Mangroves for the Future
INVESTING IN COASTAL ECOSYSTEMS

Proceedings of the workshop on

Ecological Considerations in Coastal Development

Organized by Mangroves for the Future, Sri Lanka

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List of Acronyms

ADB	Asian Development Bank
CBO	Community-based Organization
CC&CRMD	Coast Conservation and Coastal Resources Management Department
CCA	Coast Conservation Act
COC	Certificate of Conformity
CZM	Coastal Zone Management
CZMP	Coastal Zone Management Plan
DRR	Disaster Risk Reduction
EFL	Environmental Foundation Limited
EIA	Environmental Impact Assessment
EMP	Environmental Management Plans
EPL	Environmental Protection Licence
FAO	Food and Agriculture Organization
GSMB	Geological Surveys and Mines Bureau
IEE	Initial Environmental Examination
IESL	Institute of Engineers, Sri Lanka
IMCC	Inter-Ministerial Co-coordinating Committee
ITPSL	Institute of Town Planners Sri Lanka
IUCN	International Union for Conservation of Nature
LA	Local Authority
MFF	Mangroves for the Future
NARA	National Aquatic Resources Research and Development Agency
NARESA	Natural Resources, Energy and Science Authority (now called National Science Foundation)
NCB	National Coordinating Body
NEA	National Environmental Act
NGO	Non-governmental Organization
NPP	National Physical Plan
NPPC	The National Physical Planning Council
NPPD	The National Physical Planning Department
NPPP	National Physical Planning Policy
NSC	National Steering Committee
PAA	Project Approving Agencies
RDA	Road Development Authority
RSC	Regional Steering Committee
SAM	Special Area Management
SEA	Strategic Environmental Assessment
SIDA	Swedish International Development Agency
SLIA	Sri Lanka Institute of Architects
UDA	Urban Development Authority
UNDP	United Nations Development Program
UNEP	United Nations Environmental Program
WI	Wetlands International

Executive Summary

A half-day workshop on 'Ecological Considerations in Coastal Development' was held at the Sequel, Cinnamon Grand, Colombo, for 31 participants from a range of organizations, under the aegis of Mangrove for the Future (MFF), Sri Lanka.

Mr. Shamen Vidanage, Acting Country Representative of IUCN, Sri Lanka Country Office, which is the national secretariat for MFF in Sri Lanka, welcomed the participants and spoke of the importance of viewing and valuing coastal ecosystems as natural infrastructure that provides dividends in the long-term.

Mr. Ajith Silva, Chairman of the National Steering Committee of Mangroves for the Future, Sri Lanka, gave a brief introduction about the MFF initiative and how it functions in each country in the Asian region.

The keynote address was delivered by **Dr. Jayampathy Samarakoon**, Coastal Ecologist and Consultant, Integrated Coastal Management. He noted that we are entering an interesting period of many transitions and even more dangers. This transition is the sustainability transition, but Dr. Samarakoon preferred to refer to it as the 'humanistic transition.' Ecological engineering has emerged as a discipline and there is now a shared language emerging between engineers and ecologists. Civil engineers, ecological engineers and ecologists all deal with systems — engineers with complicated systems, ecologists with complex systems. Dr. Samarakoon noted that there are no coastal ecosystems that have not been influenced by people. Coastal ecosystems are, therefore, complex social-ecological-political systems. They are complex systems because their structure and functioning are based upon changing relationships among the interacting parts.

Focusing on barrier-built estuaries, Dr. Samarakoon stated that as soon as a barrier-built estuary is born, it will eventually die through sediment entrapment and infilling through a process of maturation and evolution. Sri Lanka's barrier-built estuaries, because of their inherent shallowness and relatively small size, will fill up sooner than deeper, larger counterparts elsewhere in the world. Engineers make complicated systems that are meant to be stable and predictable, for instance, in barrier-built estuaries that are complex, characterized by uncertainty, inherently unstable and constantly changing. Combining engineering and ecosystems, in general, and barrier-built estuaries, in particular, is, therefore, a major challenge in a humanistic approach. Any engineering activity that does not take into account the sedimentation behaviour of barrier built estuaries undermines their ecosystem services. In Sri Lanka, much of the ecological engineering in barrier-built estuaries involves what is pretended to be 'restoration engineering', that also damages the ecosystem.

Ecologists have identified the three factors that contribute to ecosystem degradation. They are: (i) *the failure to define the focal system*; (ii) *the failure to clarify the role of humans in the focal system* and (iii) *failure to distinguish between external drivers and internal system variables.*

Dr. Samarakoon, quoting Robert Merton, stated that much of what goes awry in planning development could be attributed to five sources: (i) *ignorance*: incomplete use of available information and knowledge to make decisions; (ii) *error*: incorrect analysis of a problem or following habits that worked in the past; (iii) *immediate interest* (greed): short-term payback being made the priority while ignoring, entrained long-term changes; (iv) *values*: refers mainly to the lack of ethics and morality coupled with lack of empathy with persons affected by an engineering activity; and (v) *self-fulfilling prophesy*: this is where planners predict an outcome and strive to demonstrate its manifestation even in the face of contradictory feedback.

Dr. Samarakoon concluded by noting that civil engineers and ecologists must collaborate together, with other disciplines and exchange ideas in regard to how coastal ecosystems in general may be managed humanely. A National Physical Planning Policy has been gazetted and gives clear guiding principles to promote environmental sustainability through (i) *the precautionary principle*; (ii) *inter-generational equity*; (iii) *conservation of biological diversity and ecological integrity*; and (iv) *improved valuation, pricing and incentive.*

Prof. Mahanama spoke about the gazetted National Physical Plan. The National Physical Planning Policy (NPPP) has been formulated by the National Physical Planning Department (NPPD) to direct the physical development of the country up to the year 2030. This policy has attempted to address major environmental issues — such as an increase in the incidence of natural disasters, damage to coastal ecosystems and coastal erosion. In addition, it addresses a number of economic and social problems in the country that result from differences in income distribution, an increase in poverty, unemployment and regional disparities.

Physical Planning is carried out in Sri Lanka mainly by two authorities, the Urban Development Authority (UDA) and the NPPD. These organizations are legally governed by two laws: the Urban Development Authority Law No. 41 of 1978 and its amendments; and the Town and Country Planning Ordinance No. 13 of 1946, and its amendments, one of which created the NPPD. The UDA is authorized to carry out physical planning activities in areas declared by the UDA as ‘urban development areas’. The NPPD is the apex body for physical planning in Sri Lanka and is authorized to carry out physical planning at national, regional, district and local levels.

The NPPP was prepared under the guidance of three important committees established under the new Act, the Town and Country Planning [Amendment] Act. No. 2000: a) the National Physical Planning Council (NPPC); b) the Inter-Ministerial Co-coordinating Committee (IMCC) and c) the Technical Advisory Committee.

The main element of the National Physical Plan is to restructure the country’s landscape and the entire human settlement pattern in following manner for next 20 years: to establish (i) Metro Regions with Metro Cities; (ii) District capitals; (iii) main highways; (iv) main railway lines; (v) seaports and (vi) airports.

The total population among five metro regions is projected to be 10.5 million by 2030.

The NPPP has also declared a policy framework, to identify highly environmentally-sensitive zones and to conserve such zones in the country. Accordingly, two major highly environmentally-sensitive zones have been identified: (i) the environmentally highly sensitive central hill country, and (ii) environmentally highly sensitive coastal areas. These environmentally sensitive areas

have been designated to prevent damage by human activities and to protect them for future generations because of their value to human well-being.

All five metro regions are located in coastal areas of the country. In order to prevent further coastal erosion, the NPPP has recommended that activities already identified in the coastal zone management plan are implemented.

It is understood and accepted that sectoral planning cannot solve problems and issues as they are implemented in isolation. Provincial councils are expected to prepare their own integrated plans in line with NPPP, considering the needs of the specific region. In practice, it is evident that sectoral institutions and provincial authorities have carried out and are still carrying out development activities contrary to the NPPP at the national and sub-national level.

Dr. Anil Premaratne, Director General of the Coast Conservation and Coastal Resources Management Department made a presentation on 'Ecological considerations in coastal development: perspectives of the Coast Conservation and Coastal Resource Management Department'. He set the stage by noting that Sri Lanka has a coastline of 1,620 km, of which various extents have been protected with hard structures because of erosion; other stretches are wildlife parks or protected coastal areas; yet others are classified as highly sensitive where no development can be permitted. There are fish landing sites, anchorage sites and fisheries harbours, as well as tourist areas and narrow coastal stretches comprising roads and railway tracks, urban centres, other settlements and industries. These figures beg the question 'How much of coastal areas is now available for coastal development activities without damaging ecosystems?'

Along the coastline there is tourism; fisheries infrastructure; aquaculture development; industries and associated structures; and roads and bridges as the main types of developmental activities. Because of time constraints, the focus of the presentation was only on the first area: tourism. Although tourism suffered during the decades of conflict, since 2009, after the cessation of hostilities, the industry recovered strongly, with arrivals exceeding one million. The projected target for tourist arrivals is 2.5 million tourists, and 42,500 rooms will be needed to accommodate this influx of tourists. This gives an indication of the magnitude of development that is necessary in the coastal area for tourism alone. This again begs another question, 'Can the coastal area accommodate this extent of development, when there is such a small extent of the coast available for development?'

In coastal areas, as a consequence of coastal development, there is degradation of coastal ecosystems: pollution; user conflicts; increasing poverty; uncertainty of food security; and increasing of disasters. The challenge for the Coast Conservation and Coastal Resources Management Department is to provide solutions to these issues. For example, unless poverty is alleviated, mangroves will continue to be destroyed.

The Coast Conservation and Coastal Resources Management Department has implemented six strategies to minimize ecological impacts: regulation; education and awareness; policy development; monitoring; research and coordination.

Dr. Premaratne then discussed the effectiveness of each of these management strategies, noting that regulation is extremely difficult to implement and that inter-agency coordination is weak.

He concluded that the balance among ecology, development and economy needs much more practical action by all agencies, actors, and nations. Active people's participation is essential. Whatever action is taken, ultimately depends on political will.

Prof. Samantha Hettiarachchi of the University of Moratuwa spoke about 'Investigating the performance of coastal ecosystems for hazard mitigation'. The coastal zone — comprising coastal communities, the built environment and ecosystems — is exposed to a wide range of hazards, both episodic and chronic, arising from natural phenomena and human-induced activities.

There are many mitigation measures that could be adopted in coastal zone management when planning for a tsunami and other coastal hazards that accompany high waves, heavy inundation and extreme impacts. They essentially deal with hazard mitigation, vulnerability reduction and improving the capacity and preparedness. In combination, they reduce disaster risk reduction and develop hazard resilient communities.

Measures that mitigate the impact of the hazard are identified as physical interventions or structural measures and can be classified broadly into three types depending on their location and function in protecting the coast. This is the platform on which engineering and ecologists must meet to work together. The types of measures and typical examples for each category are (i) reducing the impacts of waves prior to reaching the shoreline (a partial barrier located in coastal waters); (ii) protecting the coastal zone by preventing the inland movement of waves (a full barrier at the shoreline); and (iii) mitigating the severe impacts of waves on entry to the shoreline (a partial barrier at the shoreline). Prof. Hettiarachchi showed how these barriers can be artificial or natural.

Field investigations conducted in Indian Ocean states after the Indian Ocean tsunami of December 2004 highlighted the resilience of coastal ecosystems and vegetation in their ability to mitigate the impact of hazard. Depending on the height and other characteristics of the incoming waves, there were many examples which provided evidence of efficient wave energy absorption of ecosystems and vegetation. However, engineers need guidelines in order to use natural ecosystems. Research into the 'design specifications' of natural ecosystems is strongly recommended.

It is important to recognize that measures to be adopted at a given location or region will mitigate (i) multiple hazards of different origin, (ii) potential impacts of varying intensities and spatial distribution, and (iii) a wide range frequency of occurrence, while sustaining multiple uses of the coastal zone. This can be achieved by either adopting a single measure or by developing a well-integrated hybrid solution comprising a number of measures that also alleviates environmental concerns. Hybrid methods, therefore, refer to combinations of artificial methods or a combination of natural methods, as well as joint application of artificial and natural methods.

Therefore, within an overall integrated coastal area management plan, measures which mitigate the impact of the coastal hazard represent a coherent set of interventions, specified in time and space, to achieve a certain expected level of protection against existing or anticipated damage from single or multiple hazards, and being proactive in leading to shoreline restoration and stability.

Ms. Gayani Hewawasan, of the Environmental Foundation Limited spoke about 'Legal aspects and approval process in the coastal environment'. The three keys national laws with respect to the coastal zone of Sri Lanka are: (i) the National Environmental Act (NEA); (ii) the Coast Conservation Act No. 57 of 1981 as amended (Amendment Act No. 64 of 1988 and Act No. 49 of 2011) now known as Coast Conservation and Coastal Resource Management Act and (iii) the Mines and Minerals Act No. 33 of 1992.

Various procedures and licenses have been set in place in order to provide checks and balances against environmental damage. The law is very clear about how, where and by whom these licensing and other procedures must be obtained and observed before potentially environmentally harmful activities are carried out. Licensing and Planning Procedures involve: 1. Initial Environmental Examinations (IEEs); 2. Environmental Impact Assessment (EIA); and 3. Environmental Protection Licence (EPL).

The Coast Conservation and Coastal Resources Management Department (CC&CRMD) and Urban Development Authority (UDA) are primarily responsible for planning and regulation of development activities.

There are three types of approval permits issued for development activities within the coastal zone: major permits; minor permits and emergency permits. Major permits are issued directly either by the Director General or any other authorised officer of CC&CRMD. Minor permits are issued for selected activities initiated based on the Coastal Zone Management Plan by the Divisional Secretary or an authorised officer to whom authority is delegated by the Director General of the CC&CRMD. Under emergency conditions — such as a natural hazard or any other distractions — the Director General of CC&CRMD or Divisional Secretary of the relevant area or an authorized officer can issue an emergency permit as a temporary measure, not exceeding one week as the validity period.

The Local Authority has a separate process for approval permits and undertakes physical planning. The Local Authorities deal with the UDA, NPPD, CC&CRMD and Provincial Councils while doing so. All new construction and modifications to current buildings need to be approved by the appropriate local authority.

The workshop ended with a short panel discussion on **the way forward** with all resource personnel. All resource personnel welcomed this interdisciplinary workshop and stressed the need for engineers and ecologists to collaborate within the needed context. The need for champions to spearhead change was noted as a critical need. The deliberations of the workshop need to be shared with a wider audience. Participants noted that there was a need to take these deliberations to the provincial, local and divisional levels.

Although a national physical plan has been prepared, with consideration of national policies on development and environment, *ad hoc* sectoral development interventions are making this plan redundant. There is a strong case for strengthening the NPP process, with the participation of all key agencies and making it mandatory that project approving procedures, including EIAs, ensure that projects are evaluated in conformity with the NPP. It was felt that the NPP should to be treated as a strategic level document and that detailed regional physical plans should be developed to address regional priorities.

It was noted that with all their shortcoming Environmental Impact Assessments (EIA) have a tremendous positive impact. When EIAs are not carried out properly, regulatory authorities simply must reject such EIAs and demand high quality EIAs. Regulatory authorities must demand a raising of the standard of EIAs because it is crucial for decision-making. Authorities should use the vast pool of technical knowledge available outside of their agencies to guide them to make better decisions through a stronger technical evaluation process. Tourism is a great opportunity for the generation of revenue but environmental appraisal and necessary precautions must be taken to safeguard local interests and very resource on which tourism development is dependent.

Almost all speakers spoke about political influence that hinders effective implementation of due regulations in the coastal zone.

Ecosystem valuation has been shown globally to be a very effective tool for showing decision makers and politicians, in terms of actual monetary costs and benefits, analyses of short-term financial benefits of development project versus long-term dividends of sustaining ecosystems.

Welcome and Introductory Remarks

Mr. Shamen Vidanage,
Acting Country Representative,
IUCN, Sri Lanka Country Office,
53, Horton Place, Colombo 7.

Mr. Ajith Silva, Director Policy Planning, Ministry of Environment and Renewable Energy; Dr. Jayampathy Samarakoon, Coastal Ecologist and Integrated Coastal Zone Management Expert; Dr. Anil Premaratne, Director General, Coast Conservation and Coastal Resources Management Department; Prof. Samantha Hettiarachchi, Coastal Engineer; Prof. P. K. S. Mahanama, Urban Planner; distinguished invitees, colleagues, ladies and gentlemen. I warmly welcome all of you to the workshop on 'Ecological Considerations in Coastal Development'.

The subject selected for this workshop is very pertinent, as Sri Lanka is moving forward in the path of rapid development, after the cessation of a three-decade long conflict. Today's event is organized by IUCN Sri Lanka, under the aegis of the 'Mangroves for Future Initiative' with its partner agencies.

As we are all aware, coastal ecosystems provide numerous ecosystem goods and services that sustain livelihoods in the coastal zone. These ecosystems can be considered as natural capital that we inherited. Like man-made capital, these ecosystems also provide returns or dividends — which we now call ecosystem services. If ecological functionality is not hampered, these ecosystems will provide dividends in the long-term. However, these systems are threatened by a range of human activities — such as overexploitation and unplanned human activities, including poorly-planned coastal development. Over and above these threats, coastal ecosystems are vulnerable to climate change-induced threats.

If we are to continue to benefit from coastal ecosystem services, their functionality should not be impeded or disturbed. Therefore, coastal infrastructure development must occur with minimum disturbance to these systems, and it must do so by accommodating appropriate design principles.

When ecological considerations are not addressed in coastal development projects, often, in the short-term, there are time and financial savings for the developer. However, in the long-term, there will be enormous economic costs to society, in terms of lost benefits from ecosystem services in years to come. These may be realized as social support service cost by way of compensating those who lose livelihoods. The government will then have to incur recurrent costs in terms of compensating affected parties, whereas nature would have looked after all, if it were allowed to function the way it should.

The purpose of this workshop is to highlight the importance of taking ecological considerations into coastal development planning, for win-win situations in achieving sustainable development objectives, as given in Haritha Lanka programme.

Sometimes, due to urgency and cost factors, development agencies tend to neglect or oversee some of these ecological considerations. In such cases, regulatory agencies must take the responsibility of guiding these development agencies to ensure that ecological considerations are taken into account. Regulators will also have to face the challenge of convincing politicians when necessary; to inform them that delays and extra costs that may be incurred by accommodating ecological considerations into projects, but, in the long-term, they yield much larger dividends in a national context.

The today's topic is 'Ecological Considerations in Coastal Development'. We have an eminent panel: Dr. Jayampathy Samarkoon, the well-known Coastal Ecologist; Prof. P. K. S. Mahanama, an Urban Planner; Dr. Anil Premaratne, Director General, Coast Conservation and Coastal Resources Management Department; Prof. Samantha Hettiarachchi, Coastal Engineer; and Ms. Gayani Hewawasan, Environmental Lawyer — who kindly agreed to join us today in place of Mr. Jagath Gunawardena who is unable to be here because of ill health.

Thank you very much for taking time off to attend this event. I would like to conclude this welcome by wishing you a very productive workshop.

Address by the Chairman, National Steering Committee Mangroves for the Future

Mr. Ajith Silva,
Chairman, National Steering Committee Mangroves for the Future, and
Director of Policy and Planning,
Ministry of Environment and Renewable Energy,
Sampathpaya, 82, Rajamalwatta Road,
Battaramulla.

Known as MFF, Mangroves for the Future is a partnership-based initiative that promotes investment in coastal ecosystems for sustainable development. Its vision is 'Healthy coastal ecosystems for a more prosperous and secure future for all coastal communities'. While mangroves are regarded as the flagship species, MFF addresses all coastal ecosystems.

MFF was begun in 2006 as a response to the tsunami of December 2004 by IUCN, International Union for Conservation of Nature, and the United Nations Development Program (UNDP). MFF's support base has now grown and includes other UN agencies, such as the Food and Agriculture Organization (FAO), the United Nations Environmental Program (UNEP), as well as CARE International and Wetlands International (WI).

In December 2006, President Clinton planted the first mangrove sapling to launch MFF at a ceremony on Phuket Island, Thailand. After focusing initially on the countries worst-affected by the tsunami — India, Indonesia, Maldives, Seychelles, Sri Lanka and Thailand — MFF has now expanded to include Bangladesh, Cambodia, Pakistan and Viet Nam and it will continue to reach out to other countries in the region facing similar challenges. Each country has a governing body — a National Coordinating Body (NCB) — which guides the implementation of MFF activities in respective countries.

The programmes are implemented through/or in partnership with national governments, UN agencies, non-governmental organizations(NGOs), community-based organizations (CBOs) etc. The Regional Steering Committee (RSC) and the National Coordinating Body (NCB) in the country concerned oversee this work. These bodies ensure accountability and transparency to MFF's donors (Danida, Norad and Sida being the key donors) and stakeholders. The RSC provides overall direction and guidance to the programme and the NCB provides national level direction and coordination.

