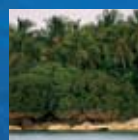




Addu Atoll

Framework for an Ecosystem-based Management Plan Addu Atoll, Republic of Maldives



Acknowledgements

This Framework for an Ecosystem-based Management Plan for Addu Atoll in the Republic of the Maldives was developed as an output from the ‘Capacity building ecosystem-based approaches for coastal areas and coral reefs in the Maldives’ project. We would like to acknowledge the Australian Agency for International Development (AusAID) through the Public Sector Linkages Program, The University of Queensland and the Maldivian Ministry for Environment, Energy and Water for providing support for this project.

This framework was a collaboratory effort involving the following personnel:

Mr Geoff Dews	Adjunct Lecturer, Centre for Marine Studies, The University of Queensland (Australia)
Professor Richard Kenchington	Honorary Fellow, Centre for Maritime Policy, University of Wollongong (Australia)
Mr Hussain Naeem	Deputy Director, Ministry of Environment, Energy and Water (Maldives)
Mr Shibau Abdulla	Project Manager, Atoll Ecosystem Project; Ministry of Environment, Energy and Water (Maldives)
Mr Amjad Abdulla	Director, Ministry of Environment, Energy and Water (Maldives)
Ms Melanie King	Executive Officer, Centre for Marine Studies, The University of Queensland (Australia)
Mr David Harris	Manager, Centre for Marine Studies, The University of Queensland (Australia)
Ms Nadha Fathimath	Environmental Officer, Ministry of Environment, Energy and Water (Maldives)
Professor Ove Hoegh-Guldberg	Director, Centre for Marine Studies, The University of Queensland (Australia)
Dr Ron Neller	Senior Lecturer, University of the Sunshine Coast

We would also like to thank the Directors and staff from the Ministry of Environment, Energy and Water, the Environment Research Centre, Marine Research Centre and the Education Development Centre for their time and assistance during this project.

Preface

This document is the outcome of an AusAID Public Sector Linkage Program with the Government of the Maldives and the Centre for Marine Studies, the University of Queensland. The project was designed to be both instructional through seminars and mentoring using the University of Queensland’s technical expertise. This document can be used as a template for Maldivian counterparts to develop their own Ecosystem-based Management Plan, and incorporates the initial Addu Vision into an Atoll Management Plan. This approach reduces the dependency of local counterparts on foreign advisors in the future and allows for a flow of information and techniques between the University of Queensland and the Ministry of Environment, Energy and Water in the Maldives.



The Ecosystem-based Management Plan (EBMP) sets out a plan and a trigger for addressing environmental issues for development of the atoll. EBMP connects the various natural biophysical elements that go to make up the atoll ecosystem whilst recognising the limitations of the natural system to support human activities that are not sustainable. EBMP relies on the precautionary principle which is an expression of need by the decision-makers to anticipate harm before it occurs.

Contents

- Acknowledgements	2
- Preface	3
- Abbreviations	4
- Contents	5
- Background to ecosystem-based management	7

Addu Atoll9

- Background	9
- Human dimension	10
- Historical impacts	11
- Decision-making process	12
- Planning scales	13

Framework of the Ecosystem-based Management Plan14

- Information network	15
- Major ecosystem linkages	16
- Conceptual model	16

Management Plans18

- Goals, and indicators for success	18
- Responsibility and assessment	18
- Strategic Environmental Assessment and Environmental Impacts Assessment	18
- Potential benefits of a Strategic Environmental Assessment	19
- Environmental Management Plans	20
- Environmental Management Plan and Environmental Impact Assessments	21
- Map of the ecosystems planning through the use of zones	22
- Evidence for persuasion	23
- Steps in developing and implementing an Ecosystem-based Management Plan	24
- Checklist for Ecosystem-based Management Plans	25
- Impact summary	26
- Data management	26

Appendix A29

- Case example: Addu Atoll – Potential and issues for ecotourism	29
--	----

References31

Abbreviations

CMS	Centre for Marine Studies
EBMP	Ecosystem-based Management Plan
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
GIS	Geographical Information Systems
MEEW	Ministry of Environment, Energy and Water, Maldives
SEA	Strategic Environmental Assessment
SOE	State of the Environment
UQ	The University of Queensland

Background to ecosystem-based management

Many researchers endorse the concept of Ecosystem-based Management Plans (EBMP). The EBMP premise is to account for the interrelationship between land, seas and all living things including humans. Researchers use this approach to describe the relationship between the physical and biological elements in easily defined visual and ecological boundaries. An ecological approach is both a way of doing things and a way of thinking.



Shangri-La Resort under construction (August 2008) on Villingili Island, Addu Atoll. Photo: Melanie King

A well-designed EBMP involves all user groups commonly referred to as stakeholders. In practicality it is almost impossible to have all stakeholders in agreement and to keep those agreements in place over extended periods of time. An EBMP should accept that stakeholders will not always be in agreement with every decision and action but the success of the plan will depend on agreement on the most important elements and that management plans are to be adaptive as new threats and responses occur. The important elements of the EBMP will be those that address the maintenance of ecological services and the non-point source loading and take into account cumulative impacts. The EBMP is not a substitute for an Environmental Impact Assessment (EIA) or a Strategic Environmental Assessment (SEA) - these assessment tools are still required to be included in the overall planning activities.

