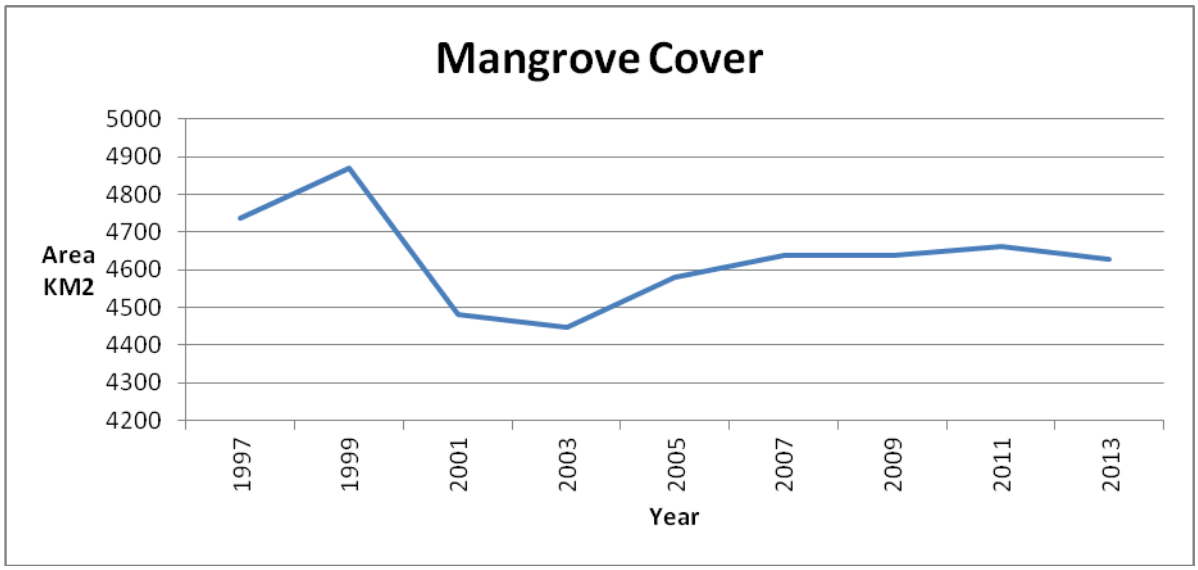
The country shelters the fourth largest mangrove area in the world (A.K.Singh, et al., 2012). The state of West Bengal has the maximum cover (2,097 km^2), followed by Gujarat (1103 km^2) and the Andaman and Nicobar Islands (604 km^2).

Of last century's 40% loss, the Indian east coast has lost about 26%, the west coast about 44%, and Andaman and Nicobar Islands about 32% of their mangroves (Sahu., et al., 2015).

Source: Kumar, 2000

According to the Ministry of environment and forest, India's mangrove areas have been increasing with the maximum increment observed in the state of Gujarat. According to the 2015 Assessment of mangrove cover (Forest Survey of India, 2015), there has been a net increase of 112 km^2 in the mangrove cover of the country as compared to the 2013 Assessment.

Figure 2: India's mangrove cover (1997-2013) in km^2



Source: Adapted from Forest Survey of India, 2015.

Since 1990s, many conservation programmes have been put in place by the State Forest Departments and the Ministry of Environment and Forests for the safeguard of mangroves in India. Maharashtra for example has set up the 'Mangrove and Marine Biodiversity Conservation Foundation' (Government of Maharashtra, 2015). Gujarat under the 'Gujarat Forestry Development Project' has commissioned about Rs. 830 crore for restoration and development of mangrove plantations (Gujarat Institute of Development Research , 2011). Several NGO's and companies are also contributing towards conservation and plantation of mangroves. These public and private sector efforts have resulted in an increase in mangrove areas in India. According to the 2015 Assessment of mangrove cover (Forest Survey of India, 2015), there has been a net increase of 112 km^2 in the mangrove cover of the country as compared to the 2013 Assessment.