In Sri Lanka, the National Steering Committee (NSC) comprising 23 members, is represented by 12 government organizations, four civil society organizations, four partner organizations, one private sector company and two independent experts. The NSC is chaired by the Ministry of Environment and Renewable Energy. The country office of IUCN in Sri Lanka functions as the National Secretariat.

MFF presently has three categories of project funding: a Small Grant Facility, Medium Grant Facility and Regional Grant Facility. As a country, Sri Lanka participates in all three programmes.

With this brief address, I will conclude, thanking all of you for your participation, on behalf of the National Steering Committee of MFF.

Keynote Address: Ecosystems and Engineering: Island Sri Lanka's Geomorphological Challenges and Opportunities With Particular Reference To Barrier-built Estuaries

Jayampathy Samarakoon, Ph.D.
Coastal Ecologist and Freelance Consultant,
Integrated Coastal Management.

Introduction

I am dealing with an inter-disciplinary and complex topic. I will be as simple as possible. But rest assured that every statement has been carefully thought over. We are entering an interesting period of many transitions and even more dangers. One is a developmental transition where many public infrastructure projects are being implemented in coastal ecosystems. Another transition is the relationship between ecosystems and civil engineering as the foundation of development. We may call this transition the sustainability transition. I prefer to call it the 'humanistic transition'. This is where engineers are becoming more conscious of human interests affected by development projects. The danger is exposure to sea level rise and intensified rains associated with climate change. Coastal communities, particularly those associated with barrier-built estuaries, are among the most exposed because of (a) their livelihood pattern, and (b) the physical structure of the ecosystems in which they live. Risk for some of these communities is increasing since they are becoming concentrated in smaller settlements because of development projects. When people in locations exposed to floods and storm surges become concentrated, quite expectedly, more people are affected when such an event occurs.

The President of the Institute of Engineers Sri Lanka in his 2013 inaugural address reflected this transition. First he quoted an excerpt from a speech of Herbert Hoover, a former president of the United States, himself an engineer: "*An engineer cannot bury his mistakes like a doctor; he cannot argue them into thin air like a lawyer, he cannot blame the opponents for his shortcomings like how the politicians do, but unlike a doctor he is not one among the weak and unlike a soldier, destruction is not his purpose. On the engineer falls the job of clothing the bare bones of science with life, comfort and hope*". Then he appealed to engineers in responding to people's expectations by adopting a way of thinking. He said "*Yes there is just only one trick. Put yourself in their shoes, think that he is my father, brother, friend or relation, she is my mother, sister, friend or relation. Then the solutions which we never thought before will emerge*". In other words he was saying put human interests into engineering (IESL 2013).

Engineers create what never was. Sometimes we take engineering for granted. In fact everything that contributes to comfort and convenience we owe to engineering. Ecologists study what is.

But now ‘ecological engineering’ has emerged as a discipline. Therefore a shared language also is emerging. What engineers create are complicated systems that are stable. They are systems because they are composed of many interacting parts, be it a bridge or a road. What ecosystem engineers do is defined as ‘the design of sustainable ecosystems that integrate human society with its natural environment for the benefit of both’ (Mitsch 2006). The goals of ecological engineering and ecotechnology are: (1) the restoration of **ecosystems** that have been substantially disturbed by human activities such as environmental pollution or land disturbance; and (2) the development of new sustainable **ecosystems** that have human and ecological value. Civil engineers, ecological engineers and ecologists all deal with systems — engineers with **complicated** systems, ecologists with **complex** systems. I will explain the difference shortly.

Ecosystems are what exist naturally. Humans never made them. Therefore, they are natural assets. Here, for the moment I exclude engineered ecosystems. Development occurs mainly in the form of public infrastructure in one or another class of coastal ecosystems. In Sri Lanka seven classes exist: the coastal marine zone, bays, beaches, dunes, barrier-built estuaries, lagoons, and tidal flats (IUCN, 2009). This differs from the ‘critical habitats’ classification still used by the Coast Conservation ad Coastal Resources Management Department. My focus will be mainly the barrier-built estuaries. An ecosystem is a complex system composed of interacting parts: physical factors, chemical factors, biological communities, driven by solar energy and recycled materials. There are no coastal ecosystems that have not been influenced by people. So we are talking about social-ecological systems. There are no social-ecological systems that have not been influenced by development decisions. So what we are actually talking about are coastal ecosystems which are complex social-ecological-political systems. They are complex systems because their structure and functioning are based upon changing relationships among the interacting parts. Complex systems are unpredictable. The uncertainty arises from the fact that not only are the relationships among the parts changing, but the parts themselves keep changing. The simplest way to understand complex systems is to think about your own body in relation to aging.

What engineers do and what ecologists study occur in a common setting. That setting consists of the surface landforms — shaped by many variables such as weathering, erosion, vegetation, etc. acting on an underlying geology. Geomorphologists study the processes that shape surface land forms. The coastal ecosystems came into being in their present form during what is known as the Holocene Transgression. It occurred about 10,000 years ago when the sea level rose to what it is today. Barrier-built estuaries were also born out of that sea level rise and the resulting formation of sand barriers that partially enclosed river outlets. As soon as a barrier-built estuary is born, its destiny also is sealed. They must die through sediment entrapment and infilling through a process of maturation and evolution. Sri Lanka’s barrier-built estuaries, because of their inherent shallowness and relatively small size, will fill up sooner than deeper, larger counterparts elsewhere in the world. Filling up is accelerated by the weakness of the flushing force generated by the tides. This is because the difference between the high tide and the low tide in Sri Lanka is only about 50 centimetres. The defining geomorphological limitation of our barrier-built estuaries is the ease with which they get filled up. Where measurements have been made as in Negombo Lagoon, the rate of sediment entrapment is 60,000 tons/year. The major opportunities provided by the formation of barrier-built estuaries are food security and drainage.

Engineers make complicated systems that are meant to be stable and predictable, for instance, in barrier-built estuaries that are complex, characterized by uncertainty, inherently unstable

and constantly changing. Combining engineering and ecosystems, in general, and barrier-built estuaries, in particular, is therefore a major challenge in a humanistic approach. That means safeguarding particularly the livelihood interests of people whose income depends on small-scale fishing, and whose lives themselves depend upon protection from flooding. I am here reminded of one of my early experiences in 1967. I had to report on the construction of a salt exclusion structure in Kalametiya Lagoon. In that episode, farmers won and lagoon fishers lost their livelihood without compensation. Fishermen's voice was considered to be politically unimportant. With time, the farmers also lost because of the nature of water flow.

Any engineering activity that does not take into account the sedimentation behaviour of barrier-built estuaries undermines their ecosystem services. Their most significant services are the fishery (provisioning service), drainage and flood protection (regulating service), and religious traditions (cultural service). Engineering here means civil engineering, as well as ecological engineering. Civil engineering works include roads and bridges, drainage and flood protection works, salt exclusion structures, waste management systems that discharge into the water body, housing schemes, hotels etc. Any civil engineering structure that does not compensate for changes in the force of water flow causes imbalance in the ability of the ecosystem to self-regulate. It is the same with ecological engineering. Much of the ecological engineering in barrier-built estuaries in Sri Lanka involves what is pretended to be 'restoration engineering'. More specifically, this involves deliberately misplaced mangrove planting in the water body, under the label 'ecosystem restoration'. What happens here is that the 'mangrove planters' focus on a part of an interacting system and calls that single part — the system? Thereby, the balance is lost between the parent ecosystem and a nested sub-system. Because ecosystems are error-correcting, negative feedback systems, there is a balance among forces by which the negative feedback shapes how the dynamic balance is maintained. If there is no negative feedback, then change is forced in a single direction. Directional change in an ecosystem is a disaster. A medical analogy is cancer.

Ecologists have identified the three factors that contribute to ecosystem degradation (Walker et al. 2012). They are:

1. *The failure to define the focal system*: One of the basic concepts of ecology is that 'ecosystems are composed of nested sub-systems that are organized hierarchically'.
2. *Failure to clarify the role of humans in the focal system*: The manner in which people and ecosystems influence each other.
3. *Failure to distinguish between external drivers and internal system variables*.

I will explain these in relation to barrier-built estuaries.

Value of ecosystem services of barrier-built estuaries

It is easier to understand the value of ecosystem services when we give them numbers. Time is insufficient for comprehensively demonstrating the value of ecosystem services of barrier-built estuaries. Only a single aspect of a provisioning service, the fishery, and an aspect of a regulating service, drainage and flood protection are considered. The earnings from the fishery of three barrier-built estuaries, Batticaloa Lagoon, Puttalam Lagoon and Negombo Lagoon and the coupled near shore fishery in the Marine Coastal Zone will suffice to indicate the scale of value that we need to take note of (Table 1). The total annual value of fisheries from all barrier-built estuaries is not available. Predictably, the cumulative value will be significant

from any standpoint. The value of the nearshore coastal fishery is considered as a part of the provisioning service of barrier-built estuaries since they are coupled ecologically by (a) life histories of important fishery organisms, and (b) by seasonal nutrient flows that support the food web of small pelagic fishes, and (c) the weakness in ecological structure of our continental shelf. This weakness is compensated by barrier-built estuaries.

Table 1. The value of earnings from the fishery of three barrier-built estuaries

Location	Estimated annual value Rs (US$)	% of tourism earning	Total dependent households	Cost of replacing if income lost (Samurdhi: Rs 400/= household/ month
Batticaloa lagoon	1,350,000,000 (12,272,727)	3.0%	15,000-25,000	72,000,000
Negombo lagoon	250,000,000 (4,812,230)	1.1%	3,000	14,400,000
Puttalam lagoon	455,292,000 (8,755,615)	2.8%	12,647	60,705,600
Marine small-scale fishers	4,680,000,000 (90,000,000)	20.5%	100,000	480,000,000
TOTAL	26.0% (uncorrected tourism earnings)			

Year	No. of tourists	Total earnings	Total employed (persons)
2010	600,000	Rs 43,790,000,000 (437.9 million)	?

(Source: The value of earnings for Negombo Lagoon and Puttalam Lagoon are from FAO 2000 and NARESA/SIDA/NARA 1997. The value for the coastal nearshore fishery is from FAO 2006. Tourism earnings are from a web source).

The drainage and flood protection value of Batticaloa Lagoon, in particular, and barrier-built estuaries, in general, were brought out sharply in 2010/2011. The flood that killed 57 persons and displaced several hundred thousand in Batticaloa District was mitigated substantially by breaching the road that had been constructed across the Dutch Bar Road tidal inlet. Flood relief for a segment of the affected population in Batticaloa District cost Rs. 160 million. With anticipated sea level rise and changes in weather that may bring intensified rains, the role of drainage through tidal inlets would become a major concern.

Evidence of Compatibilities and Incompatibilities

A few case studies supported by slides illustrate some compatibilities and incompatibilities between engineering, fishery-based livelihoods and security.

Analysis

An appropriate approach to the analysis of causes of some incompatibilities between engineering and the structure and functioning of barrier-built estuaries is through the application of Robert Merton's 'law of unintended consequences'. In a paper titled the 'Unanticipated consequences of purposive social action' (1936) he explained why planned development goes awry in complex systems. Subsequently he explained his thesis in greater detail in his book titled 'On Social Structure and Science' (1996). He showed that much of what goes awry in planning development could be attributed to five sources:

Ignorance: incomplete use of available information and knowledge to make decisions;

- *Error*: Incorrect analysis of a problem or following habits that worked in the past
- *Immediate interest* (greed): short-term payback being made the priority while ignoring, entrained long-term changes;
- *Values*: refers mainly to the lack of ethics and morality coupled with lack of empathy with persons affected by an engineering activity;
- *Self-fulfilling prophesy*: this is where planners predict an outcome and strive to demonstrate its manifestation even in the face of contradictory feedback.

Conclusion

Clearly civil engineers and ecologists must collaborate together with other disciplines and exchange ideas in regard to how barrier-built estuaries, and coastal ecosystems in general may be managed humanely. Professor Hettiarachchi may touch on relevant inter-disciplinary aspects. Already, we have a National Physical Planning Policy with clear guiding principles to promote environmental sustainability in regard to particular classes of coastal projects, *viz*.

- The *precautionary principle* — If threats of serious or irreversible environmental damage exist, lack of full scientific certainty should not be used as a reason for postponing measures for preventing environmental degradation.
- *Inter-generational equity* — The present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.
- *Conservation of biological diversity and ecological integrity* — Conservation of biological diversity and ecological integrity must be a fundamental consideration.
- *Improved valuation, pricing and incentive mechanisms* — Environmental factors should be included in the valuation of assets and services.

Professor Mahanama will inform us more in this regard. Dr. Anil Premaratne will probably provide more information on how the 'Physical Planning Guidelines and Project Proposals for the 'Vulnerable Coastal Zone of Sri Lanka' could be translated into action with regard to coastal ecosystems. Humane management means that natural assets and resources that belong to the many must not be allowed to be captured by the few without meaningful compensation (Collier 2010). Where the few extract what belongs to the many, we witness plunder. To decrease plunder we have environmental impact assessment and social impact assessment as meaningful tools. Mr. Jagath Gunawardena[1] was probably going to touch on this aspect. Many societies have failed simply because their extractive institutions could not shift to better decisions resulting in equitable sharing of benefits from natural assets (Acemoglu & Robinson 2013).

[1] Ms. Gayani Hewawasan made the presentation on law, instead of Mr Jagath Gunawardena

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Dr. Samarakoon illustrated his keynote address with the following slides.

Figure 1. Islands north of Puttalam Lagoon — a very fragile area — where people are now being concentrated into small areas of land.

People live on these islands, making a living out of the Lagoon and the sea. These people are now being concentrated into smaller and smaller areas. If there is a storm surge or any hazard, these communities are faced with a human-made disaster. Their land is being taken away, by the Tourism Authority and other developers. Already some areas are being flooded, and there are proposals to come up with fantastic structures for star-class hotels[2].

Figure 2. Barrier-built estuaries in Sri Lanka

Examples of barrier-built estuaries include Puttalam, Chilaw and Negombo lagoons. All of these have a seaward barrier (sand barrier or a dune system), which separates a partially enclosed body of water from the sea. These are highly productive systems and compensate for the deficiency in Sri Lanka's continental shelf. The Sri Lanka continental shelf is regarded globally as the weakest in ecological structure. (This is excepting the northern area, shared with India.) This weakness is noted by geologists themselves. Because of the ecological inadequacies of the continental shelf, the nutrient flows from barrier-built estuaries into the nearshore coastal waters becomes crucial for enchaining the food webs that support small pelagic fisheries.

[2] Later, in plenary, it was pointed out that such fantastic structures have not been approved.

Figure 3. Size diversity of barrier-built estuaries in Sri Lanka

Top left: the estuary of the Mahaweli River, showing the barriers that keep forming all the time;
Bottom left: Rekawa Lagoon, about 270 ha, which is virtually dead;
Centre: Negombo Lagoon, 10 times larger, and still has a very productive ecological system;
Right: Puttalam Lagoon, 10 times larger than Negombo Lagoon. Because of it largeness, it has the ability to cope with sedimentation and pollution and support, on a large scale, livelihoods.

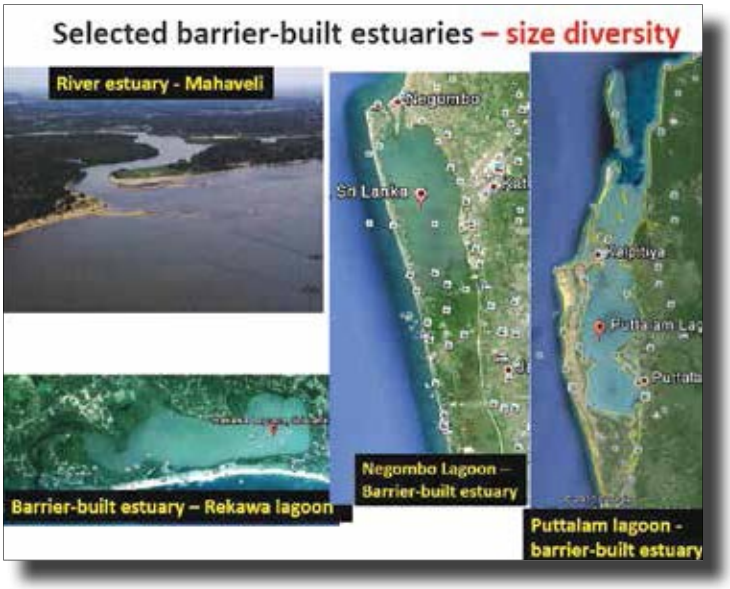


Figure 4. Evolution and maturation of barrier-built estuaries.

This figure shows the transition of a barrier-built estuary into a creek. These figures are a result of very intensive and careful study of Australian barrier-built estuaries, which included micro-tidal, meso-tidal and macro-tidal barrier-built estuaries. From all the sedimentation studies and geomorphological studies this interpretation is how we should look at the evolution and maturation of barrier-built estuaries. Through human activities, the process by which these barrier-built estuaries die, can be accelerated.

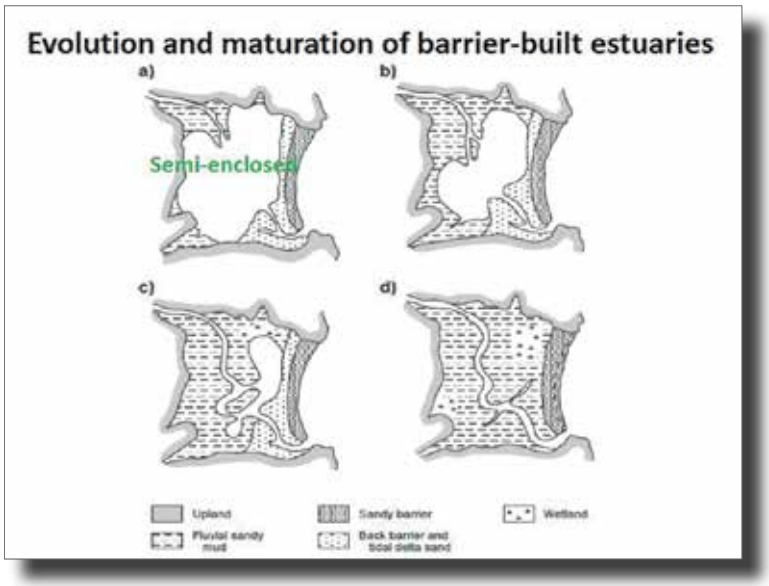


Figure 5. Barriers to drainage

This picture shows a body of water and a bottleneck of drainage to the sea — a tidal inlet. If this tidal inlet is blocked, or if the water body itself becomes sedimented, rapid flooding is inevitable. This is what is seen happening regularly in Batticaloa Lagoon which has become so compartmentalised. Haphazard planting of mangroves has accelerated sedimentation. During the floods of 2010 and 2011, 57 people died. During the tsunami of December 2004, a number of people died because the flood waters could not recede through the tidal inlets.

Figure 6. Hierarchical organization of an ecosystem

The two most important parts of a barrier-built estuary are the tidal inlets and the river flow system. There are many other parts, which all can be arranged in a hierarchical way, showing the significance, as well as the total structure and function of an ecosystem.

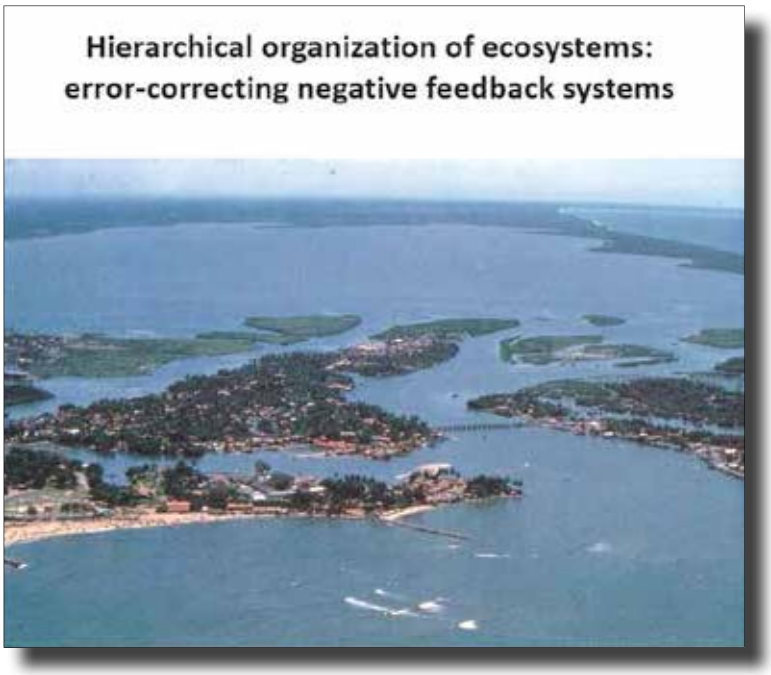


Table 2. The value of coastal ecosystems

The value of earnings for Negombo Lagoon and Puttalam Lagoon are from FAO 2000 and NARESA/SIDA/NARA 1997. The value for the coastal near shore fishery is from FAO 2006. Tourism earnings are from a web source. In Sri Lanka, close to 50% of tourism earnings are leaked out in the form of foreign exchange.

