

## **Revised Draft**

# **MANGROVES FOR THE FUTURE (MFF) NATIONAL STRATEGY AND ACTION PLAN (NSAP) INDIA**

## **EXECUTIVE SUMMARY**

“Mangroves for the Future (MFF)” is a regional initiative, being coordinated by United Nations Development Programme (UNDP) and International Union for the Conservation of Nature (IUCN). It aims at promoting coastal ecosystem conservation in six tsunami-hit countries including India. Under this initiative, the present document on ‘*National Strategy and Action Plan*’ (NSAP) for India has been drafted in consonance with national policies and programmes of India.

India is blessed with a variety of coastal and marine ecosystems enriched with biodiversity, which provides essential resources for socio-economic development. The country is very strong on the policy front, as well as on the legal support available for conservation of the ecosystems. MFF programme in India provides focus on promoting conservation and management of coastal and marine biodiversity, while mangrove ecosystems are at center-stage, on three important aspects: (1) coastal restoration; (2) coastal livelihoods; and (3) Integrated coastal zone management.

The initial Action Plan under the MFF initiative will be executed and monitored by the National Coordination Body (NCB) of India on the following three types of projects starting from 2008-09:

- **Projects of large and medium size on conservation and management of coastal and marine biodiversity:** This project type is an action-oriented and field-level activity. Projects operate within 3621 km<sup>2</sup> of mangroves in five States (West Bengal, Gujarat, Orissa, Andhra Pradesh and Tamil Nadu). This can be executed through community participation by creating eco-development committees, and through a Government departmental protection model. However, greater emphasis and a larger role shall be given to community participation. The action plan will consider (i) imparting new skills and upgrading of existing skills of people; (ii) enhancing the existing coastal resource base; (iii) providing basic amenities such as water, health,

transportation, *etc.*; (iv) bringing all the mangrove areas under the control of Forest department and also by financially supporting the private owners of the mangrove areas through Government schemes to protect and develop the mangroves; and (vi) improving the educational facilities as a long term strategy.

- **Under the large and medium size projects, mangrove restoration in approximately 200 km<sup>2</sup> areas** will also be done mainly with the support of Government of India. The restoration strategy is adopted based on the tidal amplitude. Consequently, the entire coastal area in the five States is divided in to (i) high tidal amplitude area; and (ii) low tidal amplitude area. In the low tidal amplitude area, 'canal bank planting' technique with 'fish bone' design is preferable for restoration; and, in the high tidal amplitude area, restoration will be made by direct seed sowing and seedling planting in the mud flats. Wherever communities are willing and can undertake restoration operations, the communities may be mobilized and funds may be transferred to them. In other areas, where communities are not involved or not dependant on the mangroves, the Government departments may have to step in to undertake restoration operations. The idea of contracting out the restoration works wherever possible to the eco-development committees or village forest committees or National Green Corps or NGOs may be considered. Duration of this type of project is for 3-5 years.
- **Small Grant Facility will support projects** for coastal community empowerment and capacity building on environment friendly activities as a part of the MFF coastal resource conservation and management strategy. This type of small grant project would provide leads to develop models for better conservation and management. Duration of this type of project may be for 6 months to 18 months .
- **Targeted Research Projects** have to address knowledge gap areas, which are required for efficient management of coastal ecosystems and will provide essential inputs for the conservation and management strategy. This type of targeted research project would generate data and information for better conservation and management. Duration of this type of project may be for 1-2 years.

## 1. INTRODUCTION

“Mangroves for the Future (MFF)” is a regional initiative, being coordinated by UNDP and IUCN. It focuses on tsunami-hit countries such as India, Indonesia, Maldives, Seychelles, Sri Lanka and Thailand. It recognizes coastal ecosystems as rich assets, vital for human well-being that must be restored, protected and invested in. MFF adopts a new approach by promoting partnerships to stimulate investment, thereby moving from reactive responses to proactive activities. These activities include raising awareness and capacity for secured livelihoods, disaster preparedness and resilience-building, as well as climate change adaptation measures.

India has agreed to participate in the MFF initiative. To oversee and guide the entire India country programme under MFF, a National Coordination Body (NCB) of India was constituted under the Chairmanship of Dr. B.S. Parsheera. Under this initiative, the following two national consultants were appointed to prepare the National Strategy and Action Plan (NSAP) for India (**Annexure-I**).

- Dr. Sukhdev Thakur, Principal Chief Conservator of Forests and Chief Wildlife Warden (Retd.), Govt. of Tamil Nadu; and,
- Dr. K. Kathiresan, Professor, Annamalai University, Tamil Nadu.

In order to facilitate preparation of the NSAP, a two day workshop on the “*Conservation and Management of Mangrove Ecosystems in India: Stakeholder Consultation for Assessment of Training and Capacity Building Needs and Design of a National Strategy and Action Plan*” was organized by the Ministry of Environment and Forests, together with Asian Institute of Technology, Bangkok and IUCN–MFF secretariat, Bangkok, on the 12<sup>th</sup> and 13<sup>th</sup> February 2008 at the Gujarat Ecological Education and Research Foundation in Gujarat. Based on the discussion and recommendations held in the workshop, the consultant team has prepared a draft NSAP. The National Consultant team also interacted with Mr. Dan Willhelmsson, an International Consultant to finalize the structure and proposed content of the NSAP. The draft NSAP was submitted to the NCB, IUCN country office and IUCN secretariat in March, 2008. The MFF Secretariat appreciated the broad ecosystem approach of the draft NSAP and made some suggestions for its improvement. Accordingly the necessary revision was made to the draft NSAP in April 2008.

A delegation from India under the Chairmanship of Shri. B.S. Parsheera visited Sri Lanka to participate in the “*IUCN-MFF Initiate: Review Forum*” held on the 21<sup>st</sup>-24<sup>th</sup> April 2008, organized by MFF Secretariat and IUCN Sri Lanka. The Forum brought together 60 participants including MFF partners, country representatives and international and regional technical expertise to review progress of each MFF programme of work. A country working group for India discussed the key findings and recommendations from different Programme of Work (PoW) presented at the Forum and the relevant ones were incorporated in to the draft National Strategy and Action Plan (NSAP).

A second meeting of the core group of NCB was held at the IUCN country office in New Delhi on the 14<sup>th</sup> May 2008 to discuss the NSAP further and assistance was requested from the NCB members present and the MFF coordinator to improve the document further. Based on the inputs given by them, the draft NSAP was further improved.

The present document on ‘*National Strategy and Action Plan*’ for India (June 2008) has been prepared in consonance with National policies and programmes, to analyze, identify and tackle various facets of coastal and marine biodiversity, while mangrove ecosystems are at the centre-stage for conservation and management of coastal and marine biodiversity under the IUCN-MFF initiative.

## **2. IUCN AND INDIA: A STRONG ASSOCIATION**

India has a long history of association with IUCN since the 1960s, beginning even before the Government of India became a state member in 1969. The IUCN’s tenth General Assembly was held in New Delhi. Four hundred and twenty five Indian nationals serve in a voluntary capacity on IUCN Commissions, and 320 of whom are members of the Species Survival Commission. Twenty three organizations in India are members of IUCN; the highest number of members in Asia after Pakistan.

During the last four decades, IUCN has worked together with members and partners in India on a wide range of issues. A series of IUCN missions concluded that there was need for a country programme, led by an office in New Delhi so that the engagement in India would broaden, as well as deepen. An IUCN office in India was established in the end of 2006 and it has started its work in building partnerships with members and other organizations working within India in the region.

### 3. COASTAL AND MARINE ENVIRONMENT IN INDIA

#### 3.1. Coastal Marine Ecosystems

Surrounded by the Indian Ocean, Arabian Sea and the Bay of Bengal, India has about 8,000 km long coastline that spans 13 maritime States and Union Territories (UTs) including Island UTs. India has rich assets of a variety of coastal and marine ecosystems (Table 1), including considerable nationally and globally significant biodiversity. These coastal and marine ecosystems are extremely important from an economic perspective, as they provide a wide range of ecosystem goods and services to the entire country. Approximately 20% of India's population lives in coastal areas, a large proportion of them in urban centers such as Mumbai, Chennai and Kolkata. Some of the India's poorest people also live in the coastal belt and rely on coastal and marine resources for their immediate welfare and as a source of livelihood through fishing and other forms of economic activities. The December 2004 tsunami which struck the South East coast of India and the Andaman Islands reaffirmed the importance of maintaining healthy coastal and marine ecosystems for natural disaster risk management and post-disaster recovery, as well as for general human well-being.

**Table 1. Extent of coastal ecosystems in India**

<b>Coastal Ecosystem</b>	<b>Extent (km<sup>2</sup>).</b>
Tidal/ Mud flats	23,621
Sandy beaches/ bars/ spits	4,210
Mangroves	4,445
Coral reefs	2,375
Salt marshes	1,698
Lagoons	1,564
Estuaries	1,540
Other vegetation (including sea grass beds)	1,391
Aquaculture ponds	769
Salt pans	655
Creeks	192
Rocky coasts	177
Back waters	171
<b>Total</b>	<b>42,763</b>

### 3.2. Coastal and Marine Biodiversity

India has remarkable biodiversity in its coastal and marine ecosystems. The mangrove ecosystem alone has a total of 3985 biological species that include 919 flora and 3066 fauna. There are 199 coral species representing all the three major reef types (atoll, fringing and barrier reefs), 14 species of seagrasses and 844 species of seaweeds. A number of factors including the long coastline, tropical climate, and nutrients supplied by rivers along the coast, have combined to produce a variety of biologically rich and productive coastal and off-shore marine ecosystems (Table 1). Inter-tidal mudflats teeming with migratory birds in winter, dense mangrove forests inhabited by the endangered tiger, and delicate seagrass beds favoured by the enigmatic and elusive seacow (dugong), are just a few of the natural treasures to be found along India's coastline.

India is home for globally threatened species such as Royal Bengal tiger, sea turtles, fishing cat, estuarine crocodile, the Gangetic dolphin, and river terrapin. Long-term survival of the rare and endangered species depends on health of the coastal and marine ecosystems. There is also tremendous resident and migratory bird diversity associated with coastal and marine ecosystems in India. Nearly 2 million water birds of about 200 species over-winter in India before heading back to colder northern climes in April. Five of the world's seven species of sea turtles are found in India, namely the Olive Ridley (*Lepidochelys olivacea*), Green (*Chelonia mydas*), Hawksbill (*Eretmochelys imbricata*), Loggerhead (*Caretta caretta*) and the critically endangered Leatherback (*Dermochelys coriacea*) turtles. Orissa on the east coast of India has the world's largest mass nesting Olive Ridley Turtles during the months of October to April supporting a nesting population of probably more than half a million of the species. The threatened whale shark (*Rhincodon typus*), the largest fish species in the world can be found off the coast of Saurashtra in Gujarat, while the last population of one of five threatened sub-species of Asiatic wild ass (*Equus hemionus khur*) occurs in the salt marshes of the Little Rann of Kutch in Gujarat. A detailed account of biodiversity of India's mangrove ecosystem, along with the species at threat, is given in **Annexure-II**.

### **3.3. Economic values of coastal and marine ecosystems**

Coastal and marine ecosystems are among the most biologically and economically productive ecosystems in the world and the same is true for India where these ecosystems provide both a source of livelihood and a range goods and services that are critical for the day to day well-being of millions of people, particularly poorer coastal communities. For example, the fisheries sector provides employment to more than six million people and accounts for 1.2% of India's total GDP and 5.4% of total agricultural GDP. Fish is an important protein source for many poor people. In addition to fisheries, the coastal and marine environment is also of importance to other major economic production sectors that include agriculture, tourism, ports and maritime shipping, other major transport and communication sectors and their related infrastructures.

### **3.4. Threats and constrains to coastal and marine ecosystems**

Despite their tremendous ecological and economic importance, India's coastal and marine ecosystems are under increasing threat – in part, and as recognized by the Government of India, due to the country's on-going push for rapid economic growth over the past decade. There are also numerous direct and indirect pressures arising from different types of economic development across the country. Major anthropogenic direct drivers of ecosystem degradation and destruction include habitat conversion to other forms of land use (*e.g.* through coastal development for roads, ports, tourist resorts, aquaculture *etc.*); overexploitation of species and associated destructive harvesting practices (*e.g.* through use of inappropriate fishing gear and methods); and the impacts of agricultural, domestic and industrial sewage and waste. Additionally, climate change is expected to have a growing impact on coastal and marine ecosystems, including a likely increase in extreme weather events, as well as sea level rise, warming of the sea surface temperatures, and ocean acidification. Coastal habitats are also subject to powerful natural weather phenomena, such as cyclones, hurricanes and storms. Indirect drivers of ecosystem change include demographic, socio-political, cultural, economic and technological factors.

The impacts of different economic sectors on coastal and marine biodiversity vary from region to region. In Gujarat for example, industrial development, urbanization port development, high maritime traffic and mechanized fishing are particularly significant, while in Orissa, large-scale mechanized fishing, commercial

aquaculture, and off-shore oil exploration are important issues. It is often difficult to determine a clear causal link between the activities of a particular production sector and their environmental impacts, given that the direct and indirect drivers of ecosystem change operate at different temporal and spatial scales, and interact with each other in complex ways. It is clear, however, that the cumulative impacts of pressures on the coastal and marine ecosystems are intensifying as both India's economy and population, including its coastal population, continues to grow rapidly.

To date, biodiversity conservation efforts and investments in India (as in much of the rest of the world) have focused largely on terrestrial ecosystems. Nevertheless, India has established thirty three coastal and marine protected areas and three Marine Biosphere Reserves, with a total area of approximately 5,318.9 km<sup>2</sup>. However, these protected areas cover only less than 1.3 per cent of the Indian continental shelf (4,15,000 km<sup>2</sup> including the Islands) and even less than 0.3 per cent of the Indian EEZ (approximately 2 million km<sup>2</sup>).

While Marine Protected Areas (MPAs) are an important tool for conservation of coastal and marine biodiversity, these alone are unlikely to ensure the maintenance of biodiversity and ecosystem processes, given the complex ecological dynamics of coastal and marine ecosystems and the nature and scale of the direct and indirect drivers of ecosystem degradation. Additionally, MPAs by their very nature are inherently difficult to manage. Generally, the functioning of coastal and marine systems is far less well-understood than that of terrestrial systems and there is less technical capacity and expertise available for their effective management. It is also difficult to manage such areas effectively, given the vast array of direct and indirect pressures on these areas; moreover, many of the pressures are difficult to exclude or control. Finally, the preceding factors greatly increase the cost of managing MPAs.

The Government of India has long recognized that the long-term solution to coastal and marine ecosystem degradation requires a more holistic and integrated approach that promotes multi-sectoral coordination to integrate environmental management principles, including biodiversity conservation objectives, into economic production activities. Similarly, ensuring compliance with existing laws and regulations requires a coordinated response from a number of sectors.