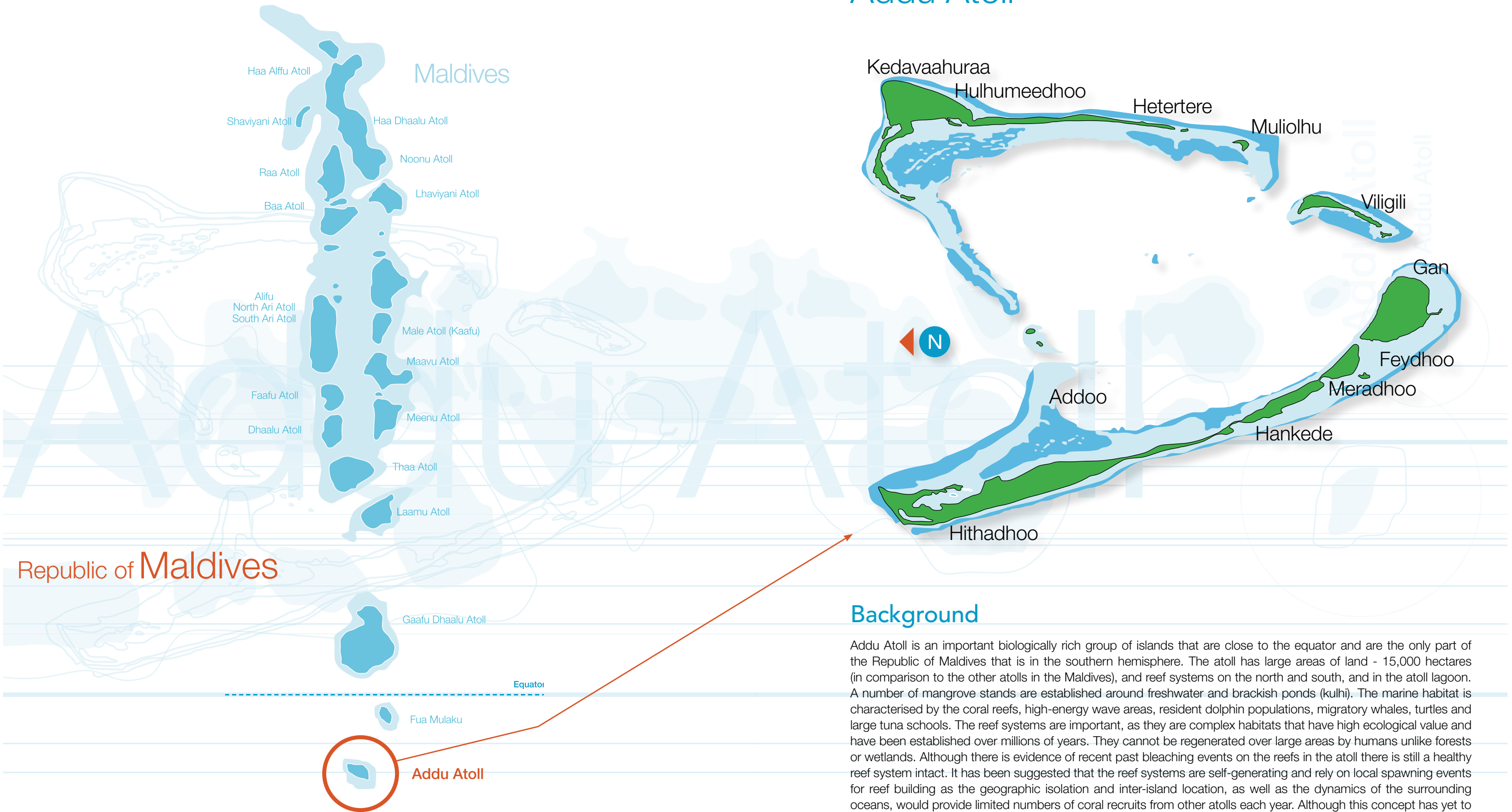


Eidhigali Kulhi, Hithadhoo Island, Addu Atoll. Photo: Melanie King.



Photo: David Harris.

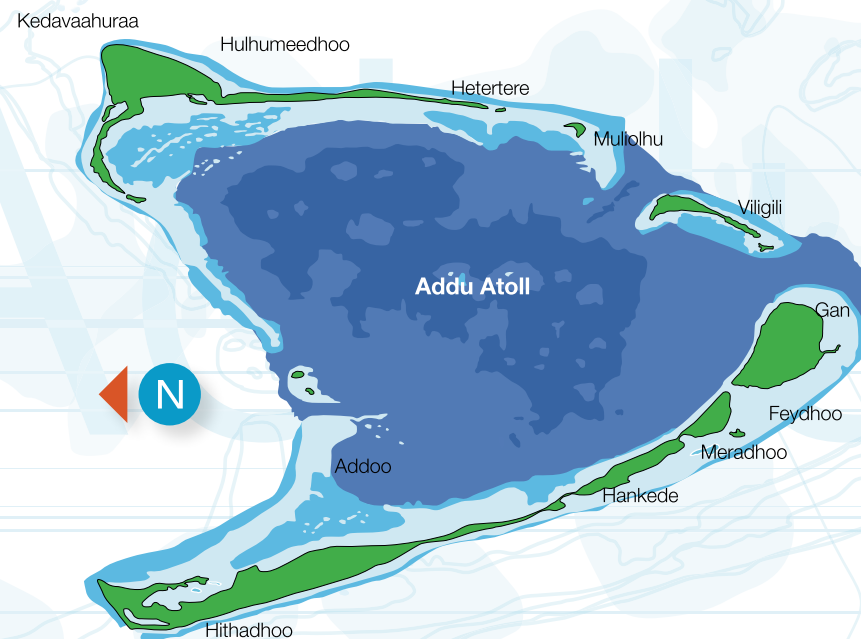
Addu Atoll



Fish species which are rare in other parts of the Maldives are found on the reefs in the Addu Atoll. The coral reef area in the north-west of the atoll has a high abundance and diversity of corals and fish species. The total coral area of the atoll is estimated to be 7200 hectares. Four deepwater channels that facilitate oceanic water exchange over a tidal cycle drive water circulation within the atoll. The circulation patterns of the water in the atoll have been disrupted by the construction of a series of connecting causeways in the 1940s. The British military constructed these causeways during WWII to facilitate the movement of equipment and troops between islands. Although there has been some additional re-opening of these causeways there appears to be some long term local impacts on the corals, seagrasses and coral rubble/sand accumulation due to the altered water flows around the islands. Any management plan should aim at restoring the natural system.

The islands in the atoll are low lying (less than 2m above sea level) and are mostly sand and coral based although some other soils are present that support areas of small dense vegetation and mangroves. These vegetation stands are an important source of traditional medicines for Maldivians. The largest brackish freshwater pond (Kulhi) in the Maldives is found on Hithadhoo Island on the northwest side of the atoll. A number of other small brackish water systems are found throughout the other islands in the atoll. These freshwater systems have a high ecological value because they support resident and migratory bird populations and important species of plants. These ecosystems have contributed to sustainable human occupation of the islands over a long period.

Figure 1. Addu Atoll showing the population centres



Human dimension

Addu is a relatively small atoll in total area but it has the largest population outside Male, the capital. With an increasing population there is a demand for more usable land. There are small areas of land under agriculture on the islands but most of the income generated comes from tuna fishing, remittance from resort employment outside the Addu Atoll and recently from the existing and newly developed resorts in the atoll. There is also government employment in the administration sector and small businesses such as boat building and retail services.



Strong community involvement in management is essential.
Photo: Geoff Dews.



Managing tourism will be an important component in an Atoll Management Plan. Photo: Geoff Dews.

Historical impacts

Historically, Addu has had cumulative impacts as a result of the construction of the British military base on Gan in the southern part of the atoll. Gan was established to service the British naval fleet in the Indian Ocean and included the construction of the present aircraft runway, the building of the causeways, the construction of the roads, and the military barracks (that are still used as a resort and government guest house). Recent road infrastructure development in the early 2000s saw some of the causeways opened up and the commencement of reclamation for an industrial harbour complex. Traditional boat building has always been a big part of Addu life and still today there is a strong demand for Addu constructed dhonis. The demand has been for bigger tuna dhonis that are capable of fishing further out to sea and the larger tourist live-aboard cruise style vessels.

All of this development has partially contributed to the alteration of water flows in and out of the lagoon. This alteration in water movement has possibly influenced the pattern of fish migration, coral and fish connectivity and the movement of sediments as well as impacting on water quality and the balance in fish species on the reef. Traditionally local people consume very little reef fish but rely on the tuna caught outside the reef system. A significant limiting factor to the tuna fishery is the amount of live baitfish that is available. Live bait is harvested from near or on top of the coral reefs using nets with small size mesh. The live bait is kept in live fish tanks onboard the dhonis and used to attract the tuna into feeding schools in offshore waters. When the tuna are near the surface the fisherman can then use non-baited hooks and line to haul the fish onboard. It's a very effective fishing method but it relies to some extent on the availability of a sustainable supply of live baitfish.

Coral reefs are the supporting habitat for the baitfish. The increase in human populations in the communities has increased the risk of nutrients entering the lagoon, the coastal areas and the freshwater aquifers. The management of waste is now a high priority for the Government of the Maldives.

Increasing populations have also increased the demands on transport and hence there has been an increase in cars and bikes as well as the industries that are required to service the vehicles. The distribution and cumulative impacts of all of these activities varies between islands within the Atoll, but the impacts are resulting in a cost to the community and government. The level of environmental tolerance to these impacts varies across the Atoll. Some islands have polluted ground water to the extent that it is no longer safe to use while others have some access to potable water. Many of the impacts are difficult to quantify or detect in the short term, as they do not have indicators as to the level of, or size of, the impacts that can easily be recognised or monitored.



Causeways were constructed during WWII by the British military to facilitate the movement of troops and equipment between the islands. These causeways have led to a change in the circulation patterns of water flows in and out of the lagoon. Photo: Melanie King.



Fishing is the second largest income earner for the Maldives after tourism. These photos show the modern tuna boats used in the Maldives. Many companies use 'holding ships' for storage of the tuna. Photo: Geoff Dews.

The Addu plan and vision

Vision Addu 2015: The people determined the Addu Atoll goals through consultations and meetings. The agreement was that Addu Atoll be a prosperous, liveable, safe, clean and green model atoll. Addu will have an educated, healthy, creative, industrious, ethical and cohesive community. The vision sets out the ideals of economic development, tourism, education, health, trade, transport, heritage and environmental conservation.



Tourism is the single largest income earner for the Maldives. This new resort for the Shangri-La consortium is currently being constructed on Villingili Island in Addu Atoll - August 2008. Photo: Melanie King.