Location	Estimated annual value Rs (US$)	% of Tourism Earnings	Total dependent households	Cost of replacing if income lost (Samurdhi: Rs. 400/= household/month
Batticaloa Lagoon	1,350,000,000 (12,272,727)	3.0%	15,000 – 25,000	72,000,000
Negombo Lagoon	250,000,000 (4,812,230)	1.1%	3,000	14,400,000
Puttalam Lagoon	455,292,000 (8,755,615)	2.8%	12,647	60,705,600
Marine small scale fishers	4,680,000,000 (90,000,000)	20.5%	100,000	480,000,000
Total		*26.0% (uncorrected tourism earnings)*		

Year	No. Tourists	Total Earnings	Total Employed (persons)
2010	600,000	Rs. 43,790,000,000 (US$ 437.9 million)	?
CORRECTIONS NOT MADE FOR FOREIGN EXCHANGE LEAKAGE			

Figure 7. Batticaloa and Negombo Lagoon

Roads were built after the tsunami in Batticaloa Lagoon, which accelerate sedimentation. Roads are necessary but it is possible to build bridges with roads that leave adequate stands for water exchange and which do not contribute to sediment build up. Immediately after the tsunami of December 2004, the Road Development Authority (RDA) built a solid road, right across the tidal inlet at the Dutch Bar Road. When the floods of 2010 occurred, it was necessary to breach this road to release flood waters. During the great flood of 1957, flood waters were released by breaching the inlet at Dutch Bar Road. The engineers who built the Dutch Bar road after the tsunami had not understood that there was a lesson to be learned from experience.

In Negombo, there is now a new Colombo-Katunayake expressway. The way this expressway is constructed into the Negombo Lagoon, is completely contrary to the agreed Environmental Impact Assessment report. The author was deeply involved in this process, so the facts are known. The discussions were all about dredging 4.5 million m^3 of sand. The part of the road that penetrates into Negombo Lagoon was not built on a sand blanket, the contract for using 4.5 million m^3 of sand would not be accepted by the Dutch dredging company. Digging up the Lagoon in such a way has done a great deal of harm to its productivity.

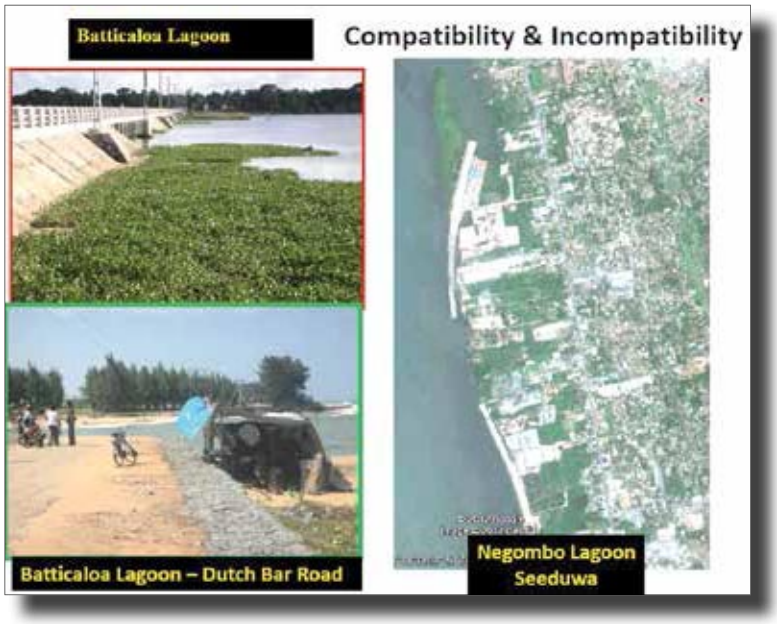
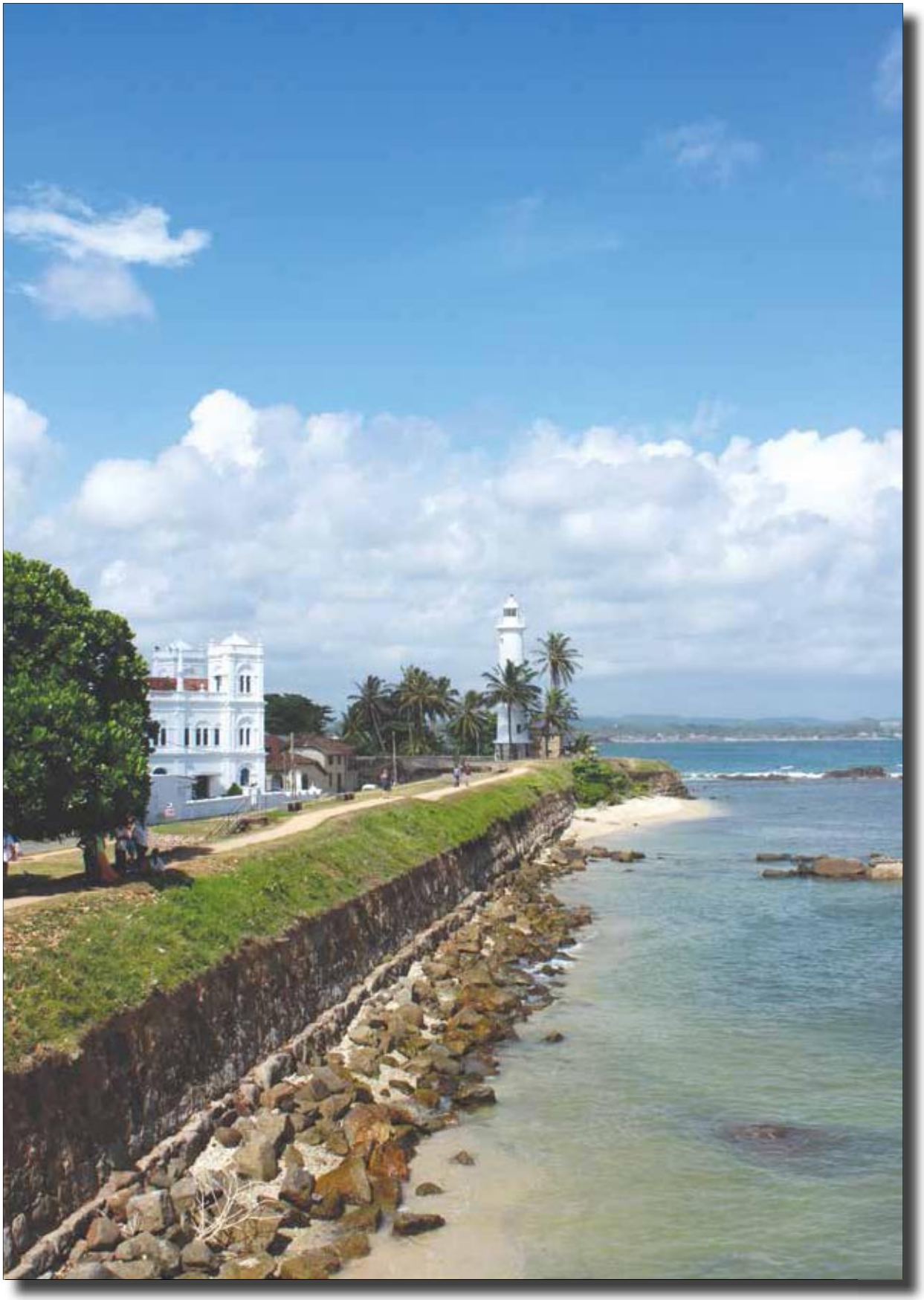


Figure 8. Compatibilities and incompatibilities

In Puttalam Lagoon (top left), patches of mangroves have been planted, right in the body of the water, under the name of ecological restoration. This is a powerful external driver, where money is given by foreign agencies to plant mangroves, because globally, mangroves are threatened. In Sri Lanka, we have a different geomorphologcal landscape, in which mangroves are found only as fringing mangroves but are not found in bodies of water. This is not restoration.

Bottom left: The next stage is that the Lagoon is filled, up to the new border formed by the mangroves. These are human-made, chronic disasters.

One of the best examples that shows what happens when engineering goes awry is shown in the figures on the right, in Segara Anakan, Indonesia, a micro-tidal barrier-built estuary about the same size as Negombo. There are records from 1964, which shows the pale blue area (the water body) reducing gradually. This reduction was through rehabilitated mangroves. The fishery died in this water body, and the Asian Development Bank (ADB) in their final report note 'although the project achieved its target in mangrove rehabilitation, sustainability of project benefits is unlikely'.



A National Physical Planning Perspective — the Coastal Sector

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Introduction

The National Physical Planning Policy (NPPP) has been formulated by the National Physical Planning Department (NPPD) to direct the physical development of the country up to the year 2030. This policy has attempted to address major environmental issues — such as increased the incidence of natural disasters, damage to coastal ecosystems and coastal erosion. In addition, it addressed a number of economic and social problems in the country that result from differences in income distribution, an increase in poverty, unemployment and regional disparities.

This policy has introduced a settlement policy to create a planned urban area network, including five metro regions, with a system of infrastructure facilities necessary for development. Policies have also been formulated for the protection of environmentally highly sensitive areas — such as the environmentally highly sensitive central hill country and coastal areas. The NPPP has given adequate attention for the conservation and wise use of fragile coastal ecosystems in the country, with the guidance from the Coast Conservation and Coastal Resource Management Department.

Physical Planning

Physical planning involves design, growth and management of the physical environment, in accordance with a predetermined guide and policies. The main goal of physical planning is to make provision for the coordination of all forms of development activities at the national, regional and local levels. It is expected that physical planning will play a key role in promoting integrated and balanced physical, social and economic development.

Physical planning is normally carried out by the state, or by provincial or local authorities for the well-being of the community. It has two main functions: (i) to develop a rational land use planning; and (ii) to regulate the development in the interests of the community as a whole. This latter function usually leads to physical planning being associated with a system of laws.

Physical Planning Practice in Sri Lanka

Physical Planning is carried out in Sri Lanka mainly by two authorities, the Urban Development Authority (UDA) and the National Physical Planning Department (NPPD). These organizations are legally governed by the two laws:

- The Urban Development Authority Law No. 41 of 1978 and its amendments, Acts No. 70 of 1979 and No. 4 of 1982, the UDA (Special Provision) act No. 44 of 1984 and the UDA (Amendment) Act No. 49 of 1987; and
- The Town and Country Planning Ordinance No. 13 of 1946, as amended by act No. 49 of 2000. The amendment created the NPPD.

Both laws authorize the making and implementation of physical plans, with the object of promoting and regulating integrated planning of economic, social, physical, and environmental aspects of the land. They also provide for the protection of natural amenities, the conservation of the natural environment, buildings of architectural, and historic interest, and places of natural beauty.

The UDA is authorized to carry out physical planning activities in areas declared by the UDA as 'urban development areas' (Figure 10, opposite page). Most of the plans developed by the UDA are zoning plans.

The NPPD is the apex body for physical planning in Sri Lanka and is authorized to carry out physical planning in four planning areas as shown in Table 3.

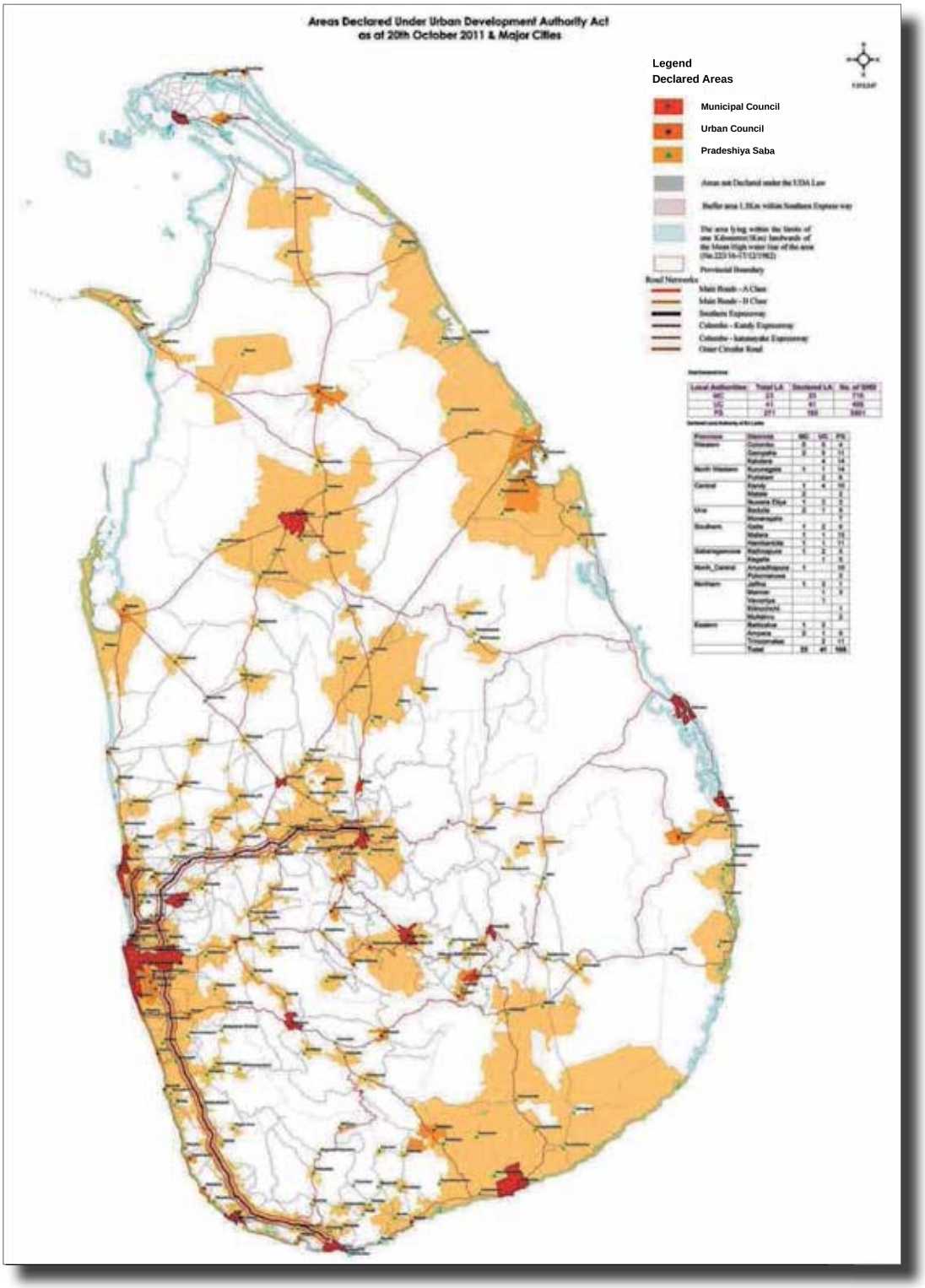
Table 3. Types of physical plans

Area	Type of plan
The entire nation	National Physical Plan
The province	Regional Physical Plan
The municipal or urban council area	Local Physical Plan
Trunk roads	Trunk Road Area Physical Plan

Figure 9. NPPD levels of planning

Figure 10. Areas declared under the UDA act

(Source: NPPD)



The National Physical Planning Policy

The NPPD has gazetted the National Physical Plan and Policy (NPPP) in the Extraordinary Gazette No 1729/15 of 27/10/2011. This plan has provided physical planning guidelines for utilization of land in the country and its targeted socio-economic development through the provision of an infrastructure network and services in a sustainable manner, by rationalizing the use of land for each activity without disturbing the ecological landscape of the country.

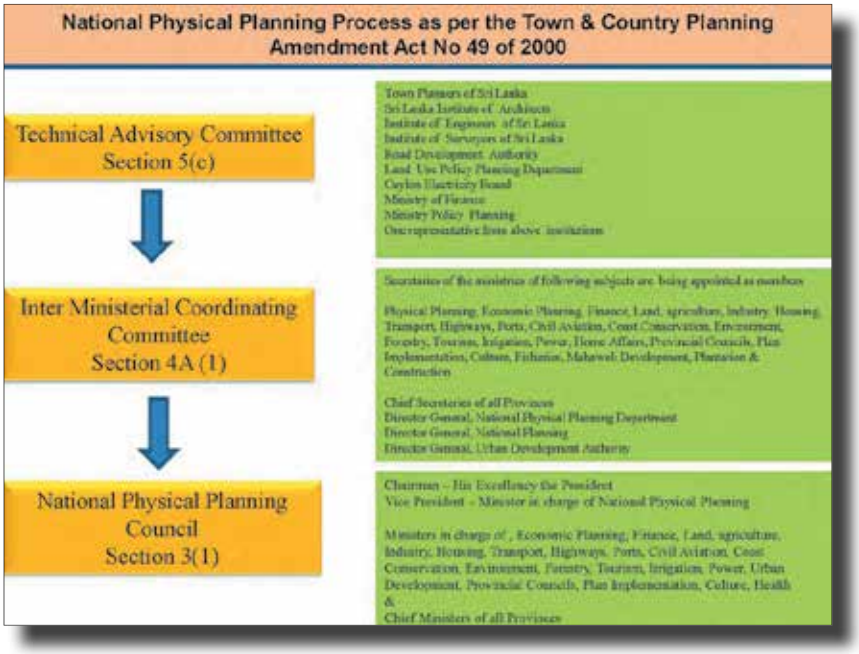
The NPPP was prepared under the guidance of three important committees established under the new Act, the Town and Country Planning [Amendment] Act. No. 2000.

- *The National Physical Planning Council (NPPC)* is headed by the head of state, His Excellency the President. Under him, is a Committee consisting of 18 Ministers, as identified in the Act, established to ensure that important issues related to development and implementation brought before the council are resolved. The purpose of the NPPC is to integrate and develop activities at the highest levels, to ensure that there is no overlap in development activities taking place in the country.

- *The Inter-Ministerial Co-coordinating Committee (IMCC)* consisting of Secretaries of each Ministry and Chief secretaries of the nine Provincial Councils. This committee coordinated with those actually involved in the implementation of any plans and projects approved by the NPPC, to prevent overlap or conflicts.

- *The Technical Advisory Committee* includes representatives from the professional institutions in the country — such as the Institute of Engineers, Sri Lanka (IESL), Sri Lanka Institute of Architects (SLIA), Institute of Surveyors, Institute of Town Planners Sri Lanka (ITPSL) and Institute of Valuers. The Plan, prepared by the NPPD, was deliberated by this Advisory Committee in order to upgrade and develop it to a professional acceptability.

