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A COMMUNITY-BASED ECOSYSTEM APPROACH TO FISHERIES MANAGEMENT:

GUIDELINES FOR PACIFIC ISLANDS COUNTRIES

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Compiled by
the Secretariat of the Pacific Community

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Secretariat of the Pacific Community
BP D5, 98848 Noumea Cedex, New Caledonia
Tel: +687 26.20.00, Fax: +687 26.38.18
www.spc.int spc@spc.int

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These guidelines have been developed to meet the aspirations of Pacific Island countries as stated in the *Pacific Islands regional coastal fisheries management policy and strategic actions* (known as the Apia Policy) in which authorities agreed to take steps to achieve healthy ecosystems and sustainable stock of fish. It has also been developed in response to the recommendations of the 2008 ecosystem approach to fisheries (EAF) regional workshop in Nadi, Fiji Islands, and a subregional workshop held in Guam.

Gabriella Bianchi (Senior Fishery Resources Officer, Marine and Inland Fisheries Service, Food and Agriculture Organization of the United Nations – FAO) and Rebecca Metzner (Fishery Analyst, Policy, Economics and Institution Services, FAO) provided useful comments on an early draft of this document.

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SUMMARY

These guidelines have been produced to describe how an EAF can be merged with community-based fisheries management (CBFM) in PICs.

This merger of approaches is referred to in these guidelines as the community-based ecosystem approach to fisheries management (CEAFM), and represents a combination of three different perspectives; namely, fisheries management, ecosystem management and community-based management. CEAFM is the management of fisheries, within an ecosystem context, by local communities working with government and other partners.

The main requirement for such a merger is the involvement of a broader range of stakeholders and access to the expertise and experience of several government agencies in addition to a fisheries agency. CEAFM is not seen as a replacement for current fisheries management but an extension that combines a high degree of community and other stakeholder participation to minimise the impacts of fishing and other activities on ecosystems. In addition to fishing activities, coastal ecosystems in many PICs are affected by excessive shoreline development and by coastal waters that contain high levels of nutrients and silt.

CEAFM aims to involve the participation of community stakeholders to ensure that future generations of Pacific Island people will continue to have access to the benefits associated with sustainable fisheries and healthy ecosystems.

ACRONYMS

CEAFM	community-based ecosystem approach to fisheries management
CBFM	community-based fisheries management
CFMP	community fisheries management plan
EAF	ecosystem approach to fisheries
E-MAG	ecosystem management advisory group
FAO	Food and Agriculture Organization of the United Nations
HABs	harmful algal blooms (including those responsible for ciguatera)
LMMA	Locally-Managed Marine Area
NGO	non-government organisation
PICs	Pacific Island countries
SPC	Secretariat of the Pacific Community
TNC	The Nature Conservancy
UVC	underwater visual census (to estimate the abundance of fish, corals etc)

1. BACKGROUND

1.1 The purpose of these guidelines

These guidelines are intended to help communities, government agencies and non-governmental organisations (NGOs) in Pacific Islands countries (PICs) work together to develop and implement community-owned fisheries management plans for a designated area. Although these guidelines are particularly designed to enable a government fisheries agency to work with communities to manage coastal areas, they may be used by any group, including community leaders, an environmental agency or an NGO, for the same purpose. In these guidelines, the agency or group initiating the work with communities is referred to as the **promoting agency**.

Section 1 gives some background, including a summary of the key issues in coastal ecosystems of Pacific Island countries and territories. Section 2 presents step-by-step guidelines and simple tools to assist communities and their partners in creating and implementing community plans that reduce human impacts on ecosystems and ensure that catches of seafood species are sustainable. Section 3 provides some basic requirements for implementation.

1.2 A community-based ecosystem approach to fisheries management (CEAFM)

1.2.1 Community-based fisheries management (CBFM)

CBFM refers to a management system under which communities take a leading role in managing fisheries and adjacent coastal areas in partnership with, or with support from, a promoting agency.

Communities in the Pacific Islands have been involved in managing and protecting their coastal ecosystems and fish stocks for many hundreds of years. And now, many government and NGOs are actively encouraging communities to take on more management responsibilities under CBFM projects. Many PICs have been assisted in establishing CBFM by SPC – a regional organisation based in New Caledonia, as well as several NGOs.

1.2.2 An ecosystem approach to fisheries (EAF)

An ecosystem can be defined as a relatively self-contained system that contains plants, animals (including humans), micro-organisms and non-living components of the environment as well as the interactions between them.

Managing a resource species or fish stock in isolation from its ecosystem ignores the fact that fish species depend on ecosystems that are being affected by the fishing activity itself and by other human activities. Fishing can affect other components of the ecosystem by: catching unwanted species, causing physical damage to habitats, disrupting food chains and causing changes in biodiversity. Other human activities unrelated to fishing, such as agriculture, forestry and development, can also affect marine ecosystems, including the species that are part of them. The human impacts on ecosystems are often being exacerbated by the effects of climate change.

It is pointless to address the problem of depleted fish stocks merely by placing controls on fishing activities if the key threats to their recovery are related to other human activities and natural factors that are causing the degradation of ecosystems. For these reasons, fisheries authorities are replacing narrow, target species–based fisheries management with a broader approach that attempts to manage fish stocks as components

of marine ecosystems. Under an EAF, the usual concern of fisheries managers – the sustainability of targeted species – is extended to address the sustainability of ecosystems upon which the fisheries depend, which include people and fish stocks. EAF addresses both human and ecological well-being and merges two paradigms: protecting and conserving ecosystem structure and functioning; and fisheries management that focuses on providing food, income and livelihoods for humans.

As the objective of EAF is the sustainable use of entire ecosystems as well as targeted species, it implies that non-fisheries activities that impact marine ecosystems must also be managed, even though these activities may be outside of the responsibilities of fisheries authorities. In addition to fishing, target stocks are affected by non-fishing issues including climate change, coastal development, pollution and the loss of critical habitats by reclamation. (See Box 1 for more information about EAF.) *Because of the broad issues involved, the full implementation of EAF requires collaboration and cooperation between communities and a range of government agencies responsible for managing activities that impact on marine ecosystems*.

SPC and TNC have produced a booklet that presents key information on aspects of the ecosystem approach to coastal fisheries and aquaculture in the Pacific (see websites in Appendix A).

BOX 1: QUESTIONS ABOUT EAF

We have a government fisheries agency to manage fish stocks. Why can't we leave it to them to ensure that fish stocks are sustainable?

A government fisheries agency cannot manage the complex marine ecosystems that support fisheries on its own. The involvement of local communities and the expertise of people in other government agencies, regional organisations and NGOs are required for such a task.

How can we apply EAF when we don't have enough information about local marine ecosystems?

EAF involves making decisions to achieve objectives based on the best available knowledge, whether it is scientific or traditional. Urgent actions are required now and there is no time to wait to collect extensive scientific information. In any case, local communities are repositories of much information on local ecosystems.

Would the application of EAF involve banning fishing in large areas? And, if so, how are local people going to have access to seafood?

EAF does not necessarily involve the use of no-take areas, which represent just one of several possible fisheries management tools. Other management tools include restricting damaging fishing methods and preventing damage to ecosystems. It should be remembered that the ultimate objective of EAF is to ensure that ecosystems are healthy, fish stocks are sustainable and that the well-being of the communities and stakeholders depending on them is safeguarded.