Decision-making process

The long-term goals set by the Vision Addu 2015 must be balanced against the inevitable impacts that come with economic and social aspirations. It is **neither possible** nor **practical** to achieve the visions without incurring some environmental, social and economic changes or impacts. The ecosystem-based approach is a balance that recognises:

- Impacts to the environment from human settlement will occur
 - The level of impacts can be mitigated to some extent by acknowledging the environmental and social changes that will occur as a result of these impacts
 - Predicating the level of impacts is not a precise science
- Impacts should be managed or confined to a specific area or timeframe (remediation of impacts should not be passed onto future generations)
- Actions should not, wherever possible, contribute to cumulative impacts
- Where possible, cumulative impacts should be limited only to the life of the project
- Historical impacts (impacts prior to the establishment of the management plan) should not be ignored
- The risk to the environment should be recognised and reduced either by minimising the occurrences or reducing the consequences of actions i.e. risk assessment applied for each action
- Each project will meet standards as set out in the Environmental Impact Assessment, site based management plans and operational plans but with full disclose of the risks and mitigations to all the stakeholders (overall impacts will be reduced if each specific action is managed in such a way that minimises environmental harm)

The ecosystem-based approach relies on a decision-making process that is transparent and recognises all the clusters and values the social, economic and environmental sectors. Hence decisions have to be made as to what development should take place and under what conditions this development should proceed. To aid the decision-making process a series of tools can be established. Addu has natural values as discussed above but there is a requirement for infrastructure development to proceed in order to maintain the well-being of the people both in Addu and the nation. The method that was used in setting the Vision Addu can be used to establish a decision-making process with the inclusion of the government of the day into the process.

The decision-making process should be established for all the community with regional and national options to be discussed and agreed upon. It is recognised that there will never be complete agreement and that where possible the process and outcomes should be supported by legislation and regulations so that conditions and agreements are lawful and comply with the justice system.

Planning scales

The EBMP recognises three planning and management scales defined for the Addu Atoll: *entire atoll*, *cluster of islands* (north, south and eastern groups) and *individual communities or islands*.

Planning at each of these scales tends to have its own focus and outputs either because of regulatory requirements or because the availability of knowledge or ecosystem linkages and planning tools lend themselves to certain planning outputs at particular scales. Regional planning focuses on broad assessment, policymaking and strategic development (e.g. protected areas or market development strategies).

A summary of the scale is set out in Table 1, which identifies the process, the outcomes and objectives, and links these to relevant policies and legal institutions.

Table 1. Scale of planning for the Addu Ecosystem-based Management Plan

Scale	Process	Outputs	Objective	Verification
Atoll	Policy, institutional design and strategic development	- Agreement and policy contained in economic, marine and land use policies - Climate change adaptation policies	- Coordinated government approach - Cooperation with local communities	- Vision Addu 2015 - Millennium Goals 2002
Island groups	Strategies planning (government documents)	- Strategic land use plans - Waste management strategy - Infrastructure development strategy - Ground water management strategies	- Sustainable use of the resources - Minimisation of cumulative impacts	- 7th National Development Plan - National Biodiversity and Action Plan
Lagoon areas	Tactical planning (sustainable resource management planning)	- Marine protected areas	- Specific targeted intervention to off-set impacts from some human activity	- Environmental Protection and Preservation Act - Fisheries Law of Maldives
Near shore oceanic region adjacent to the atoll	Tactical planning (marine resource use)	- Regional and international agreements recognised	- Recognise the impacts from actions outside the atoll	- Environmental Protection and Preservation Act - Fisheries Law of Maldives
Village	Site planning (environmental management plans (EMPs))	- Ecosystem reserves - Resource use or harvest plans - Business and project plans - Site tenure / management plans	- Targeted management of specific biophysical and cultural impacts as a result of human development	- National Solid Waste Management Policy for the Republic of Maldives - Environmental Impact Assessment Regulations 2007 - Population Policy of the Maldives
Households	Promote "best practice" in environmental management and conservation	- Prevention of impacts and pollution at the source	- Reduction in waste, sediment run-off, coral and sand loss, noise and visual pollution through individual actions	- National Solid Waste Management Policy for the Republic of Maldives - Environmental Impact Assessment Regulations 2007 - Population Policy of the Maldives
Individuals	Education on the cause and effects of environmental damage	- Better informed community	- Better understanding of actions and individuals on the environment	

Framework of the Ecosystem-based Management Plan

The initial step is to cluster each of the significant elements. The criteria for clustering is that each element has a strong relationship or dependency with the other element. For example fisheries can be dependant on the establishment of protected areas, which has one of its objectives as being the conservation of the habitat of baitfish. Clustering of the sectors allows for the important, relevant and practical information to be addressed in the management plan in a way that is simple to understand hence making it easy to assign tasks, outcomes and indicators to specific objectives. Without clustering of the sectors, the management plans can become too complicated and difficult to understand and implement. This complexity leads to confusion and no indicator can be assigned to measure success or otherwise of any policy or intervention.

Each of these clusters is linked with each other and in some cases dependant on each other. It is therefore easier to develop policies for each cluster, but also to recognise the implication each policy will have on other sectors.

By clustering each of the elements and combining these with the characteristics of the atoll listed below, a plan can be devised that is visually convincing and not complex so that management objectives can be determined by all the stakeholders (not just other experts). A list of stakeholders can be generated based on the people involved in setting the Vision Addu 2015. The number of stakeholders consulted in developing the Addu Vision indicates that there are many varied community expectations that need to be addressed creating the need for a consistent and evidence-based analysis as to the environmental risks associated with each sector.

For example the cultural values depend on both the development cluster and the natural resource cluster. If we are to manage for cultural elements then we need to manage the natural resources (ecosystem-based approach) that connect with the cultural element (e.g. the management of vegetation because this is a source of traditional medicine).

Table 2. Framework of the Ecosystem-based Management Plan

Ecosystem Types	Policy	Plan	Issues
Natural resources cluster - Fish - Coral reefs - Sand islands - Trees and natural fresh water systems - Birds - Atoll island chains	Sustainable management of the natural resources using the precautionary principle to assign levels of resource use	In consultation with the stakeholders set limits on the amount and how a resource is used. Accept the level of human resource use and implement appropriate management of the waste generated from the resource use	- Increased population leading to increased waste, demand for more house lots and therefore more suitable land - Declining tuna catches, reduced availability of baitfish to support the tuna fishery, rising fuel prices - More reliance on the building and operating of new tourist resorts and increase in the demand for a cash economy to support family education goals and increased cost of living
Development cluster - Housing development - Heavy industry expansion - Shipping, vehicle and air transport increasing - Increased bait fishing - Tourism	Economic development, employment, wealth creation so that there is less need for people to seek employment outside Addu	Cost benefit analysis of each development, limit the type and size of operations, understand all the issues before making a commitment to establishing the processes (precautionary principle, use EIAS SEAs etc to predict impacts and establish environmental management plans (EMPs) for individual activities	- Increased population leading to increased waste, demand for more house lots and therefore more suitable land - Declining tuna catches, reduced availability of baitfish to support the tuna fishery, rising fuel prices - More reliance on the building and operating of new tourist resorts and increase in the demand for a cash economy to support family education goals and increased cost of living
Cultural values cluster - Traditional medicinal purposes - Important buildings (places of prayer) - Visual amenities (scenic beauty which is often overlooked as a cultural value)	Maintain cultural links and important places of significance to the local people	Management plans for dealing with each issue that is agreed to by stakeholders and government	- Increased population leading to increased waste, demand for more house lots and therefore more suitable land - Declining tuna catches, reduced availability of baitfish to support the tuna fishery, rising fuel prices - More reliance on the building and operating of new tourist resorts and increase in the demand for a cash economy to support family education goals and increased cost of living



Agriculture is important but limited to small plots due to the scarcity of land area. Photo: Geoff Dews.

Information network

The information network helps to determine the type of threats to the environment and assign possible responses. The information network is helpful to planners in the first instance and it leads into the development of the Ecosystem-based Management Plan.