Figure 11. The national physical planning process



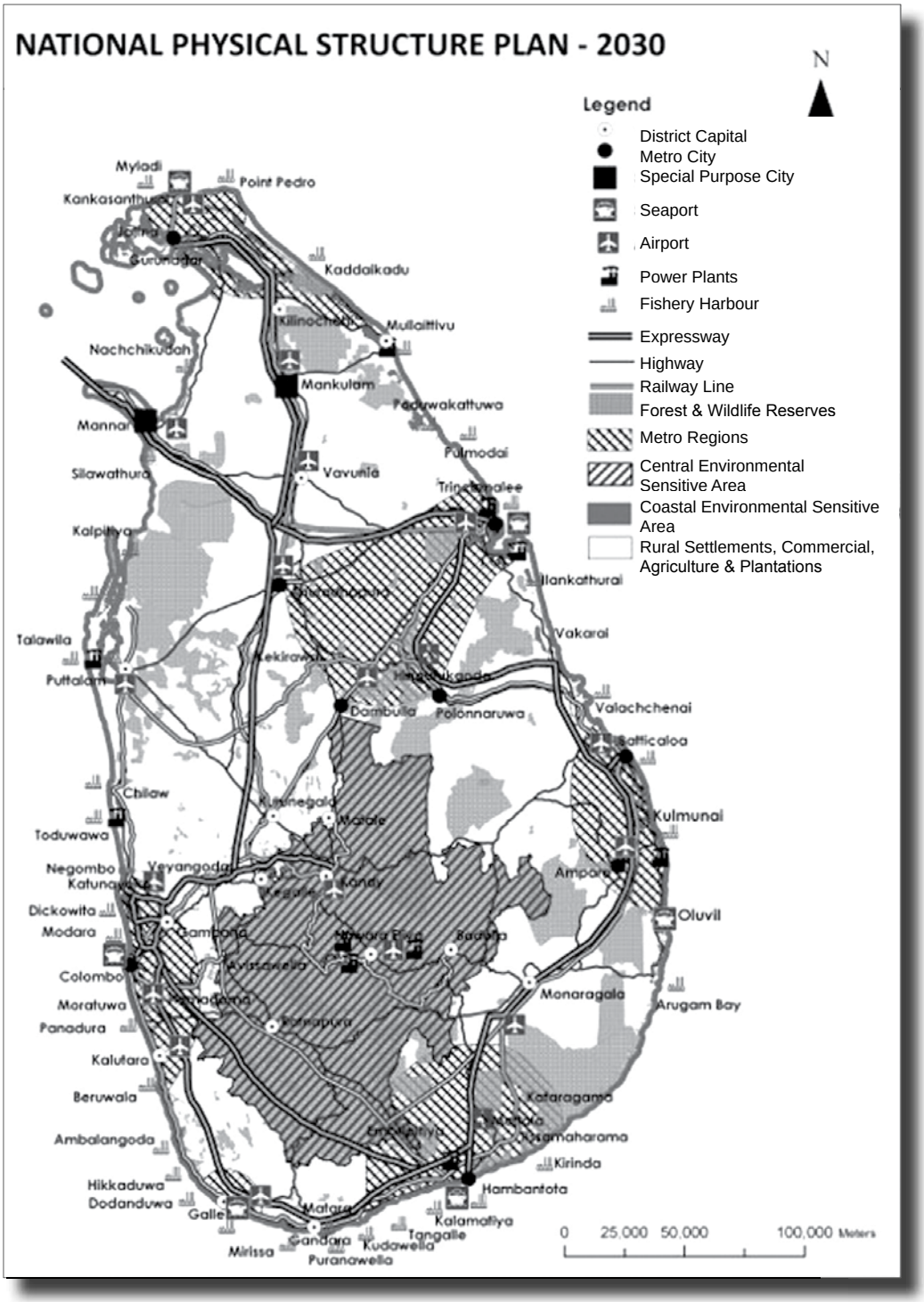
The National Physical Planning Policy (NPPP) is expected to:

- Promote integrated spatial development;
- Accelerate national economic growth;
- Incorporate potential internal development opportunities;
- Implement environmentally friendly sustainable development across the country;
- Strengthen ethnic integration among communities;
- Introduce a planned settlement network;
- Conserve valuable, environmentally-sensitive areas;
- Mitigate natural disasters by limiting development in areas prone to natural disasters;
- Evolve compact cities with modern urban facilities and utilities;
- Transform small urban centres into strong service centres;
- Develop sufficient services and infrastructure facilities to cater to needs of the projected population;
- Provide proper linkages among land use, transport and economic activities;
- Reduce regional disparities;
- Reduce income disparities and increase employment opportunities; and
- Protect forest reserves, wildlife sanctuaries and archaeological reserves.

The main elements of the National Physical Structure plan

Figure 12. Map of the National Physical Plan

(Source: NPPD)



The main element of the National Physical Plan is to restructure the country's landscape and the entire human settlement pattern in following manner for next 20 years:

To establish:

- **Metro Regions with Metro Cities**
  - Western Metro Region (Colombo-Gampaha-Kalutara);
  - Southern Metro Region (Hambantota);
  - North Central Metro Region (Anuradhapura-Trincomalee-Polonnaruwa-Dambulla);
  - Eastern Metro Region (Ampara-Batticaloa); and
  - Northern Metro Region (Jaffna) (Figure 13).

- **District Capitals**
  - Puttalam, Kurunegala, Matale, Kandy, Nuwara Eliya, Kegalle, Ratnapura, Badulla, Monaragala, Galle, Matara, Vavuniya, Mannar, Kilinochchi, Mullativu (Figure 13).

- **Main Highways**
  - Southern Expressway (Colombo-Matara);
  - Extension of Southern Expressway (Matara-Hambantota-Monaragala);
  - Kandy Expressway (Colombo-Kandy);
  - Hambantota-Batticaloa-Trincomalee Highway;
  - Negombo-Mannar Highway;
  - Colombo-Jaffna Highway; and
  - Colombo-Trincomalee Highway (Figure 14).

- **Main Railway Lines**
  - Matara-Batticaloa (*via* Hambantota-Monaragala-Oluvil-Ampara);
  - Kurunegala-Habarana (via Dambulla);
  - Colombo-Ratnapura-Hambantota; and
  - Batticaloa-Trincomalee.

- **Seaports**
  - Colombo;
  - Galle;
  - Hambantota;
  - Trincomalee;
  - Kankasanthurai; and
  - Oluvil (Figure 15).

- **Airports**
  - Katunayake;
  - Hambantota;
  - Domestic Airports (Ratmalana, Hingurakgoda, Jaffna, Vavuniya, Trincomalee, Anuradhapura, Puttlam, Dambulla, Batticaloa, Ampara and Kalutara) (Figure 16).

Figure 13. Proposed metro regions under the NPPP

(Source: NPPD)

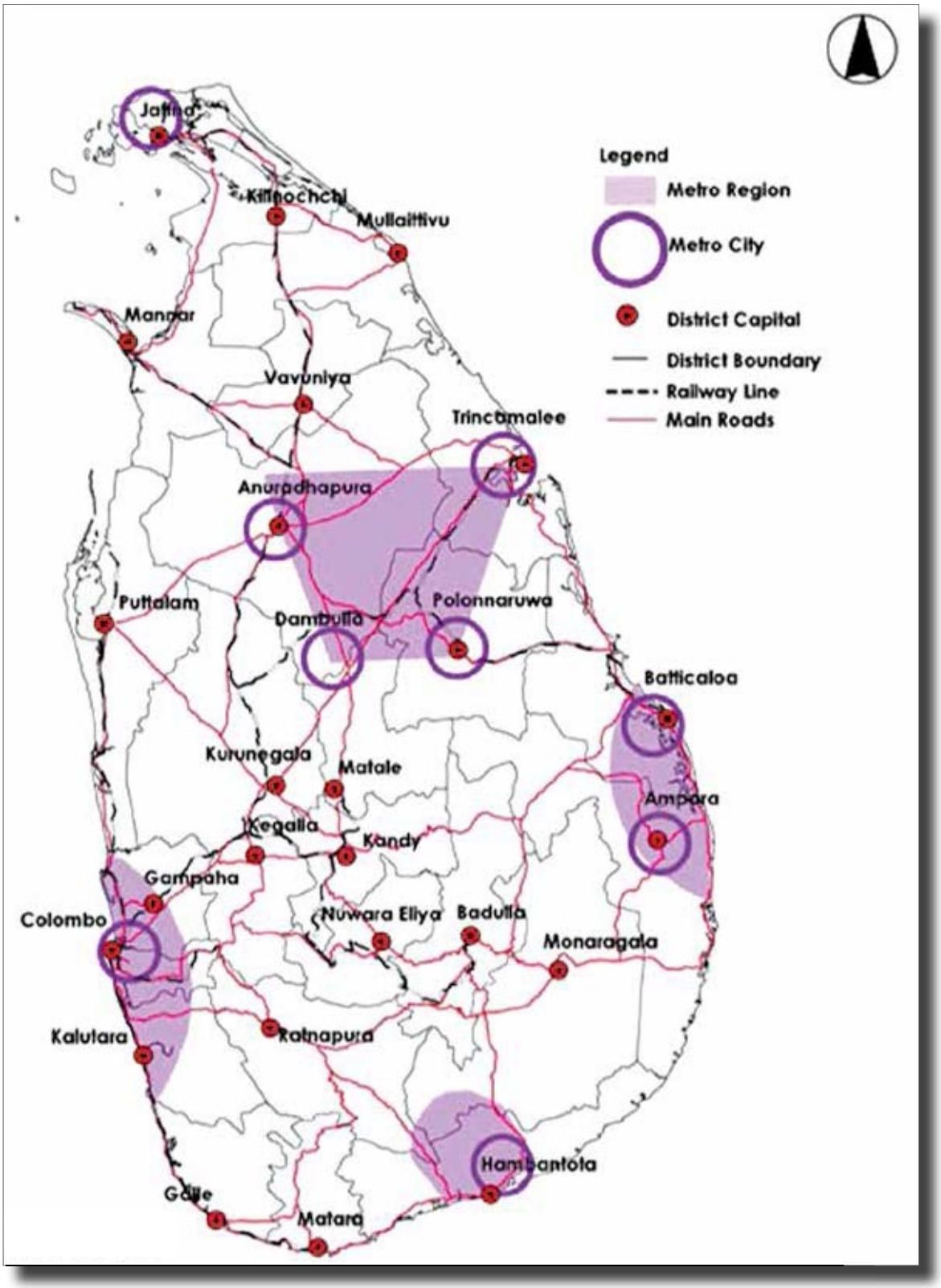


Figure 14. Proposed highways under the NPPP

(Source: NPPD)

Figure 15. Proposed seaports under the NPPP

(Source: NPPD)

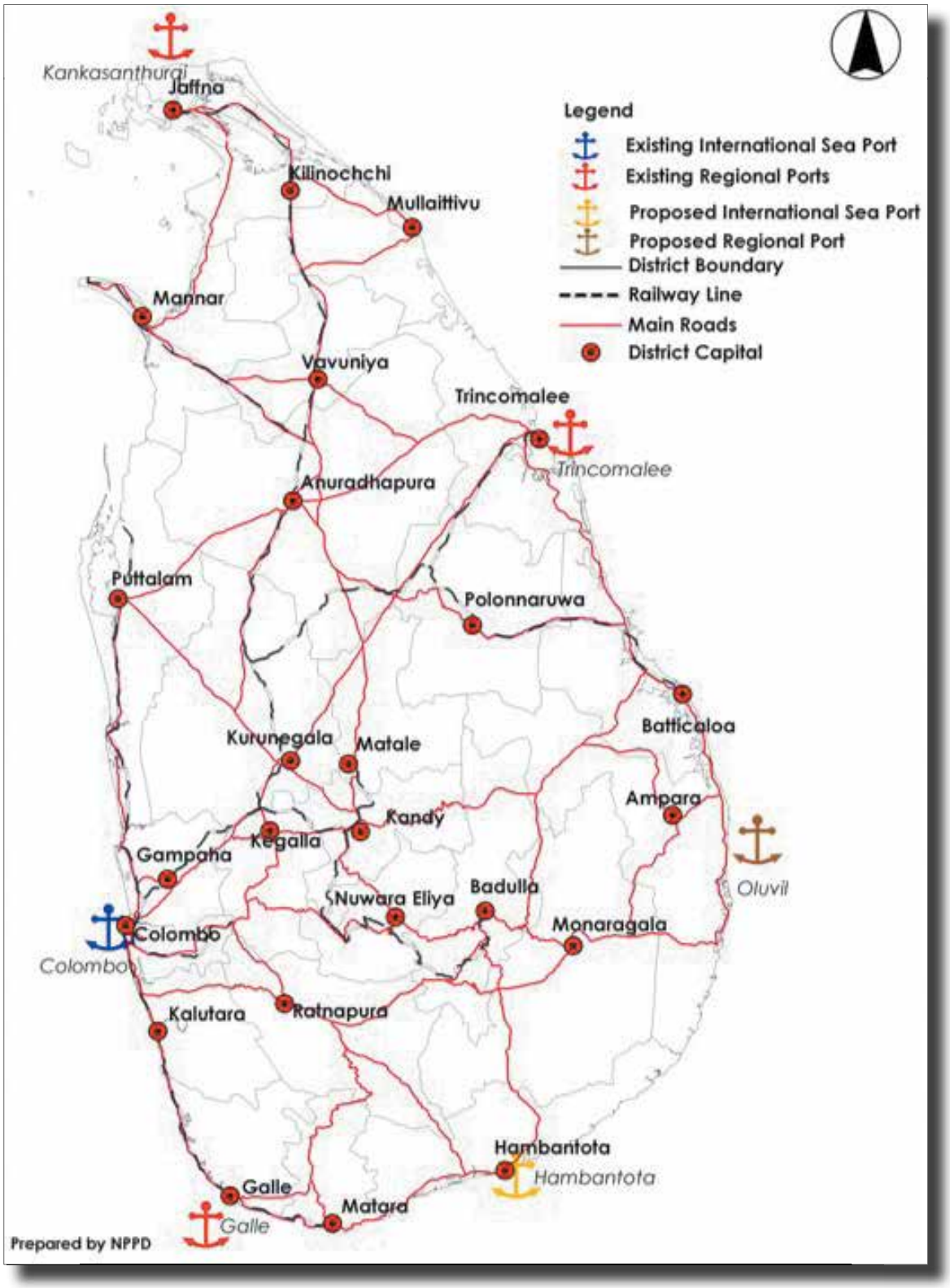
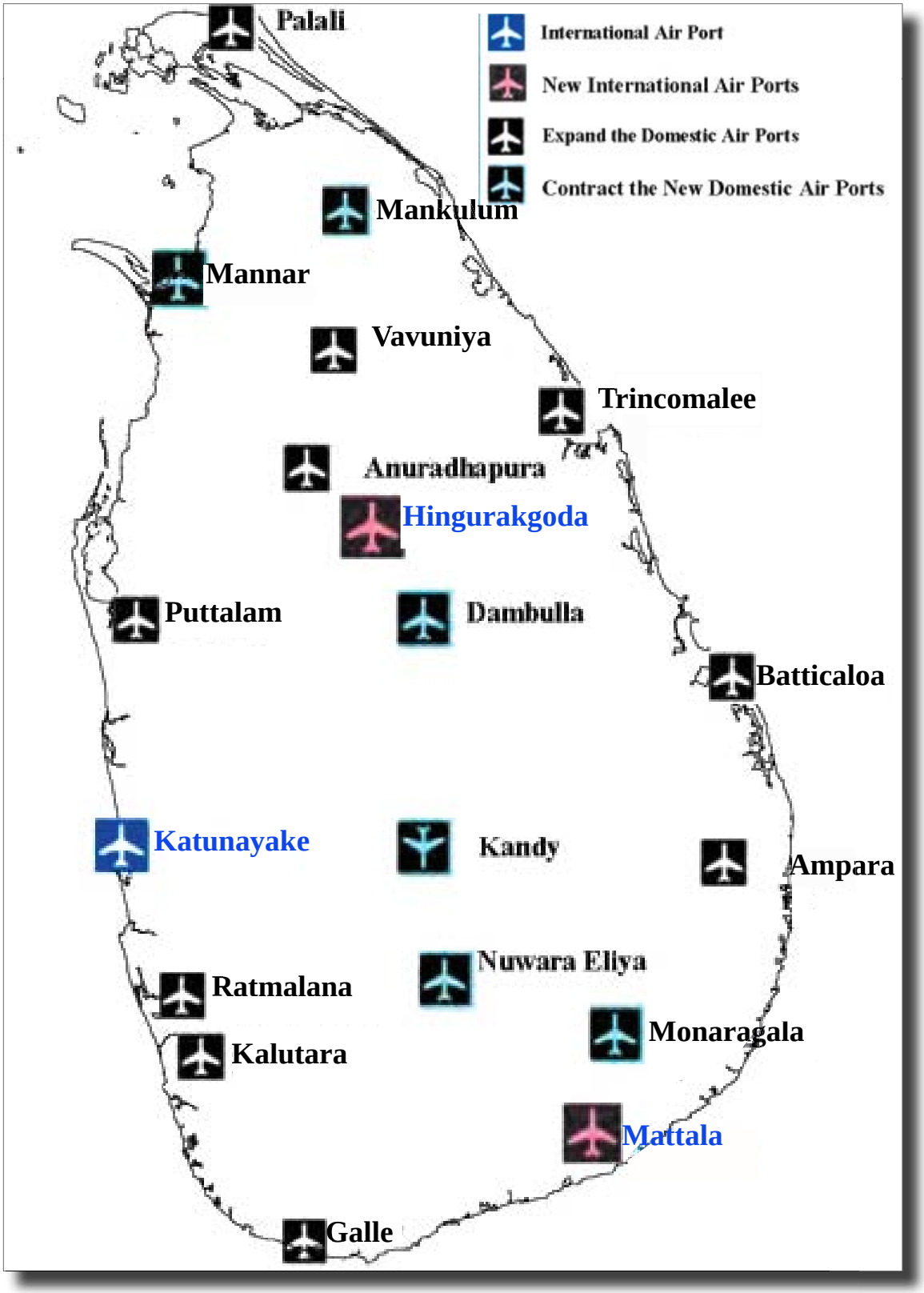


Figure 16. Proposed airports under the NPPP

(Source: NPPD)



Implications of National Physical Planning Policy (NPPP) for the Coastal Environment

It is observed that the major policy decision of the NPPP is the development of the human settlement structure of the country, which comprises five Metro Regions, nine Metro Cities and 25 District Capitals.

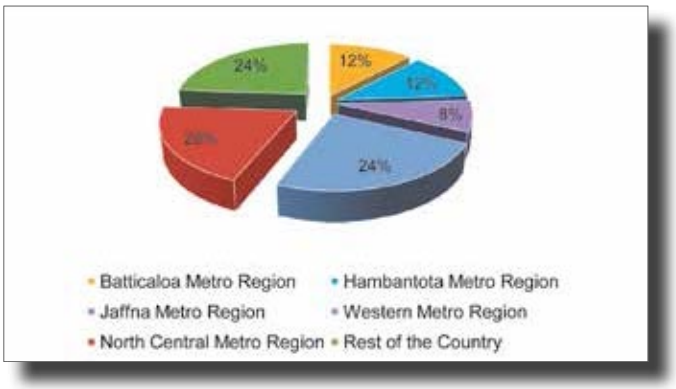
It is expected that, in the future, through this urban development policy, urban centres will accommodate more than 70% of the population. It is also envisaged that the balance 30% of the population will be housed in rural centres with adequate infrastructure facilities to carry out rural economic activities.

All five metro regions are located in coastal areas of the country (Figure 12 and Figure 13). The total population among five metro regions is projected to be 10.5 million by 2030 and will be distributed as shown in Table 4.

Table 4. Distribution of the population in the proposed metro regions

Metro region	Population (in millions)
Western Metro region	3.50
North Central Metro region	4.00
Eastern Metro Region	1.00
Jaffna Metro Region	1.00
Hambantota Metro Region	1.00

Figure 17. Targeted distribution of population in the metro regions



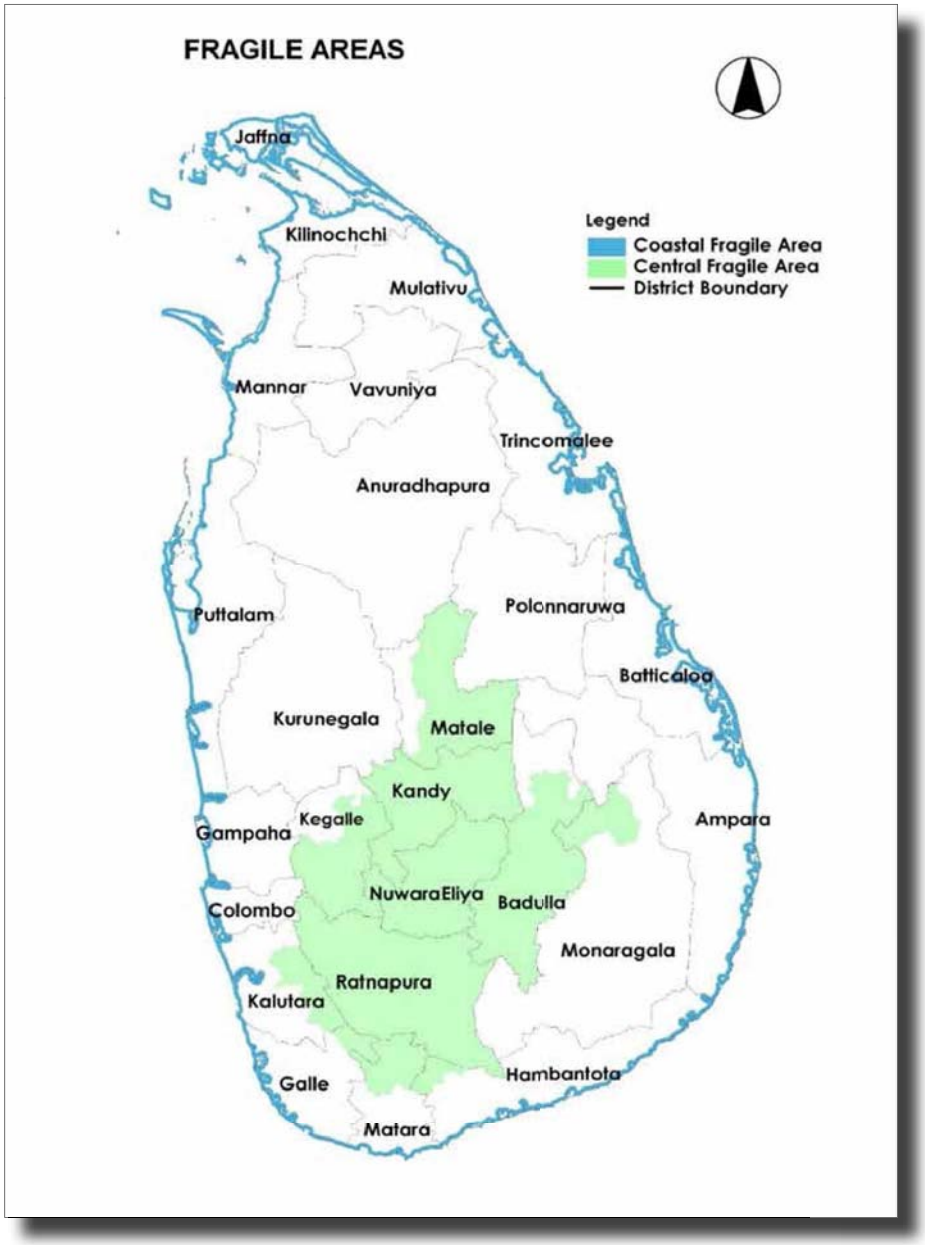
In the future, the demand for land for housing and infrastructure will be very high in the above-mentioned metro regions. The development of lands within the metro regions will have a direct impact on coastal ecosystems if proper action is not taken. All the coastal areas neighbouring the metro regions are already eroded and highly vulnerable to further sea erosion. The only solution to this issue is to integrate the proposal and action plans of Coast Conservation and Coastal Resources Management Department into the Regional Physical Plan or Local Physical Plan, when the planning process commences.