1.2.3 Combining the ecosystem approach with CEAFM

In many instances where communities are involved in managing fisheries, actions are already being taken to protect key ecosystems such as coral reefs and mangrove areas. In other words, addressing human impacts on ecosystems is not a new concept in CBFM.

Combining the two concepts can be regarded as an effort to formalise a process under which community-owned fisheries management plans include measures to protect not only fish stocks but the ecosystems on which they depend. This broader view of fisheries management by communities has been referred to as a CEAFM.

CEAFM represents a combination of three different perspectives; namely, fisheries management, ecosystem management and community-based management. *An appropriate definition of CEAFM is therefore the management of fisheries, within an ecosystem context, by local communities working with government and other partners.* The close involvement of communities accentuates that humans are also an integral part of ecosystems and their needs must be addressed.

1.3. Coastal ecosystem issues of concern for PICs

1.3.1 Issues related to fishing

Direct impacts on ecosystems from fishing

The direct effects of fishing include impacts on target species, bycatch species and habitats. Many fisheries authorities in PICs are concerned about excessive fishing on a number of fish species. When a species is fished at a sustainable level, the number of individuals caught and dying is balanced, on average, by gains through the addition of young (recruitment) resulting from reproduction. If this is the case, stock abundance will fluctuate, often considerably, around an average number. However, if a fish stock is heavily fished, the number of mature fish may be reduced to a level where reproduction and recruitment are unable to replace losses. In these conditions, referred to as overfishing or overexploitation, stock numbers will continually decrease.

Fisheries authorities in Pacific Islands believe that many important fish stocks have been overfished in coastal areas. Much effort has been spent on conventional stock assessment and in estimating the optimum yield that can be taken from a stock. But obtaining and using such estimates can be very difficult in the multispecies fisheries that are common on tropical coasts, where the species diversity within catches is very high.

There are several aspects of target species that result in them being particularly vulnerable. Many species need to be part of a relatively large population in order to reproduce successfully (known as the 'Allee effect'). If the population is fished down to low numbers, the chances of drifting sperm and eggs meeting are greatly reduced and the species may become locally extinct; this has been the fate of giant clam species in many areas of the Pacific.

Some target species of fish gather in large aggregations at certain times of the year and in specific places to reproduce and this makes them particularly vulnerable. These spawning aggregations involve species such as groupers and snappers that, while normally living apart, make extended migrations to reach spawning areas. The sites and timing of aggregations are often well known to traditional fishers who target the fish milling about in dense aggregations as they release sperm and eggs. There is some concern that even moderate fishing may break up aggregations and thus affect the overall reproductive success of the spawning stock.

Some communities and countries are banning fishing either in the spawning sites or during the time of forming aggregations.

In addition to reducing the abundance of a target species, overfishing will also affect other characteristics of the stock, including its size structure and genetic composition. Most fishing selectively removes larger individuals from the fished area. And it is the largest female fish that produce the greatest number of eggs and therefore contribute most to the next generation. This is one of the reasons that some fisheries managers have placed maximum size limits on the capture of some species.

It should be noted that adopting a broader ecosystem approach to fisheries management does not diminish the need for managing target species. Some fisheries in PICs are based on a single species or a small group of species which makes them suitable for conventional resource assessment. Such species groups include lobsters, sea cucumbers (beche-de-mer), deepwater bottom-fish, trochus and mullet. Studies directed toward target species are needed not only to predict how stocks will respond to different levels of fishing effort but to elucidate the basic biology, distribution and life-cycle of the species, including its place in marine ecosystems and the habitats that are crucial for its survival.

Excessive levels of fishing that result in overfishing or overexploitation, as well as damage to marine ecosystems and the destruction of fish habitats, have all been implicated in the poor condition of fish stocks around the world.

In addition to the target species, most types of fishing gear catch other species, collectively known as bycatch. In world fisheries, bycatch species from fishing operations are of great concern because of wastage as well as the effects on biodiversity and marine ecosystems. Data from the Food and Agriculture Organization of the United Nations (FAO) suggest that prawn trawls, tuna longlines, dredges and traps account for most of the bycatch in world fisheries.

Most of the fishing methods that result in high levels of waste are not used in Pacific Island countries. Prawn trawling is limited to Papua New Guinea and there are no dredging operations in the region. Although tuna longlining is widespread in the Pacific, it is not relevant to this document on coastal fisheries. Traps are used in many Pacific Island countries but fishing gear such as fence or maze traps (Figure 1) and loosely hung gill nets may be the main offenders as they appear to catch indiscriminately. Some fisheries agencies and local communities have restricted the number, or mesh sizes, of gill nets and fence traps allowed in particular areas.

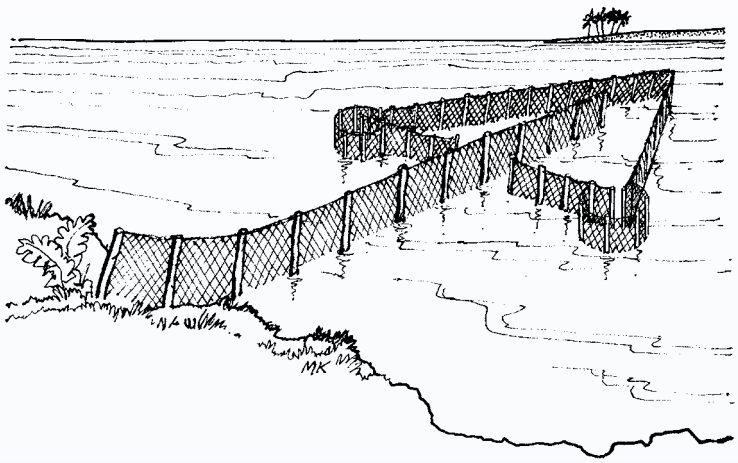


Figure 1: A fence or maze trap. Similar traps are used in several PICs

However, in many artisanal fisheries very few caught species are discarded. In many coastal fisheries in tropical areas, where a large variety of marine species are utilised and can be found in local markets, only about 5% of the total catch is discarded. Fence traps, for example, are usually family or clan owned and used to catch a wide variety of species, only some of which, such as toadfishes and boxfishes (Tetraodontidae), are not kept as food.

An additional problem is that some fishing gear continues to catch marine species after being lost or abandoned. Several types of fishing gear have been implicated in this phenomenon, known as ghost fishing, in the Pacific Islands and these include traps, fence or maze traps and gill nets.

Many different types of fishing gear and fishing methods cause direct physical damage to nearby areas, habitats and ecosystems. Table 1, which was compiled during SPC workshops in PICs, shows issues with target species, fishing gear and methods that impact on coastal ecosystems.

Table 1: Issues with target species, fishing gear and methods that impact on coastal ecosystems in PICs.

Target species issues	Impacts
Selectively targeting a single species	Imbalance in food webs/ecosystems
Targeting spawning aggregations	Overexploitation; disrupted spawning; changes in sex ratios
Catching threatened/protected species	Further reduction in size of threatened populations
Targeting large individuals	Loss of large egg-bearing females; changes in sex ratios
Damaging gear and methods	**Impacts**
Explosives, commercial poisons, plant poisons	Collateral damage to corals and wider ecosystem
Intensive gleaning, fish drives	Physical damage to fringing reef corals
Gear that makes contact with the sea floor	Habitat damage
Gear that requires setting by walking on reefs	Coral damage
Breaking corals to catch sheltering species	Collateral damage to corals
Overly efficient gear and methods	**Impacts**
Gill nets	Excessive catches and ghost fishing when lost
Seine nets	Excessive catches of schooling species
Barrier nets (set across passages and channels)	Excessive catches of schooling species
Fence traps	Excessive catches; bycatch issues; ghost fishing
Scuba gear	Overexploitation of lobsters; trochus; sea cucumber
Fish traps	Habitat damage; bycatch species
Throw nets	Habitat damage; bycatch species
Underwater lights, night spear fishing	Devastation of large key reef species

Source: Surveys and feedback from in-country workshops.