This matrix approach can be simple or complex. The most suitable way to commence is to use the clusters as a first pass to determine the threats and responses. In many cases the information may not be available and this may determine future research priorities. The more detailed the matrix, the more precise the management action will be.

The matrix analysis method sets out the areas for management intervention. This then leads to allocation of resources and the establishment of measurable targets.

Table 3. Information Framework

Element	Current state of knowledge	Threats that are scientifically verifiable	Government responses	Management comments	Cluster group (completed by expert team approach and consultation process)
State of the atoll environment	Scientific reports, community consultation	Loss of habitats and biodiversity resulting in loss of resilience to impacts and climate change – well being decreased	Ecosystem-based Management Plans that set out areas for conservation and areas for development	A designated zoning system for the entire atoll including inshore and lagoon water	
Specific elements					
Population numbers, demographics increasing	Information from published statistics	Inadequate housing, medical services and education	Link population with infrastructure development	Infrastructure should not impact beyond what the local ecosystem can withstand	
Coral reefs	Dive survey, remote sensing	Elevated level of nutrients and sediments coming onto the reefs	Improved waste water treatment and appropriate sediment and erosion controls	This can be measured by monitoring surveys	
Tuna fishing sites	Community survey	Catch and effort statistics	Catch limited	Need community support to obtain data	Natural resources
Tuna bait sites	Dive survey	Catch and effort data	Area of no-take established	Link the reef health to baitfish population levels	
Etc. to be completed as required for consultation and cooperative decision making processes					

Major ecosystem linkages

Conceptual model

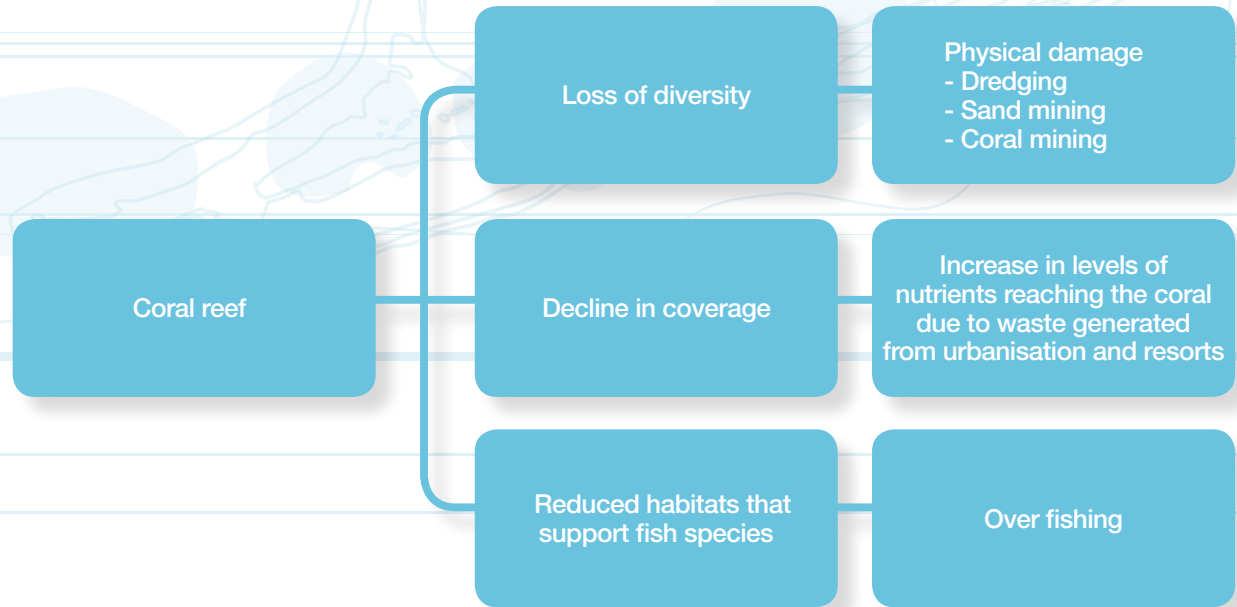
The establishment of a conceptual model is useful for displaying the message to a non-technical audience. A conceptual model is one of the primary planning tools that can be used to support the decision-making process of managing ecosystems on a large scale. The conceptual model organises available information about the specific element and facilitates the identification of data and information gaps. Once the model is established, additional data can be gathered and integrated into the process, followed by a revision of the conceptual model and a refinement of decision goals, if required. Thus, the conceptual model matures and enables an improved understanding of the site



The marine and coastal ecosystems are linked throughout the atoll. Photos: David Harris, Geoff Dews and Richard Kenchington.

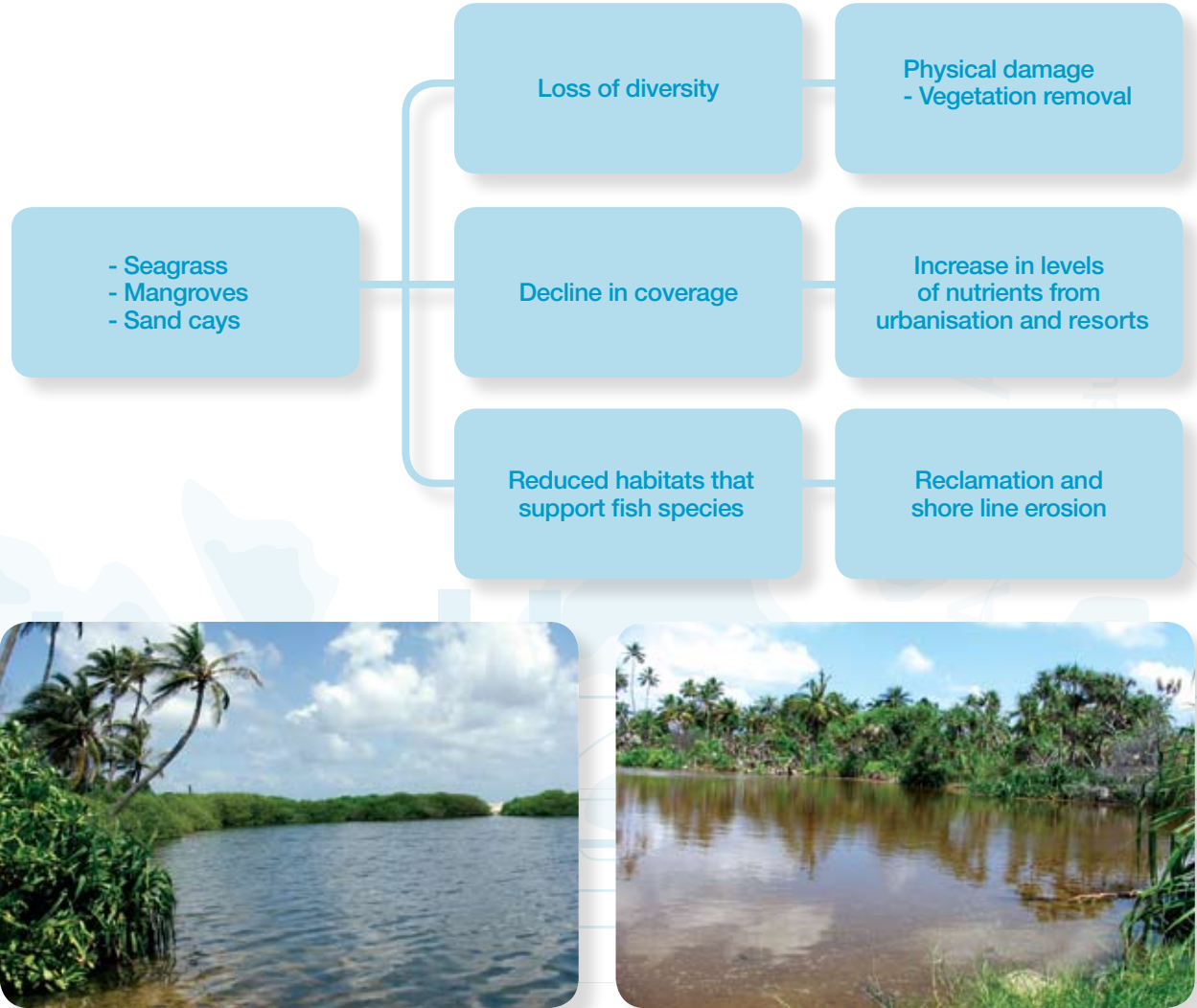
characteristics, such as inter-relationships between elements that go to make up the ecosystem. The major ecosystems of atolls in the Maldives are coral reefs, which are the building blocks of the islands that make up the atolls. These islands have evolved and support a range of island ecosystems such as the mangroves, seagrass and sand cays, the wetlands and brackish water systems as well as the ground water systems. These ecosystems in turn support agriculture, traditional medicine, and water supplies for households and are one of the major attractions for visitors.