**A luxuriantly growing mangrove forest in Pichavaram, southeast India**

#### **4. MANGROVES IN INDIA IN RELATION TO GLOBAL STATUS**

##### **4.1. Global Status of Mangroves**

FAO has recently given a list of the recent, reliable national/area estimated for each country or territory as shown in the table 2. Global mangrove area currently stands at about 15.2 million hectares in 124 countries. The most extensive mangrove area is found in Asia, followed by Africa and North and Central America. Five countries (Indonesia, Australia, Brazil, Nigeria and Mexico) together account for 48 per cent of the total global area and 65 per cent of the total mangrove area is found in just ten countries. The remaining 35 per cent is spread over 114 countries and areas, of which 60 have less than 10,000 hectares of mangroves each. Asia is the region with the lowest forest cover in terms of percentage of land area, but has the largest extent of mangroves (approximately six million hectares), while five of the ten countries with the largest extent of mangroves worldwide are found in this region.

Globally, mangrove ecosystems continue to disappear at an alarming rate. Twenty per cent, or 3.6 million hectares of mangroves, have been lost since 1980. More recently, the rate of net loss appears to have slowed down, although it is still disturbingly high. About 185,000 ha were lost every year in the 1980s; this figure dropped to some 118,500 ha per year in the 1990s, and to 102,000 ha per year during the period 2000-2005, reflecting an increased awareness of the value of mangrove ecosystems, supplied by mangrove projects in a numbers of countries, including India.

**Table 2. Most recent reliable mangrove area estimate by country area as per FAO report (2007)**

Country/ Area	ha	Year	Country/ Area	ha	Year
Angola	33 600	2000	Kuwait	5	2004
Benin	1 700	1989	Malaysia	564 971	2005
British Indian Ocean Territory	n.a.	n.a.	Maldives	n.a.	n.a.
Cameroon	251 545	2000	Myanmar	518 646	1999
Comoros	117	2002	Oman	1 088	1995
Congo	8 000	2003	Pakistan	158 000	2001
Cote d'Ivoire	9 940	2000	Philippines	247 362	2003
Dem Rep. of the Congo	19 600	2000	Qatar	500	1992
Djibouti	1 000	1985	Saudi Arabia	20 400	1985
Egypt	512	2002	Singapore	500	1990
Equatorial Guinea	25 700	1995	Sri Lanka	9 530	1996
Eritrea	6 400	1997	Thailand	244 085	2000
Gabon	152 940	2000	Timor-Leste	1 802	2000
Gambia	58 100	2000	United Arab Emirates	4 000	1999
Ghana	13 729	2000	Viet Nam	157 500	2000
Guinea	276 342	1997	Yemen	927	1993
Guinea-Bissau	248 400	1990	<b>Total Asia</b>	<b>6 047 798</b>	<b>2002</b>
Kenya	52 980	1982	American Samoa	52	2003
Liberia	9 244	2000	Australia	1 451 411	2005
Madagascar	303 814	2004	Christmas Island	n.a.	n.a.
Mauritania	104	1993	Fiji	42 464	1991
Mauritius	120	2004	French Polynesia	n.a.	n.a.
Mayotte	668	1989	Guam	70	1993
Mozambique	392 749	1997	Kiribati	258	1995
Nigeria	997 700	1995	Marshall Islands	n.a.	n.a.
Sao Tome and Principe	n.a.	n.a.	Micronesia (Fed. States of)	8 564	1983
Senegal	127 702	2000	Nauru	2	1991
Seychelles	2 900	1960	New Caledonia	17 140	2003
Sierra Leone	105 300	2000	New Zealand	26 032	2001
Somalia	10 000	1975	Niue	3 000	1981
South Africa	3 054	1999	Northern Marina Islands	7	1976
Sudan	500	1995	Palau	4 708	1985
Togo	1 094	2000	Papua New Guinea	410 000	2000
United Rep. of Tanzania	127 200	2000	Samoa	370	1999
<b>Total Africa</b>	<b>3 242 754</b>	<b>1997</b>	Solomon Islands	50 572	1993
Bahrain	100	1992	Tokelau	n.a.	n.a.
Bangladesh	476 215	1995	Tonga	1 305	1997
Brunei Darussalam	18 418	1996	Tuvalu	40	1993
Cambodia	72 835	1997	Vanuatu	2 519	1993
China	22 480	2001	Wallis and Futuna Islands	25	2005
India	444 500	2005	<b>Total Oceania</b>	<b>2 018 537</b>	<b>2003</b>
Indonesia	3 062 300	2003	Anguilla	90	1991
Iran, Islamic Rep. of	19 234	1997	Antigua and Barbuda	1 175	1991
Japan	800	2005			

Country/ Area	ha	Year	Country/ Area	ha	Year
Aruba	420	1986	Panama	174 435	2000
Bahamas	141 957	1991	Puerto Rico	8 870	2000
Barbados	4	2004	Saint Kitts and Nevis	79	1991
Belize	78 511	1990	Saint Lucia	200	2002
Bermuda	16	1992	Saint Vincent and the Grenadines	51	1991
British Virgin Islands	587	2001	Trinklad and Tobago	7 150	1991
Cayman Islands	7 830	1998	Turks and Cakos Islands	23 600	1988
Costa Rica	41 840	2000	United States	197 648	2001
Cuba	545 805	2003	Unites States Virgin Islands	216	1999
Dominica	10	1991	Total North and Central America	2 358 105	2000
Dominican Republic	21 215	1998			
El Salvador	28 000	2004	Brazil	1 012 376	1991
Grenada	255	1992	Colombia	371 250	1997
Guadeloupe	2 950	1997	Ecuador	149 556	1999
Guatemala	17 727	1999	French Guiana	55 000	1980
Haiti	15 000	1988	Guyana	80 432	1992
Honduras	78 668	2000	Peru	4 550	1995
Jamaica	9 731	1997	Suriname	114 600	1998
Martinique	1 840	1998	Venezuela (Bolivarian Rep. of)	250 000	1986
Mexico	882 032	2002	Total South America	2 037 764	1992
Montserrat	5	1991			
Netherlands Antilles	1 138	1980			
Nicaragua	69 050	1998			

Note: n.a. = not available

Even though mangroves are often used for the collection of forest wood products, and as a source of subsistence for local populations, the removal of wood and non-wood forest products is rarely the main cause of mangrove habitat loss. Human pressure on coastal ecosystems and the competition for land for aquaculture, agriculture, infrastructure and tourism are often high and are major causes of the decrease in mangrove areas.

#### 4.2. Mangrove Forest Cover in India

**Mangrove cover in India:** Mangroves in India account for about five per cent of the world's mangrove vegetation with green cover of 4445 km<sup>2</sup> along the coastal States and Union Territories (UT) of the country, which is 0.14% of the country's total geographic area. The Forest Survey of India has been assessing the mangroves using remote sensing since 1987. It published the first assessment in 1987 and the area estimated was 4,046 km<sup>2</sup> (scale of assessment – 1:1 million). Thereafter, mangroves were assessed regularly on a two-year cycle from 1989 to 1999, where the scale of assessment was 1:250,000. The assessment for 2001 and 2003 was done on 1:50,000 scale.

State/UT wise mangrove cover as assessed by FSI in different assessments is given in the table 3. West Bengal has the greatest area of mangrove cover in the country, followed by Gujarat and Andaman and Nicobar Islands. About 60 % mangrove cover is found on the east coast of India, 14 % on the west coast and the remaining on the Andaman and Nicobar Islands. On a macro scale, geomorphic settings of the mangrove ecosystems of the east coast of India are different from those of the west coast. The presence of larger brackish water-bodies and a complex network of tidal creeks and canals characterize the mangrove ecosystems of the east coast. This is mainly due to the larger deltas created by east-flowing rivers and the gentle slope of the coast. On the other hand, the coastal zone of the west coast is narrow and steep in slope, due to the presence of the Western Ghats. Secondly, there are no major west-flowing rivers. As a result, the mangrove ecosystems on the west coast of India are small in size, lower in diversity and less complicated in terms of their tidal creek networks. The tables 4 and 5 present State/UT wise and district-wise status of mangrove cover as estimated in the 2005 assessment.

**Status of forest cover:** In the FSI assessment, mangrove cover has been categorized into (i) very dense mangroves (canopy density of more than 70%); (ii) moderately dense mangroves (canopy density between 40-70%); and (iii) open mangroves (canopy density between 10-40%). The very dense mangroves comprise 1,147 km<sup>2</sup> (25.8% of mangrove cover), moderately dense mangroves is 1,629 km<sup>2</sup> (36.6%), while open mangroves cover an areas of 1,669 km<sup>2</sup> (37.6%) (Table 4).

**Trend of change:** Compared with the 2003 assessment, there has been a marginal decrease in mangrove cover in India mainly because of the tsunami that hit the Andaman and Nicobar Islands on the 26<sup>th</sup> December 2004. Gujarat has shown an increase in mangrove cover mainly because of plantations and forest protection measures (Table 4).

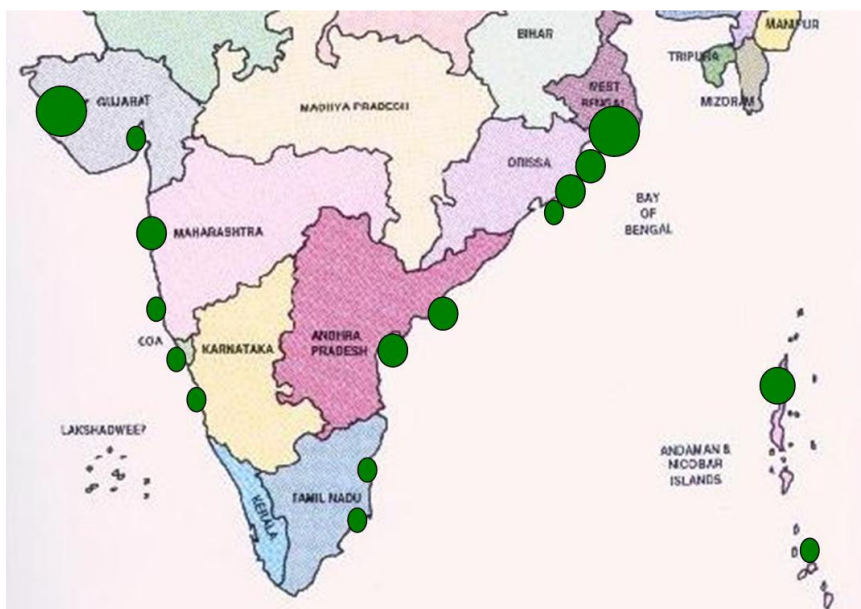
**Table 3. State/UT wise mangrove cover assessment since 1987 as per Forest Survey of India (2005)**

Sl. No.	State/UT	Assessment Year									
		1987	1989	1991	1993	1995	1997	1999	2001	2003	2005
1.	Andhra Pradesh	495	405	399	378	383	383	397	333	329	329
2.	Goa	0	3	3	3	3	5	5	5	16	16
3.	Gujarat	427	412	397	419	689	901	1031	911	916	936
4.	Karnataka	0	0	0	0	2	3	3	2	3	3
5.	Maharashtra	140	114	113	155	155	124	108	118	158	8
6.	Orissa	199	192	195	195	195	211	215	219	203	158
7.	Tamil Nadu	23	47	47	21	21	21	21	23	35	203
8.	West Bengal*	2,076	2,109	2,119	2,119	2,119	2,123	2,125	2,081	2120	35
9.	Andaman and Nicobar	686	973	971	966	966	966	966	789	658	2,118
10.	Pondicherry	0	0	0	0	0	0	0	1	1	637
11.	Kerala	0	0	0	0	0	0	0	0	8	1
12.	Daman and Diu	0	0	0	0	0	0	0	0	1	1
	<b>Total</b>	<b>4,046</b>	<b>4,255</b>	<b>4,244</b>	<b>4,256</b>	<b>4,533</b>	<b>4,737</b>	<b>4,871</b>	<b>4,482</b>	<b>4,448</b>	<b>4,445</b>

\*As per the West Bengal forest department, mangrove area in the Sundarbans is approximately 4200 km<sup>2</sup> which is almost double the area estimated by FSI. This is mainly because West Bengal forest department includes the areas of water body also besides the mangrove vegetation. But for change detection, it is prudent not to include the water areas.

**Table 4. State/UT wise mangrove cover as per Forest Survey of India (2005)**

Sl. No	State/UT	Very Dense Mangrove	Moderately Dense Mangrove	Open Mangrove	Total	Change w.r.t 2003 Assessment
1	Andhra Pradesh	0	15	314	329	0
2	Goa	0	14	2	16	0
3	Gujarat	0	195	741	936	20
4	Karnataka	0	3	0	3	0
5	Kerala	0	3	5	8	0
6	Maharashtra	0	58	100	158	0
7	Orissa	0	156	47	203	0
8	Tamil Nadu	0	18	17	35	0
9	West Bengal	892	895	331	2,118	-2
10	Andaman & Nicobar	255	272	110	637	-21
11	Daman & Diu	0	0	1	1	0
12	Pondicherry	0	0	1	1	0
	<b>Total</b>	<b>1,147</b>	<b>1,629</b>	<b>1,669</b>	<b>4,445</b>	<b>-3</b>



**Significant mangrove areas on the Indian coastline**

**Table 5. District wise mangrove cover as per Forest Survey of India (2005)**

Sl. No	State/UT and District	Very Dense Mangrove	Moderately Dense Mangrove	Open Mangrove	Total	Change w.r.t 2003 Assessment
1	Andhra Pradesh					
	East Godavari	0	7	181	188	0
	Guntur	0	3	44	47	0
	Krishna	0	5	88	93	0
	Prakasam	0	0	1	1	0
	<b>Total</b>	<b>0</b>	<b>15</b>	<b>314</b>	<b>329</b>	<b>0</b>
2	Goa					
	North Goa	0	10	1	11	0
	South Goa	0	4	1	5	0
	<b>Total</b>	<b>0</b>	<b>14</b>	<b>2</b>	<b>16</b>	<b>0</b>
3	Gujarat					
	Ahmedabad	0	2	4	6	4
	Bharuch	0	22	14	36	3
	Bhavnagar	0	6	8	14	0
	Jam Nagar	0	28	122	150	9
	Kuchchh	0	127	580	707	0
	Navsari	0	0	1	1	0
	Porbander	0	1	0	1	0
	Rajkot	0	1	1	2	0
	Surat	0	7	10	17	4
	Valsad	0	1	1	2	0
	<b>Total</b>	<b>0</b>	<b>195</b>	<b>741</b>	<b>936</b>	<b>20</b>

Sl. No	State/UT and District	Very Dense Mangrove	Moderately Dense Mangrove	Open Mangrove	Total	Change w.r.t 2003 Assessment
4	Karnataka					
	Udipi	0	2	0	2	0
	Kannad Uttar	0	1	0	1	0
	<b>Total</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>3</b>	<b>0</b>
5	Kerala					
	Kannur	0	3	4	7	0
	Ernakulam	0	0	1	1	0
	<b>Total</b>	<b>0</b>	<b>3</b>	<b>5</b>	<b>8</b>	<b>0</b>
6	Maharashtra					
	Mumbai City	0	0	2	2	0
	Mumbai Suburb	0	20	20	40	0
	Raigarh	0	9	38	47	0
	Ratnagiri	0	9	12	21	0
	Sindhudurg	0	1	0	1	0
	Thane	0	19	28	47	0
	<b>Total</b>	<b>0</b>	<b>58</b>	<b>100</b>	<b>158</b>	<b>0</b>
7	Orissa					
	Baleshwar	0	0	4	4	0
	Bhadrak	0	17	3	20	0
	Jagatsinghpur	0	2	2	4	0
	Kendrapara	0	137	38	175	0
	<b>Total</b>	<b>0</b>	<b>156</b>	<b>47</b>	<b>203</b>	<b>0</b>
8	Tamil Nadu					
	Chidambaranar	0	0	2	2	0
	Cuddalore	0	5	2	7	0
	Nagapattinam	0	8	9	17	0
	Ramanathapuram	0	1	0	1	0
	Thanjavur	0	4	4	8	0
	<b>Total</b>	<b>0</b>	<b>18</b>	<b>17</b>	<b>35</b>	<b>0</b>
9	West Bengal					
	Midinipur	6	1	2	9	0
	24 Pargana North	16	10	2	28	0
	24 Pargana South	870	884	327	2081	-2
	<b>Total</b>	<b>892</b>	<b>895</b>	<b>331</b>	<b>2118</b>	<b>-2</b>
10	Andaman & Nicobar					
	Andaman	255	262	108	625	-6
	Nicobar	0	10	2	12	-15
	<b>Total</b>	<b>255</b>	<b>272</b>	<b>110</b>	<b>637</b>	<b>-21</b>
11	Daman & Diu					
	Diu	0	0	1	1	0
	<b>Total</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>0</b>
12	Pondicherry					
	Yenam	0	0	1	1	0
	<b>Total</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>0</b>
	<b>Grand Total</b>	<b>1,147</b>	<b>1,629</b>	<b>1,669</b>	<b>4,445</b>	<b>-3</b>

**Religious faith and beliefs in conservation:** Mangroves have long been regarded as 'sacred groves' in some places of India. There is an ancient temple at Chidambaram, nearer to Pichavaram mangrove forests in Tamil Nadu. In this temple, a mangrove species namely *Excoecaria agallocha* has been worshipped as a 'temple tree' by the Hindu religious people, since the 3<sup>rd</sup> century. There was a belief that a 'holy' dip in the temple's pond water that was surrounded by the mangrove species cured even incurable human diseases. The medicinal properties of the plant species have recently been proved scientifically. There is another type of temples by the name 'Bano bibi' temples present at the entry points of Indian Sundarbans. Each temple has a forest god for the Muslims to worship, a forest goddess for the Hindus religious people, and a tiger god. Local people worship in the temple before entering the forest with a belief that the worship will protect them from the tiger attack.