Destructive fishing methods used in some Islands of the Pacific include the use of explosives (often obtained from mining operations, road works and even the police) and commercial bleaches (sodium hypochlorite). Bleach may be poured into pools isolated at low tide and explosives are either thrown from a canoe or set on coral where fish have been encouraged to gather by setting bait. Explosives and severe poisons are more

damaging to fish larvae and coral polyps than they are to large fish. Destroyed coral reefs result in low fish production and may not recover for many years – dynamited reefs in the Philippines, for example, took an average of 38 years to recover.

It is important to recognise that several traditional fishing methods are just as destructive as modern fishing techniques. Collecting (gleaning) invertebrates and algae from reefs, communal fish drives across lagoons, the setting of gill nets by people walking on reefs and the breaking apart of corals to extract speared fish can cause extensive damage to coral reefs. In many PICs, poisonous plant material is traditionally used to catch fish. Fish poisons are derived from the roots of the climbing vine *Derris elliptica* and the nut of the coastal tree *Barringtonia asiatica*, which are ground into a paste. The effects of these damaging traditional methods have been exacerbated by the weakening of traditional controls on certain fishing methods and by increasing human population numbers — in the past, the marine environment was able to sustain occasional, localised damage because the frequency of the activity was low and fewer people were involved.

Barringtonia asiatica

Indirect impacts on ecosystems from fishing

Fishing can affect a fish stock or ecosystem indirectly by, for example, increasing or reducing the abundance of a predator, prey or competitor. Adverse ecological effects are related to the reduction in numbers of target species from ecosystems and food chains. The reduction in numbers of a predatory species may allow its prey to increase in numbers and the reduction of a prey species may induce predators to feed on other species. The flow-on effects of removing species from an ecosystem have been referred to as 'trophic cascades'.

Many commercial fisheries involve the use of a small range of fishing gear to target a number of particular species from an ecosystem and this may result in an ecological imbalance. Artisanal and subsistence fishers on tropical coasts, on the other hand, use many different fishing methods and catch a wide range of species within an ecosystem and it has been suggested that this is less damaging. This is based on the view that an ecosystem is less affected by the removal of sizes and species from many different trophic levels rather than just one or two; this is supported by the fact that the size and species composition in artisanal catches often resembles the structure found in ecosystems. Food species taken by subsistence fishers in Pacific Islands range from algae and herbivores to large carnivorous fishes.

Some highly targeted fishing undoubtedly affects coral reef ecosystems. A reduction in the numbers of herbivores, including parrotfishes, that keep coral surfaces clear of algae, for example, may leave corals exposed to excessive algal growth and eventual smothering. On the other hand, the excessive erosion of corals can be caused by the removal of predators that keep coral bioeroders in check (see Box 2). Populations of sea urchins that erode corals, for example, are controlled by predators including triggerfishes (balistids), emperors (lethrinids) and wrasses (labrids). The overfishing of these species may allow urchin populations to increase dramatically and destroy coral formations by abrasion. Beche-de-mer (sea cucumber) fisheries are common in many areas and the removal of large numbers of sea cucumbers can result in an increase of bacterial/algal mats and a decrease in sand and water quality.

BOX 2: BIOEROSION

Bioerosion is the breaking down of substrates, usually coral, by the actions of various organisms referred to as bioeroders. Some sponges, bivalve molluscs and worms are internal bioeroders and bore into, and live in, the coral structure. External bioeroders, including some fish and sea urchins, feed on the surface of the coral. Two important bioeroders of corals are the colourful parrotfishes (family Scaridae) and sea urchins (Figure 2).

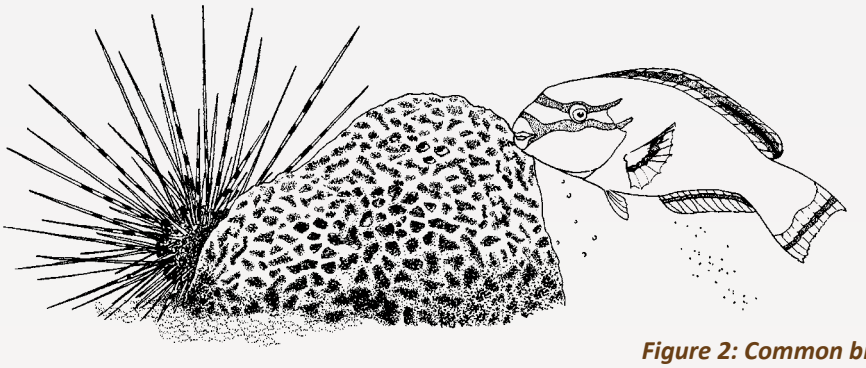


Figure 2: Common bioeroders of coral include sea urchins, such as Diadema ***sp. (left), and parrotfishes (family Scaridae) (right).***

Parrotfishes have massive fused teeth with which they scrape coral to feed on algae and symbiotic zooxanthellae within the coral polyps. The fishes have to graze large quantities of coral to gain a small amount of organic material and they appear to be continually evacuating clouds of fine coral particles. As each adult parrotfish produces about one tonne of particulate matter each year, the contribution to the sand of lagoons and beaches is considerable. Some sea urchins, such as various species of *Diadema*, are among the most common invertebrate bioeroders on coral reefs around the world.

1.3.2 Issues related to other activities (external impacts)

In addition to threats from excessive fishing activities, marine ecosystems are threatened by many non-fishing activities on coastlines and further inland. Sources of damaging impacts from many non-fishing sources have been identified by fisheries authorities in PICs through interviews and questionnaires (Figure 3).

Other than overfishing, the most common human (or anthropogenic) impacts on marine ecosystems and fish stocks appear to be related to sewage and nutrients in coastal waters, garbage dumps located at the sea's edge, excessive coastal development, silt entering the sea and the loss of beaches due to sand mining (see Box 3 on silt and sewage). The high level of concern over eutrophic conditions, often caused by the inadequate treatment of sewage, seems to be justified considering the increasing occurrence of harmful algal blooms (HABs; Box 4), including those responsible for ciguatera (a foodborne illness caused by eating reef fishes; see Box 4). Thirty-eight percent of PICs responding to a questionnaire believe that there has been at least some increase in the occurrence of HABs.

Outbreaks of crown-of-thorns sea stars, *Acanthaster planci*, were also reported by fisheries authorities; these outbreaks may be associated with the overharvesting of its predators (including the giant Pacific triton) and high nutrient loads resulting in algal blooms that may supply predators of the crown-of-thorns' larvae with alternative food sources.