Nevertheless, despite the conservation efforts, mangrove destruction and degradation continue; sometimes due to natural hazards but mainly resulting from anthropogenic stress such as human settlements, expansion of agricultural or salt-making lands, development of industries and ports, coastal aquaculture. Indeed, marine ecosystems are experiencing unprecedented degradation rates higher than any other ecosystem on the planet. In some instances, they are up to 4 times those of rainforests. Currently between 2 and 7 % of these ecosystems are lost annually, a seven-fold increase compared to only half a century ago (Nellemann, et al., 2009). In the State of Tamil Nadu, the Pichavaram mangrove wetland is affected by regular inflow of pollutants generated from industrial discharges, agricultural runoff, and sewage. As a result, mangrove cover reduced from 40 sq. km at the beginning of the 20^{th} Century, to 11 sq. km currently. Additionally, due to heavily siltation, connectivity was lost between Picharavam mangroves and Vellar estuary, which resulted in the formation of large mud flats preventing beach formation necessary to protect the mangroves from direct interaction with the Bay of Bengal (Ghosh, et al., 2015). According to the Indian States of Forest Report (2015), open mangroves, which have a canopy density between 10-40%,

constitute approximately 40% of total mangrove area in India. There is a pressing need to safeguard the quality of Indian mangroves as the area under open mangroves has been consistently increasing over the years.

The absence of a legal framework specifically dedicated to mangrove management is also problematic. If a National Mangrove Committee was set up in the Ministry of Environment and Forests in 1976 by the Government of India, there is no legislative framework specifically dedicated to the conservation and management of mangroves. The Indian Forest Act (1927), the Wildlife (Protection) Act (1972) and the Forest Conservation Act (1980) all apply to mangrove areas as they apply to generic forests, without valuing the geographic and physical specificities of mangrove ecosystems. It is the Environment (Protection) Act of 1986 that has had the most impact in the conservation and management of mangroves, by declaring a Coastal Regulation Zone in which industrial and other mangrove-detrimental activities – such as discharge of untreated water and effluents, dumping of waste, land reclamation – are restricted (Kumar, 2000).

More needs to be done for the safeguard of the Indian mangroves. Raising public awareness on the importance of mangrove ecosystems and the good and services they provide is paramount. Mangrove ecosystem services must be weighted and valued so that mangrove conservation becomes a priority in environmental policy-making. The valuation of mangrove ecosystem services is needed to inform governance and sustainable management of mangroves (Mukherjee, et al., 2014).

III. Valuing Ecosystem Services (ES)

“Ecosystem services are the benefits provided by ecosystems to humans, which contribute to making human life both possible and worth living” (Millennium Ecosystem Assessment, 2005) ES are indispensable for both the natural environment and human beings. In other words, ecosystem services consist of flows of materials, energy, and information from natural capital stocks, which can be combined with manufactured and human capital services to produce human welfare (Vo, et al., 2012).

The major portion of the goods and services ecosystems provide are not valued or are greatly undervalued by society. According to (Costanza, et al., 1987), “ecosystem services are not fully captured in commercial markets or adequately quantified in terms comparable with economic services and manufactured capital, they are often given too little weight in policy decisions”.

There are various approaches to value ES. The valuation of ES is a relatively new concept and is still evolving. A pre-requisite to valuing ES lies in their classification into different types of service categories. They can then be valued according to appropriate techniques or methods.

The Economics of Ecosystem and Biodiversity (TEEB), which is a global initiative to mainstream the values of biodiversity and ecosystem services into decision-making, groups ecosystems into four categories.