Figure 2. Conceptual model for coral reefs and fish population



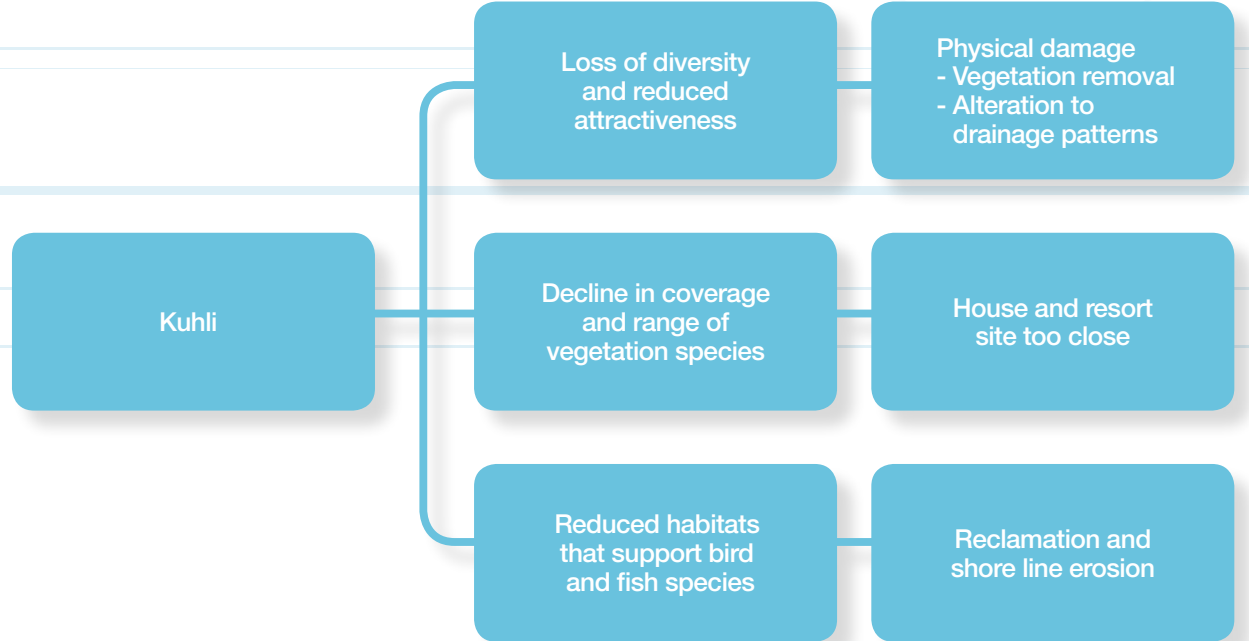
The linkages to human activities are shown in the conceptual models for corals, seagrass – mangroves – sand cays and kulhi (Figures 2,3,4). The links identify the pressures and threats to the ecosystem and help to determine the causes and effects of actions by humans on the environment.

Figure 3. Conceptual model for seagrass, mangroves and sand cays



Kulhis are freshwater and brackish ponds found in Addu Atoll. The Eidhigali Kulhi in Hithadhoo (far left) is one such freshwater pond, home to a diverse range of species, and is now a protected area.

Figure 4. Conceptual model for kuhli and brackish water systems



Management plans

The management plan incorporates the conceptual model ideas but realises these models are not representative of spatial and temporal aspects of ecosystem function. It does mediate the dependencies of the ecosystem health to the ecosystem services. Therefore the management plans should be adaptive and reviewed against indicators and goals.

Goals, and indicators for success

The goals should be linked to the short and long-term aims and be accompanied by a date and have a specific measurable target. The plan should include a mechanism for monitoring these targets and have a review process (of the plan) that allows for adaptation and modification.

Table 4. Goals and indicators for the management plan

Goal	Indicator
Conserve comprehensive, adequate and representative areas of coral reef	30% (estimate only) of all live coral be under conservation
Establish and maintain a level of fishing that is sustainable	Set appropriate and enforceable catch and or effort limits to the bait fishery and the tuna fishery
Reduce sediment from the land entering the lagoon	Turbidity levels below established baselines set by accompanying EIA and EMP
Sustain the present level of mangrove and seagrass ecosystems	30% (estimate only) to be conserved and all EIAs to recognise the importance of these ecosystems
Water quality (oceanic) to be maintained at or above present level	Use ASEAN standard water quality parameters to set standards for discharge into the lagoon or ocean
Ground water to be improved	Establish best practices for treatment of waste water
Limit population growth	Establish population growth in line with the carrying capacity of individual islands
Scientific verification	Establish world's best practice for scientific surveys of the marine and terrestrial environments based on long-term data gathering policies

Responsibility and assessment

This plan advocates three levels of assessment applicable to the above criteria: Strategic Environmental Assessment (SEA), Environmental Impact Assessment (EIA) and Environmental Management Plans (EMP). The level of responsibility depends on the spatial scale of the issue, the time frame resultant and the cumulative impacts. This is set out in Table 5, which indicates the appropriate application of the three assessment tools.



Local fishermen cleaning nets. Photo: Geoff Dews.

Strategic Environmental Assessment and Environmental Impacts Assessment

Many environmental problems can be traced back to the way the resources of the atoll are used. Land and marine resource use planning and therefore atoll planning can influence the environment in a number of ways:

- Dealing with local site-related matters
- Ensuring that development does not exceed the ecological threshold of the atoll
- Balancing the social, environmental and economic needs of new developments
- Maintaining and restoring the quality of local environments

It is important to note that the local environment is the source of resources, an assimilator of wastes and provider of environmental services and that the planning process has the potential to influence each of these functions. Planning policies can encourage positive environmental impacts and benefits that may include the safeguarding of marine protected areas, the promotion of energy efficient settlement patterns, or the encouragement of renewable sources of energy and waste management. Hence atoll management is a process that is part of the political process where sustainable development can be declared as the ultimate planning goal.

Strategic Environmental Assessment refers to the environmental assessment of policies, plans and programmes. The concept of SEA has evolved from the well-established practice of Environmental Impact Assessment (EIA), which has been widely accepted as a means of improving the quality of decisions about proposed projects. SEA has developed in part as a consequence of the emerging awareness that project EIA may occur too late in the planning process to ensure that all the alternatives and impacts relevant to sustainable development goals are adequately considered (Jones et. al. 2005). The SEA is intended to help predict potential environmental impacts that could occur as a result of their implementation as part of a wider promotion of the planning system as a tool to help deliver sustainable development.



Solid waste is one of the major environmental issues within the Maldives particularly as the population rises and demand for consumer items increases. The issue of how to dispose of solid waste is becoming critical and has major impacts on the surrounding environment. The management of solid waste is particularly challenging within the Maldives island environment but without sound policies and practices put in place, the threat to the tourism industry, marine environment and health of the population will increase.



Due to the shortage of land, the government is using reclamation techniques to extend the land mass of islands. The photo on the left shows reclaimed land in Male which has been utilised for local markets, whilst the photo on the right shows reclaimed land at Feydhoo which has been created for industry, mainly fisheries warehouses. Photo: Geoff Dews.