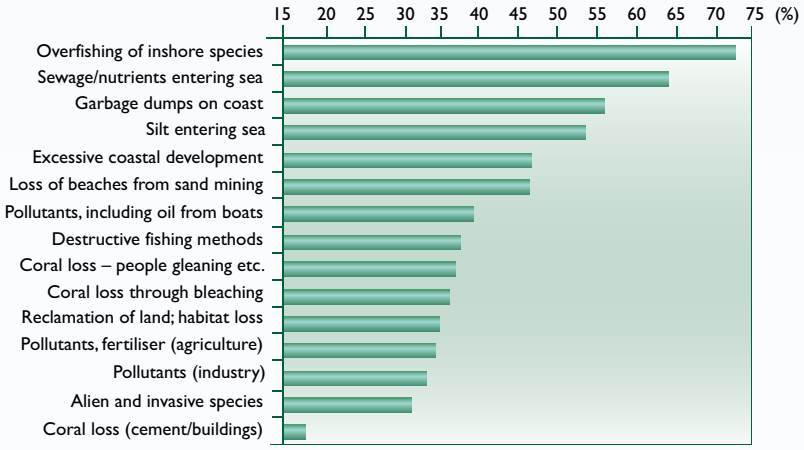


Figure 3: Sources of damaging impacts identified by fisheries managers in PICs. Mean scores from 0% (no effect) through to 100% (severe effect).

Source: Survey responses from 21 PICs.

It is noteworthy that most of the environmental impacts summarised in Figure 3 are caused by activities that are beyond the usual responsibilities of fisheries agencies. This reinforces the view that the management base for an ecosystems-based approach to fisheries must be broadened to include other relevant government agencies.

BOX 3: SILT AND SEWAGE

Most tropical waters contain very low levels of nutrients that are taken up by microscopic planktonic algae or phytoplankton. A healthy coral reef supports a very large biomass and productivity by recycling very small amounts of nutrients in the surrounding water. Corals are adapted to clear water with low nutrient levels and are therefore badly affected by light-reducing silt and terrestrial (land-based) sources of nutrients.

In PICs, the major sources of silt appear to be erosion, dredging, reclamation, coastal development and the removal of trees. Nutrients are mainly derived from poor or non-existent sewerage systems. Although coral reefs are the most nutrient-sensitive of all ecosystems, larger quantities of nutrients can result in many other deleterious effects including the overgrowth of algae and permanent phytoplankton blooms that change water from clear blue to turbid green.

It has been suggested that nutrient concentrations in seawater need to be many times lower than the standards used for drinking water (1 to 10 parts per million) in order for coral reefs to remain intact. There is a strong relationship between nutrient levels (causing eutrophication) and human population density. If sewage is secondary treated, it appears that population density should be less than 5000 people per kilometre of coastline if coral reefs are to be unaffected.

Various agents (pollutants or stressors) resulting from non-fishing activities have been identified by participants at in-country workshops, and these are listed in Table 2. Nutrients from inadequate sewerage systems and silt from several sources, including reclamation, excessive coastal development and poor land-management practices, were most commonly identified as important issues. In some countries, there have been attempts to address some of these coastal ecosystem issues through a multisectoral approach referred to as integrated coastal management (ICM).

Table 2: Agents (pollutants; stressors) and issues resulting from non-fishing activities that impact on coastal ecosystems in PICs.

Pollutant/issue	Impact	Source
Nutrients	HABs/ciguatera Excessive algae/seagrass growth Coral loss Fish kills	• Inadequate sewerage systems • Wastes from livestock • FertiliSer runoff • Run-off from fish/meat processors
Silt	Loss of corals and fish species	• Reclamation • Excessive coastal development • Coastal/riverbank tree clearing; forestry • Sand mining; harbour dredging
Toxic pollutants	Fish kills Accumulation of heavy metals	• Coastal garbage dumps • Abandoned vehicles & batteries • Tributyl tin (TBT) from marine antifouling • Runoff from civil works and industry
Oil	Loss of corals and fish species	• Coastal garbage dumps • Vehicles • Shipping and industry
Alien/invasive species	Competition with native species	• Ballast water from ships • Introductions associated with aquaculture
Loss of habitats (corals)	Loss of marine species General ecosystem damage	• Cement manufacturing • Use of coral building blocks • Tourism (coral collection; reef walks)
Loss of habitats (wetlands and beaches)	Loss of marine species General ecosystem damage	• Reclamation • Coastal development • Sand mining

Source: Survey of 21 PICs and information from in-country workshops.

Many of the environmental impacts discussed in this section are being made worse by climate change. Rising sea levels as well as the increasing frequency and severity of storms are increasing shoreline erosion and siltation in lagoons. Changing sea temperatures may affect the distribution and migration of fish species and some corals may disappear from reefs due to bleaching effects and ocean acidification. Even more disastrous effects include the loss of low-lying atolls. Management strategies must be developed that allow for the uncertainties associated with temperature change. This may involve adopting a precautionary approach under which the conservation of fish stocks is given priority over the optimisation of fisheries yield.

1.3.3 Issues relating to governance and social well-being

To effectively manage a fishery, it is essential to understand not only the fishery, but also its natural and human environment. All fisheries, and especially community-based fisheries, occur within the context of the community, and reflect the economic and social goals and values of that community. In general, people in Pacific Island communities rely on healthy ecosystems and sustainable fishing for food, employment and income. Identifying and understanding the social, economic and governance (sometimes referred to as 'institutional') forces are central to achieving effective fisheries management. For example, FAO notes that:

1. social, economic and institutional objectives and factors may be driving forces behind the need for fisheries management;

2. the fisheries' costs and benefits, whether to individuals or to society, have social, economic and institutional impacts and implications;

3. social, economic and institutional processes are all crucial for successful implementation of fisheries management; and

4. social, economic and institutional factors can play either supporting or constraining roles in whether management is effective or not.

The management of fisheries is really the management of people. Understanding the social, economic and governance issues associated with marine resource use is just as important as understanding the ecological or environmental components of a fishery. In identifying the socio-economic issues, it is useful to consider the following sectors:

- fishers
- local community
- general community
- industry (where commercial fishing is occurring)
- national

The governance, or institutional, issues relate to the 'ability to achieve'. Governance includes both traditional and government systems. Issues that might be constraining effective fisheries management and factors that might support effective management include:

- institutions
- legal frameworks
- tenure and use-rights systems
- enforcement and compliance
- capacity – human and financial
- information and awareness
- external factors – market forces, climate change, natural disasters (storms, tsunamis), development

A range of issues to be taken into account in the implementation of EAF is provided in Table 3.

Table 3: Possible categories of issues to consider under an EAF.

Ecosystem issues		

	• Target species
	• Bycatch species
	  o Retained
	  o Discarded
	• Special species (protected species; vulnerable species)
	• Fish community structure
	  o Trophic structure changes
		• Ecosystem/habitat
		  o Habitat damage from equipment
		  o Spawning aggregations
		  o Water quality changes
		  o Land-based impacts
		  o Natural impacts (bleaching, earthquakes, storms, etc.)
		  o Man-made impacts (dredging, sediment, etc.)