In Gujarat, there are some religious sites of Muslims on the Islands of Mitha Chusna, Khara Chusna, Chhad and Pirotan. Muslims do not cut mangrove trees or molest animals on such Islands. The boat-loads of fishermen with their families arrive on certain festival days on those islands. There were about four dozen old trees of *Avicennia* on Chhas and Zindra and most of them were protected religiously because fishermen worship them. Such individual trees are seen marked by green cloth or flag as symbol of site for muslim's worship place. Shravan Kavadiya is another place of religious importance in Gujarat. Even though the place is located more than 100 km away from the coastal area, it has a mangrove area of 0.7 hectares near the temple "Shravan Kavadiya". These inland mangroves were identified as temple forest and nobody cuts or causes any damage to very old trees of *Avicennia* in the groves.

Besides mangroves, marine mammals like dolphins and whales are also worshipped in India. The fishermen in Tamil Nadu believe that dolphins save them if they happen to fall in to the sea. The Kharwas community of Gujarat worships the whales as an incarnation of Lord Hanuman. However, the largest fish like whale sharks were hunted. Every year, at least 250 whale sharks were killed along the Saurashtra coast. Therefore, the Government of India put a ban on killing whale sharks in 2001. However, the forest department was struggling to implement it. A Hindu religious leader by name 'Morari Bapu', stepped to save the whale sharks in 2003. He touched the sentimental feelings of people by comparing the whale shark with a daughter who comes from as far as the waters of Australia and Mexico to give birth at home in the warmth of the Arabian Sea along the Saurashtra. As a result,

most fishermen have stopped fishing the whale sharks and even if they get entangled, the fishermen cut their nets that often cost up to Rs. 10000, to release the trapped fish. Corporate sectors like the International Fund for Animal Welfare and Wildlife Trust of India, Tata Chemicals and Gujarat Heavy Chemicals have also joined the campaign of the religious leader to save the rare fish in the sea.

## **5. LEGAL FRAMEWORK IN INDIA FOR CONSERVATION OF COASTAL MANGROVES**

Many countries have promulgated laws and regulations to protect the remaining mangrove areas and mitigate against further widespread loss. Effective enforcement of this legislation is, however, often hampered by a lack of financial and human resources. Several Asian countries have ratified the Ramsar Convention on Wetlands and have designated mangrove areas as Ramsar sites, or as National Parks, Reserves or Wildlife Sanctuaries. In India, mangrove forests that are declared as Reserve Forests, Reserve Lands or Sanctuaries are protected by the Forest Department of the concerned State/UT, but mangroves located outside these Reserves and on community lands have not been assisted so far. Such areas exist in Kerala, Karnataka, Andhra Pradesh, Maharashtra and elsewhere.

India is very strong on the policy front, as well as on the legal support available for the conservation of biological resources in the country. Environmental protection is enshrined in the Constitution of India. Article 48-A and Article 51-A(g) of the Directive Principles of State Policy in the Constitution of India state that “*the State shall endeavour to protect and improve the environment and to safeguard the forests and wildlife in the country, and it is a duty of every citizen to protect and improve the national environment including forests, lakes, rivers and wildlife, and to have compassion for living creatures*”.

Under the system of democratic decentralization of responsibilities enshrined in Constitution amendment No. 73 of 1993, local bodies consisting of elected representatives, one third of whom are women, have been entrusted with the responsibility of safeguarding the local environmental capital stocks.

The National Forest Policy 1988 spells out very clearly that the principal aim of Forest Policy must be to ensure environmental stability and maintenance of

ecological balance, including atmospheric equilibrium, which are vital for sustenance of all life-forms, human beings, animals and plants. The derivation of direct economic benefit must be subordinated to this principal aim.

The National Conservation Strategy and Policy Statement on Environment and Development (1992) highlights conservation and sustainable development of mangroves, including coastal areas, riverine and Island ecosystems. Similarly, the National Forest Policy and National Wildlife Action Plan emphasize the conservation of mangroves based on scientific principles, including social and cultural aspects.

India's National Environment Policy (NEP), approved by the Cabinet in 2006, seeks to achieve balance and harmony between conservation and development. The policy is intended to mainstream environmental concerns in all development activities. The dominant theme of this Policy is that while conservation of environmental resources is necessary to secure livelihoods and well-being of all, the most secure basis for conservation is to ensure that people dependent on particular resources obtain better livelihoods through conservation, than from degradation of the resources. The NEP prescribes that human beings are at the centre of concerns for sustainable development and they are entitled to a healthy and productive life in harmony with nature. The Policy recognizes that mangroves are an important coastal environmental resource. They provide habitats for marine species; protection from extreme weather events; and a resource base for sustainable tourism.

The National Environment Policy also recognizes that mangroves, as indeed the other coastal resources like coral reefs and coastal forests, face threats from the following quarters:

- a) poorly planned human settlements;
- b) improper location of industries and infrastructure;
- c) pollution from industries and settlements;
- d) over exploitation of living natural resources;
- e) inadequate institutional capacities for, and participation of local communities in, formulation and implementation of coastal management plans;
- f) lack of consensus on means of provision of sanitation and waste treatment; and
- g) open access nature of many coastal resources.

In view of the above, the National Environment Policy underlines the need to mainstream the sustainable management of mangroves into the forestry sector regulatory regime and to adopt a comprehensive approach to Integrated Coastal Zone Management.

India has many policy and legal frame work especially for conservation of coastal and marine ecosystems as given in the table 6.

**Table 6. India's Existing Policy and Legal Framework for Coastal and Marine Ecosystems**

No	Year	Acts/policies/programmes	Features
1	1882	<u>Indian Forest Act</u>	Provides necessary statutory protection to the mangroves falling under Reserve Forests, Protected Forests and Village Forest Categories.
2	1897	Indian Fisheries Act	Regulates fishing and protects fisheries against destructive fishing using dynamite and explosives
3	1908	Indian Ports Act	Regulates port and vessel movement and safety
4	1950	Coast Guard Act	Levies penalties for pollution of port waters and responsible for combating marine pollution
5	1958	Merchant Shipping Act	Controls pollution from ships and offshore platform
6	1972	Wildlife Protection Act	Provides protection to marine flora and fauna.
7	1974	Water (Prevention and Control of Pollution) Act	Controls pollution from land sources with a jurisdiction upto 5kms from the sea.
8	1976	Maritime Zones Act	Describes various zones such as the EEZ, continental shelf, etc
9	1978	Marine Fishing Regulation Act	Provides guidelines to regulate fishing in territorial waters, regulates mesh size, zones for fishing sectors, fishing seasons, etc
10	1980	Forest Conservation Act	Protects forests, including mangrove forests
11	1982	Coastal Pollution Control Series (COPOCS Prog)	Aims to assess pollution status of coastal waters
12	1986	Environment Protection Act (EPA)	Sets standards for discharged effluents, guidelines for industries, etc
13	1991	Coastal Regulation Zone Notification (under EPA 1986)	Regulates activities in coastal region by classifying into 4 categories
14	1991	Coastal Ocean Monitoring and Prediction Systems (COMAPS)	Assesses the health of coastal waters, pollution monitoring, regulation and legislation

15	1995	National Environmental Tribunal Act	Provides for awarding compensation for damages to persons, property and environment from use of hazardous substances
16	1995	UNCLOS	Provides comprehensive legal framework for issues relating to oceans and seas
17	1996	Coastal Zone Management Plans	Coastal regulation by all coastal states as per order of the Supreme Court
18	1997	National Environment Appellate Authority Act	Addresses appeals related to areas where classes of industries may be established under the EPA for expeditious implementation of projects
19	1998	Ocean Observation and Information Services	Generates oceanographic data
20	1998	Integrated Coastal and Marine Area Management (ICMAM) Project	Provides for the integration of coastal and marine regions by preparing GIS studies and ICMAM model plan for 3 states.
21	1998	Turtle Excluder Device	Judgment by the Supreme Court that all trawlers be equipped with TEDs
22	1998	DOD Programme on assessing marine life beyond 70m depth	Initiated under the ninth five year plan for comprehensive understanding of the Indian EEZ.
23	2002	The Biodiversity Act	Conservation and protection of biodiversity in India
24	2004	Swaminathan Review Committee on CRZ Notification 1991	Suggested a more integrated and scientific approach to coastal zone management
25	2006	National Environment Policy	Adopts a comprehensive approach to environmental protection by addressing linkages in relevant policies, regulations and programmes
26	2007	Draft National Biodiversity Action Plan	Provides action plan for biodiversity protection; notes the limited information, expertise, funding, etc, on biodiversity of coastal and marine areas of the country.

In addition, there are special Acts such as the Karnataka Tree Act and Tamil Nadu Hill Preservation Act, which are specific to the States and have specific application to particular tree species that need protection. The mangroves are also protected through a range of regulatory measures, such as Environment Impact Assessment (EIA) studies under the EIA Notification, 1994 for specialized industries; monitoring of compliance, with conditions imposed while according Environmental Clearance, by Regional Offices of the Ministry and State Pollution Control Boards; enforcement of emission and effluent standards by industries and other entities, and recourse to legal action against defaulters.

**Coastal Regulation:** For the purpose of protecting and conserving the coastal environment, the Ministry of Environment and Forests, Government of India issued the Coastal Regulation Zone (CRZ) Notification, 1991 under the Environment Protection Act, 1986. This notification provides a unique regulatory framework without any parallel, globally speaking, for the conservation of the coastal resources by regulating development activities within the CRZ.

**The main features of the CRZ Notification (1991), as amended from time to time, are as follows:**

- Government of India issued the coastal zone regulation on 19<sup>th</sup> February, 1991 under Section 3(1) and Section 3(2)(v) of the Environment (Protection) Act, 1986.
- The Coastal Regulation Zone (CRZ) Notification, 1991, declares coastal stretches of seas, bays, estuaries, creeks, rivers and backwaters, which are influenced by tidal action (in the landward side) up to 500 meters from the High Tide Line (HTL) and the land between the Low Tide Line (LTL) and the High Tide Line as the Coastal Regulation Zone.
- The Notification regulates all developmental activities in the CRZ area. In the Notification, as per para 6(1) under Annexure-I sub-heading Coastal Regulation Zone-I, mangroves are declared as CRZ-I(i) area. Further, as per para 6(2) sub-heading CRZ-I, no new constructions shall be permitted in CRZ-I area including mangrove areas, except those listed under the Notification.
- The Ministry has constituted National and State/UT Coastal Zone Management Authorities under the Environment (Protection) Act, 1986 for enforcing and monitoring the CRZ Notification (1991).

For regulating developmental activities, coastal stretches within 500 metres of the High Tide Line on the landward side are classified into four categories, as follows:

**Category - I (CRZ-I) :**

CRZ-I(i) :

Ecologically sensitive and important areas: The CRZ I (i) is afforded protection of the highest order to strictly protect all the sensitive coastal/marine living ecosystems.

- National Parks/Marine Parks
- Sanctuaries/reserve forests
- Wildlife habitats
- Mangroves
- Corals/coral reefs *etc.*

CRZ-I (ii) :

Area between the Low Tide Line and the High Tide Line.

- No development activities are permitted in CRZ-I, except for the most essential facilities like laying of pipelines, *etc.*

**Category – II (CRZ-II):**

CRZ-II includes built-up areas. CRZ II includes mainly developed areas such as metropolitan cities. Development in CRZ-II zone can take place beyond the limits of an authorized structure.

**Category – III (CRZ-III):**

CRZ-III categories refer to rural areas where developments like tourism can be extended beyond 200 meters on the landward side.

**Category - IV (CRZ-IV):**

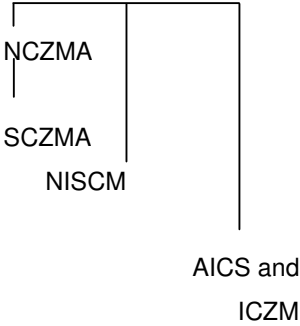
CRZ-IV includes coastal stretches of the Andaman and Nicobar Islands, and Lakshadweep Islands.

The Ministry of Environment and Forests, Government of India is the nodal agency for implementing the CRZ rules. The Ministry, after implementation of the Coastal Regulation Zone Notification over a decade and consequent to the feedback and suggestions received from the stakeholders and NGOs, the Ministry constituted an Expert Committee under the Chairmanship of Dr. M.S. Swaminathan in July 2004 to review and make recommendations with regard to implementation of CRZ Notification, 1991. The Swaminathan Committee submitted its report in February 2005 to the Ministry of Environment and Forest, Government of India. A comparative statement of CRZ notification and recommendations of the Swaminathan Committee is given in the Table 7.