The NPPP has also declared a policy framework, using scientific criteria, to identify highly environmentally-sensitive zones and to conserve such zones in the country. Accordingly, two major highly environmentally-sensitive zones have been identified and the appropriate development activities in these zones have also been recommended.

1. Environmentally highly sensitive central hill country; and
2. Environmentally highly sensitive coastal areas.

Figure 18. Environmentally-sensitive areas identified in the NPP

(Source: NPPD)



These environmentally-sensitive areas have been designated to prevent damage by human activities and to protect them for future generations because of their value to human well-being

Figure 19. The importance of the Central Fragile Area

(Source: NPPD)

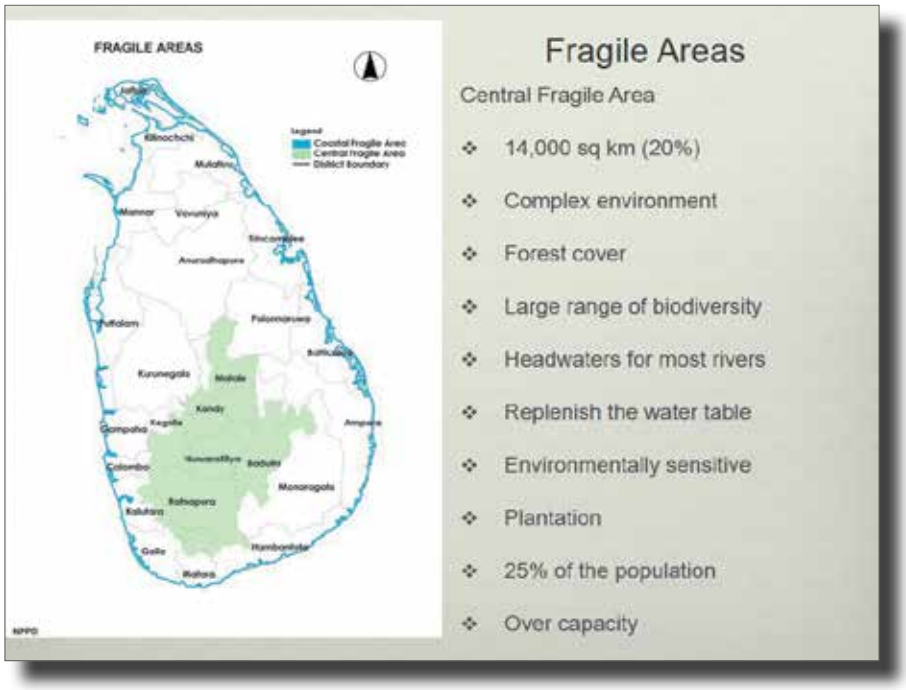
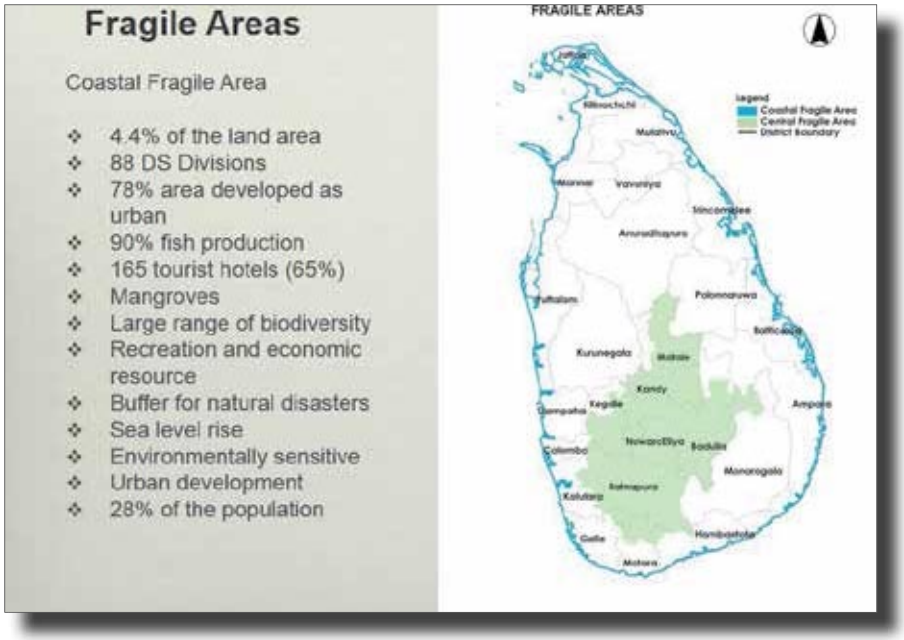


Figure 20. The importance of the Coastal Fragile Area

(Source: NPPD)

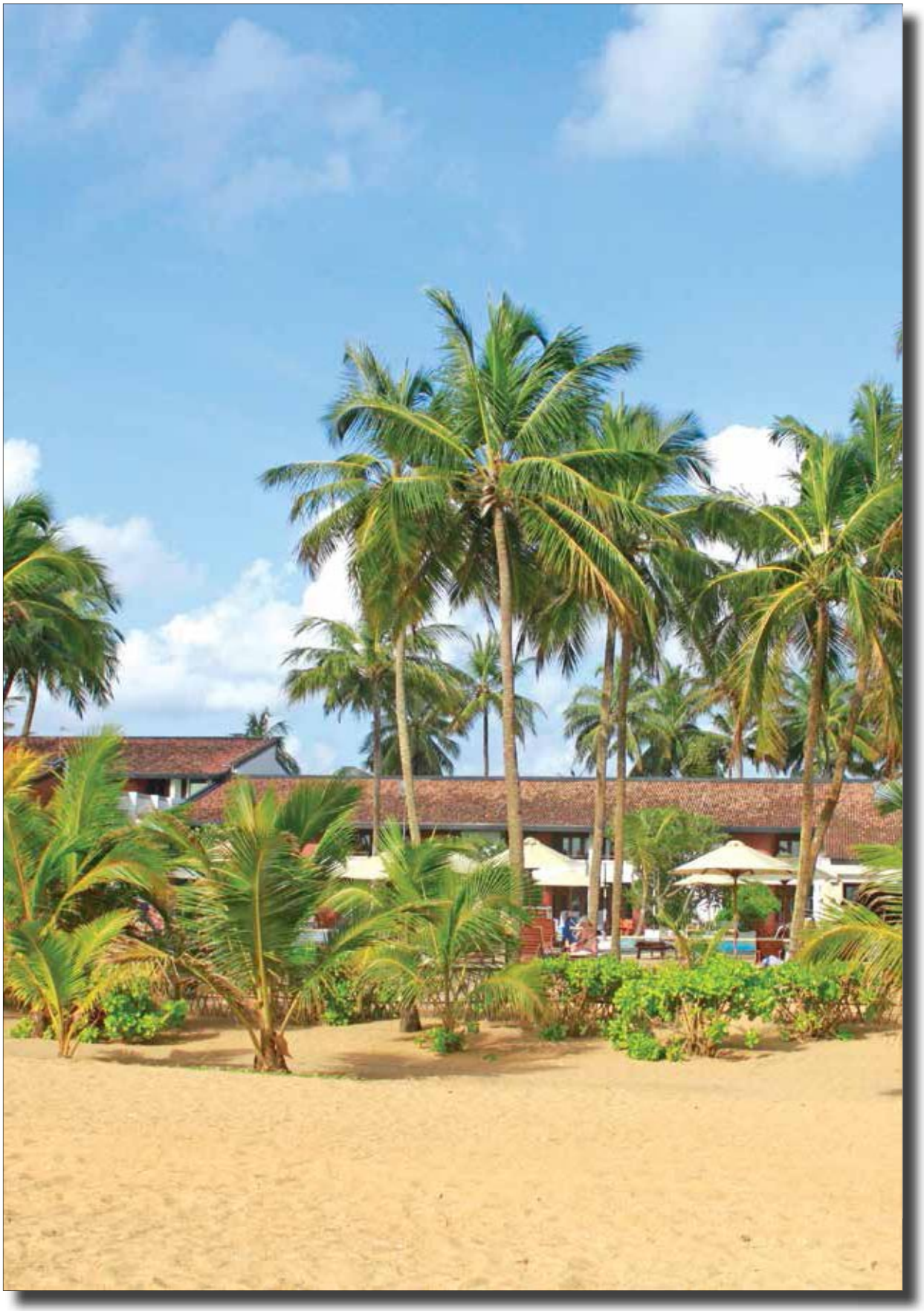


The central hill country and the coastal areas of Sri Lanka are undergoing massive destruction because of human activities. It is important to note that the NPPP provides a policy framework to maintain human activities at a minimum level in these areas. The coastal sensitive area is earmarked in the NPPP in line with the coastal zone, which is currently managed by the CC&CRMD.

The NPPP has also given attention to prevailing coastal erosion in the country. In order to prevent further coastal erosion, the NPPP has recommended that activities already identified in the coastal zone management plan are implemented.

Conclusion

The NPPP has been formulated and has evolved to provide guidelines to restructure the landscape of the country. The coastal area has been identified as a highly sensitive area and it is recommended that projects are implemented in consultation with the CC&CRMD. It is also understood and accepted that sectoral planning cannot solve problems and issues as they are implemented in isolation. In order to avoid such segregation in planning, provincial councils are expected to prepare their own integrated plans in line with the NPPP, considering the needs of the specific region. However, in practice, it is evident that sectoral institutions and provincial authorities have carried out and are still carrying out development activities contrary to the NPPP at the national and sub-national level.



Ecological Considerations in Coastal Development: Perspectives of the Coast Conservation and Coastal Resource Management Department

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Introduction

Sri Lanka has a coastline about 1,620 km (CZMP, 2006). Of this length, 267 km have been protected with hard structures because of erosion; more than 650 km are wildlife parks or protected coastal areas; more than 280 km are classified as highly sensitive where no development can be permitted; there are fish landing sites, anchorages sites and fisheries harbours on an extent of 35 km; and there are tourist areas in more than 140 km. In addition, there are narrow coastal stretches comprising roads and railway tracks, urban centres and other settlements, as well as industries. These figures beg the question 'How much of the extent of coastal areas is now available for coastal development activities, without damaging ecosystems?'

Development activities in coastal areas: trends

Presented below is the main list of developmental activities (occurring simultaneously) found in Sri Lankan coastal areas. The mandate of the Coast Conservation and Coastal Resource Management Department (CC&CRMD) is to maintain the integrity of coastal ecosystems, while allowing for the following development needs — which is a difficult balance.

- Tourism;
- Fisheries infrastructure;
- Aquaculture development;
- Industries and associated structures; and
- Roads and bridges.

Because of time constraints, the focus in this paper will be on the first area: tourism. This is a sector in which there is rapid development in Sri Lanka. The other activities mentioned above also have similar impacts and pressures.

Tourism

Although tourism suffered during the decades of conflict, since 2009, after the cessation of hostilities, the industry recovered strongly, with arrivals currently at one million per year. The number of rooms available in Sri Lanka is around 18,000[3]. The room requirement for the projected number of arrivals — 2.5 million — is 42,500[3]. This gives an indication of the magnitude of development that is necessary in the coastal area for tourism alone. This again begs the question, 'Can the coastal area accommodate this extent of development, when there is such a small extent of the coast available for development?'

Pristine beaches in coastal areas are promoted by the tourism industry. In order to supply the demand for these beaches, there are many transgressions in the coastal zone. Structures are built, without any consideration of the guidelines and rules relating to the coastal zone; fragile areas such as Kalpitiya are taken for tourism. Should this kind of blatant disregard for coastal zone regulations be allowed?

Development activities in coastal areas: issues

In coastal area, as a consequence of coastal development, there is

- Degradation of coastal ecosystems;
- Pollution;
- User conflicts;
- Increasing poverty;
- Uncertainty of food security; and
- Increasing of disasters.

The challenge for CC&CRMD is to provide solutions to these issues. For example, unless poverty is alleviated, mangroves will continue to be destroyed.

Management Strategies used by the CC&CRMD to minimize ecological impacts

The CC&CRMD has implemented six strategies to minimize ecological impacts.

Regulation

Prohibition of certain activities

The following activities are prohibited in the coastal zone.

- Removal of corals;
- Removal of sand, except in areas identified by CC&CRMD as specific locations;
- Any development activities that will significantly degrade the scenic or cultural value of the area;
- Development within designated protected areas; and
- Development within a radius of 200 m of archaeological, historical and cultural sites designated by the Department of Archaeology.

[3] More up-to-date figures for tourism will be available at the Sri Lanka Tourism Development Authority.

Figure 21. Stretches of the coastline unavailable for development

Top: Erosion control, where hard engineering structures have been erected along the coastline. No development activities can occur here. Middle left: Coastal areas already developed under tourism; middle right: Fish landing sites dotting the Kalutara coastline; bottom: Ecologically-sensitive areas — such as sand dunes, where no development can occur.

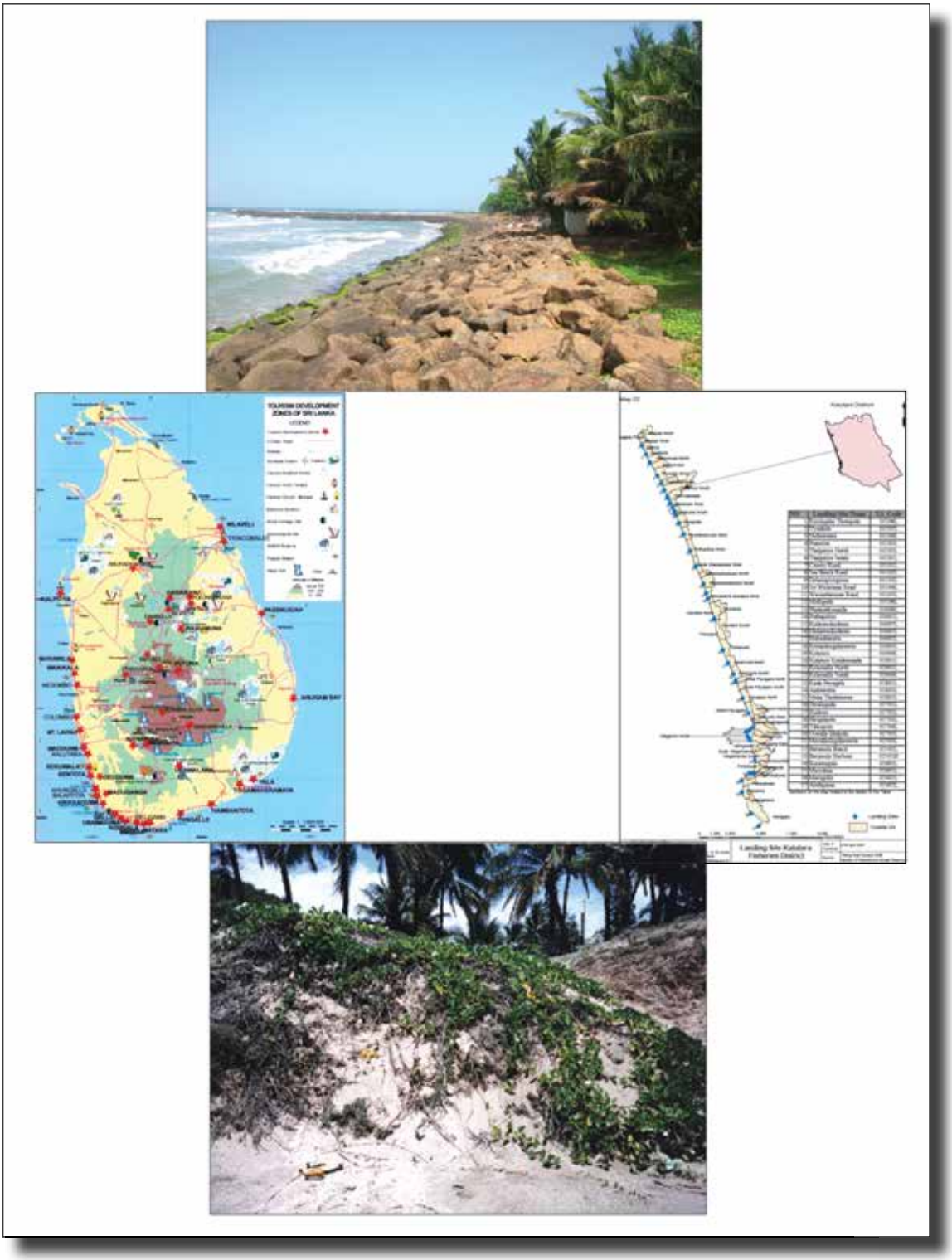


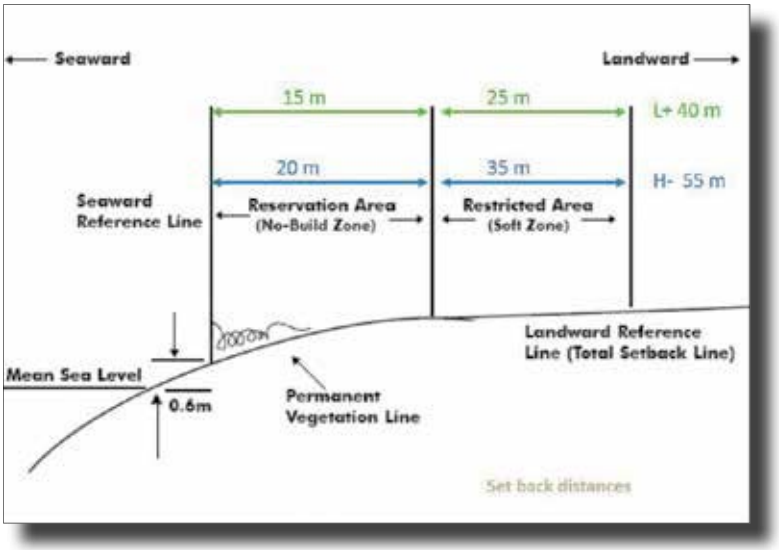
Figure 22. Coastal issues related to tourism

Top: The kind of pristine beach that tourism promotes; 2nd and 3rd rows: Tourism structures built without consideration for the rules and regulations pertaining to the coastal zone; bottom: Areas in Kalpitiya considered to be highly fragile and vulnerable, but being used by the tourism sector.

Implementation of the setback standard

The reservation area is nearest to the shoreline and corresponds to a 'no-build-zone' to protect the environment; while the restricted area (or soft zone) can be used for a few low impact activities — such as small dwelling units — prescribed by the approval of the CC&CRMD advisory council.

Figure 23. Setback standards for coastal areas in Sri Lanka



In Sri Lanka, there are multiple setbacks, where setbacks differ from place to place. In some countries — such as India — there is a uniform, 500 m coastal reservation area around the entire coast. In Sri Lanka, the coastline has been divided into 75 segments and different setbacks are applied to these, depending on, *inter alia*, the population density, erosion rates, other social impacts, as well as ecosystem diversity. The minimum setback in Sri Lanka is 35 m and the maximum is 125 m. If the vulnerability is high, then the setback is also high.