Socio-economic issues: community well-being		

	• Fishers
	  o Income
	  o Work-related injuries
	  o Food
	  o Well-being
	• Community
	  o Employment
	  o Food
	  o Fees
	  o Cost to alternative activities or opportunities
	  o Social disputes – resource ownership, equity, benefits
	  o Fuel, boats
	  o Training
	  o Cultural values and issues
	  o Climate change
	  o Natural disasters
		• Small-scale commercial sector
		  o Income, profit
		  o Work-related injuries
		  o Risk – storage, shipping
		  o Community relations
		  o Fuel, supplies
		  o Fees and licenses
		  o Training
		  o Market price variability
		  o Demand fluctuations
		  o Infrastructure
		• National
		  o Management capacity
		  o Export income
		  o License fees
		  o National social and economic plans
		  o Food security
		  o Market forces
		  o Development

Governance		

	Ability to achieve (governance)
	
	• Institutional
	• Legal framework
	  o National
	  o Provincial/state
	  o Local
	  o Other
	• Management plan
	• Compliance
	• Enforcement
	• Monitoring
	• Research
	• Community leadership and structures
	• Resources to manage at national, provincial and community levels
	  o Staff capacity
	  o Financial resources
		• Consultation
		  o Community
		  o Industry
		  o Provinces / states
		  o Interagency
		  o NGOs
		• Reporting
		• Information and awareness
		• Interagency cooperation and coordination
		• Community – national agency cooperation
		
		External factors (natural and human induced)
		
		• External drivers affecting governance (fisheries and non-fisheries sources)
		  o Climate change impacts (bleaching, etc.)
		  o Development (e.g. tourism related)
		  o Market forces

BOX 4: HABS, INCLUDING CIGUATERA

Populations of phytoplankton (microscopic plants that drift in the surface layers of the sea) periodically go through massive increases in abundance, referred to as plankton blooms, and a few species produce potent toxins. Ciguatera poisoning results from the consumption of fishes that have accumulated toxins produced by several organisms including the benthic dinoflagellate *Gambierdiscus toxicus*. Figure 4 shows a cartoon used to raise community awareness of ciguatera in PICs. The sequence of events is as follows.

A) The dinoflagellate *Gambierdiscus* occurs as a film on corals and seagrasses. Usually its abundance is low but numbers increase dramatically when there are high levels of nutrients available.

B) Nutrients increase naturally during the wet season with runoff from the land and during cyclones when nutrients are released from damaged shorelines and coral reefs. Nutrients also increase when sewage and agricultural fertilisers enter coastal waters. *Gambierdiscus* contains the precursor to ciguatoxin, to which is it is converted in the livers of small grazing fish.

C) By magnification up the food chain, ciguatoxin reaches dangerous levels in top carnivores, such as some emperors, red snappers, barracudas, moray eels and large mackerels.

D) People eating these usually edible fishes suffer from tingling, numbness, muscle pains and a curious reversal of temperature sensations (cold objects feel hot to touch). In extreme cases, death occurs through respiratory failure.

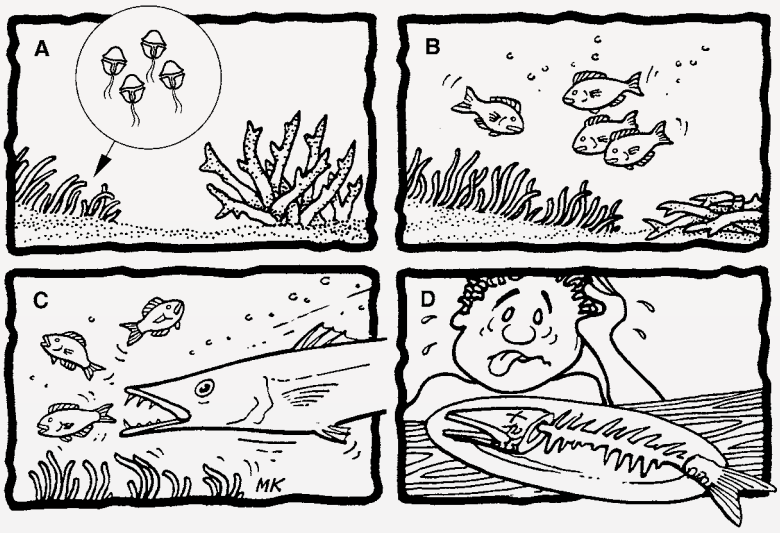


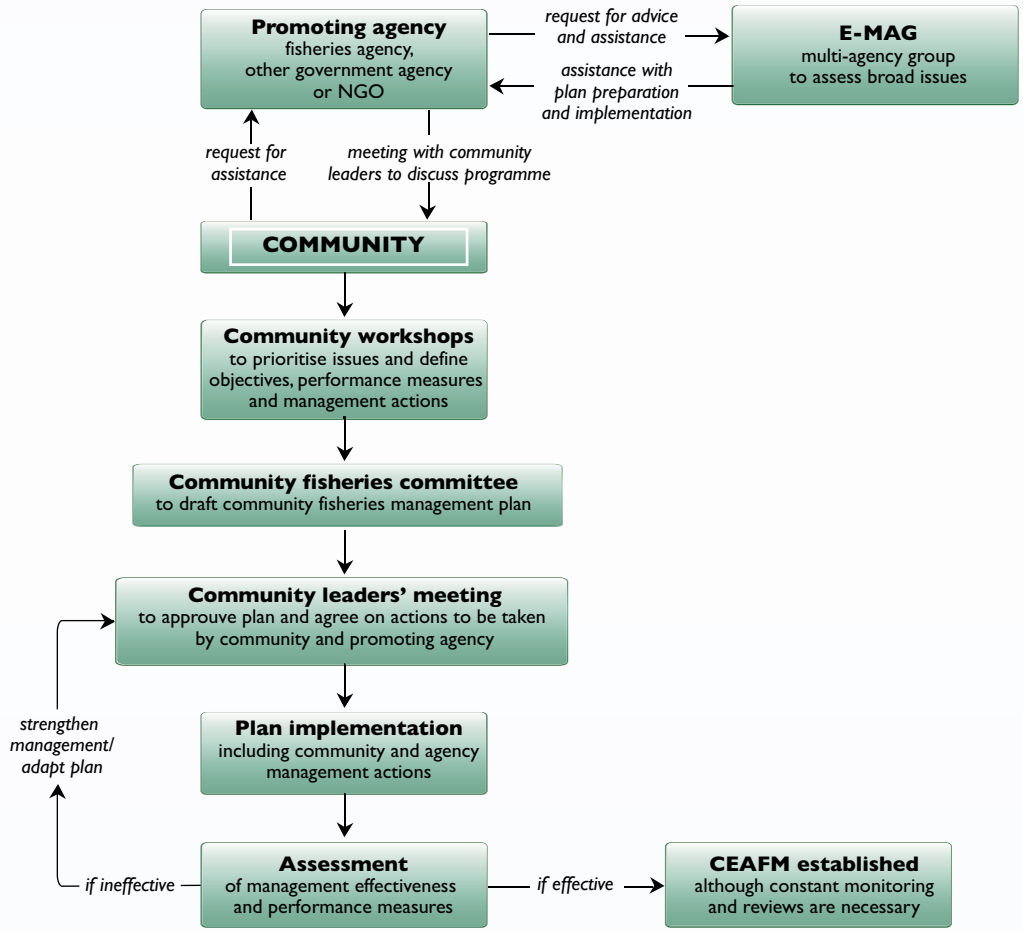
Figure 4: A cartoon used to raise community awareness of ciguatera in PICs.

Other harmful algal blooms affect people in different ways. Toxins produced by the dinoflagellates *Karenia brevis* and *Gymnodinium breve* can become airborne (as toxic aerosols) because of wave action and cause people swimming and walking on the shoreline to suffer respiratory asthma-like symptoms from inhaling the airborne droplets. This effect has been noted in the Cook Islands where sewage-derived nutrients are believed to be responsible for the blooms.

2. IMPLEMENTING A CEAFM

This section contains a generalised step-by-step process for a **promoting agency** to work with a community to develop a CEAFM plan. Actual steps for community involvement depend on models and practices developed by respective countries and promoting agencies. The promoting agency may be a government fisheries agency but could also be another government agency or NGO.