**Table 7. A comparative analysis of CRZ notification and Recommendations of Swaminathan Committee**

No.	Detail	Existing notification issued in Feb.1991	Swaminathan Committee recommendation	Remarks
1.	Coastal Regulation Zone (CRZ)	Coastal stretches of seas, bays, estuaries, creeks, rivers and backwaters which are influenced by tidal action	Areas from territorial limits (12 nautical miles) including its seabed to the administrative boundaries demarcated on the landward side of the seacoast. It will also include tidal influenced water bodies	Seems difficult to implement. Implementing Agencies not identified.
2.	Set back line	(a) 500m from the High tide line (HTL) on the landward side. (b) Land area between the low tide line and high tide line. (c) In case of tidal influenced water bodies, 100 m. on either bank	Setback line in CMZ-II and CMZ-III will be based on vulnerability of coast to natural and manmade hazards. The vulnerability line will be demarcated based on elevation, geology, geomorphology, sea level trends, horizontal shoreline displacement, tidal ranges and wave heights.	The vulnerability line demarcation may give rise to horizontal shore line displacement affecting large extent of areas particularly in low lying flat areas involving even densely populated urban areas. Therefore, this recommendation is likely to face stiff resistance. Hence, not implementable

3.	Categorization of Zones	<p>CRZ consists of 4 Regulatory Zones.</p> <p>(i) CRZ-I.(Sensitive and inter tidal areas) which includes, National Parks and sanctuaries, RFs, wildlife habitats, mangroves, coral reefs, breeding and spawning grounds of fish and marine life, natural heritage and areas rich in genetic diversity, area between the Low and High tide line.</p> <p>(ii) CRZ-II.(Urban or developed) Areas that have been developed up to or close to the shore line i.e. within the Municipal limits, any other legally designated urban area which is already substantially built up and having infrastructure facilities.</p> <p>(iii) CRZ-III.( Rural or undeveloped) Areas that relatively undisturbed and those which do not belong to categories I and II. These include coastal zone in rural areas (developed and undeveloped) and also areas within municipal limits /in other legally designated urban areas which are not sufficiently built up.</p> <p>(iv) CRZ-IV (Islands) Andaman and Nicobar and Lakshadweep.</p>	<p>Proposes 4 Coastal Management Zones.</p> <p>(i)CMZ-I-Ecologically sensitive areas like mangroves, coral reefs, sand dunes, inland water bodies, mudflats, Marine Parks and sanctuaries, coastal forests and wildlife, coastal fresh water lakes, salt marshes, Turtle nesting grounds <i>etc.</i></p> <p>(ii) CMZ-II Areas of particular concern like coastal Municipalities/Corp- orations/ Panchayats with population density more than 400/sq.m., Ports and harbors <i>etc.</i></p> <p>(iii) CMZ-III All other coastal areas not covered under other zones.</p> <p>(iv)CMZ-IV(Islands) Andamanand Nicobar and Lakshadweep.</p>	No comments
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4.	Developmental activities	Prohibited and permissible activities detailed in the notification.	Prohibited and permissible activities will be based on an Integrated Coastal Zone Management Plan to be prepared and implemented with shareholder involvement.	It is a huge task, extremely complicated requiring mosaic of planning units and extremely difficult to implement.
5.	Institutional arrangement	(i) State Coastal Zone Management Authorities (SCZMA). (ii) National Coastal Zone Management Authority (NCZMA)	National Board for sustainable Coastal Zone Management. 	Both current and proposed Institutional arrangements appear grossly inadequate to handle the said task. It would have been better if the Govt. created the Coastal Zone Regulatory Authority rather than Management Authority and Management part left to the State Govts. to implement.

The Swaminathan Committee has evolved the following 12 basic guiding principles to govern future decisions on coastal zone management:

- (1) Ecological and cultural security, livelihood security and national security should be the cornerstones of an integrated coastal zone management policy.
- (2) The coastal zone will include an area of the sea to form territorial limits (12 nautical miles), including its sea-bed, to the administrative boundaries or the

biological boundaries demarcated on the landward side of the sea coast. The coastal zone management will also include the inland tidal water bodies influenced by tidal action and the land area along such water bodies. This area should be taken up for an integrated, cohesive, multi-disciplinary and multi-sectoral coastal area management and regulatory system.

- (3) Regulation, education and social mobilization should be the three major components of a participatory and sustainable coastal zone management strategy. Panchayat Raj institutions in coastal areas should be fully involved in the educational and social mobilization programmes.
- (4) The protection and sustainable development of the marine and coastal environment and its resources should be in conformity with international law, as laid down in 1982 UNCLOS, as well as with the suggestions contained in Chapter 17 of Agenda 21. The Draft National Environment Policy of India also contains useful guidelines. Every effort should be made towards ensuring an Integrated Marine and Coastal Area Management (IMCAM) as prescribed in the 1995 Jakarta Mandate under the 1992 Convention on Biological Diversity.
- (5) Coastal regulation needs to be based on sound, scientific and ecological principles and should safeguard both natural and cultural heritage. Heritage sites need particular care and should be conserved in their pristine purity. These include buildings, artifacts, precincts of spiritual, historical, aesthetic and architectural and/or areas of environmental significance such as richness of biodiversity and scenic beauty. Bird sanctuaries, parks and breeding grounds of migratory birds should be protected.
- (6) The precautionary approach should be used where there are potential threats of serious or irreversible damage to ecologically fragile critical coastal systems and to living aquatic resources. Scientific uncertainty should not be used as an institution for the unsustainable exploitation of coastal resources - both living and non-living as well as to prevent environmental degradation, injustice, and harm.
- (7) Significant or irreversible risks and harm to human health and life, critical coastal systems and resources, including cultural and architectural heritage, would be considered unacceptable. Ecological economics should underpin economic activities, so that present day interests and future prospects are not antagonistic. Significant biological, cultural and natural assets should be considered incomparable, invaluable and irreplaceable and should receive overriding priority in the allocation of resources for coastal area protection and conservation.

- (8) Coastal policy and regulations should be guided by the principles of gender and social equity as well as intra-generational and inter-generational equity, (*i.e.*, the interests of future generations). They should be based on Mahatma Gandhi's dictum, "*Nature provides for everyone's needs, but not for everyone's greed.*" All stakeholders should be involved in decision-making. Precious biological wealth, coming under Marine Biosphere Reserves, should be managed in a Trusteeship mode, with all the stakeholders protecting the unique natural wealth of biosphere reserves as Trustees and not as owners. A case study should be made on how the Gulf of Mannar Biosphere Trust is functioning, so that the Trusteeship pattern of sustainable management can be replicated by the principal stakeholders.
- (9) Coastal protection and bio-resources conservation policies should be guided by techno economic efficiency, the precautionary approach, 'polluter-pays' principle(s) and 'public trust' doctrine. There should be strict liability on the part of those engaged in hazardous or inherently dangerous coastal activities, including the liability to compensate the victims of all human made hazards such as marine pollution and fish contamination. They should also bear the cost of restoring the coastal environmental degradation. The onus of proof in such cases should be on the developers/industrialists for demonstrating that their "development" activities are environmentally benign.
- (10) The principles contained in the Biodiversity Act (2002), should be applied to coastal bio-resources management. This will involve concurrent attention to conservation, sustainable use and equitable sharing of benefits. To address the issue of pressures on marine and coastal ecosystems, as defined in the Johannesburg Plan of Implementation (Part IV) adopted at the 2002 World Summit on Sustainable Development, every effort should be made to promote sustainable fisheries, prevent loss of biological diversity, prevent all forms of marine pollution and ensure that coastal area development and urbanization are eco-friendly.
- (11) The regeneration of mangrove wetlands, coral reefs and seagrass beds as well as the promotion of coastal forestry and agro-forestry will confer both short and long term ecological and livelihood benefits. Carbon sequestration through coastal bio-shields will make an important contribution to promoting a balance between carbon emission and absorption, in addition to offering protection during coastal storms and calamities like Tsunami. An important lesson taught by the tsunami disaster is that the rehabilitation of degraded mangrove forests and the raising of coastal plantations of *salicornia*, *casuarina* and appropriate species of halophytes

will represent a “win-win” situation both for nature and coastal human habitations. No further time should be lost in initiating a national coastal bio-shield movement along the coasts of the mainland of India as well as Islands. This can be a priority task under the National Rural Employment Guarantee and Food for Work Programmes.

- (12) The severe loss of life and livelihoods as well as property caused by Tsunami in Andaman & Nicobar Islands and in the coastal regions of Tamil Nadu, Kerala, Andhra Pradesh and Pondicherry teaches us that short term commercial interests should not be allowed to undermine the ecological security of our coastal areas. Human memory tends to be short and neglecting the lessons of Tsunami will be equivalent to writing off the future of coastal communities.

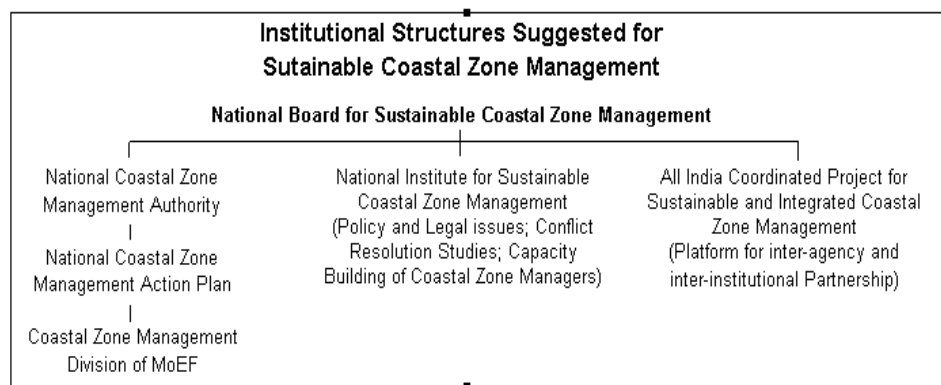
The Committee has also recommended a National Coastal Zone Management Action Plan with an objective *“to protect the coastal zone with people's participation, the livelihood security of the coastal fisher and other communities, and the ecosystem, which sustains the productivity of the coastal areas, while promoting sustainable development that contributes to nation's economy and prosperity.”* The salient features of the Committee's recommendations are as follows:

The Committee has recommended the reclassification of the coastal zone into four Zones and they are:

- 1. Coastal Management Zone-I** - consists of areas designated as Ecologically Sensitive Areas such as Mangroves, Coral reefs, Sand Dunes, Inland tide/water bodies such as estuaries, lakes, lagoons, creeks & straits, Mudflats, Marine parks and sanctuaries, Coastal forests & wildlife, Coastal fresh water lakes, Salt Marshes, Turtle nesting grounds, Horse shoe crabs habitats, Seagrass beds, Sea weed beds, Nesting grounds of migratory birds.
- 2. Coastal Management Zone-II** - consists of areas identified as Areas of Particular Concern such as economically important areas, high population areas and culturally/strategically important areas. The administrative boundaries of these areas would be boundaries of CMZ-II.
- 3. Coastal Management Zone-III** - consists of all other open areas including the coastal seas but excluding those areas classified as CMZ-I, CMZ-II and CMZ -IV.
- 4. Coastal Management Zone-IV** - consists of Islands of The Andaman and Nicobar and Lakshadweep.

For the purpose of managing the above areas, the Committee has suggested Integrated Coastal Zone Management Approach. After taking into account the recent Tsunami, the Committee has laid emphasis on demarcation of vulnerability line all along the coastal areas and has suggested developmental activities to be regulated on the seaward side of the vulnerability line. Since the coastal management is a multi-disciplinary subject, the Committee has suggested a National Sustainable Coastal Zone Management Institute along with organizational structure to address issues relating to policy, law, conflict resolution and to creating public awareness. The Committee has laid special emphasis on developing bio shields all along the coastal areas by intensive plantation of mangroves, casuarinas *etc.*

For the implementation of the recommendations, the report also suggests creation of an organisation:



The Ministry of Environment & Forests has broadly accepted the recommendations made in the Report and has initiated an action for implementing the recommendations. (For details: <http://envfor.nic.in>)

**Fisheries Policies of India:** India is committed for ensuring sustainability of fish population and securing livelihood of about six million people dependent on it. State Governments deal with coastal fishing in the territorial waters, which extend up to a distance of twelve nautical miles from the shore. Whereas, the Central Government handles deep sea beyond a distance of twelve nautical miles from the shore to the deep sea or exclusive economic zone that extends up to a distance of 200 nautical miles. At the central level, the fishery activities are handled by two bodies of the Ministry of Agriculture - Department of Animal Husbandry and Dairying and the Indian Council for Agricultural Research.

The Governments have tried to conserve fish population by resorting to command and control methods- dictating periods and time of fishing, imposing bans, specifying size of nets and kind of gear. The following examples give an idea about the command and control methods that have been practiced:

- Setting apart inshore waters up to a depth of 20 m for the exclusive use of the traditional fishermen;
- The Government has banned the use of certain methods of fishing. For instance, in 1993, the Supreme Court banned the process of bottom trawling in the monsoon seasons;
- A ban of fishing in the seawater in east coast for 45 days from April 15<sup>th</sup> to May 30<sup>th</sup> and in west coast for 65 days from 10<sup>th</sup> June to 15<sup>th</sup> August; ;
- No fishing gear or less than 10 mm mesh from knot to knot in respect of nets other than trawl net shall be used in Tamil Nadu;
- Banning of midnight trawling in certain parts of Tamil Nadu and Andhra Pradesh;
- The non-mechanised fishing vessel, but not mechanized fishing vessel shall be used for fishing within three nautical miles from the shore and shall go for hook and line fishing and boat seine in Tamil Nadu. Fishing within 100 metres below a river mouth is prohibited.

**International Co-operation:** India has promoted regional and international co-operations for effective implementation of suitable strategies for conservation of biodiversity. The Country has participated in major international events on environment and biodiversity conservation since 1972. India has also contributed to developing the agreed texts, ratified, and complied with the commitments in various international conventions relating to biodiversity. These agreements are : Convention on Biological Diversity (CBD), Convention on International Trade in Wild Species of Endangered Flora and Fauna (CITES), Ramsar Convention on Wetlands, World Heritage Convention, and the Bonn Convention on Conservation of Migratory Species (CMS). Some other international agreements with a bearing on biodiversity, to which is a party include; UNFCCC, UNCCD, Commission on sustainable Development, World Trade Organisation, FAO facilitated International Treaty on Plant Genetic Resources and UN Law of the seas. A Global Tiger Forum of Tiger Range Countries has been created for addressing international issues related to tiger conservation.

India has also actively supported numerous regional and bilateral programmes on biodiversity especially with neighboring countries through for a like SAARC, ASEAN and ESCAP. MoEF, the nodal Ministry for the CBD and other biodiversity related conventions, is also the nodal agency in the country for the United Nations Environment Programme (UNEP), SACEP, ICIMOD, and IUCN-MFF (Mangroves for the Future). It has institutionalized the process for developing country's position on major issues for negotiations under different International Conventions.

India along with sixteen other mega-diverse countries, which are rich in biodiversity and traditional knowledge, has formed a group known as the Like-minded Megadiverse Countries (LMMCs). These countries are Bolivia, Brazil, China, Colombia, Costa Rica, democratic Republic of Congo, Ecuador, Indonesia, Kenya, Madagascar, Malaysia, Mexico, Peru, Philippines, South Africa and Venezuela. The LMMCs hold nearly 70% of all biodiversity. India chaired the LMMCs for a two-year period from March 2004 to March 2006, and coordinated the activities of this group focusing particularly on access and benefit sharing issues under the CBD.