Figure 24. Setback standards on the western coastline of Sri Lanka

Level of vulnerability	Coastal Segment Nos. 1-40		
	Reservation Area	Restricted Area	Total Setback
Low (-)	10	25	35
Low (+)	15	25	40
Medium (-)	15	30	45
Medium (+)	20	30	50
High (-)	20	35	55
High (+)	25	35	60
Protected Area			300

Environmental Impact Assessment (EIA)/ Initial Environmental Examination (IEE) Procedure

Environmental Impact Assessments (EIA) and Initial Environmental Examinations (IEE) are used as strategies to minimize negative impacts to the environment. Reports are meant to address the impacts on the environment from a development project and suggest methods for mitigating damage. In certain cases, the EIA can suggest to the developer the reformulation of the proposed activity and the accommodation of ecological functions.

Education and awareness

This strategy is successful and is used to locate development activities in ideal locations; minimize ecological degradation; and reduce destructive activities in highly sensitive coastal habitats.

Policy Development

The CC&CRMD has developed three major policies:

- Coastal 2000;
- Coastal zone management plan; whose objectives are to
  - identify and prioritize coastal problems that need to be addressed;
  - present the management programme adopted by the CC&CRMD to address these problems;
  - identify the measures which should be adopted by all stakeholders to reduce the magnitude of coastal problems; and
  - identify research activities to enhance the management of coastal resources.
- Special area management plans to manage isolated coastal ecosystems with public participation.

Monitoring

The CC&CRMD is monitoring, in selected areas,

- Pollution levels (monitored in five tourist sites: Arungam Bay, Hikkaduwa, Mt. Lavinia, Polhena and Nilaweli);
- Habitat degradation; and
- Salinity variation.

Research

The CC&CRMD is studying

- The impacts of development on coastal ecosystems and their habitats; and
- Carrying out socio-economic research.

Coordination

The CC&CRMD coordinates activities among agencies, as well as within agencies.

The effectiveness of management strategies

The effectiveness of regulations

This is a very difficult process to implement.

- The compliance of permits is satisfactory but unauthorized construction is increasing;
- In many cases, EIA reports are biased towards the justification of development rather than the real assessment of the impacts and are ambiguous; and
- Banning of resource use is difficult unless alternatives can be provided. Sand mining is a clear example.

Table 5. Sand supply and demand

	Sand demand	
CRMP Sand Study of 2002	estimated 8.1 million m^3	The demand estimated base on cement used.
2006	11.8 million m^3	
	Sand supply	
From Chilaw to Matara	3.63 million m^3	From where is the shortfall obtained? Even though there is a ban, this shortfall must be obtained from beaches. There is a tendency to obtain sand legally or illegally from where it is available.

The effectiveness of education and awareness

This is a very effective strategy, but the knowledge on regulation, law and guidelines still needs improvement. Within department and inter-agency capacity development is very poor. Technical capacities need considerable strengthening, otherwise technical officers cannot carry out their duties.

The effectiveness of policy development

SAM process

The CC&CRMD has identified in 1997, the Special Area Management (SAM) Strategy. This process has not been evaluated thoroughly. However piecemeal studies show some shortcomings in this process as listed below.

- There is a lack of awareness about rural dynamics among implementing agencies and professionals involved in development;
- Government and donor priorities drive the process rather than the requirements of the community;
- Limited institutional capacity of local NGOs resulting in single representative dominating the thinking of the said NGO: participation is limited;
- Donor funding policies;
- Lack of access to rural communities for productive resources;
- Confusion of the terms co-management, participatory management and community-based resource management;

- Improper stakeholder analysis;
- Public participation;
- Balancing 'participation' and "direction", in many cases the process is not participatory but directed; and
- Omitting the lead agency from the system.

Coastal zone management plan (CZMP)

Implementation of the regulation chapter is satisfactory but strategies relevant to other agencies are not implemented properly. Agencies tend to implement their sectoral plans, without reference to the CZMP. In the CZMP of 1997, there were chapters related to policy regarding aquaculture and fisheries, but these policies were ignored by the relevant agencies. Therefore, in the revision of the CZMP, these chapters were omitted, based on the thinking that all chapters in the CZMP should be those which the CC&CRMD could implement themselves.

There are many agencies that have responsibility for specific areas of CZM, but these responsibilities are not being borne effectively. A large number of actions/tasks, prioritization and periodic review of the priorities are essential but are still not being carried out. In addition, a long-term financing programme is necessary to ensure a continuity in implementation.

The effectiveness of monitoring

Overall, this area is very weak. Monitoring is being carried out only in certain areas. In order to increase the geographical ambit, the support of academic institutions is essential.

The effectiveness of coordination

Even though a holistic approach is always advocated, encouraging inter-agency coordination, still, management remains essentially sectoral. There is also a lack of understanding of environmental and ecosystem functional processes by many development-oriented national agencies.

Conclusion

'Progress has been made but it has been neither fast or deep enough and the need for further reaching action is ever more urgent. At the same time we face increasingly powerful drivers of change including the impacts of current production and consumption patterns and resources scarcity, innovation, demographic change, changes in global economy, green growth, growing inequality, changing political dynamics and urbanization' (UN Secretary-General's High-level Panel on Global Sustainability, 2012).

Therefore the balance among ecology, development and economy needs much more practical action by all agencies, actors, and nations. Active people's participation is essential. Whatever action ultimately depends on political will.

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Investigating the Performance of Coastal Ecosystems for Hazard Mitigation

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Coastal hazards, their impacts and mitigation

The coastal zone — comprising coastal communities, the built environment and ecosystems — is exposed to a wide range of hazards (both episodic and chronic) arising from natural phenomena and human-induced activities.

Episodic hazards include severe storms, earthquakes, tsunamis and oil spills, all of which have limited predictability and may result in major disasters. Chronic conditions include shoreline erosion, flooding, sedimentation, sea level rise and coastal environmental and resource degradation. These conditions, which may result or increase from disasters arising from episodic hazards, relate to processes which could be measured and monitored. Unplanned or poorly-designed engineering interventions in the coastal zone also contribute to the increase of chronic conditions. There are also coincident coastal hazards — more than one hazard acting the same time. At a given location along the coastline, hazards are characterized by their source of origin, intensity, frequency of occurrence and the potential impact both in magnitude and space. For an existing and projected scenario of coastal zone activities, the preparation of mitigation measures for multi hazards requires a deep understanding of the associated physical processes over a wider coastal region.

There are many mitigation measures that could be adopted in coastal zone management when planning for a tsunami and other coastal hazards that accompany high waves, heavy inundation and extreme impacts. They essentially deal with hazard mitigation, vulnerability reduction and improving the capacity and preparedness. In combination, they reduce disaster risk reduction and develop hazard resilient communities (See Figure 25).

Figure 25. Approach towards coastal hazards, risk assessment and management

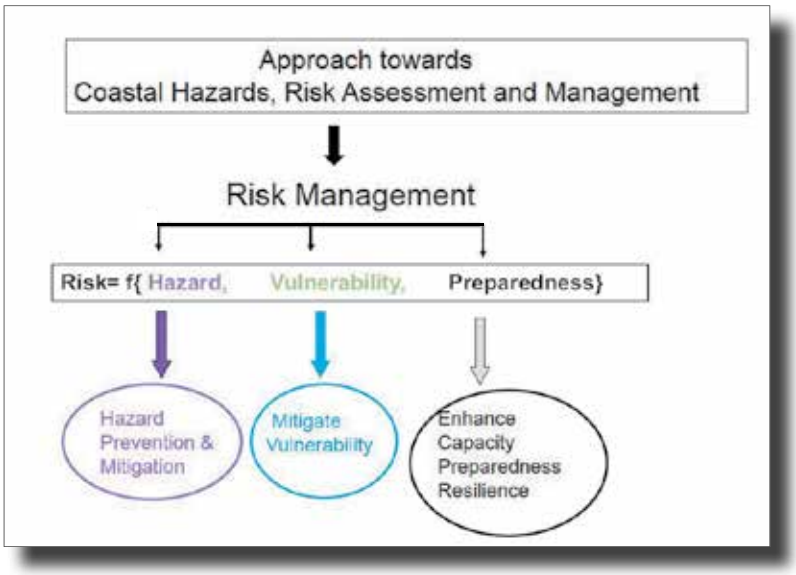


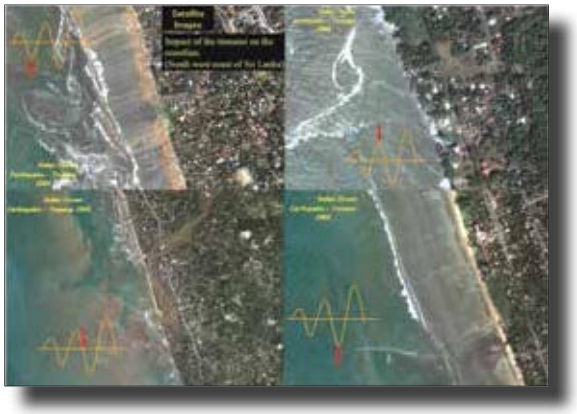
Figure 26. Methods of risk management

It is important that mitigation measures against coastal hazards be developed within a Multi-Hazard Coastal Risk Assessment Framework, which should be an integral component of an overall coastal area management plan. This will ensure an orderly, balanced utilization of resources and where possible, restore and enhance the stability and environmental quality of the coastal zone.

Classification of measures that mitigate the impact of hazards

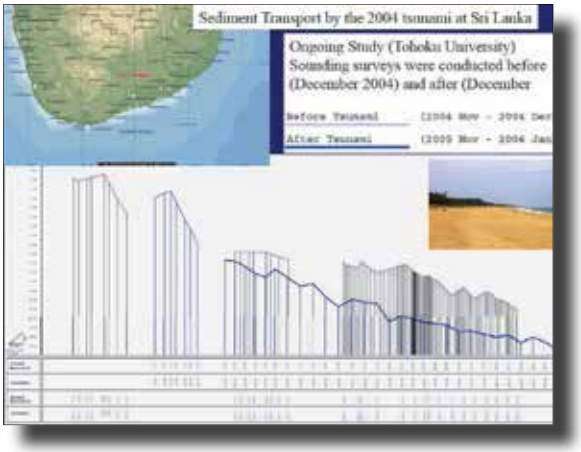
Although coastal hazards impose a wide range of impacts, coastal erosion, flooding and environment pollution have apparent and immediate consequences to humans and society, and are, therefore, often principal concerns in the administration of coastal districts. The severe impacts of the Indian Ocean tsunami on the Sri Lankan coastline — in particular, the manner in which it affected infrastructure and ecosystems — are well documented. Even though a holistic approach is always advocated, encouraging inter-agency coordination, still, management remains essentially sectoral. There is also a lack of understanding of environmental and ecosystem functional processes by many development-oriented national agencies.

Figure 27. The impact of the Indian Ocean tsunami on the western coastline of Sri Lanka



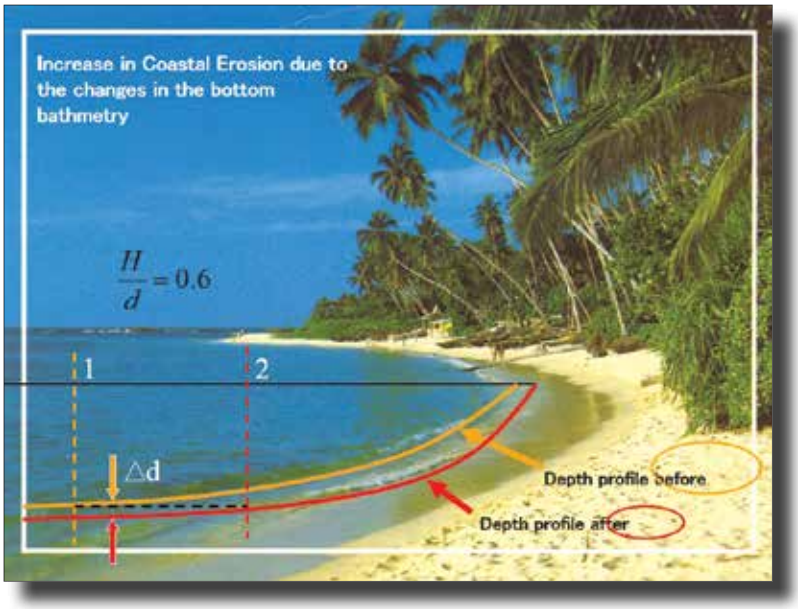
What must be appreciated is that hazards cannot be viewed in isolation. For example, a typical tsunami wave tends to erode the seabed, leading to increased depth. The increase in depth, in some cases, was of one to two metres.

Figure 28. Erosion in the seabed in the Hambantota area



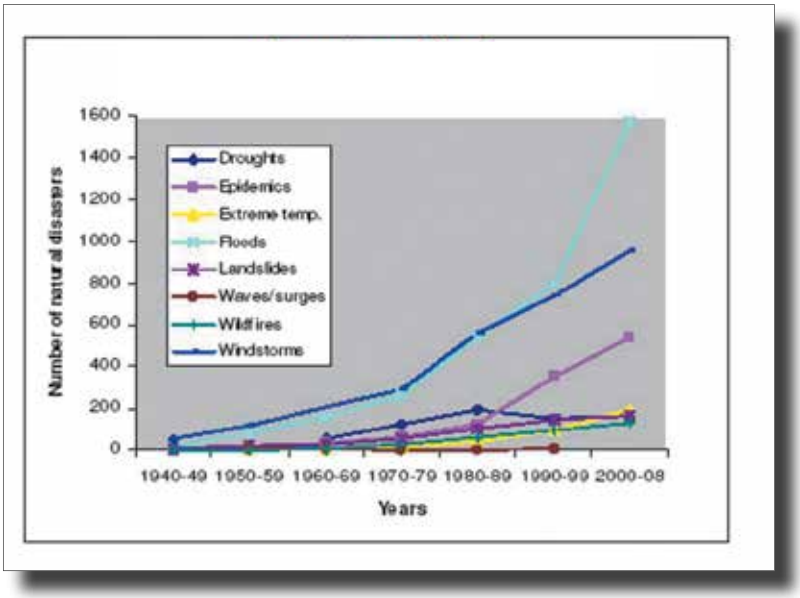
When bottom bathymetry changes (as a consequence of a hazard) then erosion is increased with larger waves observed near the coastline.

Figure 29. Changes in bottom bathymetry increase erosion



During the last several decades, there has been an increase in natural disasters.

Figure 30. Increase in the frequency of natural disasters 1940-2008



Climate change in the coastal zone has several impacts.

- It introduces new hazards, such as increasing temperature, sea level rise, inundation and degradation of low-lying shorelines;
- It increases the frequency and magnitude of existing hazards; and
- It also affects the vulnerability profile of the region.

It must be appreciated that a certain magnitude of sea level rise is not associated with the same magnitude of coastal erosion, in fact it could be 50-100 times greater in magnitude, because of coastal phenomena[4].

Figure 31. Climate change exacerbates coastal erosion

It is recognized that irrespective of the source of the hazard, the underlying principles of protection against flooding and erosion protection are similar. However, depending on the magnitude of the impact and based on overall risk assessment, larger and robust measures have to be adopted to withstand the hydrodynamics of flow. Furthermore, the impact of episodic hazards may contribute to long-term changes in sedimentation and coastal erosion.

Because climate change will increase the frequency and magnitude of existing hazards, a clear understanding of the connectivity of issues is needed. Certain impacts of climate change — such as global warming, melting ice caps — are measurable and predictable, however difficult it may be. However, the impact of climate change on storms and waves cannot be measured or predicted easily in view of the complexities of understanding the processes and uncertainty. They rely on predicted wind databases, taking into account impacts of climate changes.

[4] A factor known as Brunn's Rule says that as sea level rises, the retreating beach assumes exactly the same shape in a new position. In other words, sea level rise makes beaches move. In order to maintain exactly the same shape, erosion has to be greater than the sea level rise (Bruun, 1963). The IPCC reports that 1 cm rise in sea level erodes beaches about 1 m horizontally. This becomes a large issue for developed beaches that are less than 5 m from the ocean (IPCC, 1998 in litt. UNFCC, 20134).

Figure 32. Measurable impacts of climate change

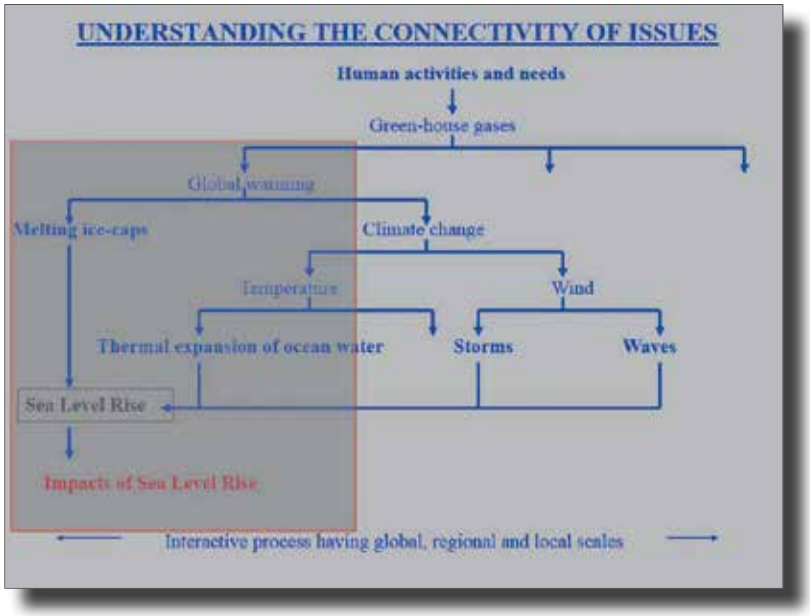
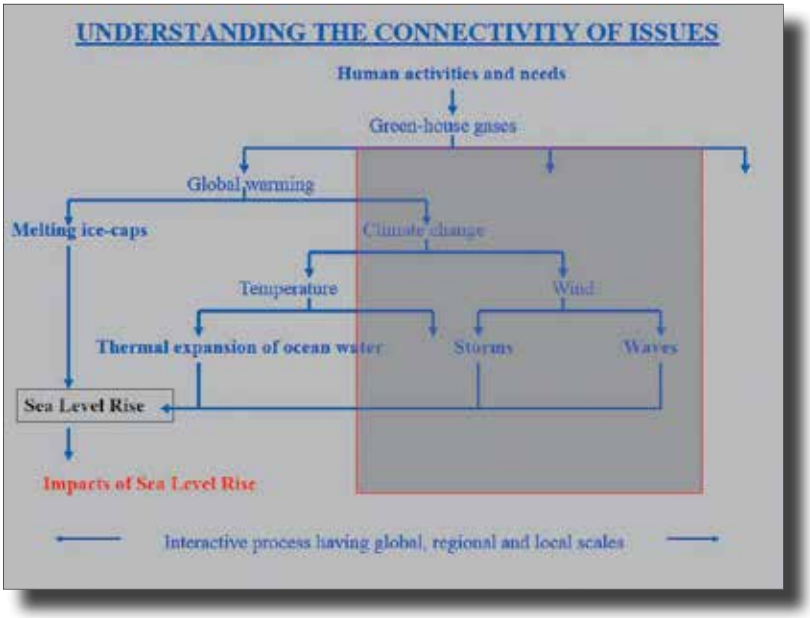


Figure 33. Impacts of climate change which cannot be measured.



Coastal hazard mitigation

Measures that mitigate the impact of the hazard are identified as physical interventions or structural measures and can be classified broadly into three types depending on their location and function in protecting the coast.

These measures may be achieved not only by artificial methods *via* engineering design but also by harnessing the full potential of natural coastal ecosystems. This approach creates a platform on which engineers and ecologists can work together. The types of measures and typical examples for each category are listed below.

1. Reduce the impacts of waves prior to reaching the shoreline (a partial barrier located in coastal waters);
2. Protect the coastal zone by preventing the inland movement of waves (a full barrier at the shoreline); and
3. Mitigate the severe impacts of waves on entry to the shoreline (a partial barrier at the shoreline) (See Figure 34).

Full and partial barriers — either artificial or natural — are physical interventions and are expected to withstand extreme flow and wave attack, and dissipate wave energy in an efficient manner.

There can also be hybrid solutions — a mixture of natural and artificial methods.

The role of ecosystems in hazard mitigation

Field investigations conducted in Indian Ocean states after the Indian Ocean tsunami of December 2004 highlighted the resilience of coastal ecosystems and vegetation in their ability to mitigate the impact of hazard. Depending on the height and other characteristics of the incoming waves, there were many examples which provided evidence of efficient wave energy absorption of ecosystems and vegetation. Some performed well, while others failed because threshold resilience characteristics were exceeded. In the case of hazards where extreme impacts occur but the frequency of occurrence is low, natural solutions provide cost-effective and environmentally-friendly solutions.