The merger of CEAFM with conventional fisheries management involves adopting a comprehensive approach by addressing a broad range of ecosystem, socio-economic and governance issues. Furthermore, community involvement is maximized but additional inputs and expertise from a wide range of government or other agencies is also sought (represented in this document by the ecosystem management advisory group [E-MAG]). The generalised process or framework used by SPC is summarised in Figure 5 and the steps shown are amplified in subsequent sections. General principles developed by SPC for the process and implementation of CEAFM are presented in Box 5.



The process starts with a request from a local community to the promoting agency. The community is assisted in prioritising issues, setting goals and objectives and producing a community fisheries management plan (CFMP). After implementing the plan, the process includes reviewing the effectiveness of management and actions taken and strengthening or adapting the plan as necessary. The inclusion of a multi-agency group to address broad issues is an integral part of the process.

Figure 5: A generalised SPC process for the implementation of CEAFM.

Other ways of depicting the management process shown in Figure 5 include the use of conceptual models and results chains. Results chains, which are graphical depictions of a sequence that links project strategies to one or more targets, are being increasingly required by donor agencies that support conservation projects. More details can be found in the Conservation Measures Partnership (2007) *Open standards for the practice of conservation* — see the website in Appendix A.

BOX 5: SPC PRINCIPLES FOR THE DEVELOPMENT OF CEAFM

Keep the process simple: The process and reasons for management actions, or undertakings, have to be understood at the community level.

Respect local customs and protocols: The local traditions and customs must be respected if the process to implement CEAFM is to succeed (see Section 2.1.7).

Provide motivation: Most communities have a good understanding of problems that are affecting their fisheries and the marine environment. The major need is to motivate communities to address these problems (see Section 2.1.1).

Maximise community participation: All sectors of the community, including youths, women, and community leaders should be encouraged to participate. Most community members are involved in fishing.

Make use of traditional knowledge: The knowledge held by older members of the community is likely to be valuable in proposing management actions in a CFMP.

Use science to support community objectives: Technical advice and information should be made available to community members. Examples include providing recommendations on size limits of fish, advice on the likely source and effects of existing pollutants, and on ways of improving the well-being of community members.

Enlist the support of a broad range of government agencies: Many issues affecting a community will be beyond the control of the community. The maximum participation of stakeholders, including a broad range of government agencies, is important in the CEAFM process (see Section 2.1.4).

Use a demand-based system: Work with communities that are aware of their problems and keen to take actions to resolve them. As the resources of most fisheries agencies and other promoting agencies are limited, it makes sense to work with communities that are eager to take local actions. Less committed communities may eventually see the benefits and request to join the programme (see Section 2.1.1).

Adopt a precautionary approach: Encourage communities to take precautionary actions or undertakings without waiting for scientific confirmation of what is generally known.

Manage human activities: Most management is about regulating human activities – activities that are reducing stocks of fish and polluting coastal ecosystems need to be regulated.

(Box 5 contiuned)

(Box 5 continued)

Suggest alternatives to the overexploitation of resources: Wherever possible, suggest alternatives to the overexploitation of resources. These may include the diversion of fishing pressure from lagoons to offshore areas by the installation of fish aggregating devices (FADs) and developing aquaculture or agriculture.

Develop supporting legislation for CEAFM: For effective management under CEAFM, it is desirable that local communities are legally provided with the authority to manage their management areas and fisheries resources (see Section 2.1.5).

2.1 Set-up tasks for the promoting agency

2.1.1 Define broad goals and strategies

The objective of CEAFM is to work with communities to develop and implement their own plans to manage fisheries within an ecosystem context. Each participating community is encouraged to analyse its fishing practices and develop a community-owned plan with undertakings to introduce appropriate regulations and pursue other conservation measures. Reciprocally, the promoting agency provides undertakings to support the community by providing advice and assistance. Ideally, the project strategy is based on three principles:

a) **Maximum community participation** involves mobilising each community through direct contact with key groups. These include women's groups and men's groups to ensure the widest community participation and eventual ownership of the CEAFM plan.

b) **Motivation rather than education** takes into account the knowledge of island and coastal people regarding the marine environment. Most coastal communities have an awareness of, and concern for, their marine environment. Although public awareness-raising activities may be needed, the prime need is not for education, but for motivation and support. *A key task is to convince communities that they, not the government, have the primary responsibility to manage their marine environment.*

c) **A process that is demand-based** requires focusing on communities that have a concern for the marine environment and are prepared to take action in finding solutions to problems. For reasons of efficiency and sustainability, this requires prioritisation by selectively working with communities that are eager to participate in the programme.

2.1.2 Raise public awareness of the need to protect ecosystems

The knowledge of island and coastal people regarding the marine environment has often been underestimated. Most coastal communities have an acute awareness of, and concern for, the marine environment. However, there may still be a need to provide technical information on marine species and ecosystems, including coral reefs and mangroves. Many fisheries agencies, environmental agencies and NGOs have raised public awareness by producing and distributing printed information, fact sheets and producing a range of other media containing technical information on various topics.

The provision of awareness-raising materials will place members of communities in a better position to assess problems with fisheries resources and marine ecosystems through CEAFM.

2.1.3 Review work of other groups working in communities

Many groups including government agencies, regional agencies and NGOs are also working closely with communities on a range of complementary issues (conservation, agriculture, health, etc.). It is necessary to find out which groups are working in the target communities for two reasons. First, it may be possible to combine approaches and save on costs and time by working collaboratively. Second, the presence of different groups using different methods in the same area can often lead to community confusion and disenchantment.

2.1.4 Establish a consultative multidisciplinary group

Identifying and addressing threats from non-fishing activities (such as reclamation and development) as well as social well-being issues will require the collaboration and cooperation of a wide range of authorities, experts and agencies responsible for managing the activities that impact on the marine ecosystem. This group of people is referred to as **E-MAG** in these guidelines.

In some countries, there may be an existing group of people from various government agencies that has the responsibility to address broad environmental issues and this group may be used to perform the functions of the suggested E-MAG.

The membership of E-MAG will depend on local circumstances, but should include representatives from the local community, the fisheries agency and environmental authorities. Depending on the range of issues affecting marine ecosystems, membership could also include representatives from authorities responsible for coastal development, road works, agriculture, forestry, sewerage systems, waste disposal, sand mining, water supply, community affairs and planning. An alternative is to have a core E-MAG membership (say with community, fisheries and environmental members) with the ability to ask representatives from other authorities to attend relevant meetings. E-MAG should be chaired by a person with sufficient authority to ensure that actions are taken.

2.1.5 Establish a formal or legal basis for CEAFM

In many PICs, the traditional ownership of lagoons and reefs is claimed by adjacent coastal communities. For effective management under CEAFM, it is desirable that local communities are legally provided with the authority to manage their marine management areas and fisheries resources. The development of fisheries legislation should therefore provide this authority. In some countries, the development of community fisheries by-laws or fisheries management ordinances includes provisions to allocate this authority.

E-MAG should preferably have some legal legitimacy, but at a minimum be formalised in some way. Things to consider are whether E-MAG can be established under existing policy, or whether new policy or legislation is required. In some cases, E-MAG can be established under a cabinet directive or even under the existing powers of government ministers. In some countries, a government minister has the ability to appoint a committee or board to address complex issues and provide solutions that are beyond the mandate of a single government agency.

Although establishing a legal basis for CEAFM is desirable, the lack of appropriate existing legislation should not be used as a reason to delay beginning the process.