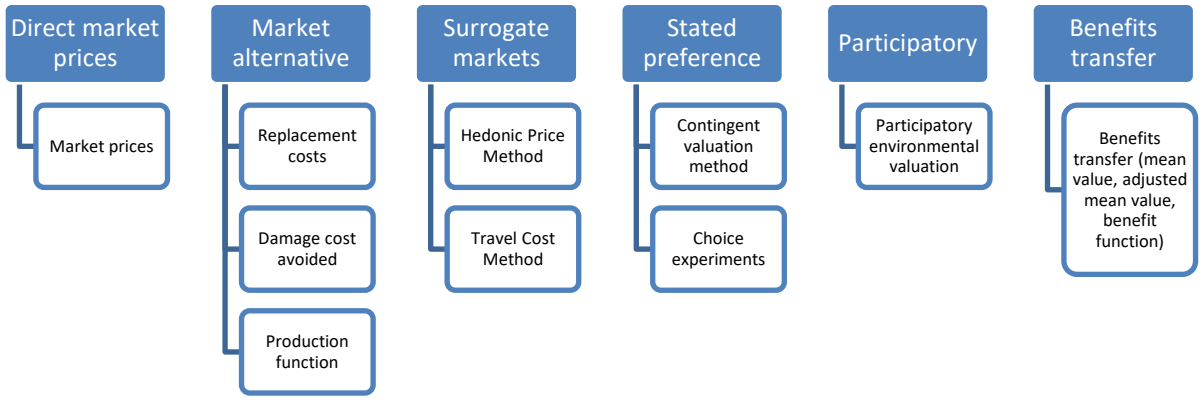
Table 1: ES Categories

Provisioning Services	These are products or goods obtained from ecosystem such as food, fuelwood, medicinal plants, water etc.
Regulating Services	Ecosystem regulate various process such as climate, water, waste assimilation, pollination, disease control etc.
Cultural Services	These are non-material benefits obtained from ecosystems and including components which contribute to human wellbeing, satisfy spiritual, religious, recreational, aesthetic requirements.
Habitat/Supporting Services	These are ecosystem services which are necessary for production of all other ecosystem services. They underpin almost all other services as they provide living spaces for plants or animals as well as maintain a diversity of different breeds of plants and animals.

TEEB's approach to capture in economic terms the wide range of goods and services provided by ecosystems is widely used (Pandeya, et al., 2016; UNEP, 2011; Rasul, et al., 2011).

The TEEB report provides techniques to be used during valuation of the various services. The table below shows a summary of the various techniques to be used during valuation.

Figure 3: ES Valuation Techniques



Source: Adapted from Hussai & Gundimeda, 2010.

IV. Identifying and valuing the ecosystem services provided by mangroves (MES)

This section has two purposes. First, identifying the ecosystem services provided by mangroves (MES), then pinning down the MES that can be evaluated and valued by GIST.

Mangroves economic invisibility is a problem. With no economic acknowledged value, mangroves are considered useless and can be destroyed with impunity. Identifying and valuing the MES is meant to make the value of mangroves visible. The principal objective is to mainstream the values of biodiversity and mangrove ecosystem services into decision-making at all levels, thus fostering the conservation and sustainable management of mangrove areas in India. For this aim to be achieved, a structured approach to valuation is to be followed so that decision-makers recognise the wide range of benefits provided by pristine mangrove ecosystems and biodiversity. Once the values of MES are demonstrated in economic terms, those values can more easily be captured in decision-making.

Although it is difficult to estimate the true value of the numerous goods and services mangroves provide both for the marine environment and nearby communities, a few studies attempt to value some of the services. Mangrove forests provide at least US $1.6 billion each year in ecosystem services and support coastal livelihoods worldwide (Polidoro, et al., 2010). A report by WWF, measured some of the goods and services provided by mangroves including fisheries, timber and plant product, tourism and costal protection; they are conservatively estimated to be worth US$180 million each year globally (WWF, 2017).