Access to genetic resources and sharing of the benefits arising out of these resources constitute the core elements of the Convention. While access and benefit sharing is subject to national legislation, as provided for in Article 15 of the CBD, national action alone is not sufficient to ensure benefits to the country that prides the resources, particularly in instances where the genetic resources is utilized in another country for developing processes and products on which protection is obtained. In this background, an international regime (IR) on Access and Benefit sharing (ABS) is presently being negotiated by a working group on Access and Benefit Sharing under the aegis of CBD, pursuant to a landmark decision of Seventh Conference of Parties (COP) to the CBD. The eighth COP held in March 2006 has set a deadline of 2010 for completing the negotiations of IR on ABS.

Notable progress in this area notwithstanding, concerted efforts are now required to further improve bilateral, regional and multilateral cooperation, as also cooperation with UN agencies and other international organizations on issues related to biodiversity. There is also a need enhance our own capacities to comply with our commitments, and ensure sustained flows of resources for biodiversity management.

## **6. ROLE OF GOVERNMENT IN CONSERVATION AND MANAGEMENT OF MANGROVES AND CORAL REEFS IN INDIA**

In India, the Ministry of Environment and Forests under Government of India has an overall responsibility for conservation and management of coastal and marine ecosystems. The Government of India provides 100% financial assistance for implementation of Management Action Plan (MAP) related to mangroves, coral reefs and other related ecosystems. To assist the Ministry and regulate the activities, a committee namely the “*National Committee on Mangroves and Coral Reefs*” is functioning. The overall mandate of the Committee is to assist Government regarding policies and action programmes for conservation of mangroves, coral reefs and related ecosystems. The National Committee is chaired by the secretary of Ministry of Environment and Forests or his nominee. The Committee has representatives of Forest Departments, Coast Guards, Department of Ocean Development, Central Marine Fisheries Research Institute, Space Application Centre, and experts/scientists from academic and research institutions. A similar committee at different maritime States, namely ‘State Level Steering Committee on Mangroves and Coral Reefs’ is also functioning.

The State Governments prepares Management Action Plans (MAPs) for specific mangrove and coral reef areas. After obtaining approval of the State Level Steering Committee, the States/Union Territories submit their MAPs to the National Committee for financial assistance.

The MAPs have the following components:

- (i) Survey, assessment and demarcation;
- (ii) Capacity building: staff training and skills;
- (iii) Shelter belt development;
- (iv) Protection and monitoring;
- (v) Restoration and regeneration measures;
- (vi) Alternate and supplementary livelihoods;
- (vii) Community participation;
- (viii) Mangrove afforestation/plantation on degraded areas and open mudflats;
- (ix) Biodiversity conservation;
- (x) Sustainable resource development;
- (xi) Desilting;

- (xii) Weed control;
- (xiii) Pollution control;
- (xiv) Environmental education and awareness;
- (xv) Impact assessment;
- (xvi) Concurrent and terminal evaluation.

Currently approved MAPs are being implemented in 38 mangrove areas and 4 coral reef areas all along the Indian coastline (**Annexure III**). New mangrove/coral reef areas can be identified by State Governments for their inclusion in the management action plans.

## **7. ROLE OF MFF IN CONSERVATION AND MANAGEMENT OF COASTAL ECOSYSTEMS IN INDIA**

In order to conserve and manage coastal ecosystems, the Government of India is already pursuing activities, which are relevant to the Programmes of Work (PoW) as proposed by the MFF initiative. Thus the activities of Government of India will be complementary to the efforts of the MFF initiative. All these efforts were made without any financial help by IUCN, but with resources generated through various schemes and programmes of the country. Data generated in the past activities will form baseline information which would be of immense help to undertake the MFF initiative in India.

The country has many sites which are vulnerable to natural calamities to be brought under management action plans. The country also has some knowledge gaps which are essential for more efficient coastal management and better livelihood. In this context, the financial support is essential under IUCN-MFF programme to support and promote the efforts of Government of India for conservation and management of coastal and marine ecosystems. Priorities for MFF support are given in Section 9.

## **8. KEY ISSUES IDENTIFIED**

### **8.1. Coastal Livelihood issues (PoW 8)**

Human inhabitations are significant along the estuaries, deltas, backwaters and townships of India. The Sundarbans has large human settlements within the mangrove forest. Other mangrove forests in India have negligible villages inside the mangrove forests. In the absence of any alternative employment, the poor people depend on traditional skills to earn their livelihood and depend largely on forest

resources; they tend to resort to illegal practices like over-fishing, poaching and felling. The people are collecting the tiger shrimp seeds in large numbers thereby causing damage to juvenile fish stocks. It is estimated that in the Sundarbans each year, about 5000 fishermen and 500 honey collectors and woodcutters enter the forests in search of livelihood ignoring even the threat of attacks by tigers and crocodiles!

Environmentally sustainable livelihoods are extremely important to be provided to the people, in order to reduce pressure on the coastal environment and to make coastal communities less dependent on coastal resources, and to motivate local people for to support protective management measures. The efforts of MFF should target especially the communities involved in the most unsustainable practices regarding coastal resources use.

Some examples of coastal livelihoods are: (i) Mariculture practices in the open coastal water for farming of seaweeds, shell fish and finfish; (ii) Integrated fish farming with cultivation of mangroves, other halophytes, fishes, prawns, mollusks, crabs *etc.*; (iii) Organic cultivation of vegetables along the non-saline or less saline landward areas of coast, and near human dwellings; (iv). Honey production using apiculture practices, which will also help in better pollination opportunities for some mangrove species that are insect-pollinated; and (v) Ecotourism.

Ecotourism especially in coastal and marine areas has great potential for generation of better livelihood for the local community. However, it requires stronger Governmental involvement for the reasons: (i) reliance on public common property resources; (ii) direct competition between tourists and local people for use of the resources; (iii) high degree of risk in the adverse marine and coastal environment; and (iv) complex and dynamic nature of the coastal and ocean environment. Eco-tourism model has to aim at saving the coastal and marine ecosystems and helping the local community. The model has to be developed in site-specific manner, following the four guidelines *viz.*, (i) Minimize adverse impact; (ii) Build environmental and cultural awareness and respect; (iii) Provide enriching experiences for visitors and stakeholders; (iv) Channel direct economic benefit to conservators; and (iv) Empower and involve local communities.

A new concept of “Dawn Festival” is conducted at Pichavaram mangrove forests, Tamil Nadu once in a year at the early morning hours by the district administration in association with Tamil Nadu Tourism Development Corporation and local Panchayat. The aim of this event is to showcase Pichavaram as an ecotourism destination especially to the stake holders of the industry like inbound tour operators, tourism consultants, hoteliers, State and National media and tourism media.

A tourism consultant (‘Help Tourism’) in partnership with WWF and the Sundarbans Tiger project developed a new ecotourism module in 2003 at Bali Island, near Gosaba National Park, where the tourists can stay, interact with the local people and enjoy nature, with a package cost of Rs. 4500-15000. The locals run a nature shop, selling gifts and handicraft items. The money that comes in from the shop goes back to the locals



**Fishing: a major livelihood in mangrove waters**

## **8.2. People’s participation issue (PoWs 2, 3, 6, 8, and 10)**

People’s participation is extremely important in conservation and management of coastal resources. Realizing this, almost all States of India have initiated Joint Forest Management (JFM) activities in conservation and management of their coastal ecosystems.

No decision-making is complete without participation of local people whose livelihood depends upon wetland resources. People have been using mangrove areas in a traditional manner since times immemorial. Both traditional and latest scientific technologies need to be blended to achieve long-term conservation goals.

Participatory Rural Appraisal (PRA) involving local communities should be the main approach to ensure community participation. This approach should also take into consideration issues of gender sensitization and involve women in the management issues.

The main constituents of this component should include:

- Situation Analysis to understand the biophysical conditions and resource utilization pattern;
- Additional alternate income generation programmes such as handloom, handicrafts, integrated farm management techniques and other measures to reduce pressures on mangroves;
- Highlighting of gender-related cross-cultural, governance-related practices and other special concerns for assessment and change by community;
- Selection of villages based on socio-economic conditions and willingness of local communities to participate;
- Participatory Rural Appraisal for understanding the concerns of the community relating to mangrove conservation and socio-economic development;
- Formation of village level institutions;
- Identification of Mangrove Management Units for restoring and conserving the area;
- Village level microplans for implementing the activities;
- Implementation, monitoring and evaluation.

The M.S. Swaminathan Research Foundation (MSSRF) and State Forest Department have successfully demonstrated a pilot project on Joint Forest Management (JFM) in restoration and conservation of mangrove wetlands through a people's participatory approach in Tamil Nadu, Andhra Pradesh and Orissa. However, JFM is at various stages of development in different states. The mangrove atlas of India for the three states prepared by MSSRF contains information about mangrove resources which will be helpful for the user agencies to develop management action plans.

In the Sundarbans, the forest department has formed 54 forest protection committees and 11 eco-development committees (EDC), covering 47,325 families in an area of 87,287 hectares. JFM has picked up in almost 70% of the committees. It

has achieved remarkable improvement of relationship between people and the forest department, in saving most of the strayed tigers, protecting the plantations and voluntary patrolling to protect the forest. Many eco-development activities have been taken up; their success depends on the level of participation of the community, particularly of women members in planning and implementing besides proper monitoring and evaluation.

In the Sundarbans, about 95% of the population depends primarily on agriculture and about 50% of them are landless laborers. The priority need of the communities is for freshwater, which is required for irrigation and drinking purpose. As the Sundarbans are within a high rainfall zone, the EDC/JFM activities relating to rainwater harvesting have great scope and demand and such activities are likely to get full support of the people. Hence, under the JFM programme, the people are provided with deep tube wells for drinking water, irrigation tanks and canal for agriculture and ponds for fish culture. Larger support for those activities will improve livelihoods and income generation for landless families and marginal farmers. . However, the availability of land is a major constraint.

Ecotourism generates employment for local people in the Sundarbans. Entry fees are collected from tourists entering the buffer area of the Sundarbans Tiger Reserve, with 25% of the revenue earned in the Reserve area is ploughed back to the eco-development committees.

Other eco-development activities in the Sundarbans include (i) improvement of village roads, bridges and culverts; (ii), construction of jetties; (iii) supply of seedlings for forestry, fruit species for orchards, and fuel wood and fodder species; (iv) provision of poultry and piggery units; (v) bee hives for apiculture; (vi) solar street light and solar lanterns in remote villages; (vii) artificial insemination and immunization of cattle; (viii) conducting medical camps; (ix) provision of smokeless 'chullahs', nylon net and fencing nets; and, (x) offering training to people on crab fattening, sewing, apiculture, nursery techniques, *etc.*, to improve their skills and to help them attain economic independence.

### **8.3. Coastal Restoration issues (PoW 2 and 9)**

About 38% of Indian mangroves are of an open type with sparse vegetation. This deserves immediate attention for rehabilitation and restoration practices. In this

regard, understanding of the planting site is necessary, especially, in respect of tidal amplitude, ground level height, salinity, soil texture and topography.

A priority task in the coastal zone of India is the creation of bio-shield consisting of mangroves and coastal shelter belts with appropriate width and density, along the entire length of the coast. It was observed during the 2004 Tsunami that a coastal shelter belt less than 200 meters wide is not very effective against Tsunami forces. It is also necessary to take up large-scale plantation programmes in all the catchment areas or watershed regions to minimize soil erosion.



**Participatory restoration practice: a successful option**

#### **8.4. Coastal Management issues**

Sustainable management of coastal and inshore marine resources is imperative for the benefit of society, especially natural resource-dependent coastal communities. In this regard, three important issues such as private ownership, local field surveys and marine and coastal protected areas are highlighted here-under:

##### **8.4.1. Private ownership issue (PoW 3 and 12)**

Mangrove lands are privately owned in some areas especially in the States of Kerala, Karnataka, Andhra Pradesh and Maharashtra. To cite an example, the mangroves of Kerala cover a total area of 17 km<sup>2</sup>, but only about 2 km<sup>2</sup> are controlled by government and the rest are with private ownership. A high rate of human population growth has resulted in acute land scarcity that led to widespread reclamation of wetlands, which has resulted in significant loss of mangroves.

#### **8.4.2. Local Field Surveys (PoW 1, 5, 7 and 14)**

For the purpose of effective management, survey intensity of mangrove forests needs to be improved and strengthened. Whereas the Forest Survey of India (FSI) may continue with the current scale, intensity and interval of its survey activities, the mangrove States should take up State-level annual surveys on a much larger scale, so that it is possible to pick up even the smaller and fragmented patches of mangroves, using the forest department's existing facilities and wherever such facilities are found inadequate to implement the task, they may avail the MFF funds to upgrade their GIS facilities under Small Grant Facility.

#### **8.4.3. Marine and Coastal Protected Areas (MCPAs) (PoW 13.1)**

The MCPAs are recommended as a good potential tool for marine resource conservation, provided clear objectives are set for each of such area supported by a strong locally-designed management plan. However, it should be focused more on national priorities than on regional ones. Management effectiveness of the MCPA implementation should be based on biodiversity rather than on economics. There is a need for a separate department and Authority for dealing the MCPAs. Basic information on MCPAs are required as follows:

1. What is the global extent of MCPAs?
2. What is actual extent of MCPAs in India?
3. What are the potential areas of MCPAs in India for further action?

A detailed description of Marine and Coastal Protected Areas is given in **Annexure-IV**.

### **8.5. Other Related Issues**

#### **8.5.1. Capacity and Training needs for integrated coastal management (PoW 7.1):**

Capacity needs are required much on ecotourism, restoration of coastal ecosystems, and coastal protection. There is a need for training frontline forest staff on SCUBA diving, snorkeling, monitoring of corals and efficient mangrove nursery raising. In Andhra Pradesh, the Forest Department formed Eco-Development Committees (EDC) and 'Vana Samarakshana Samithis' (VSS) in the mangrove areas under an on-going World Bank aided forestry project. The local communities (EDC/VSS) have been provided with training and capacity building in skill development for alternate livelihood and in restoration of mangroves. As a result of these activities, there is an

increase in the area under dense mangrove forest and water bodies, as well a decrease in scrub forests, grasslands and saline blank areas.

#### **8.5.2. Ecosystem valuation issues (PoW 4.1)**

Better understanding and information on economic valuation of coastal and marine ecosystems is essential. This valuation would be of immense help in planning and appraising coastal conservation and developmental activities. For the valuation, simple, consistent, user-friendly tools and methods are necessary.

#### **8.5.3. Civil society awareness (PoW 6.1)**

There are flagship species related to ecotourism and livelihood. People do not know the value of them. For example, highly endangered Whale shark visits Gujarat coast; Olive Ridley turtles migrate for breeding to Orissa coast where 50% of world turtle population is found. However, the eggs of the turtles are poached by dogs, wildlife and humans; Irawadi dolphins and other cetaceans are of great concern the world over. Therefore, environmental education and awareness is necessary.

#### **8.5.4. Issue of participatory monitoring (PoW 6.1 and 14.3)**

There is a need to develop and demonstrate the monitoring of coastal ecosystems using appropriate indicators (including socioeconomic and biological indicators). In this process, local people have to be involved. This participatory approach will greatly increase manpower to collect large amounts of data in a short time at a low cost. The effort will help in educating the local community and enhancing their feeling of ownership for the ecosystems. A guideline for the participatory monitoring is given in **Annexure-V**.