2.1.6 Provide community facilitators with appropriate skills

Many fisheries agencies have used their existing extension staff to work with communities. However, the activities of fisheries extension staff have conventionally focused on development and they may not have the community engagement skills required for the task.

In working with communities, facilitation skills are most important. The word facilitate means 'to make easy' – in other words, the extension officer (best described as a facilitator) 'makes it easier' for a meeting or a community to achieve its own objectives by its own actions. In this role, the facilitator is more of a listener than a teacher. A facilitator needs to unobtrusively encourage groups to define problems and to propose their own solutions without imposing their own views on the proceedings. Previous experience with problem-solving techniques would be an advantage.

Some of the most successful facilitators are confident people, both men and women, who like people and are good at encouraging all individuals in a group to give their opinions. This may (depending on local custom) involve joking and friendly cajoling. However, what is not required is an egotistical bully who is likely to embarrass people and impose their own opinions on the group.

Many younger people require training in cultural skills in order to address groups that include community elders. It should also be taken into account that having female facilitators often makes it easier, or culturally more acceptable, to facilitate community meetings involving women. Women not only make up an important and influential part of the community, but they are also involved in catching shoreline fish and invertebrates as well as being responsible for most seafood preparation and marketing.

2.1.7 Develop a culturally appropriate process

Preparation for working with communities consists of designing a culturally appropriate process. Under SPC methodology, the process or model results in the development of a CFMP. The process has to be adapted to suit the traditional and cultural systems in each country. In most countries, the process will involve working with, or through, traditional community leaders or institutions while still allowing ample opportunities for other community groups to participate. Examples of traditional hierarchies include the chiefly system in Fiji Islands, the *te kaotibwai* in Kiribati, the *matai* in Samoa, the *raui* in Cook Islands and the *falekaupule* in Tuvalu. Hierarchical community structures have weakened in some PICs and governments have had to provide exclusive access rights to local communities (e.g. the special management areas in the Kingdom of Tonga). Whatever process is developed, the end result should be a CFMP that is owned by the broader community.

2.2 The community involvement process

2.2.1 Assess community requests

Following an initial expression of interest by members of a community, facilitators must assess whether the community as a whole is ready to commit to the process. The three key components are: a) an awareness of problems with fisheries and the marine environment; b) a concern for these problems; and c) a willingness to take actions to solve these problems. It should also be determined if the community is cohesive – that is, there are no intractable internal disputes that would render community-based management difficult. If this assessment is positive, it is usually culturally appropriate to arrange a meeting with community leaders.

2.2.2 Define the scope

During initial contact with a target community, facilitators and community members should jointly define the scope of the intended project. A project's scope sets the broad parameters of what will be involved, who will be affected and what can be accomplished. The scoping process should be conducted with community members who are familiar with the area and community issues. A scoping report should contain a description of the geographical area to be managed, the stakeholders, the main fisheries and species of concern and the key issues which the project must address.

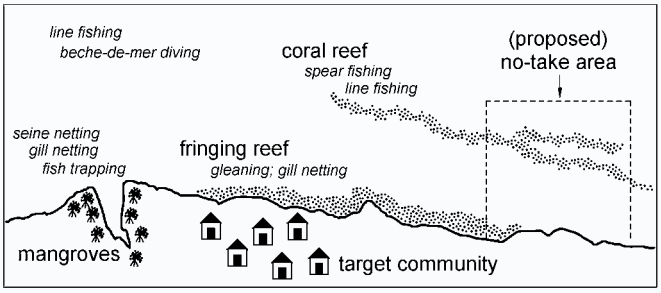
In the case of CEAFM, the area of concern (referred to here as the **managed area**) is usually the area (or a subset of the area) under the legal or traditional control of the target community. The scoping team should make themselves aware of key characteristics of the managed area and record these in the scoping report. A sketch map similar to that shown in Figure 6, which includes significant ecosystem characteristics and fisheries, can be prepared at this stage. Two important questions to be answered are:

- **Do ecosystem boundaries extend beyond the managed area?**

  For example, a continuous area of mangroves may extend beyond the managed area and, therefore, be beyond the target community's control.

- **Is the area affected by human activities outside the managed area?**

  For example, coral reefs in the managed area may be adversely affected by silt from a reclamation operation some distance away.



A managed area is an area (often with traditional boundaries) that is managed by a coastal (target) community, usually working in partnership with a promoting agency. Key ecosystem attributes (a mangrove forest, fringing reef and a coral reef) and fisheries have been noted. The managed area may include, although not necessarily, a no-take area.

Figure 6: Example of a sketch map of a managed area or area of concern.

The facilitators should familiarise themselves with details of the environment and perceived problems – one way of doing this is by completing a walk-through survey of the area with some knowledgeable members of the community (Box 6).

During the scoping process, it should be determined whether it is more practical and efficient to address all ecosystem issues combined or split these into fishing issues, non-fishing issues and social well-being issues for the later process of identification, prioritisation and mitigation (see Sections 2.2.3 to 2.2.5). This largely depends on what the community sees as the most important issues in general terms.

BOX 6: A STROLL-THROUGH ENVIRONMENTAL ASSESSMENT

Some promoting agencies conduct a 'stroll-through environmental assessment' with knowledgeable members of the target community. This involves walking through the managed area, examining and recording the environmental features on a sketch map and noting those with which the community is concerned (Figure 6). The purpose of the assessment is to prompt community discussions of environmentally critical areas. The method has also been successful in avoiding wasting time on unrealistic community undertakings. For example, if the community wants to create a no-take area in a particular area of bare coral rubble, facilitators could point out that there may be more suitable areas.

SPC methodology involves conducting a stroll-through survey to confirm information gained through workshops with community members. A stroll-through assessment, as described here, is similar to the Locally-Managed Marine Area (LMMA) Network's use of 'mapping' in which participants record and discuss a geographical representation of the area to be managed with notes identifying key issues.

2.2.3 Identify and prioritize key issues

There are several tools available for identifying issues that affect fisheries, communities and ecosystems. In Section 1 of these guidelines, issues were discussed separately as fishing, non-fishing and social well-being issues. These issues can be addressed in total (all issues together) or separately. One way of proceeding is to take a broad approach, encouraging communities to address all issues, and then proceed to address issues under the separate three headings. Many issues of community concern will have been broadly identified during the scoping process including stroll-through surveys (Section 2.2.2) or by community workshops.

Issues are dealt with at meetings between facilitators from the promoting agency and members of the community (these meetings may correspond to the community workshops in the process shown in Figure 5).

Whether addressing all issues together or separately, the tasks of the meeting are to identify and then prioritise the various issues. **Identification** involves listing of all the key issues and **prioritisation** involves judging the severity of threats associated with each. At the identification stage, the meeting should list all issues. At the prioritisation stage, each issue is given a score in relation to its relative effect on the community and marine ecosystems. One way of doing this is by using a pair-wise ranking system, which has been adapted from the one used by the LMMA Network. The procedure is described below.

1) Break into small groups of about six community members. A facilitator should be with each group to answer technical questions but must not influence the decisions of the group. Each group is given a piece of butcher's paper and some markers.

2) Each small group now creates a ranking table as shown in Figure 7 on their piece of paper with all the identified issues repeated as headings for the columns and rows. In Figure 7, only six issues are shown as an example.

	Issue 1	Issue 2	Issue 3	Issue 4	Issue 5	Issue 6	etc.
Issue 1				X			
Issue 2							
Issue 3							
Issue 4							
Issue 5							
Issue 6							
etc.							