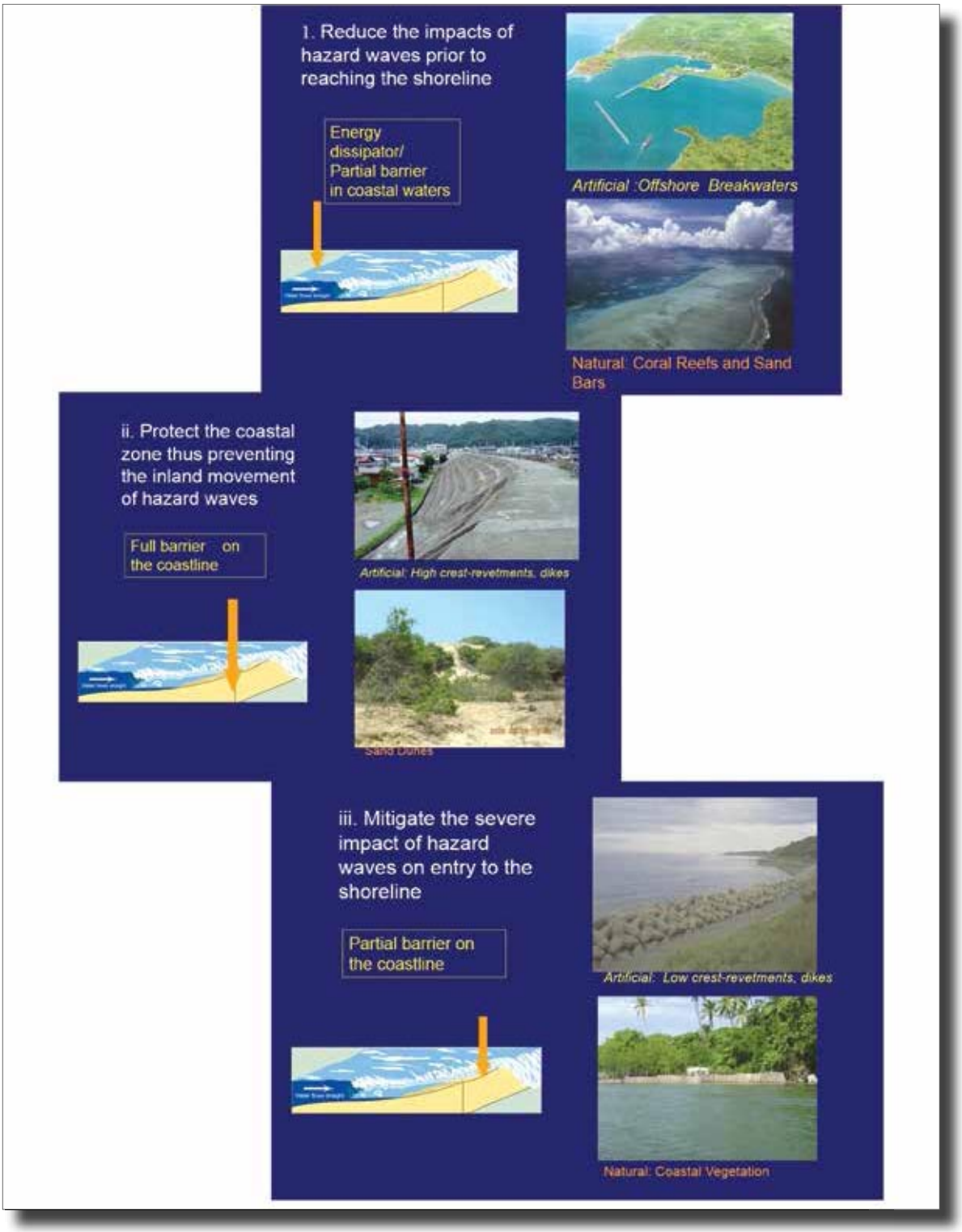
However, engineers need guidelines in order to use natural ecosystems. Research into the ‘design criteria’ of natural ecosystems is strongly recommended.

Strengthening existing defences

The coastline has widely varying natural defences against wave action and currents. These include the offshore seabed, sand banks, coral reefs on which waves break, beaches and dune systems. Natural defences play a vital role in coast protection and conservation. However they may be in danger of degradation and it is very important to conserve and strengthen these defences at every possible opportunity. Such action enhances their capacity in performing their role as protection and conservation measures.

Figure 34. Methods of hazard mitigation

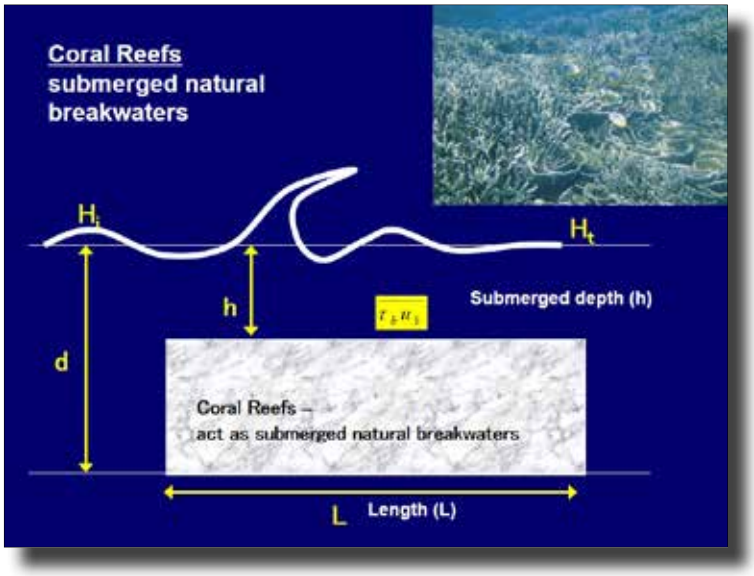
Top: Reducing the impacts of waves prior to reaching the shoreline (a partial barrier located in coastal waters); middle: protecting the coastal zone by preventing the inland movement of waves (a full barrier at the shoreline); and bottom: mitigating the severe impacts of waves on entry to the shoreline (a partial barrier at the shoreline).



Coral Reefs

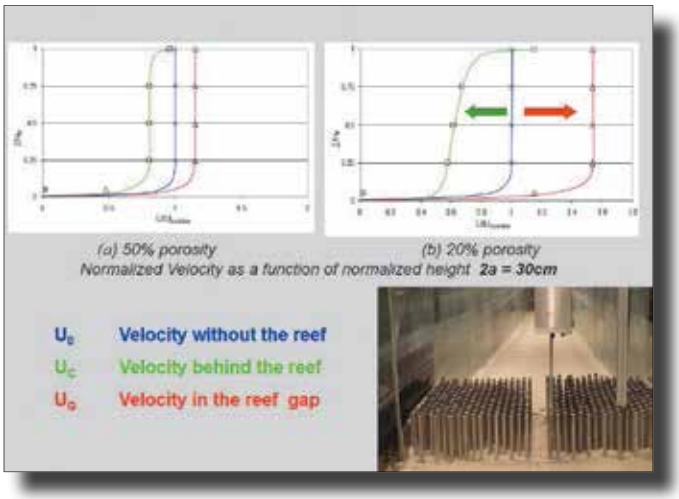
From an engineer's point of view, a coral reef dissipates energy and acts as a submerged natural breakwater — a porous submerged barrier. When the Indian Ocean tsunami struck the coast of Kenya, it was low tide, and virtually all the energy of the wave was dissipated over the length of the coral reef system.

Figure 35. Coral reefs act as submerged natural breakwaters
(A small 'h' and a large 'l', will dissipate much energy)



But human impacts on coral reefs create gaps within reefs, and these gaps can increase the energy of the wave. In a collaborative study with the University of Arizona and the University of Moratuwa, a coral reef system was simulated using vertical cylinders, and three scenarios were examined: with a reef, without a reef and a reef with a gap. With the reef, the simulation showed a clear reduction in the velocity of the wave. With a gap, there was a very strong jetting effect created, that exacerbated impacts. This same impact will be felt in built infrastructure as well.

Figure 36. The effect of gaps in coral reefs



Sand dunes

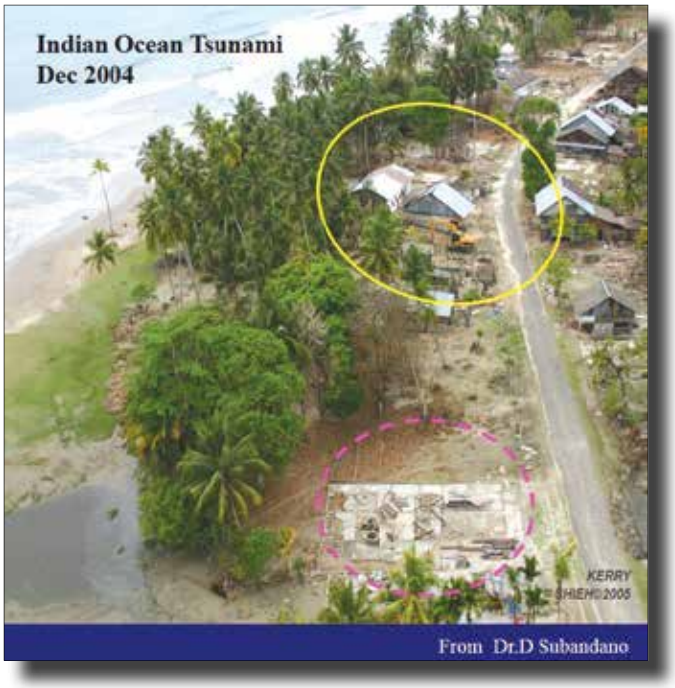
Sand dunes are very effective in dissipating wave energy, functioning as full barriers against tsunami wave propagation. Their effectiveness was proved in many countries during the Indian Ocean tsunami. Dunes represent the final line of defence. They restrict or prevent the intrusion of waves, reduce the impact of wind, salt spray and also control the movement of sand into back beach regions. Dunes, on which coastal vegetation have grown, perform more efficiently ensuring stability, greater energy dissipation and resistance to erosion. Sand dunes have performed extremely well against coastal flooding. Even when overtopped, those having coastal vegetation on the surface have shown greater stability in resisting failure.

Coastal vegetation and mangroves

After the Indian Ocean tsunami of December 2004, several images revealed that coastal vegetation had protected infrastructure inland. These act as partial barriers onshore.

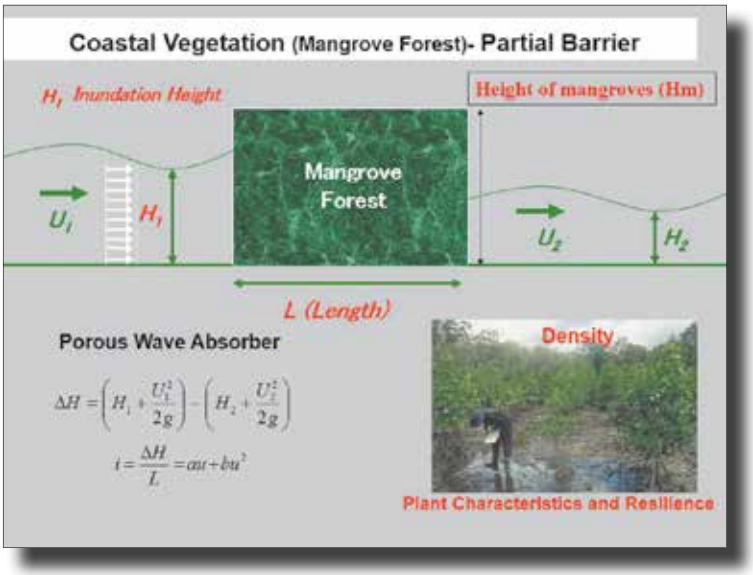
Coastal vegetation can be used effectively to dissipate part of the tsunami wave energy *via* turbulent flow through the media. The dissipation is dependent on the density of vegetation, overall porosity and the tortuous characteristics of porous matrix of the vegetation. It is important that vegetation itself is resilient against the wave propagation and imposed loads, and they have a root structure to resist the high velocity regime at the floor bed.

Figure 37. The effect of coastal vegetation on the Indian Ocean tsunami of Dec 2004



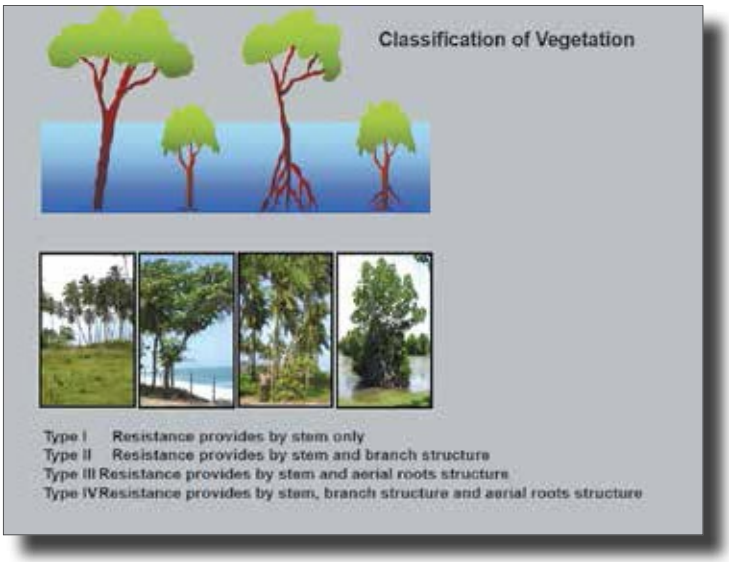
From an engineering perspective, provided the wave height is not too large and sufficient length of vegetation with the desired degree of resilience is available, then there will be dissipation of energy.

Figure 38. Dissipation of energy from coastal vegetation



It is important to understand the manner in which vegetation will fail under wave attack.

Figure 39. Classification of vegetation by engineering needs



The same strand of vegetation can function differently depending on the force of the wave.

Dunes and vegetation, in combination, are extremely effective in providing protection and dissipating energy under wave action.

Testing is being carried out in the laboratory, using different types of plants to examine how waves travel, to be able to quantify the performance of plants, in relation to the dissipation of energy. The results of these tests have been published (Hettiarachchi et al., 2013).

Selection of appropriate methods

It is important to recognize that measures to be adopted at a given location or region must mitigate multiple hazards of different origin, potential impacts of varying intensities and spatial distribution, as well as a wide range frequency of occurrence, while sustaining multiple uses of the coastal zone. This could be achieved by either adopting a single measure or, as on most occasions, by developing a well-integrated hybrid solution comprising a number of measures, which also satisfies environmental concerns. Hybrid methods, therefore, refer to combinations of artificial methods or a combination of natural methods, as well as joint application of artificial and natural methods. When adopting artificial barriers only, it is necessary to ensure the continuity of sustaining multiple uses of the existing natural environment.

Therefore, within an overall integrated coastal area management plan, measures which mitigate the impact of the coastal hazard represent a coherent set of interventions, specified in time and space, to achieve a certain expected level of protection against existing or anticipated damage from single or multiple hazards and, on many occasions, being proactive in leading to shoreline restoration and stability.

The role of Ecosystems in Disaster Risk Reduction

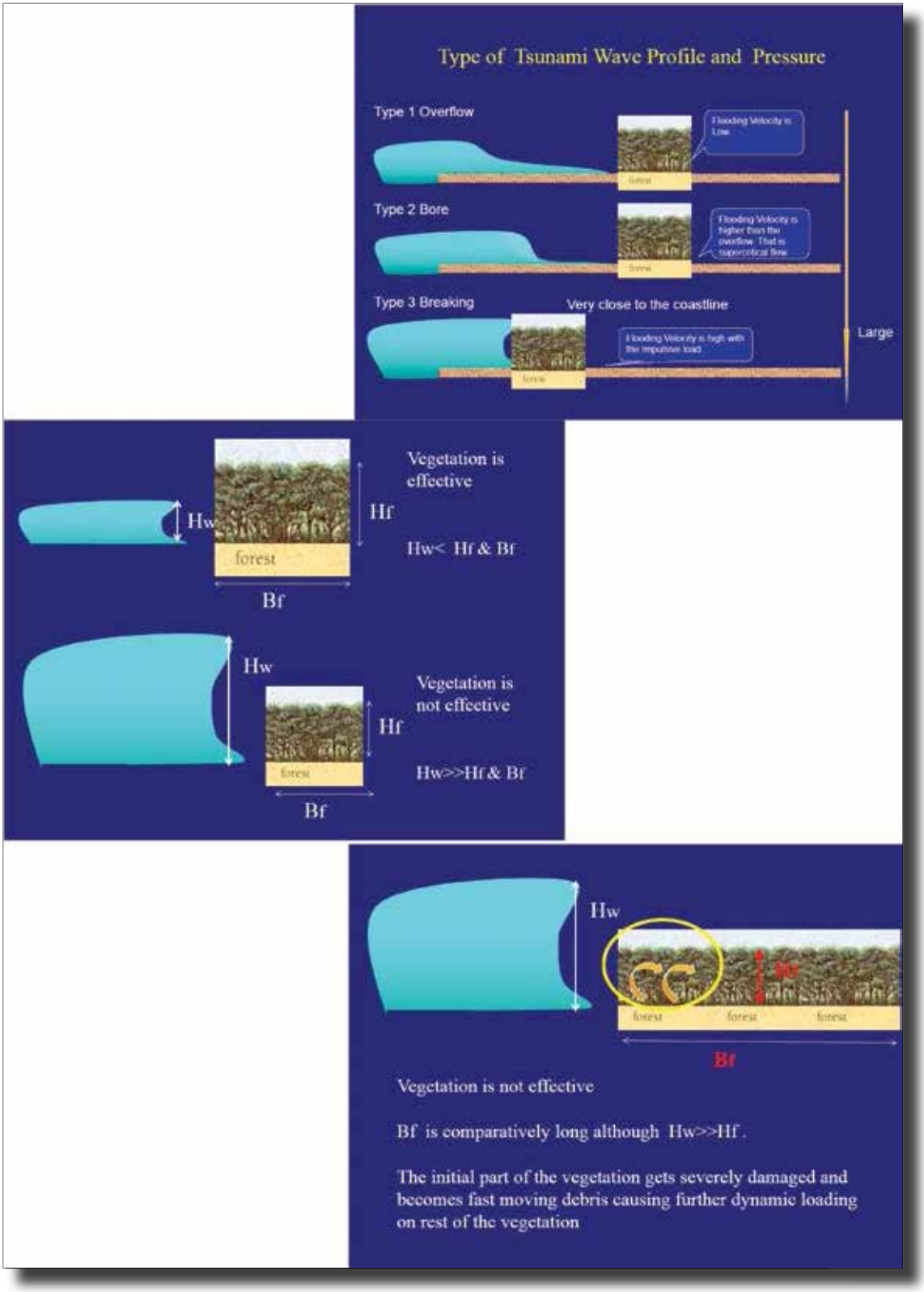
The United Nations University, Bonn, UNEP, Geneva and IUCN spearheaded an initiative in developing a publication, 'Role of Ecosystems in Disaster Risk Reduction'. This publication was formally released at the Global Platform in Geneva in May 2013. Relevant subjects are discussed under four sections:

1. Why do ecosystems matter in disaster risk reduction;
2. Ecosystems and coastal disaster risk reduction;
3. Water resources management for disaster risk reduction; and
4. Sustainable land management for disaster risk reduction.

Policy, planning and future perspectives

On the subjects of ecosystems and coastal disaster risk reduction, up to now specific guidelines on the performance of coastal ecosystems are not available. There have been several physical model investigations implemented to examine the performance of coastal ecosystems and vegetation. A chapter titled, 'Investigating the performance of coastal ecosystems for hazard mitigation' was presented in the above publication (Hettiarachchi et al., 2013). This chapter reviews some of the important studies conducted on the subject and also reports the results of studies initiated by the University of Moratuwa. These studies relate to the simulation of both coastal vegetation and coral reef systems. The chapter will identify where possible critical design parameters of practical importance and will also make recommendations on large-scale studies which are required to develop such design criteria.

Figure 40. Type of wave and impact on vegetation



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Legal Aspects and Approval Process in the Coastal Environment

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Colombo 05

Introduction

The coastline plays an important role in the socio-economic development of Sri Lanka. There is a growing population in coastal areas, with, *inter alia*, demands for proper infrastructure, employment opportunities, along the coastal zone and this creates pressure on the scarce land along the coast.

There is, therefore, a need for a protection regime implemented through national laws, institutions and management plans.

National Laws

The protection regime in respect of the coastal environment is contained in several national laws.

National Environmental Act (NEA) No. 47 of 1980 as amended (Amendment Act No. 56 of 1988 and Act No. 53 of 2000)

The NEA, as amended, provides for the protection and management of the environment, regulating pollution by a licensing scheme and evaluating through environmental impact assessments (EIAs).