#### **8.5.5. Sustainable Financing Mechanisms (PoW 10.3)**

This aspect is vital to ensure community participation in coastal management activities. Incentives in cash and kind are necessary inputs for sustainable financing. Women should be involved as coastal managers in sustainable financing. Sustainability should not be lost when credit is withdrawn.

An example in this aspect is described here. Gujarat Ecology Commission has been successful in restoration of mangroves in Gujarat with the help of India-Canada Environment Facility and Gujarat State Government. With the involvement of local communities in regeneration of mangroves, about 4,000 hectare area has been

brought under mangrove cover at ten different villages within the span of five years. Community participation has been institutionalized through formation of 10 Community Based Organization (CBO) at the village level. A corpus fund has been created in each village by depositing a part of daily wages in the bank account. Out of daily wage amount of Rs. 80, Rs. 56 is paid in cash, whereas Rs. 20 is deposited in the corpus fund. Remaining Rs. 4 is treated to be the contribution from the community towards the project. 60% of this fund along with the interest is reserved for maintenance of mangroves and other assets created under the project. Balance 40% amount is used as revolving fund to give loans at an interest rate (not exceeding bank rates) for income generation activities of CBO members.

#### **8.5.6. Communication issues**

Information based on scientific principles and successful stories are useful only when they reach the end users. This requires attractive and efficient channels of visuals, toolkits, websites and outreach activities.

#### **8.5.7. Knowledge gaps (PoW 1.1)**

There are knowledge gaps in the management of coastal resources. To fill the gaps, research activities are required. The research findings can be incorporated for effective management action. The gap areas include (i) biodiversity (taxonomic impediments in terms of coastal marine biodiversity which deserve attention) (ii) bioprospecting, (iii) genetic and tree breeding, (iv) pests and diseases, (v) interrelationship between coastal ecosystems, (vi) coastal processes, and (vii) pollution abatement.

#### **8.5.8. Issue of Climate Change**

Climate change and its impacts on coastal regions of India are little known. Researchers at the Centre for Atmospheric Study, Indian Institute of Technology, Delhi, have predicted a mean sea level rise of 15-38 cm in India along with a 15% projected increase in tropical cyclones by the end of this century. An estimated total area of 5763 sq. km along the coastal States of India could be inundated and almost 7.1 million (4.6% of the coastal population) could be directly affected. The most vulnerable areas along the Indian coastline are the Kutch region of Gujarat, Mumbai and South Kerala. The deltas of the Ganges (West Bengal), Cauvery (Tamil Nadu), Krishna and Godavari (Andhra Pradesh), Mahanadi (Orissa) and also the Islands of Lakshadweep Archipelago are likely to be damaged heavily. On the East Coast,

West Bengal is the most vulnerable to sea level rise, followed closely by Orissa. Past observations of the mean sea level along the Orissa coast indicated a long-term rising trend of about 1.0 mm, on an annual mean basis. However, the recent data suggests a rising trend of 2.5 mm a year in sea level rise along the Indian coastline, particularly in and around Orissa.

Mangroves act as a sink of atmospheric carbon. They are able to sequester about 1.5 metric tons of carbon per hectare per year, and the upper layers of mangrove sediments have high carbon content, with conservative estimates indicating the levels of 10 per cent. Conversion of mangroves to fishponds – which invariably involves excavation of about two metres of sediment – will eventually result in a release of about 1400 tons of carbon from the sediments alone.

## **9. PRIORITIES**

### **9.1. Priorities in the Programmes of Work**

There are four priority areas related to the MFF Programmes of Work and they are:

- **Environmentally sustainable livelihoods, to off-load pressure from coastal ecosystems (PoWs 8.1, 8.3, 8.4, and 8.5):** There is a great need for training to empower people to take up different enterprises. It is necessary to develop alternate livelihood options for the people who are dependent on coastal mangrove resources. The alternate options may be mangrove resources based, wherein additional or alternate employment opportunity is created in more than one stage, through the process of value addition owing to the training and skills acquired. Livelihood projects should explicitly target the people involved in illicit felling, poaching and destructive fishing methods, and women groups. The identification of activities and training needs should be done through the consultative process between the community, NGOs and the Governmental departments. PRA exercises should form part of the Micro-Plans prepared for the coastal villages.
- **Plantations of mangroves for creating green belts (PoW 2 and 9.3);**
- **Civil society awareness, its participation in coastal decision-making and its sustainable financing (PoW 6.1, 6.2, 6.4, 6.6, 10.3 and 11.1);**
- **Improving the knowledge gaps (PoW 1.1).**

## 9.2. Priorities in Types of Projects

MFF Project priorities for India are broadly three fold, as follows, and all these three priorities are placed equally and merit simultaneous attention.

- **Large and Medium Size Projects** are to address major gap areas and issues in conservation and management of coastal and marine biodiversity. This project type is an action-oriented and it involves field-level activities.
- **Small Grant Projects** are to generate leads for developing efficient models for conservation and management of coastal and marine biodiversity.
- **Targeted Research Projects** are proposed as back-up for 1 and 2 above, to generate data and information to fill the knowledge gap areas.

## 10. LARGE AND MEDIUM SIZE PROJECTS

### 10.1. Aims of Large and Medium Size Projects

#### General Aims:

- To conserve and restore coastal mangrove ecosystems as a key asset to support human well-being and coastal security against natural calamities.
- To promote people's participation in coastal conservation, restoration and management of mangrove resources.
- To support coastal livelihood initiatives that are sustainable and helpful to maintain natural coastal resources.

#### Specific Aim:

The total potential area, which is ready for restoration in the country is estimated at about 200 sq km. It is proposed to be covered in a period of 3-5 years, beginning 2008-2009.

### 10.2. Scope of Large and Medium Size Projects

#### General Scope:

- **Provision of basic amenities and infrastructure for better living:**  
The local people will be provided with basic requirements such as safe drinking water, sanitation, transport, electricity, education and health.

- **Facilitating the understanding of people about key resources use problems, constraints, and conflicts:** The efforts will facilitate the understanding of the local people about the status of resources, issues of degradation and the importance of conservation.
- **Empowering people with skills:** The local people will be equipped with skills so as to help them take up alternative and supplementary livelihoods.
- **Enhancement of resource base:** The local people will be involved in developing the mangroves and associated fishery resources through restoration activities in unproductive and unused lands.
- **Higher learning facilities:** The children will be provided with higher levels of education so as to enable them to have better job opportunities and to reduce the pressure of the future generation on natural resources.
- **Strengthening collaboration:** The project will initiate and strengthen the collaboration among multiple partners, including Government agencies, NGOs, research institutions, UN agencies and multilateral bodies.

#### **Specific Scope of Large and Medium Size Projects:**

The potential areas include even difficult areas which may require fairly high investment per unit area, particularly in respect of Tamil Nadu, where the investment required may go up to Rs. 40,000 per hectare, plus maintenance cost of Rs. 15,000 to 20,000 per annum for 2 years. Therefore, the achievement of annual targets will depend on the availability of financial resource.

#### **10.3. Priorities in Large and Medium Size Projects**

The Large and Medium Size Projects have to be implemented for better conservation and management of mangrove ecosystems in the coastal States which are vulnerable to natural calamities. In order to get significant effect of implementing the projects, a 3-5 year time period is necessary with proper monitoring of the projects at regular interval of six months. The large and medium size projects include conservation, restoration, people's participatory approach, development and strengthening of collaborative efforts between multiple partners including local people, government, NGOs, research institutes and other multilateral bodies.

It is suggested that the priority should be given to restoration of less difficult areas so that more area can be covered for less expenditure. The more difficult areas can be tackled after restoring other areas.

#### 10.4. Site Selection for Large and Medium Size Projects

For execution of these types of projects, five States in India were identified as the priority. For MFF, the selection has been made based on the following three major criteria:

- Large extent of mangroves;
- Biodiversity richness of mangroves; and,
- Tsunami effected mangroves.

West Bengal and Gujarat fall under the first category; Orissa and West Bengal come under the second category; and, Andhra Pradesh and Tamil Nadu fall under the third category.

The selection of the five States has also been based on seven other criteria, as given in Table 8.

**Table 8. Criteria-based Selection of Five States for Implementing Large and Medium Size Projects**

No.	Criteria	States	Reason
1	Human pressure	West Bengal	Human settlement is significant within mangrove forest.
2	Pollution	Gujarat, West Bengal	In Gujarat, several mining, cement and saltpan industries, increased terminal oil pipeline passages and refineries pose pollution problems. In Sundarbans, a large amount of wastewater is discharged daily through the Hoogli estuary, besides release of oil and grease from fishing vessels.
3	Degradation	Gujarat, West Bengal and Andhra Pradesh	These states have open sparse mangrove areas of 741,331, 314 km <sup>2</sup> respectively.
4	Cyclone	Orissa, Andhra Pradesh, Tamil Nadu	These states are frequently affected by cyclones.

5	Climate change and sea level rise	West Bengal	According to World Bank Report, about 80% of the Sundarbans area will go under the sea by 2050.
6	Seascape setting	Gujarat and Tamil Nadu	All three marine and coastal ecosystems such as mangroves, sea grass and coral reefs are existing together.
7	Unique features	West Bengal and Tamil Nadu	Sundarbans has 60% of Indian mangroves with high biomass productivity and it is the only mangrove-tiger land in the world; and, Tamil Nadu has a mangrove species which is endemic to India.

## 11. SMALL GRANT PROJECTS

The major aim of the MFF Small Grant Facility (SGF) is to support local community action in the restoration and management of coastal ecosystems as a basis for sustainable development. SGF projects will also provide tangible ‘models’ to inspire policy-making. They will contribute concrete measures to ensure participation, gender equality and secure livelihoods for marginalized groups.

## 12. TARGETED RESEARCH PROJECTS

There are still knowledge gaps in the management of coastal resources in India. Research activities are required to fill the gaps. The MFF should support targeted research to improve the scientific bases for management, but it is essential that the research findings can be incorporated for effective management action. The gap areas include (i) biodiversity, (ii) bio-prospecting; (iii) genetic and tree breeding; (iv) pests and diseases; (v) interrelationship between coastal ecosystems; (vi) coastal processes; and (vii) pollution abatement. These research needs are summarized below.

### 12.1. Biodiversity assessment (site specific) (PoW 1.1 and 1.5)

There are some coastal sites having rich biodiversity. For example, Bhitarkanika in Orissa is one of the two genetic paradises in the world of mangroves. The Government of India has recognized the area as a “*Mangrove Genetic Resource Centre*”. In this regard, a comprehensive biodiversity assessment and development as a data base is required.

### **12.2. Bioprospecting for high value products (PoW 1.5 and 15.1)**

Bioprospecting in coastal ecosystems for their pharmaceutical and industrial values should be undertaken. This effort may lead to development of patents, which in the future can be an enormous source of revenue and other opportunities. The mangroves have already been found to be a source of high value products such as enzymes, medicines, pigments, microbial bio-fertilizers, bio-feed and single cell proteins of industrial utility. A recent study in India by M.S. Swaminathan Research Foundation has isolated salt-tolerant gene from a mangrove species and introduced it into a paddy crop and the salt tolerant paddy variety is under experimental trail.

### **12.3. Genetics and tree breeding for enhancement of mangrove growth and biomass production (PoW 1.1, 1.5 and PoW on coastal climate change issues)**

Mangroves exhibit poor growth in extreme environmental conditions. However, some genotypes of mangroves exhibit remarkable growth and biomass production even under stress conditions. These genotypes have to be selected and propagated to develop mangroves capable of growing well even in adverse conditions.

With the increasing seawater intrusion due to coastal climate change, it is necessary to find out high salt tolerant genotypes of mangroves. Tree breeding may also be attempted to get superior genotypes of mangroves. Therefore, MFF can support genetic and breeding studies in mangroves of India and this will have a bearing on resilience and recovery of mangrove species under coastal climate change issues.

### **12.4. Pest and disease studies and remedial measures (PoW 2)**

Mangrove leaves are often found damaged especially in *Avicennia* species. Propagules are also heavily damaged, which reduce their survival, sprouting and establishment. The poor health condition makes the mangroves with reduced genetic vigor and poor resilience to environmental changes. This also leads to loss of reproductive potential and regenerative capability of mangroves. It is necessary to study pest and disease problems in relation to mangrove health issues, and to find suitable remedial measures to control insect and disease damages in rehabilitated mangroves.

**12.5. Interrelationship between coastal ecosystems for augmentation of fish resources (PoW 1.5 and 2.4)**

Coastal ecosystems are functionally linked, but the linkages are not properly understood. It has been proved experimentally in the Caribbean Sea that when coral habitat is connected with mangroves, the biomass of several commercially important fish species is more than doubled. Conversely, after removal of mangroves, the largest herbivorous fish in the Atlantic, *Scarus guacamaia* has suffered extinction. It is therefore necessary to study the connectivity among mangroves, coral reefs and sea grasses for augmentation of fish resources.

**12.6. Studies of coastal processes (Hydrodynamics, siltation, erosion etc.) for better conservation and management of coastal ecosystems (PoW 2, 3 and 3.3)**

Mangrove forests are highly dependent upon water sources. Freshwater from upstream regions or rainfall is required for reduction of salinity that facilitates the germination and sprouting of seedlings. Seawater is also required for salt requirement of mangroves and for wetting mangrove habitat at regular intervals. The reduced freshwater flow due to dam and embankment construction has led to increases in salinity. Moreover, the river mouths all along the east coast of India are heavily silted thereby the entry of seawater into the mangrove forests is prevented, resulting in poor flushing of mangrove habitat and in hyper-salination of soil. The high saline condition has resulted in reduction of seed germination, change of species composition, increase of hyper-saline mudflats, change in fish migration, and damage to wildlife. Therefore, research studies are required to determine the critical requirement of water for sustenance of mangroves and their fishery and wildlife resources in coastal environment. The data will be helpful to ensure the critical input of freshwater from upland and tidal water from the sea for sustainability of coastal ecosystems and for augmentation of fish resources in the coastal water bodies. This is a specific aspect of integrated land and water resource management (PoW 3.3), which is relevant to both sound coastal ecosystem rehabilitation and sustainable management (PoW 2 and 3).

**12.7. Studies of pollution abatements by mangroves for motivation of industries in restoration of mangroves (PoW 1.5 and 15)**

Mangroves are believed to be the bio-filters of pollutants. However, their efficacy has still not been understood for carbon sequestration and other pollution abatement

processes. This will have a bearing on motivating the coastal polluting industries to take up mangrove plantations on a large scale. Hence, studies on the use of mangroves for pollution control are necessary. It is important to stimulate the private industrial sectors to engage in coastal restoration and livelihood needs.

### **13. NATIONAL STRATEGY AND ACTION PLAN**

The total extent of mangrove forests already available in five identified States is about **3621 km<sup>2</sup>** and the extent of area immediately available for restoration is approximately **200 km<sup>2</sup>**. Therefore, National Strategy and Action Plan (NSAP) has been prepared under the following two categories:

1. Conservation Strategy and Action Plan for the existing mangroves; and,
2. Restoration Strategy and Action Plan for potential and or degraded mangrove area.

Through this NSAP, MFF India will advocate for both these strategies within the targets mentioned above of 3621 km<sup>2</sup> and 200 km<sup>2</sup> respectively (over five years).