Aiming at filling this knowledge gap for buttressing policy-makers in their initiatives to sustainably manage Indian mangrove areas, the present project relies on the TEEB methodology for ecosystem services and biodiversity valuation. The following table relates MES to the TEEB typology:

Table 2: Mangrove Ecosystem Services (MES) classified as per service category

Provisioning Services	Food	Production of food and nutritious drink (off-shore fish, shell fish, on-site crabs) for artisanal fisheries.
	Water	Cooling and purification of water for local communities.
	Raw materials	Production of raw materials for construction (wood, leaves, tannin, nypa palm) and of fuel and energy (wood, charcoal) used by local communities.
	Genetic resources	Shelter rich diversity of species and several ecological niches, with the gradients of interacting environments providing continuity of gene flow.
	Medicinal resources	Production of medicinal resources (e.g. for skin disorders and sores) used by local communities.
	Ornamental resources	Provision of material (shells, twigs, etc.) for the creation by local communities of ornamental handicrafts potentially sold to tourists.
	Air quality regulation	Improvement of air quality for local communities with capture of dust and very active sequestration of CO2 through photosynthesis.

	Climatic regulation	Limitation of global warming through very active capture of CO2 from the atmosphere.
	Moderation of extreme events	Stabilisation of shoreline and coastal land; protection of local communities and aquaculture adjacent to mangroves from floods, tsunamis, and storms, acting as a physical barrier and recharging aquifers.
	Regulation of water flows	Provision of watershed protection for aquaculture farmers at to mangrove forests.
	Waste treatment	Water purification, useful for local communities and aquaculture adjacent to mangrove areas.
	Erosion prevention	Protection from storms and floods which contributes to prevent erosion.
	Maintenance of soil fertility	High microbial abundance and productivity of the soil, active sedimentation and porosity of some layers of mangrove soil maintain the soil fertility.
	Pollination	Crops pollination.
	Biological control	Pests control.
HABITAT SERVICES	Maintenance of life cycles of migratory species	Provision of rest, nesting, and food sites to migratory species.
	Maintenance of genetic diversity	Provision of nurseries and nesting sites for many fish species, including coral reef fish. Being outbreeders, sexually propagated and with diversity of floral biology, pollination and breeding mechanisms, mangroves naturally nurture genetic diversity.
CULTURAL SERVICES	Aesthetic information	Provides unique and aesthetic landscape of cultural, historic or spiritual meaning.
	Opportunities for recreation and tourism	Mangroves offer opportunities for ecotourism and recreational boat trips.
	Inspiration for culture, art and design	Provides unique and aesthetic landscape of cultural, historic or spiritual meaning.
	Spiritual experience	Provides unique and aesthetic landscape of cultural, historic or spiritual meaning.
	Information for cognitive development	As extremely rich and productive ecosystems, mangroves offer a privileged ground for scientific studies delivering on scientific and educational information.

Source: Authors' compilation.

V. Valuing the ecosystem services provided by mangroves (MES): Steps and expected results

1. Steps for the Valuation

GIST will follow TEEB's three-tiered approach towards economic valuation by recognising, demonstrating, and capturing value.

Recognising value means that society acknowledges and understands the range of benefits, goods and services provided by mangrove ecosystems. The simple fact of recognising is sometimes sufficient to ensure conservation and sustainable use. The valuation will entail wider recognition of MES value.

Demonstrating value consists in considering in economic terms the full costs and benefits of a proposed use of an ecosystem. In demonstrating the value of MES, we will list out the different uses of MES and value MES for each of those uses. This is the valuation exercise, which presupposes the preliminary selection of appropriate valuation methods, and setting scope and boundary for the valuation.

Regarding the selection of the most relevant valuation methods, it is important to bear in mind that estimating the value of the various services and benefits that mangrove ecosystems and biodiversity generate may be done with a variety of valuation approaches. All of these have their advantages and disadvantages. Hybridizing approaches may overcome disadvantages of particular valuation methods. A mix of qualitative, quantitative, spatial, and monetary approaches, with biophysical assessments, as well as natural capital accounts, is advocated.

GIST's valuation exercise of MES will follow the steps as listed below:

1. Setting scope and boundary for evaluation;
2. Listing out and categorising the benefits;
3. Identifying the beneficiaries;
4. Selecting the most material benefits;
5. Selecting appropriate valuation methods[1];
6. Valuation exercise – Data gathering and analysis;
7. Recommendations.