The Coast Conservation Act No. 57 of 1981 as amended (Amendment Act No. 64 of 1988 and Act No.49 of 2011)

This Act provides for a permit system for development activities in the 'Coastal Zone' and deals with coastal zone management, conservation activities and regulates development activities within this 'Coastal Zone'.

The Coast Conservation and Coastal Resource Management Department (CC&CRMD) manages this coastal zone, under the Coast Conservation Act (CCA) as amended, and the Director General of Coastal Conservation is responsible for the administration and implementation of this Act as amended.

Mines and Minerals Act No. 33 of 1992

This Act is administered primarily by the Geological Surveys and Mines Bureau (GSMB) and is relevant for coastal development in that Section 66 of the Act impacts on the authority of the Director General of CC&CRMD to issue permits for development activity in the Coastal Zone.

Planning and regulation of development

Various procedures and licenses have been set in place in order to provide checks and balances against environmental damage. Most development activities have the potential to harm the environment, particularly if carried out in an unplanned manner.

The law is very clear about how, where and by whom these licensing and other procedures must be obtained and observed before potentially environmentally harmful activities are carried out.

Licensing and Planning Procedures

1. Initial Environmental Examinations (IEEs);
2. Environmental Impact Assessments (EIAs); and
3. Environmental Protection Licences (EPLs) (EFL, 2006).

Initial Environmental Examinations (IEEs)

This is an important tool for incorporating environmental concerns into the early planning or feasibility stage of a project. IEEs look into the general environmental setting of the project, its potential impacts and required monitoring and mitigation measures. IEEs are conducted when projects are likely to have only minor or limited environmental impact, which can easily be predicted and evaluated, and for which mitigation measures can be prescribed. They are also used to confirm whether a project requires a full Environmental Impact Assessment (EIA).

Environmental Impact Assessments (EIAs)

For certain types of projects before they can be given 'development consent', a systematic assessment of the environmental effects of the project needs to be drawn up. This helps to ensure that the importance of the predicted effects and the scope of reducing the impacts are properly understood by the public and the relevant competent authority, before it makes its decision.

Part IVC of the National Environmental Act (NEA) relates to the 'approval of projects' and establishes the process for the Environmental Impact Assessment (EIA) by *Project Approving Agencies (PAAs)* as provided for in Gazette No 859/14 of 1995. The approval process by the PAAs provided for in *Sec 23Y-Z and 23AA -23FF* in the NEA as amended along with Gazettes No.772/22 of 1993 and No. 1159/22 of 2000.

The EIA procedure for development activities along the coast in Sri Lanka was first introduced by way of the Coast Conservation Act No. 57 of 1981 as amended. The provisions regarding EIAs for Coastal Development projects are contained in *Part III of the Act entitled 'Permit Procedure'.*

Section 14 (1) of the Act — no person is permitted to engage in any development activity within the coastal zone 'except under the authority of a permit issued in that behalf by the Director General of Coast Conservation'.

Section 14 (2) states that the Minister may, having regard to the effect of those development activities on the long term stability, productivity and environmental quality of the coastal zone, prescribe those activities which do not require a permit under sub section 1.

This is due to the fact that the term 'development activities' has not been defined anywhere in the Act and therefore, without this provision, minor activities which would obviously not have any significant impact on the environment in the coastal zone will be caught up within the provisions of this Act.

Section 16 (1) — (5) of the Coast Conservation and Coastal Resource Management Act as amended, provides for the procedure when the Director General receives an application for a permit to engage in development activity in the coastal zone.

On receipt of IEE or EIA reports the Director shall submit it to the Coast Conservation Advisory Council, as provided for in Section 6 of the Coast Conservation Act as amended, for its comment.

This should also be made available to public inspection by a notice published in the gazette, by the Director, inviting comments from the public. Any member of the public may, within 30 days of such notice, make such comments to the Director.

Section 16 (5) — The Director shall thereafter make his/her decision within 60 days of receiving such comments having regard to all of them.

Section 17 — Should the Director decide to issue the permit he/she may do so with any condition necessary for the proper management of the Coastal Zone and Coastal Resource Management Plan or to any scheme of work for coast conservation.

Section 18 — The Director may also specify the period during which the permit will remain in force. He/she may also under certain circumstances, vary the conditions under which the permit was issued. The permit holder may apply for renewal of the permit.

Environmental Protection Licences (EPL)

An Environmental Protection Licence (EPL) authorises the holder to emit wastes into the environment, within stipulated limits and subject to certain conditions. EPLs are intended primarily for industries and activities that produce large amounts of waste. This licence can be revoked if the holder does not comply with its stipulations, rendering the said activities to be prohibited. Those emitting waste, in whatever form, must abide by the conditions under which these licenses are issued.

The players

The CC&CRMD and Urban Development Authority (UDA) are primarily responsible for planning and regulation of development activities.

One kilometre from the Mean High Water line of the sea is designated as 'urban development areas' under the UDA regulations and is subject to planning and regulatory requirements. Therefore, all construction in coastal zone requires an approval from the CC&CRMD.

In both urban and other development areas, with respect to minor activities such as the construction of houses etc., authority for the issuance of permits has been delegated to the respective Divisional Secretaries or authorized officers in the coastal areas. For larger projects, permits are directly issued by CC&CRMD.

With respect to large-scale construction of buildings, it is compulsory to obtain an approval permit from CC&CRMD prior to commencement of construction, even though issuing of final approval is the responsibility of the local authority.

Approval permits

There are three types of approval permits issued for development activities within the coastal zone.

1. Major Permits;
2. Minor Permits; and
3. Emergency Permits (ADPC, 2011).

Major permits

These are issued directly either by the Director General or any other authorized officer of CC&CRMD.

Regulations published in the Gazette no 260/22, 1983 states, development activities are not to:

1. Infringe on public access to the beach;
2. Result in the discharge of unacceptable level of effluents or toxic substance;
3. Reduce the quality of beaches or affect their preservation;
4. Dislocate any existing fishing activity;
5. Affect the ecosystem where such development activity is located in or adjacent to an area declared a marine sanctuary;
6. Be located or sited in places of religious worship;
7. Be located in recreational areas or wildlife habitats;
8. It is important that the proposed activity is to be sited so as to allow an adequate buffer zone to accommodate the dynamics of coastal processes.

Minor permits

Minor permits are issued for selected activities initiated based on the Coastal Zone Management Plan by the Divisional Secretary or an authorized officer to whom authority is delegated by the Director General of CC&CRMD under Section 5 of the CCA as amended. Minor permits are issued only for the construction or extension of houses. In addition, minor permits for the removal of sand up to two cubic metres, from the location specified by the CC&CRMD in a coastal zone, would be issued by Divisional Secretaries.

Emergency permits

Under emergency conditions — such as a natural hazard or any other distractions — the Director General of CC&CRMD, or Divisional Secretary of the relevant area, or an authorized officer, can issue an emergency permit as a temporary measure, not exceeding one week as validity period.

Local Authority Approval Process

The Local Authority has a separate process for approval permits and undertakes physical planning. The Local Authorities deal with the UDA, NPPD, CC&CRMD and Provincial Councils while doing so. All new construction and modifications to current buildings need to be approved by the appropriate local authority.

Every Local Authority (LA) has a planning committee to facilitate the approval procedure and is headed by the Mayor or the Chairman.

When an application is submitted to the LA for approval, a team of technical officers undertakes a site inspection to consider compliance with existing planning regulations, ventilation requirements, street line certificates etc. The inspection report is submitted to the planning committee with a recommendation from the UDA.

If the application fulfils the required conditions the planning committee grants approval, the process of which generally takes up to 40 to 50 days. Once the new construction or modification is complete the Local Authority issues a Certificate of Conformity (COC) without which the construction is considered an illegal construction.

Conclusion

When an application is submitted to the LA for approval, a team of technical officers undertakes a site inspection to consider compliance with existing planning regulations, ventilation requirements, street line certificates etc. The inspection report is submitted to the planning committee with a recommendation from the UDA.

If the application fulfils the required conditions the planning committee grants approval, the process of which generally takes up to 40-50 days. Once the new construction or modification is complete, the Local Authority issues a Certificate of Conformity (COC), without which the construction is considered an illegal construction (ADPC, 2011).

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The Way Forward

A panel discussion was held at the end of the workshop comprising resource personnel. The discussion was also opened to the participants. The following recommendations are distilled from this session.

- Coastal ecosystems must now be understood as complex, dynamically stable, socio-ecological-political systems.

- All participants welcomed this interdisciplinary workshop and stressed the need for engineers and ecologists to collaborate within the needed context: that of development, ecosystems and safeguarding the security of humans, ecosystems, infrastructure and crops. This workshop can be used as a springboard to form an interdisciplinary forum that will serve as a mechanism to do so.

- Champions are needed to spearhead change that is critically needed. IUCN was suggested as one such agency, to take the lead in bringing together all the agencies and technical experts to assist authorities manage the coastal ecosystems as natural capital that provides perpetual dividends for local livelihoods.

- The deliberations of the workshop need to be shared with a wider audience. There is a critical need to take these deliberations to the provincial, local and divisional level.

- Interesting research is being carried out on the use of natural infrastructure in coastal hazard mitigation. When engineering specifications are available, environmental design guidelines need to be provided to establish/ enhance coastal natural structures as soft measures for hazard mitigation. Hybrid solutions needed also to be investigated and demonstrated on a pilot-scale.

- A national physical plan has been prepared, with consideration of national policies on development and environment. However, *ad hoc* sectoral development interventions are making this plan redundant. The national physical planning process fits well with the principles of Strategic Environmental Assessment (SEA). Therefore, there is a strong case for strengthening the NPPP process, with the participation of all key agencies and making it mandatory that project approving procedures, including EIAs, ensure that projects are evaluated in conformity with the NPP. It was felt that the NPPP should to be treated as a strategic level document and that detailed regional physical plans should be developed to address regional priorities.

- The Northern Province was identified as a priority area for action, because there is still an option for action to integrate ecological considerations into development planning, as development plans are still being finalized.

- Environmental regulatory agencies working in the coastal zone have the required legal power to appraise coastal projects with respect to environmental safeguards and to ensure that ecological considerations are incorporated in to development projects. However, because of a varying range of factors — including lack of technical capacity, political interference and the lack of interest/motivation — these agencies have been made ineffective and inefficient when addressing environmental concerns in the coastal development projects.

    - When donors have strong environmental safeguard policies, they ensure that acceptable environmental appraisal is carried out for the projects that they support under their funding. Similarly, the environmental regulatory agencies should ensure a demonstrated interest to ensure that projects are properly appraised environmentally despite the limitations in the system.

    - One of the weaknesses in the Coast Conservation Act (CCA) is that the call for IEE/EIA for projects in the coastal zone is at the discretion of the Director General of the CC&CRMD. Within the current political climate of the country, and the knowledge that there exists is great deal of political influence, there is a likelihood of not calling for environmental assessments or merely calling for IEEs for controversial projects to shorten the process in favour development without addressing ecological concerns.

    - It is recommended that the CCA should be amended to include what is found in the National Environmental Act — a list of prescribed projects that mandates IEE/EIA process without leaving it to the subjective discretion of the Director General, CC&CRMD. Because such amendments take time, CC&CRMD should obtain such a list to guide its Director General to exercise his ‘discretion’ on the need for IEE/EIA for environmental approval.

    - There are number of unauthorized coastal construction activities occurring all around the coast without the permission of CC&CRMD. This is partly because there is inadequate technical capacity within CC&CRMD. With the end of the conflict in 2009, there is a large number of underutilized security force personnel especially from the Navy. It is possible to delegate carefully selected enforcement powers of CC&CRMD to these security personnel to control unauthorized constructions in the coastal zone. Both the CC&CRMD and Navy are already in the same ministry.

    - Environmental Management Plans (EMPs) for coastal developments should be strengthened and resources for monitoring should be obtained from developers. Again, other means for compliance monitoring — such as civil society and armed forces — should be explored, given the limited in-house capacity of the CCD and CRMD.

    - It is recommended that local civil society is educated so that they can influence local politicians and officials in the development of local level implementation of plans.

    - With all their shortcomings, EIAs have a tremendous, positive impact. When EIAs are not carried properly, regulatory authorities simply must reject such EIAs and demand high quality EIAs. Regulatory authorities must demand a raising of the standard of EIAs, because it is crucial for decision-making. Authorities should use the vast pool of technical knowledge available outside their agencies to guide them

to make better decisions through a stronger technical evaluation process. Agencies such as universities, other technical agencies, NGOs and international knowledge-based agencies like IUCN, can be engaged to improve the process of decision-making. In the EIA process, the greatest weakness is the monitoring. A detailed Environmental Management Plan (EMP) has to be drawn up and compliance monitoring of the EMP ensured by project approving agencies (PAA).

- Tourism is a great opportunity for the generation of revenue but environmental appraisal and necessary precautions must be taken to safeguard the local interests and the very resource on which tourism development is dependent.

    - Special safeguards are needed to address ecological concerns in rapidly-proliferating, unplanned tourism establishments in the coastal zone. Localized solutions for tourism should be provided. For example, in Mullaitivu, localized indigenous means of tourism, including a small, hut-like accommodation design, which is architecturally acceptable, has been sited 2-3 kilometres away from the coast.

    - Sri Lanka needs to learn from tourism development in other countries, such as Thailand. In 1986, there was study on Phuket, to advise on how to void the same mistakes made in Sri Lanka in promoting tourism along the coast in Negombo. About one fifth the size of Sri Lanka, Phuket's local population was 350,000 people and the tourist population was 450,000. There was a series of recommendations made, followed by a set of guidelines given to the government, which the government followed. Today, the tourism population in Phuket is seven million direct arrivals and it is a tourist destination. All the hotels were pushed back from the coastline and the carrying capacity of the beach was expanded tremendously. There is an urgent need to think constructively in terms of the carrying capacity of the coastline.

- Almost all speakers spoke about political influence that hinders effective implementation of due regulations in the coastal zone. Ecosystem valuation has been shown globally as a very effective tool for showing decision makers and politicians, in terms of actual monetary costs and benefits, analyses of short-term financial benefits of development project versus long-term dividends of sustaining ecosystems.

Annexes

Annex 1. Agenda for the workshop

PROGRAMME

Mangroves for the Future
INVESTING IN COASTAL ECOSYSTEMS

Ecological Considerations in Coastal Development

22 November, 2013
Venue: Sequel,
Cinnamon Grand, 77, Galle Road, Colombo 3

08 45	Registration	
09 00	Welcome & Introduction to workshop	Mr. Shamen Vidanage *Acting Country Representative* *IUCN Sri Lanka*
09 15	Address	Mr. Ajith Silva Chairman *MFF National Steering Committee*
09 30	Key note address: Ecosystems and Engineering: Island Sri Lanka's Geomorphological Challenges and Opportunities with particular reference to barrier-built Estuaries	Dr. J. I. Samarakoon *Consultant*
10 15	Tea Break	
10 30	National Physical Planning perspectives — coastal sector	Prof. P. K. Mahanama *University of Moratuwa*
11 00	Ecological considerations in coastal development — CC & CRMD's perspectives	Dr. Anil Premaratne *Director General* *Coast Conservation & Coastal Resources Management Department*
11 30	Role of ecosystems in hazard mitigation	Prof. Samantha Hettiarachchi *University of Moratuwa*
12 00	Legal aspects and approval process	Ms. Gayani Hewawasan *Environmental Foundation Limited*
12 30	Way forward — Panel Discussion	
13 00	Lunch and closing	

Annex 2. List of participants

No.	Name	Organization
01	Ms. P. M. K. R. Abeyrathne	Physical Planning Assistant, Department of National Physical Planning
02	Mr. Hudson De Silva	Director (Environmental & Social Development), Road Development Authority
03	Mr. Ravi de Silva	Consultant, Hoteliers' Association of Sri Lanka
04	Ms. L. H. S. Dilhani	Physical Planning Assistant, Department of National Physical Planning
05	Mr. S. A. FairoosV	Planning Assistant, CC&CRMD
06	Mr. Eranda Gamage	Deputy Director, Department of Wildlife Conservation
07	Mr. M. Heenatigala	Assistant Conservator of Forests, Forest Department
08	Prof. Samatha Hettiarachchi	Department of Civil Engineering, University of Moratuwa
09	Ms. Gayani Hewawasan	Environmental Lawyer, Environmental Foundation Limited
10	Ms. F. M. Hussain	Deputy Project Director (CPEP), Sri Lanka Ports Authority
11	Ms. L. G. R. Isurani	Assistant Director, Department of Fisheries and Aquatic Resources
12	Mr. M. D. L. R. Jayanimala	Planning Assistant, CC&CRMD
13	Mr. Lakshman Jayasekara	Department of National Physical Planning
14	Prof. J. M. P. K. Jayasinghe	Senior Professor in Zoology, University of Wayamba
15	Dr. Gamini Kariyawasam	Director General, Small Fishers Federation
16	Prof. P. K. S. Mahanama	Dean (Faculty of Architecture), University of Moratuwa
17	Captain (ASW) P. S. Mahawithana	Sri Lanka Navy Headquarters
18	Ms. Sujatha Mayadunne	Ecologist, Road Development Authority
19	Dr. Sriyanie Miththapala	Consultant to IUCN
20	Ms. Eeasha Nanayakkara	Head (Community Outreach), Department of Wildlife Conservation
21	Dr. Anil Premaratne	Director General, CC&CRMD
22	Ms. T. S. Ranasinghe	Assistant Manager, Marine Environment Protection Authority
23	Ms. Anusha Rathnayake	Physical Planning Assistant, Department of National Physical Planning
24	Mr. P. U. Rathnayake	Director (Domestic Tourism & Resort Management), Sri Lanka Tourism
25	Dr. Jayampathy Samarakoon	Freelance Consultant, Coastal ecologist and Integrated Coastal Zone Management Expert
26	Mr. Ajith Silva	Director of Policy & Planning, Ministry of Environment and Renewable Energy, Chairman MFF NSC
27	Mr. Ruwan Sriyantha	Field Officer, CC&CRMD
28	Mr. Ajith Tennakoon	Regional Director (South & East), Sewalanka Foundation
29	Mr. Shamen Vidanage	Acting Country Representative, IUCN
30	Ms. Kumudini Ekaratne	Senior Program Officer, IUCN
31	Ms. Chameli Liyanage	Intern, IUCN

Photo credits

Page no.	Caption	Credit
Front piece	Beach in Tangalle, south coast, Sri Lanka.	© Sriyanie Miththapala
iii	A rough sea, Tangalle, south coast, Sri Lanka.	© Srilal Miththapala
vii	Beach seine, Bentota, west coast, Sri Lanka.	© Sriyanie Miththapala
2	Harbour in the south coast, Sri Lanka.	© CRMP
4	Pasikudah, eastern Sri Lanka, where there is a focus on coastal development.	© Sriyanie Miththapala
16	Galle lighthouse and ramparts.	© Niroshan Mirando
32	Coastal hotel, southwestern Sri Lanka.	© Niroshan Mirando
54	Mangroves, Kalpitiya, northwestern Sri Lanka	© Sriyanie Miththapala
60	Beach, northwestern Sri Lanka.	© Niroshan Mirando
below	Catamarans, Negombo, northwestern Sri Lanka.	© Shehani Peris

Mangroves for the Future
INVESTING IN COASTAL ECOSYSTEMS

About Mangroves for the Future

Mangroves for the Future (MFF) is a unique partner-led initiative to promote investment in coastal ecosystem conservation for sustainable development. It provides a collaborative platform among the many different agencies, sectors and countries who are addressing challenges to coastal ecosystem and livelihood issues, to work towards a common goal.

MFF builds on a history of coastal management interventions before and after the 2004 Indian Ocean tsunami, especially the call to continue the momentum and partnerships generated by the immediate post-tsunami response. It initially focused on the countries worst-affected by the tsunami; India, Indonesia, Maldives, Seychelles, Sri Lanka, and Thailand. MFF has expanded to include Bangladesh, Cambodia, Pakistan and Viet Nam. MFF will continue to reach out other countries of the region that face similar issues, with an overall aim to promote an integrated ocean wide approach to coastal zone management.

The initiative uses mangroves as a flagship ecosystem, but MFF is inclusive of all coastal ecosystems, including coral reefs, estuaries, lagoons, sandy beaches, sea grasses and wetlands. Its long-term management strategy is based on identified needs and priorities for long-term sustainable coastal ecosystem management. These priorities emerged from extensive consultations with over 200 individuals and 160 institutions involved in coastal management.
MFF seeks to achieve demonstrable results in influencing regional cooperation, national programme support, private sector engagement and community action. This will be achieved using a strategy of generating knowledge, empowering institutions and individuals to promote good governance in coastal ecosystem management.

Learn more at: www.mangrovesforthefuture.org