#### **13.1. Strategy and Action Plan for Conservation**

**Conservation Strategy** consists of three components:

1. Conservation through community participation by creating eco-development committees and facilitated by NGOs and Forest Department;
2. Conservation through Government departmental protection model. However, greater emphasis and larger role shall be given to category 1; and,
3. Long term strategy: Education (SGF and large projects to be earmarked for improvement of educational facilities)

#### **Action Plan for conservation:**

The National Forest Policy, as well as the other Acts, prohibits destructive utilization of mangroves. The non-destructive use of mangroves provides nothing much to be shared by local communities, except fishing. Therefore, eco-development committees may be allowed free fishing/prawn collection in existing mangrove waters. This should be encouraged particularly in the canal bank plantations. In addition, entry point activities, employment generation activities and imparting skills and upgrading of available skills for value addition can be taken up under eco-development programmes. These activities assume greater importance in the light of the fact that marine resource production potential is fully realized.

This Action Plan considers the following options:

**Imparting new skills and upgrading of existing skills:** In view of serious mismatches between supply and demand, it is imperative to equip the excess population with new skills to enable them to take up new vocations. This could be taken up in accordance with the micro-plan prepared based on Participatory Rural Appraisal (PRA) exercises.

Simultaneously, steps may be taken to upgrade the existing skills to enable value addition for enhancing the incomes from the existing levels. Also the levels of value addition have potential for additional employment generation. All these activities should be carried out through self-help groups (SHGs) and eco-development committees (EDC) or village forest committees (VFC) as per the micro-plans prepared collectively by the villagers, NGOs and Forest Department.

The EDC/VFC should function as a source of micro-credit for the SHGs. This interdependence is suggested to prevent polarization of village communities. The employment generation activities and alternate income generation activities may be identified in the micro-plan. In this regard, ecotourism has greater potential. The activities undertaken by West Bengal in Sundarbans under the eco-development programme can be examined by other States for their possible adoption, in addition to their own innovations. All Small Grant Projects will be undertaken for capacity building under this component.

**Increasing and enhancing the existing resource base:** This will be achieved by expanding the mangrove area through the process of restoration. It is estimated that nearly 200 km<sup>2</sup> of area shall be brought under mangroves under the mangrove restoration programme. This area, hitherto totally unproductive, will generate additional marine resources to support a part of the excess population pressure.

**Entry point activity:** This component will aim at creating community assets such as village roads, drinking water, electrification, fish drying yards, improvements to schools and provision of health services *etc.* This will be achieved by interdepartmental coordination and pooling the resources of various departments in the EDC villages.

For this purpose, a District Co-ordination Committee under the chairmanship of the District Collector shall be created and the Divisional Forest Officer (DFO) shall be the Member-Secretary. The district heads of the various departments such as fisheries, electricity, rural development, health, education departments *etc.*, will be the members. This will be a model similar to one that is being implemented by Gulf of Mannar Biosphere Trust under a GEF-UNDP assisted project in Tamil Nadu.

#### **Management of different categories of ownership for mangroves**

- Mangroves under the charge of forest departments are managed as per management plans or working plans approved by the Government.
- Mangroves under the control of other Government departments need to be taken over by the forest department for protection and proper management by constituting them as either protected forests or Reserved Forests.
- Privately owned mangroves are usually in small patches and scattered. Wherever they are contiguous to Government owned mangrove patches, the same may be acquired by the Government on an outright purchase basis, or they may be constituted as 'Community Reserve' or 'Conservation Reserve' under the Wildlife (Protection) Act, 1972, if the said area is considered ecologically sensitive or biologically important. In other cases, the private owners have to be motivated and financially supported to protect and develop the mangroves. The Government of India, Ministry of Environment and Forests has a scheme for such cases under the "*Grant-in-aid for Greening India Project*". Under this scheme, even private owners can take up afforestation activities. The scheme provides a subsidy of Rs. 18/- per seedling planted.
- There are some isolated linear strips having no clear cut ownership status. Such areas should be identified and brought under protection by the respective State Governments.

**Long-term strategy for conservation:** The long-term strategy for conservation aims at imparting higher levels of skills through education (including higher education) so that the next generation does not have to depend entirely on the existing marine resources. Therefore, the education system has to be strengthened as an entry point activity and it is suggested that about 25% of total project cost may be earmarked for strengthening this system. However, the major contributions will

come from the Government education department, while the District Co-ordination Committee may also have to take up necessary efforts in this regard.

National Green Corps (NGC)/Eco-clubs can be profitably made use of for conservation of coastal and marine ecosystems. The NGC/Eco-clubs is an ambitious programme aimed at spreading environmental awareness among children and involving them in environment related activities. The best way to attempt to bring about a change in the society is through children as they are the single most important influence in any family and are the future custodians of nature. With this in mind, the State Governments and the Ministry of Environment and Forests, Government of India have launched the programme. In Tamil Nadu alone, there are around 3 lakh student members under the programme. The activities of each school/college are undertaken under the guidance of a teacher co-ordinator and those of each educational district are carried out by an Environmental awareness co-ordinator. The Ministry of Environment and Forests, Government of India has given guidelines on the NGC functioning. These guidelines are framed for a minimum of 120 hours of activity per year, as follows: (i) orientation (30 hours); (ii) campus activities (40 hours); (iii) community activities (50 hours); and, (iv) Eco-camp activity (3 days).

### **13.2. Strategy and Action Plan for Restoration**

#### **Strategy for Restoration**

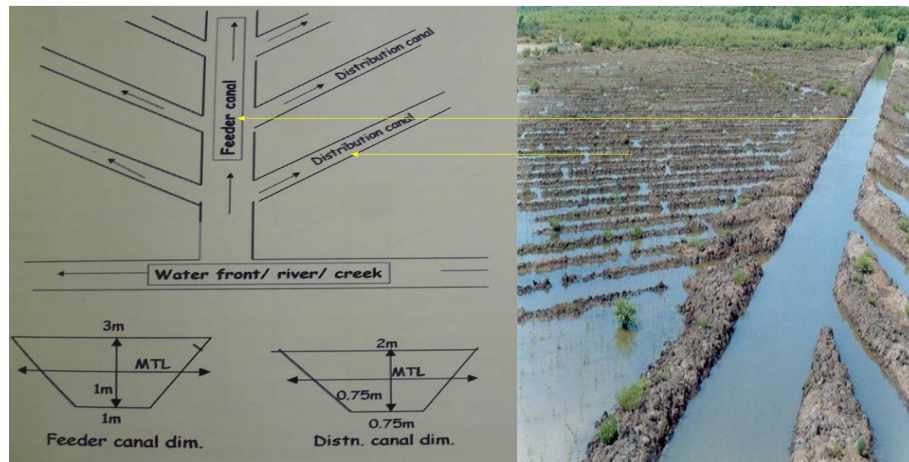
The restoration strategy is adopted based on the tidal amplitude. Consequently, the entire coastal area is divided in to two categories *viz.*,

1. High tidal amplitude area, and
2. Low tidal amplitude area.

High tidal amplitude areas: Gujarat and West Bengal fall under this category. In the high tidal amplitude areas, it is suggested that the existing planting technique of direct seed sowing and planting seedlings in the mud flats should be continued. Tamil Nadu has dispensed with the nurseries practice and has adopted direct propagule planting with very good results. This technique can also be adopted by other States as it would save on the cost of operating nurseries.

Low tidal amplitude areas such as Tamil Nadu and Andhra Pradesh have developed a planting technique called “Canal Bank Planting” for restoration of mangroves and the ‘Fish bone’ design has been the most successful of all the canal bank planting designs tried so far, and it happens to be the latest improved design for the canal bank planting. This technique involves formation of the feeder canal; 3 m-top, 1 m- bottom and 1 m-deep; and the distribution canals of 2 x 0.75 x 0.75 m dimension in the mud flats and planting propagules directly in the inter-tidal zone of the canals. Along the banks of the canals, planting is made. The Biodiversity enrichment, however, is left to the nature to take care and nature does it very efficiently.

In a nutshell, wherever tidal amplitude is low, the preference for restoration should be the canal bank planting technique with fish bone design; and, wherever tidal amplitude is high, the technology adopted should be seedling planting and direct seed sowing in the mud flats.



**“Canal bank planting” and fish bone design: a preferred restoration technique for low tidal amplitude areas.**

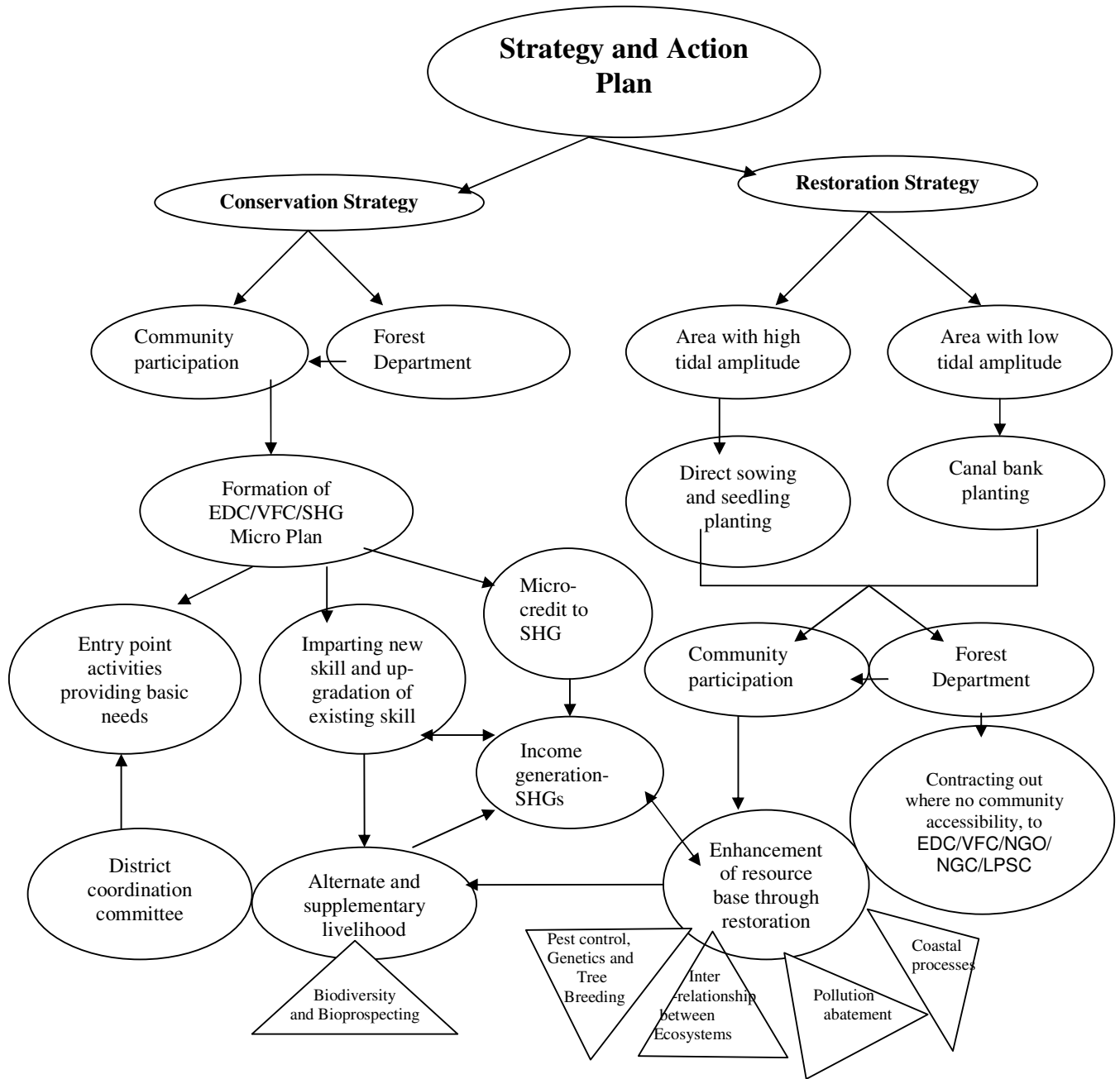
**Action Plan for Restoration**

Restoration will be carried at through:

- a) Community participation, and
- b) Government departmental effort

Wherever communities are willing and can undertake restoration operations, the communities may be mobilized and funds may be transferred to them. In other

areas, where communities are not involved, or not dependant on the mangroves, the Government departments may have to step in to undertake the restoration operation. The possibility of contracting out the restoration works wherever possible to the EDCs/VFCs/NGOs/NGCs/local private sector companies should be considered. The schematic diagram for the overall strategy and action plan is given in the Fig. 1.

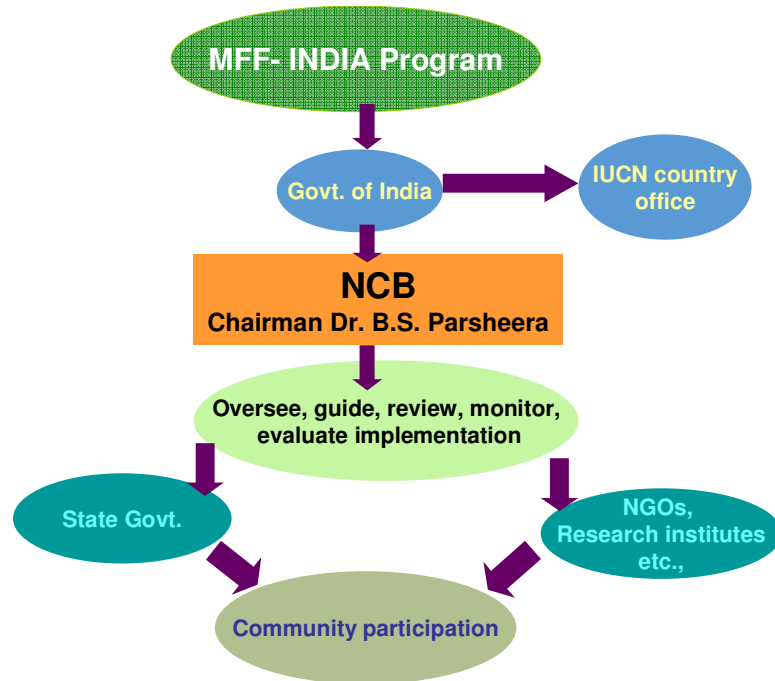


**Fig. 1. Schematic diagram for National Strategy and Action Plan**

(VFC = Village Forest Committee, SHG = Self Help Group, CBO = Community Based Organization, EDC = Eco-Development Committee, NGC = National Green Corps, LPSC = Local Private Sector Companies). The triangles indicate research priorities

#### 14. STRUCTURE AND FINANCIAL ARRANGEMENTS

The National Strategy and Action Plan formulated for India deserves support of the MFF. The NSAP will be implemented through the Ministry of Environment and Forests (MoEF), Government of India via the National Coordinating Body (NCB) of MFF India. Organizational Structure and implementation of action plan are shown respectively in the Fig. 2 and Table 9.