Capturing value involves the introduction of mechanisms that incorporate the value of MES into decision-making, through incentives and price signals.

Recognition and capture of MES value are part of the expected benefits of the valuation study.

[1] Also see TEEB for Local and Regional Policy Makers report, p.32 for a recapitulative table of valuation frameworks, and TEEB for Water and Wetlands Executive Summary, p. 8 for its mention of indicators, mapping and environmental economic accounts, as valuation approaches.

2. Expected results

Listing out the benefits and identifying key beneficiaries is part of the valuation process.

Overall, measuring MES will put the emphasis on the crucial role played by mangroves for the upkeep of ecological balance and consecutive human wellbeing. It will help to make mangroves more economically visible and ultimately influence key actors to adjust their decisions and behaviours. The valuation of MES will allow to underlie economic drivers of mangrove ecosystem decline and to mainstream them into economic and political decisions, while filling gaps in economic evidence.

Recognising and understanding the value of MES will help to:

- Generate better information about the value of mangrove services – for instance making obvious the nexus between mangrove ecosystems and water security;
- Identify the true costs of "business as usual" scenario;
- Capture the value of MES;
- Improve decision-making when trade-offs are necessary and useful information is lacking;
- Provide a basis for policy and analysis – pledging for mangroves and water-related ecosystems to become an integral part of water management in order to make the transition to a resource efficient, sustainable economy;
- Set incentives and regulating use for stakeholders – local communities, businesses. This can be done through the implementation of Payments for Ecosystem Services (PES), reforming environmentally harmful subsidies, introducing tax breaks for conservation, creating new markets for sustainable produced goods, etc.

The following questions will be answered[2]:

- **Benefits and risks of loss:** what are the roles of mangroves in providing water and wider ecosystem services and what are their values?
- **Measuring to manage:** how can we improve what we are measuring to help improve governance of our natural capital?
- **Integrating the values of water and mangroves into decision making:** what needs to be done to improve the consideration of the values and benefits of water and mangroves in policy developments and in practical decision making?
- **Transforming our approach to water and mangroves:** what are the recommendations for transforming the regional, national and international approaches for managing mangroves and their ecosystem services?

Several fields will benefit from the evaluation. Environmental science will become more knowledgeable, national and State accounting will be adjusted to include MES, and environmental, social and economic policies will be better informed, then better implemented and mangrove areas better managed.

[2] [2] These questions have been adapted from TEEB's Water and Wetlands Executive Summary available at http://www.ieep.eu/assets/1107/TEEB_Water_Wetlands_Executive_Summary.pdf.

Stakeholders will be empowered. Scientists, businesses dealing with mangrove ecosystems, politicians and local communities will be provided with economic data and recommendations for incentivising a sustainable use of MES. Action at all levels and by all stakeholders is needed if the opportunities and benefits of working with mangroves are to be fully realised and the consequences of continuing mangroves loss appreciated and acted upon.

Works Cited

A.K.Singh, Ansari, A., Kumar, D. & U.K.Sarkar, 2012. *Status, Biodiversity and Distribution of Mangroves in India: An overview,* Lucknow: National Bureau of Fish Genetic Resources (ICAR).

Brooks, S., 2016. *The human element of mangrove management.* [En ligne]
Available at: https://medium.com/@USAIDEnviro/the-human-element-of-mangrove-management-3b1794892e61
[Accessed on 10 04 2017].

Costanza, R. et al., 1987. The Value of the World's Ecosystem Services and Natural Capital. *Nature,* Volume 387.

Donato, D. C. et al., 2011. Mangroves among the most carbon-rich forests in the tropics. *Nature Geoscience,* 03 03.Issue 4, 293–297.

Forest Survey of India, 2013. *State of Forest Report 2013,* Dehradun: Ministry of Environment & Forests.

Forest Survey of India, 2015. *State of Forest Report,* s.l.: Ministry of Environment and Forests, Government of India.