Potential benefits of a Strategic Environmental Assessment

The potential benefits of undertaking an SEA include:

- Encourages the consideration of environmental objectives during policy, planning and program development activities
- Facilitates consultation between agencies and authorities and supports public involvement in evaluation of proposals
- May reduce the need for EIAs if impacts are assessed correctly
- May leave certain aspects of particular projects to EIAs
- Allows for standard or generic mitigation measures for later projects
- Determines appropriate sites for projects subsequently subject to EIA
- Allows more effective analysis of cumulative effects of both large and small projects
- Allows for more precision of secondary impacts
- Better for long-range and delayed impacts

It is understood that the Republic of Maldives is to undertake a reclamation project in Addu Atoll to allow for additional housing sites. The impacts of this proposal are not well understood but it is considered an important project and is part of a Regional Plan for all the islands in the atoll.

To assist in the identification and management of this project, the following series of activities is suggested:

1. Develop an Atoll Management Plan (or review existing plans)
2. SEA of the regional plans
 - a. Identify the technical information that is required
 - b. Gather all the information through a discovery process that would involve cooperation with all other ministries and agencies that may have the information
 - c. Analysis of the data for potential cumulated impacts
 - d. Design site-based surveys based on available information
3. Environmental Impact Assessment (EIA) of specific projects within each area of concern
4. Management plans for specific projects and activities to reduce local impacts
5. Review the Atoll Management Plan on a regular basis and to adopt changes where possible

Environmental Management Plans

Environmental Management Plans (EMP) are useful vehicles for integrating and implementing the environmental management commitments, conditions, and statutory requirements (Note: Republic of Maldives does not have statutory requirements for EMP) that development proposals may observe. Environmental management plans can be developed by proponents during a proposal’s planning and design.

Environmental management plans facilitate ecological sustainable development and integrated decision-making. They are:

- Able to form the basis for consultation and negotiation of outcomes;
- Flexible;
- Comprehensive in that they may address all relevant environmental management issues;
- A tool for promoting accountability.

They promote self-regulation and integration of environmental management issues into planning and operations. They address all relevant environmental management issues and can be drafted in a consultative manner. They can also be the focus of stakeholder input by bringing scientific information into a form that is easily understood by many in the community. An example is sediment containment plans for any dredging project.

Triggers for Environmental Management Plans

The need for a proposal to incorporate the development of an Environmental Management Plan may arise from community consultation, be identified in the EIA as mitigation against a predicted impact, be part of good corporate practice or be requested as part of the conditions of acceptance by the government.

Purpose of Environmental Management Plans

An Environmental Management Plan provides life-of-proposal control strategies in accordance with agreed performance criteria for:

- Specified acceptable levels of environmental harm;
- Potential impacts on environmental values, mitigation strategies, relevant monitoring together with appropriate responses; and
- Indicators and performance criteria, reporting requirements and, if an undesirable impact or unforeseen level of impact occurs, the appropriate corrective actions available.

Aim of Environmental Management Plans

The broad aims of Environmental Management Plans are:

- Auditable proponent commitments to practical and achievable strategies and design standards (performance specifications) for the management of a proposal to ensure that environmental requirements are specified and complied with;
- An integrated plan for comprehensive monitoring and control of impacts;
- Focus on approvals, conditions and compliance with policies and conditions; and
- Provide the community with evidence that the environmental management of a project is acceptable.

Attributes of Environmental Management Plans

Environmental Management Plans may have the following attributes:

- Integration of the various regulations pursuant to a development approval in an ordered, flexible and integrated format that is auditable by the proponent and administering agency;
- Integration of the terms of operational approvals, such as licences, with the provisions of planning and land use development approvals;
- Translation of the studies and scientific reports from the EIS into achievable management strategies; and
- Facilitation of developer planning for protection of the environment.

Environmental Management Plan and Environmental Impact Assessments

The Environmental Management Plan may relate to the various stages of planning for a proposal including development assessment, post-approval operations and proposal decommissioning.

Environmental Impact Assessments incorporate development of an Environmental Management Plan and are an established process for:

- Ensuring that proponents take primary responsibility for protection of the environment that may be affected by their proposal. This responsibility may be expressed in the Environmental Management Plan as commitments.
- Forming a basis for statutory decisions on whether a proposal should proceed. The Environmental Management Plan may be an integral part of a statutory approval.
- Including community views in the assessment and decision making processes. The Environmental Management Plan provides a summary of the likely environmental impacts and how they will be managed.

The level of assessment depends on the scale of the issue. A guide to assessment and management is shown in Table 5 with the level of scale ranging from international and regional to household, and corresponding to the level of government responses. These responses are on behalf of the communities but must also include all the stakeholders.

Table 5. Level of assessment and management

Level of government	Government of Maldives	Policies and plans	Programs	Projects	Site base management
Examples	Climate change conventions	Southern Atoll development	Expansion of house sites	Reclamation of reef flats	Construction of houses
International agreement and treaties	Regional plans treaties and conventions				
National		National Economic Policy			
Atoll			Strategic Environmental Assessment		
Island				Environmental Impact Assessment	
Household					Environmental Management Plan
Etc. to be completed as required for consultation and cooperative decision making					

Map of the ecosystems planning through the use of zones

At a strategic level the most accepted methods for management over large areas is via a zone of activities that correspond to particular ecosystem attributes. Mapping gives a visual presentation of complex issues and aims in the decision-making process. The zoning may be achieved through computer-generated programs that use GIS as the basis for data collation or they may be determined through expert discussion and panels.

Figure 5 shows some of the important biophysical attributes of Addu Atoll. Overlaid are areas of common management that corresponds to likely outputs from ecosystem-based attributes to management attributes. These maps can be used for consultation purposes, enforcement, and EIA and EMP frameworks. More detailed landuse planning is included in the Vision Addu 2015 where individual land plots have been identified for particular activities.

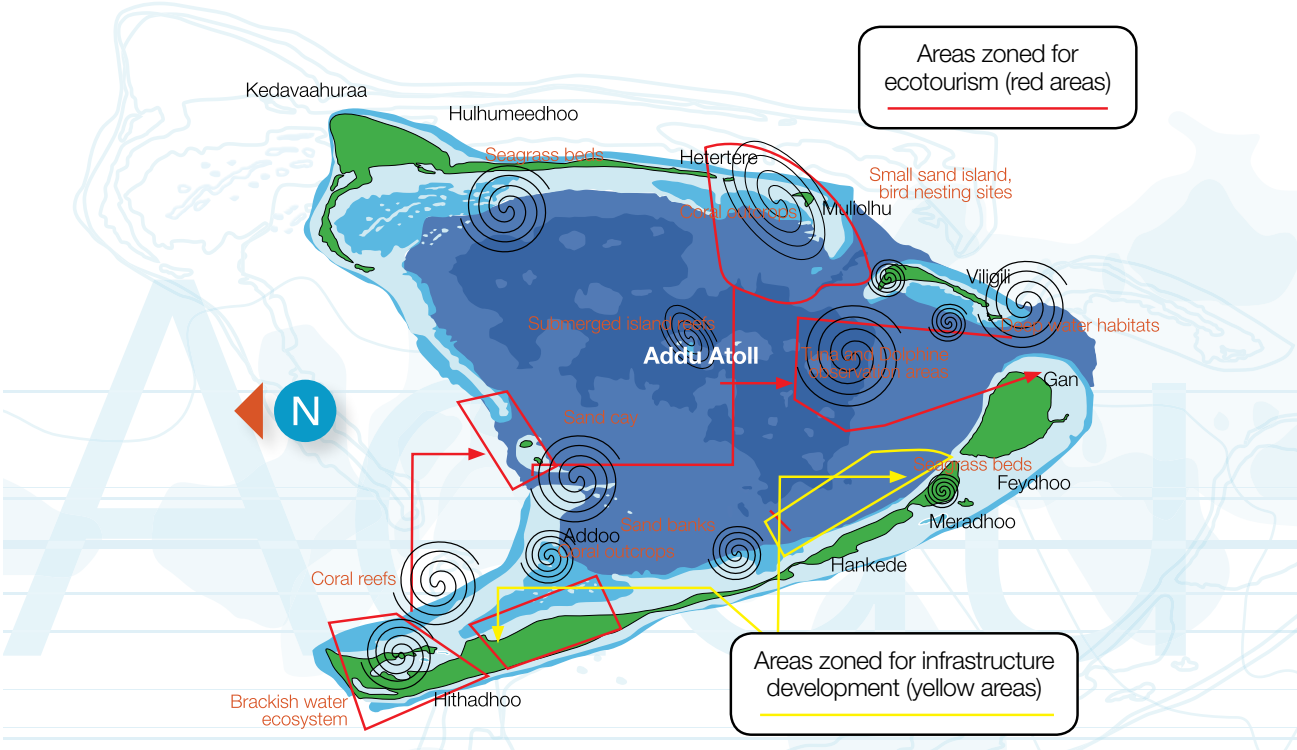


Figure 5. Addu map showing the areas of proposed development and areas of high ecological value that should be protected through zoning; the red zone represents a management area focusing on ecotourism, while yellow represents industrial development