**Fig. 2. Organizational structure for implementing the National Strategy and Action Plan**

The mangrove areas proposed in the NSAP for conservation and restoration are lying under the Government control. Moreover, large and medium size projects will be implemented by the Governmental agencies with the participation of VFCs/EDCs and NGOs. Therefore, the MFF may support implementation of such projects through Ministry of Environment and Forest, Government of India. The IUCN country office may work in close cooperation with the Ministry. It is therefore, suggested that the MFF funding support for large and medium size projects may be indicated to the MoEF year-wise and the MoEF may be requested to invite proposals from each State Government, which can be processed by the MoEF and the IUCN country office jointly. The use of good office of MoEF for this purpose will facilitate better compliance by the State Governments. The plan size for 2008-2009 will depend up on the size of funding for the year and the same should be communicated

to the Ministry immediately so that the project proposals can be invited from the concerned State Governments, received and processed by July-August so that implementation of project starts before the onset of north-east monsoon, as far as eastern coast of the country is concerned.

To start with, the National Coordination Body (NCB) in India will identify the institutions for Small Grant Projects and Targeted Research Projects for implementation, based on the available funds. The NCB will also sanction and monitor the progress of the projects.

The Large and Medium Size Projects require to be supported for a period of 3-5 years, for implementing the conservation of about 3621 km<sup>2</sup> of existing mangroves, and restoration of 200 km<sup>2</sup> mangrove areas in the five states namely West Bengal, Gujarat, Orissa, Andhra Pradesh and Tamil Nadu. The MFF initiative will serve as demonstration projects towards achieving these targets.

The Small Grant Projects require to be supported for a duration of 6 months to 18 months, depending upon the nature of work, replicability of the results, scaling up potential for the benefit of coastal people.

The Targeted Research Projects require funding for 1-2 years to fill knowledge gaps in management of coastal resources and to provide essential inputs for future conservation strategy and livelihood support.

**Table 9. Types of projects, agencies and programme of work to be initiated under MFF initiative for 2008-09**

Name of project (No.)	Type of agencies Identified by NCB	Month of work initiation (Tentative)	Duration of project
Large and Medium Size Projects (5)	State Govt. Forest Departments of West Bengal, Gujarat, Orissa, Andhra Pradesh and Tamil Nadu	July-August, 2008 (States of east coast)	3-5 years
Small Grant project (No., depending on funding)	NGOs, Research Institutions, etc.	October, 2008	6-18 months
Targeted Research projects in knowledge gap areas (No., depending on funding)	Research and academic institutions etc.	December, 2008	1-2 years

## 15. CONCLUSION

This National Strategy and Action Plan has brought out more than 100 potential project ideas, under the fifteen IUCN-MFF Programme of Work, as given in the table 10. The project ideas delineate the key aspects related to conservation of the coastal and marine ecosystems, strengthening of empowerment, and enhancement of governance in integrated coastal zone management. These project ideas will form basic concepts for formulating projects of different types: Large and Medium Projects, Small Grant Projects and Targeted Research Projects.

**Table 10. Potential project ideas *vis-à-vis* IUCN-MFF Programme of Work (PoW) Under National Strategy and Action Plan for India**

PoW No.	PoW	Potential Project idea
1	Improving the <b>Knowledge base</b> for coastal planning, policy and management	<ul style="list-style-type: none"> <li>• Biodiversity assessments in less explored and unexplored coastal and marine areas (<i>e.g.</i> deep sea biodiversity)</li> <li>• Generate baseline data of all associated flora and fauna of coastal ecosystems, including keystone species</li> <li>• Bio-prospecting of coastal and marine resources for high value products and genes</li> <li>• Ecological evaluation of coastal ecosystems</li> <li>• Biology of mangrove/coral reef/seagrass species especially those at threat</li> <li>• Understanding of structure, growth and functions of coastal ecosystems</li> <li>• Interrelationships between coastal ecosystems</li> <li>• Pests and diseases of corals, mangroves and seagrasses and their remedial measures</li> <li>• Coastal processes such as hydrodynamics, siltation and erosion on coastal and marine ecosystems</li> <li>• Studies on coastal circulation and sediment transport to identify sites for coral recruitment/growth of new colonies and seagrasses</li> <li>• Carbon sinks and sequestration potential of mangroves</li> <li>• Effects of coastal pollution on coastal and marine ecosystems</li> <li>• Bioremediation potential of mangroves in pollutant abatement</li> <li>• Focused research on the impact of global warming, climate change and sea level rise on coastal ecosystems</li> </ul>

		<ul style="list-style-type: none"> <li>• Documenting and promoting the use of traditional knowledge on management of coastal and marine resources</li> </ul>
2	Designing ecologically and socio-economically sound <b>coastal ecosystem rehabilitation</b>	<ul style="list-style-type: none"> <li>• Assessment of the past and current restoration works</li> <li>• Identification of potential areas for rehabilitation and natural regeneration of mangroves/seagrasses/coral reefs.</li> <li>• Models for innovative community based coastal restoration</li> <li>• Efficient techniques for mangrove restoration and regeneration</li> <li>• Biodiversity enrichment in mangrove plantation and its impact on ecology and fishery resources</li> <li>• Coral transplantation and rehabilitation</li> <li>• Seagrass transplantation</li> <li>• Identification of appropriate biological and socio-economic indicators for monitoring of coastal ecosystems</li> <li>• Impacts of canal digging in saline blank areas on ecology (salinity, hydrology, siltation <i>etc.</i>) and fisheries</li> <li>• Design and development of efficient 'canal bank planting' techniques for mangrove restoration</li> <li>• Training courses on coastal restoration and rehabilitation</li> <li>• Assessment of fishing activities using different crafts and gears and their impacts on fish stocks in coastal waters</li> <li>• Development and implementation of captive breeding and sea ranching for enhancing the fish stocks of commercial uses</li> <li>• Demerits of sea ranging on coastal and marine ecosystems</li> <li>• Ecological impacts of alien/invasive species in coastal and marine environment</li> <li>• Design and development of mechanisms for enhanced action on coastal restoration and associated livelihoods with involvement of stakeholders</li> </ul>
3	Providing decision support for 'reef-to-ridge' approaches to <b>land and resource management.</b>	<ul style="list-style-type: none"> <li>• Assessment of land based activities and their effects on coastal ecosystems and livelihood</li> <li>• Effect of reduced freshwater flow on coastal ecosystems and fishery resources</li> <li>• Awareness programmes for river-based planners and inland resource managers and policy makers</li> </ul>

		<ul style="list-style-type: none"> <li>• Design and development of mechanisms for inter-sectoral coordination in environmental aspects of coastal management</li> </ul>
4	Integrating coastal ecosystem <b>economic values</b> into development planning and appraisal	<ul style="list-style-type: none"> <li>• Economic valuation of ocean and coastal ecosystem services</li> <li>• Development of ecosystem valuation tools and methods</li> <li>• Data base development on coastal and marine ecosystem values in response to specific development and conservation issues</li> <li>• Impacts of mangrove degradation on local communities and socio-economics</li> <li>• Training and awareness programmes for development and conservation planners on economic values of coastal ecosystems and the use of valuation tools</li> </ul>
5	Learning from <b>evaluation of the environmental effects of coastal management</b> initiatives	<ul style="list-style-type: none"> <li>• Evaluation of the effects of coastal management initiatives</li> <li>• Develop simple methodologies for monitoring reefs, mangroves and seagrasses</li> <li>• Training for <i>in situ</i> monitoring of coastal ecosystems with involvement of stakeholders</li> <li>• Assessment of eco-development activities on conservation of coastal and marine ecosystems</li> <li>• Impact of education and awareness programmes on conservation of coastal ecosystems</li> <li>• Analysis of existing laws/policies (<i>e.g.</i> Fishing holidays) and their impacts on coastal resources and management</li> </ul>
6	Promoting <b>civil society awareness and participation in decision-making</b>	<ul style="list-style-type: none"> <li>• Awareness programmes for stakeholders on importance of conserving the coastal and marine ecosystems</li> <li>• Preparation of information materials in local language in an attractive manner</li> <li>• Resource users conflict in coastal and marine environment (eg. Fishers and farmers, traditional and non-traditional)</li> <li>• Designing of websites, visuals and toolkits for effective communication</li> <li>• Development of primary and secondary school curricula on coastal and marine ecosystems</li> <li>• Multi stakeholders fora especially women fora for coastal zone management.</li> <li>• Analysis of constraints in the formation of village committees and their remedial measures</li> </ul>

		<ul style="list-style-type: none"> <li>• Establishment of awards and incentives for the individuals and community contributing towards coastal protection and conservation of coastal and marine biodiversity</li> <li>• Involvement of National Green Corps/Eco-clubs especially from coastal regions to spread environmental awareness among school children and to involve them in environment related activities</li> <li>• Establishment and/or modernization of Interpretation centres at least one in each State/Union Territory at the entry point</li> <li>• Up-gradation and modernization of infrastructure facilities for nature education and eco-tourism</li> <li>• Public awareness about coastal and marine resource conservation through locally popular folklore like 'Yakshagana' in Karnataka State.</li> <li>• Public awareness of wetland values and benefits especially the mangroves should be created by undertaking programmes on the "International Mangrove Action Day" on July 26<sup>th</sup> each year as adopted by Mangrove Action Project, and the "World Wetland Day" on 2<sup>nd</sup> February as adopted by Ramsar Convention of Wetlands.</li> </ul>
7	<p><b>Building the capacity of professional coastal managements for integrated coastal management</b></p>	<ul style="list-style-type: none"> <li>• Assessment of status and threats for conservation of coastal and marine ecosystems</li> <li>• Development of new methodologies, criteria and indicators for sustainable management of coastal and marine ecosystems</li> <li>• Capacity for regular coastal resource survey</li> <li>• Capacity building on existing techniques of GIS and remote sensing.</li> <li>• Training and capacity building on coastal and marine taxonomy</li> <li>• Exploring possibility of adoption of new techniques such as creation of virtual herbaria, autonomous underwater vehicles, remotely operated vehicles, and molecular techniques for reef research, survey and management</li> <li>• Support to higher education and research in Integrated coastal management through grants, partnership and leadership development programmes</li> <li>• Development of training modules for coastal practitioners and coastal managers</li> <li>• Develop on-line training programme on coastal management</li> <li>• Training the frontline staff on SCUBA diving, snorkeling, coral monitoring and mangrove health monitoring <i>etc.</i></li> </ul>

		<ul style="list-style-type: none"> <li>• Work with mass media to build the capacity of journalists and writers to report on ecosystem concerns in radio, TV and newspapers, with a special focus on local language presentation.</li> <li>• Developing national center for coastal and marine biodiversity and resources</li> <li>• Developing national centre for coastal and ocean management</li> </ul>
8	Supporting environmentally <b>sustainable livelihoods</b> among coastal communities	<ul style="list-style-type: none"> <li>• Analysis of sustainable coastal livelihood incomes, equality and gender issues</li> <li>• Coastal ecotourism strategies for conservation of habitats and generation of livelihoods.</li> <li>• Mariculture practices in the open coastal waters for farming of seaweeds, shellfish and finfish</li> <li>• Integrated fish farming with mangrove silviculture and other halophytes, prawns, mollusks, crabs <i>etc.</i></li> <li>• Apiculture practices and their ecological and economic valuations</li> <li>• Organic cultivation of vegetables along the non-saline or less saline landward areas of coast</li> <li>• Development of guidelines for environmentally sustainable fishing activities</li> <li>• Critical assessment of alternate coastal livelihoods</li> <li>• Training on livelihood options among local communities</li> <li>• Development of efforts to add value to local use and marketing of non fish mangrove products</li> <li>• Impact of livelihood rehabilitation on fishery resources</li> </ul>
9	Improving <b>community resilience to natural disasters</b>	<ul style="list-style-type: none"> <li>• Assessment of status of coastal shelterbelt and green belts for coastal protection</li> <li>• Design and development of models for coastal bio-shield with regard to density, width, species composition <i>etc.</i></li> <li>• Proactive management strategies for mitigation of natural disasters in coastal environment</li> <li>• Community-based development of beach/coastal forests and sand dunes</li> </ul>
10	Identifying <b>Sustainable financing mechanisms</b> for coastal ecosystem conservation	<ul style="list-style-type: none"> <li>• Analysis of existing sustainable funding mechanisms.</li> <li>• Design and development of innovative models for sustainable financing at protected area management, coastal ecosystem rehabilitation, and community livelihood activities.</li> </ul>

		<ul style="list-style-type: none"> <li>• A pilot study on payment for ecosystem services schemes for selected coastal ecosystems and management programmes, based on private-public-community partnerships</li> <li>• Impact of women in sustainable financing practices</li> </ul>
11	Supporting <b>national integrated coastal management</b> programmes	<ul style="list-style-type: none"> <li>• Assessment of national institutional mechanisms and programmes for Integrated Coastal Management.</li> <li>• Support to the operations of State-level coastal zone management authorities.</li> </ul>
12	Strengthening the integration and enforcement of environmental and social safeguards in <b>coastal land use planning</b>	<ul style="list-style-type: none"> <li>• Analysis of legal and regulatory measures governing coastal zone land use and development</li> <li>• Development of plans for coastal zones at national and local levels, including needs for ecosystem protection within land use zoning.</li> <li>• Working out the mechanisms to deal with land-use conflicts around critical ecosystems, particularly protected areas.</li> </ul>
13	Building national systems of <b>Coastal and marine protected areas</b> that contribute to a regional network	<ul style="list-style-type: none"> <li>• Analysis of existing protected area coverage and recommend areas in need of additional protection.</li> <li>• Assessment of management effectiveness of existing protected areas leading to the development of strategies for management improvements.</li> <li>• Training the managers on effective management of coastal and marine protected areas</li> <li>• Development of new, or strengthening of existing, protected areas in critical or under-represented coastal ecosystems.</li> <li>• Integrating marine data into the World data base on protected areas</li> <li>• Establishment of national and regional networks of marine protected areas</li> </ul>
14	Promoting adaptive <b>coastal management programmes</b> that include ongoing ecological and socio-economic assessment and monitoring	<ul style="list-style-type: none"> <li>• Training for community-based scientific monitoring of coastal ecosystem health using biological and socio-economic indicators</li> <li>• Identification and inclusion of simple parameters like ratios of <i>Porites/Acropora</i> and growth patterns (vertical and horizontal growth as indices of reef health and recovery</li> <li>• Establishment of <i>in situ</i> and <i>ex situ</i> gene banks (Genome resource centres) for mangroves corals and seagasses</li> </ul>
15	Encouraging environmentally <b>sustainable business practices</b> in coastal areas	<ul style="list-style-type: none"> <li>• Awareness programmes on Corporate Social Responsibility, under which the industries/companies are committed to community-focused initiative, including environmental protection</li> </ul>

		<ul style="list-style-type: none"> <li>• Development of industrial sector specific guidelines on environmental risk, threats and opportunities, and existing regulatory mechanisms.</li> <li>• Development of models for coastal conservation by partnerships between Governments, NGOs and local communities and the private sectors</li> <li>• Implementation of captive breeding of ornamental fishes for restocking of the reef and generation of alternate livelihoods</li> </ul>
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Our strategy is based on basic tenets of the National Environment Policy and it is in consonance with cardinal principles promulgated by the M.S.Swaminathan Committee Report on regulation of coastal zones. The strategy prepared in this document is consistent with national objectives, national policies and national programmes. Action will be taken via all three types of projects, namely large and small size projects, small grant projects and targeted research projects, simultaneously with one project complementing the other. In doing so, the objectives of both India and the MFF initiative on conservation and management of coastal and marine biodiversity would be achieved successfully.