Ghosh, S. et al., 2015. A Review of Threats and Vulnerabilities to Mangrove Habitats: With Special Emphasis on East Coast of India. *Journal of Earth Science & Climatic Change.*

Government of Maharashtra, 2015. *Establishment of the Mangrove and Marine Biodiversity Conservation Foundation of Maharashtra.Government Resolution No. S-30/2015/CR 219/F-3.*. [En ligne]
Available at:
https://www.maharashtra.gov.in/site/Upload/Government%20Resolutions/Marathi/20150923121724341 9.pdf
[Accessed on 10 April 2017].

Gujarat Institute of Development Research , 2011. *Socio-Economic and Ecological Benefits of Mangrove Plantation: A Study of Community Based Mangrove Restoration Activities in Gujarat,* Gandhinagar: Gujarat Ecology Commission.

Hussai, S. & Gundimeda, H., 2010. Chapter 3: Tools for Valuation and Appraisal of Ecosystem Services in Policy Making. Dans: *The Economics of Ecosystem and Biodiversity for local and Regional Policy Makers.*. s.l.:s.n.

Kathiresan, K. & Rajendran, N., 2005. Mangrove ecosystems of the Indian Ocean region. *Indian Journal of Marine Sciences,* 34(1), pp. 104-113.

Kumar, R., 2000. *Conservation and management of mangroves in India, with special reference to the State of Goa and the Middle Andaman Islands,* s.l.: FAO.

Millennium Ecosystem Assessment, 2005. *Ecosystems and Human Well-being: Synthesis,* s.l.: Island Press.

Ministry of Environment & Forest, 2015. *Mangrove Cover: India State of Forest Report,* s.l.: Government of India.

Mukherjee, N. et al., 2014. Ecosystem Service Valuations of Mangrove Ecosystems to Inform Decision Making and Future Valuation Exercises. *PLOS ONE.*

Nellemann, C. et al., 2009. *Blue Carbon: A Rapid Response Assessment,* s.l.: United Nations Environment Programme.
Pandeyaa, B. et al., 2016. A comparative analysis of ecosystem services valuation approaches for application at the local scale and in data scarce regions. *Ecosystem Services,* Volume Volume 22, Part B, p. 250–259.
Polidoro, B. A. et al., 2010. The Loss of Species: Mangrove Extinction Risk and Geographic Areas of Global Concern. *PLOS ONE.*
Rasul, G., Chettri, N. & Sharma, E., 2011. *Framework for Valuing Ecosystem Services in the Himalayas,* Kathmandu: International Centre for Integrated Mountain Development (ICIMOD).
RECOFTC, 2017. *Mangroves more Carbon Rich and Important for Climate Change.* [En ligne]
Available at: http://www.recoftc.org/project/grassroots-capacity-building-redd/news-and-features/mangroves-more-carbon-rich-and-important-climate-change
[Accessed on 10 04 2017].
Sahu., S., H.S. Suresh, I. M. & Ravindranath, N., 2015. Mangrove Area Assessment in India: Implications of Loss of Mangroves. *Journal of Earth Science & Climatic Change,* Volume 6:280.
Sahu, S. C., Kumar, M. & Ravindranath, N. H., 2016. Carbon stocks in natural and planted mangrove forests of Mahanadi Mangrove Wetland, East Coast of India. *Current Science,* 15 06.Issue 110, NO. 12.
UN, 2015. *Sustainable Development Goals.* [En ligne]
Available at: https://sustainabledevelopment.un.org/topics/sustainabledevelopmentgoals
[Accessed on 04 2017].
UNEP, 2011. *Economic Analysis of Mangrove Forests: A case study in Gazi Bay, Kenya,* s.l.: UNEP.
Vo, Q. T. et al., 2012. Review of valuation methods for mangrove ecosystem services. *Ecological Indicators,* Volume 23, p. 431–446.
WWF, 2017. *Mangrove importance.* [En ligne]
Available at:
http://wwf.panda.org/about_our_earth/blue_planet/coasts/mangroves/mangrove_importance/
[Accessed on 10 April 2017].