Evidence for persuasion

Although a trained environmental scientist is able to quickly weigh up the options and outcomes of a particular development, other stakeholders may require more evidence. This could be scientific surveys (difficult to explain the results sometimes), reference to other similar cases (sometimes not available), or use cost benefit analysis (time consuming and sometimes difficult to calculate).

The cost benefit analysis of reclamation of islands in the Addu Atoll: what is the cost of losing coral reefs and what would be the benefits of the project?

It is possible to place a dollar value on coral reefs, which are referred to as non-market value goods or services. Coral reefs perform a number of services - coastal protection, water quality, habitat protection for fish, etc. Environmental economists make an important distinction between two main types of value related to the environment. The first is “use value” and the second is “passive-use” or “nonuser” value. The use value category includes market goods that come from nature e.g. fish, plants. These goods can often be valued based on market-price information just like other communities. Value use also includes many non-market goods and services such as views of nature (important for tourism) and clean water. In contrast passive-use or non-use value refers to the value people may place on environmental resources even if they do not consume them or benefit from them in any direct way, and often to do with people’s cultural or ethical beliefs. (Reference: Jaeger, 2005)

For Addu this may mean a cost benefit analysis be undertaken to demonstrate what the value of the coral reef is to the tourism sector and the cost of establishing and maintaining a series of protected areas. If the size of the reclamation can be determined, then we would be able to determine how much of the reef will be lost hence “value” the reef. This can then be estimated as a cost to the society for present and future use of that particular reef. An ecosystem-based plan would then argue that a proportion of reef be protected against any further impacts by establishing an appropriate amount of reef to marine protected area status including areas of no-take fishing zones. Hence establishing more marine protected areas may offset the loss of some reef areas.

Once a management plan is identified as the correct course of action there needs to be consideration as to the resources required for development and implementation. The following is a series of steps to be considered when implementing an EBMP.

Steps in developing and implementing an Ecosystem-based Management Plan

Below is a list of steps that can be taken prior to developing and implementing an Ecosystem-based Management Plan:

- Allocate realistic timelines and budgets to each of the activities that would likely take place. Using the Vision Addu 2015 allocate measurable time lines.
- Map and define all the critical marine and terrestrial habitats in the Addu Atoll. Determine all the species that are dependant on these habitats.
- Undertake an SEA of the entire atoll.
- Use the SEA to determine threats and management options.
- Ensure that each of the actions is allocated to government or the private sector. For each of the above activities, specific sectors of government or community would be allocated certain tasks.
- Because many of the responsibilities will be shared throughout key ministries it is necessary that timelines and budgets are allocated for the national budget process to facilitate the management actions.
- Commit to a state of the environment (SOE) reporting mechanism.

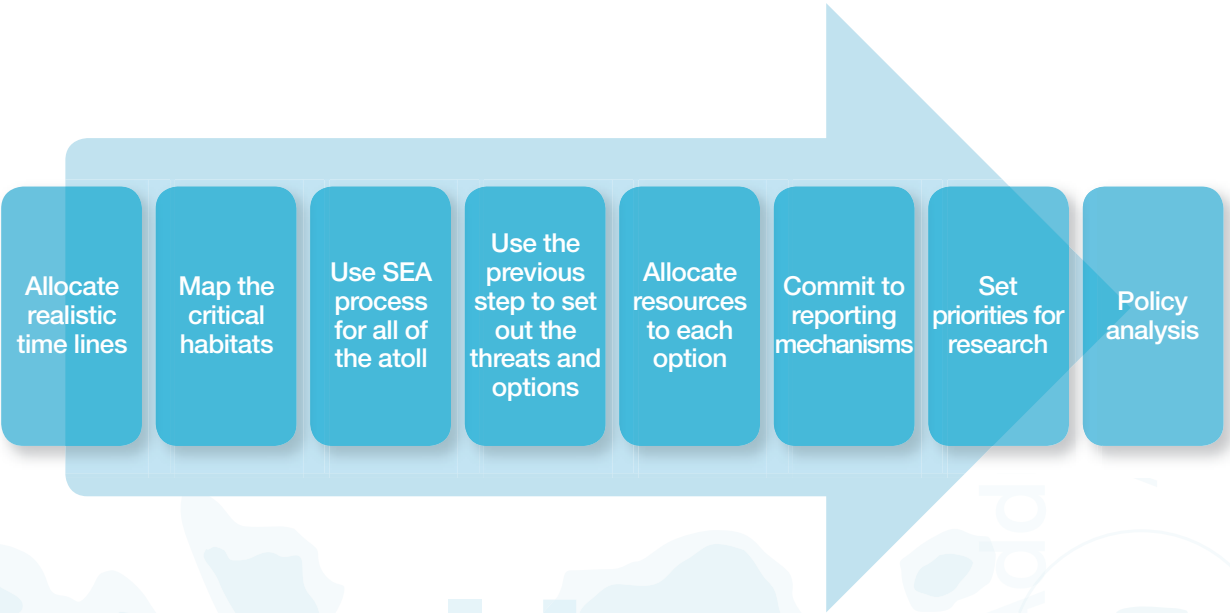
Note there is already very good SOE for the Maldives that should be used as a baseline for future SOEs that included the EBM plans for atolls.

- The most common way to report on the actions and achievements of the EBMP is through a State of the Atoll Environment Report (see above).
- Set out priorities for research. Research should be evidence-based to support management objectives.
- Determine who should carry out the research, who funds the research and who has access to the information.
- Allocate resources to undertake policy analysis (policy development should take an evidence-based approach)

Policy is the mechanism where by direction and reporting is determined. In order to create new or additional policy that may be needed for the EBMP, it would be desirable to know what policies are in place in other sectors. This sector policy analysis should be endorsed by the government of the day and be relevant only for the EBMP or run the risk of shifting focus from the management plan to the political process.

- The policies determine what type of management the communities and government would support.
- Establish an adaptive management cycle that takes into account feedback and modification. This would include dates and processes for reviewing the EBMP and the reporting mechanism should also be agreed to.

Figure 6. Implementation steps to Ecosystem-based Management Plans



Checklist for Ecosystem-based Management Plans

The following is a checklist for Ecosystem-based Management Plans

- Is it too broad? If it is too broad:
 - It will not be possible to obtain and maintain stakeholder consent
 - It will not be possible to allocate resources that are based on priorities set in the plan
 - It will not be possible to monitor it successfully
 - Targets will not be realistic
 - Too slow and too complex
- Are the majority of stakeholders consenting to the plan?
- Are the budgets realistic and funds allocated?
- Will the process be too slow and complex, and therefore not have a beginning or progressive milestones?
- Are the visions realistic and achievable?
- Are the visions raising undue expectations of the stakeholders?
- Is there equity between stakeholders?
- Are the objectives reflected in government policies?
- Does the plan harmonise with local, regional and national policies?
- Is there a need to establish policies?
- What scientific information is lacking?

Impact summary

The impacts from development vary with the nature of the development, the skills in undertaking the development, the amount of waste that will be produced, and the cumulative impacts that may occur through the atoll.

The summary of the common impacts is listed in Table 6. This table assists in developing EMP for individual activities and facilitates consultation with stakeholders. Appendix A sets out a case-study for ecotourism as part of the subset of activities defined in the Vision Addu 2015 statement and links the activities to impacts and risks. This case study outlines the methods used in defining local activities with links to the atoll ecosystem.

Table 6. Summary for potential impacts from development on islands

Action	Consequence	Mitigation actions
Dredging of sand from lagoons	Sediment into the water column: - water quality degraded - coral smothered - coral recruits unable to hold - fish mortality - seagrass smothered - fish habitat lost	The focus through the EIA should be on predicting impacts and minimising these impacts. For reclamation this may include: - Silt curtains at the reclamation site - Minimum use of excavators – dredging and slurry piping of spoil probably preferable through less impact of heavy excavators and trucks – provided the slurry pipeline is properly maintained. - Agreed operational standards monitored with contract financial penalty provisions or infringement and/or possibly incentives for length of time without infringement - Work practices to relate to tidal and rainfall conditions and with contract provisions relating to weather - Removal of corals that will be affected by reclamation smothering and relocation areas of recreational or tourism opportunity
		- Significant offset provisions of Protected Areas and resourcing for their management as compensation for environmental damage
Increase in the number of houses and hence population increase	Increase in nutrients into the aquatic ecosystem	- Waste water management infrastructure in place - Best practice in maintaining waster water system after installation - Water quality monitoring
Tourism	- Cultural loss - Increase in solid waste generation - Increase in pressure on local hospitals and services	- Solid waste facilities established to keep ahead of demand - Sufficient awareness of the preservation of cultural rights
Vegetation removal from conservation areas	- Increase the likelihood of erosion - Loss of important bird habitats - Loss of visual attraction	- Site specific management plans for protected areas - Education process for stakeholders
Removal of sand and coral	- Increase exposure of foreshore to wave damage and wave inundation	- Education program and areas of high vulnerability identified and zoned for no access

Data management

The acquisition of information on which managers can make decisions depends to a great extent on the type and availability of data sets, and maps in formats that are compatible with the scale, and coverage for the atoll in question. An initial step is to set out a format for capturing the already available information and tracking the development of new information. This helps to identify gaps in knowledge and to set a consistent pattern for data collection and storage.

Table 7. Format for data collation and information management (Table 7 sets out an example that may be adopted).

Physical parameters

Potential technical issues	Data needed	Data source	Availability {GIS ready} {excel only}	Comments {this may highlight the need for more surveys}	Check list for obtaining the data
Loss of critical habitat	Coral reef maps	MPAS MRC			
	Seagrass maps				
Alteration of currents and therefore impacts to the recruitment patterns for marine species	Atoll circulation				
Impact from dredging	Sediments movements				
	Loss of habitats				
	Destruction of benthic animals				
Increase nutrients into the marine system	Waste water management				
	Solid waste management				



Uncontrolled disposal of waste close to beach fronts. Photo: Melanie King.

Appendix A

Case example: Addu Atoll – Potential and issues for ecotourism

Addu Atoll has significant ecological attractions, areas in a natural or little-disturbed state, and historic areas that provide the basis to develop a world-class combination of ecotourism activities.

Ecotourism with a combination of resort and vessel based products is a logical development for Addu Atoll. The atoll meets the requirements of environmental attractiveness due to its climate, clear waters and intact reef systems that support mega fauna. The Addu communities can meet the needs for discrete infrastructure with minimal environmental impacts.

Strategic planning for ecotourism raises special considerations. The clientele tends to consist of educated high net worth and computer literate individuals seeking high quality experiences of natural environments that are generally remote from other forms of economic development. The environmental “footprint” of ecotourism facilities should typically be small. This is likely to require higher initial development costs for water cycle, and waste and energy management, but this is offset by the willingness to pay and generally by lower long-term operational costs and impacts. Ecotourists seek good information on the local environment and history, comfortable accommodation and good catering but otherwise generally limited entertainment. Many do substantial web research to select locations and subscribe to sites that post experience blogs and reviews.



Tourism is the single largest income earner for the Maldives. This new resort for the Shangri-La consortium is currently being constructed on Villingili Island in Addu Atoll (August 2008). Photo: Geoff Dews.

Development of ecotourism should be/is a specific component of the Addu Atoll Management Plan with overall strategic environmental assessment and specific analysis of opportunities and constraints for ecotourism activities in relation to other activities and options. The planning process would also develop outcome predictions and environmental impact and response models for different intensities of ecotourism and other economic development options.

Existing conservation management in the north western part of the atoll provides the initial basis. The Edigaikihi Protected Area enables high quality land-based activities including bird watching, photography, nature walks and studies of plants including traditional medicine herbs. The Koatley Marine Protected Area contains a range of diverse and attractive dive and snorkel sites.

The northern side of the atoll has substantial areas of attractive coral reefs with high potential for development of a network of high-class dive and snorkel sites. The lagoon supports sailing, and sea life observation (dolphin and tuna) while the outside reefs can attract the extreme surfing tourist that also enjoys the traditional village lifestyle. The traditional village lifestyle also means local food experiences and visits to ship building, organic farming and horticulture sites.

The islands of the eastern side of the lagoon, particularly the area south of Herathera Resort, Mulikede Islands and Villingili have natural areas that are important for resident and migratory birds including flamingos.

Tasks for consideration of
ecotourism in the Addu Strategic Plan

- 1. List existing ecotourism activities, value and current/future investment plans
- 2. Map sites of interest - terrestrial and marine for present and future activities
- 3. Within the Addu Strategic Plan conduct Strategic Environmental Assessment for each site/site cluster identifying conservation issues and objectives and using risk analysis of current and likely threats from “no change” management and other activities
- 4. Identify usage zonings/or area usage conditions that would protect sites of ecotourism interest
- 5. Within the Addu Strategic Plan conduct comparative economic projections of benefits and costs of ecotourism against conservation needs and other economic uses
- 6. Within the Addu Strategic Plan identify management, capacity building, community engagement, monitoring and research priorities relating to conduct and sustainability of ecotourism (see Figure 6)

A summary of like activities is set out in Table 8 which indicates the type of investment levels required, the risk of any commercial development, the skills required and the likelihood of impact to the local environment.

Table 8. Summary of ecotourism activities and likely impacts

Activity (additional information can be found in Vision Addu 2015)	Requirements	Infrastructure	Investment levels	Likely cultural and biophysical impacts
Snorkelling	Boat access to reef in the lagoon	Wharf access	High	Biophysical impacts to trampling of corals
Traditional dhoni building activities	Bus	Road access	Medium	Nil impacts
Cultural site	Bus	Road access	Low	Cultural impacts
Surfing	Boat	Wharf access	High	Nil
Sailing	Yacht	Wharf access	High	Nil
Traditional medicine tour	Bus	Road access	Medium	Minor to vegetation
Traditional food	Kitchen	Kitchen + café	Low	Nil
Diving	Boat	Wharf access	High	High
Khuli visit	Bus + expert guide	Bus	Low	High
Uninhabited islands picnic	Boat	Wharf access	High	Significant
Mega fauna watching (whales, dolphins, tuna)	Boat	Wharf access	High	Low

References

- 1. Bush M, Hance A, Judd K. and Retterman 2000.
Recent trends in ecosystem management.
Masters project, University of Michigan School of Natural Resource and Environment.
- 2. Jaeger W.K. 2005.
Environmental economics for tree huggers and other sceptics.
Island Press, Washington.
- 3. Jones C, Baker M, Carter J, Jan S, Short M. and Wood C. 2005.
Strategic environment assessment and land use planning: an international evaluation, Earthscan, London.
- 4. Ministry of Environment, Energy and Water Republic of Maldives, 2007.
Environmental impact assessment regulations 2007
- 5. Ministry Planning and National Development 2007.
Millennium development goals country report Government of Maldives
- 6. UNEP 2002. State of Environment Republic of Maldives



Ministry of Environment,
Energy and Water



THE UNIVERSITY
OF QUEENSLAND
AUSTRALIA