Figure 7: A pair-wise ranking table with six community issues entered in both column and row headings. In practice, communities may have more issues than shown in the example.

3) After checking to ensure that all issues are listed in the same order across the top as down the left-hand side, the squares in which the row and column headings are the same are blacked out as are all the squares below them. The completed table should appear as in Figure 7.

4) The paired rankings are now done by comparing the issue listed in the column heading against that listed in the row heading for each open box. For example, in the box with the 'X' in Figure 7, the comparison would be between the impact of issue 4 with the impact of issue 1. In this comparison, each small group asks themselves which of these two issues represents a greater threat in terms of their effect on fish stocks, marine ecosystems and people's lives. When the small groups reach agreement on which of the two compared threats is more important for their community to address, write the name of the threat to indicate that it is more important in comparison to the other. If no agreement can be reached, seek the advice of an outsider (from another group) or the facilitator until a choice can be made between the two options.

5) Repeat these paired comparisons until all open boxes have been filled in with the selected issues.

6) Once the table is filled in, on a separate sheet of paper list all of the issues and the total number of times each was chosen within the table. This is the 'score' for each issue and represents the community prioritisation of threats.

An example in which the threats associated with fishing methods and gear have been assessed separately is shown in Box 7.

BOX 7: PRIORITISING ISSUES ASSOCIATED WITH FISHING METHODS AND GEAR; AN EXAMPLE

Each small group listed the fishing methods as row headings and repeated them as column headings (Figure 8). They then considered which of the pairs of fishing methods or gear represented a greater threat in terms of their effect on fish stocks, marine ecosystems and people's lives. The following questions were considered:

- What is the impact on the target species? Are catches decreasing?
- What proportion of the total catch is thrown away or not used?
- What physical damage is caused to habitats such as the sea floor or corals?
- What effects does fishing have on food webs? (In general, if the gear/method catches many individuals of just a few species, the effect is likely to be more severe)

All the boxes in Figure 8 were filled in and the total number of times each fishing method was chosen was recorded as shown below. These 'scores' for each fishing method or gear represented the community group's prioritisation of threats. In this example, the use of poisons was identified as the most damaging fishing method and line fishing was identified as the least damaging.

Fishing methods/gear	Gleaning	Gill netting	Line fishing	Fence traps	Poisons	Cast nets	etc.
Gleaning		gill netting	gleaning	fence traps	poisons	gleaning	
Gill netting			gill netting	fence traps	poisons	gill netting	
Line-fishing				fence traps	poisons	cast nets	
Fence traps					poisons	fence traps	
Poisons						poisons	
Cast nets							
etc.							

Poisons	Fence traps	Gill netting	Gleaning	Cast nets	Line-fishing
5	4	3	1	1	0

Figure 8: A pair-wise ranking table with six fishing methods/gear entered in both column and row headings. In practice, communities may identify many more fishing methods/gear than in this example.

An alternative tool to pair-wise ranking is illustrated in Table 4 and based on a method used in SPC workshops. Impacts are scored as either 0 (no impact), 1 (slight impact), 2 (minor impact), 3 (moderate impact), 4 (major impact) or 5 (severe impact) depending on the severity of their effects in relation to the points shown below the table. These scores are entered in rows and summed in the final column of the table.

The scores for gleaning (provided as an example in Table 4) were from participants at a workshop and apply only to the particular area considered. The participants decided that there was a major impact on targeted species (score 4) but no bycatch issues as people collected only the species that they needed for food (score 0). However, there was believed to be a major impact on habitats – corals on a fringing reef in this case (score 4). Ecosystem damage is usually the most difficult to score in the absence of scientific evidence but participants felt that other dependent species were affected to a minor degree (score 2). The highest impact scores were given for fishing using explosives.

Table 4: Fishing impacts on ecosystems.

Fishing method/gear	Fisheries impacts on ecosystems scored as either … 0 (zero), 1 (slight), 2 (minor), 3 (moderate), 4 (major), or 5 (severe)				Total
	Retained/target species	Bycatch species	Habitat damage	Ecosystem damage	
Gleaning	4	0	4	2	10
Use of explosives	5	5	5	5	20
etc.					

Retained/target species – What is the impact on retained species? What is the level of exploitation?
Bycatch species – What proportion of the catch is discarded? Are threatened species caught?
Habitat damage – What physical damage is the gear/method causing? Is there an issue with lost gear and ghost fishing?
Ecosystem damage – What effects does fishing have on food webs and ecosystems? Are dependent species affected? (In general, if large numbers of a single species are caught the impact may be great)

All fishing methods are listed in the row headings. Each gear/method is scored from 0 (no impact) to 5 (severe impact) in relation to its impact on target species, bycatch, habitat and ecosystem. Scores in this table are from workshop participants and relate only to the particular area considered. Totals in the right-hand column were obtained by adding the scores across each row.

Key non-fishing issues and social/economic issues may be identified and prioritised in the same way as shown for fishing methods/gear. Either the pair-wise ranking table (Figure 7) or a table based on the SPC method (Table 4) can be used. In the case of non-fishing issues, facilitators may be supported by the presence of staff from other relevant government agencies in order to provide technical advice to the community groups assessing the threats – see E-MAG referred to in Section 2.1.4.

When assessing non-fishing impacts, rarely will there be any scientific evidence of the severity of the impacts that are being scored. However, the combined efforts of community fishers, fisheries agency staff and other agency staff should allow the group to identify threats and make some judgement on their relative impacts. *Under the precautionary approach, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.*

In the **identification stage**, the group should list all of the activities and agents (sometimes called stressors) and sources believed to be impacting marine ecosystems in the row headings of a table similar to that shown in the example (Table 5). In the context of this assessment, the **source** is the activity or entity that results in an **agent** (pollutant or stressor) which causes an adverse impact or stress on the ecosystem. For example, harbour dredging (the **source**) results in silt (the **agent**) that causes stress to the ecosystem.

In the **prioritisation stage**, the impact of each pollutant and its source has to be given a score in relation to its relative effect on marine ecosystems. Impacts are scored in Table 5 as either 0 (no impact), 1 (slight impact), 2 (minor impact), 3 (moderate impact), 4 (major impact) or 5 (severe impact) depending on the severity of their effects in relation to points a) to d) below.

a) Spatial exposure:

How much of the coastal ecosystem is affected by the activity or agent?
Is the pollutant released from a few (point) sources or diffuse sources along the entire coast?

The score given depends on the area of the coast that is affected;
from none of the area (score 0), to one or a few specific areas (score 1,) to entire coastlines (score 5).

b) Temporal exposure:

How long does the activity or the agent affect the coastal ecosystem?
Is the activity/pollutant present over a short time (say one week) or a long time (entire year)?

The score given depends on the period that the coastal area is affected;
from not at all (score 0), to one or a few weeks in a year (score 1), to the entire year (score 5).

c) Hazard effects:

How dangerous are the agents? Are toxic pollutants produced?
How much is released? Are they toxic, accumulative, carcinogenic?

The score given depends on the hazards associated with the pollutant;
from the release of a non-toxic pollutant (score 0) to large quantities of a toxic pollutant (score 5).

d) Social impacts:

How much are coastal communities affected by impacted ecosystems?
How much are communities disadvantaged by the impact?

The score given depends on the impacts on coastal communities;
from no effect (score 0) to a malignant effect that devastates ecosystems and affects the community's use of marine resources (score 5).

BOX 8: PRIORITISING THREATS FROM NON-FISHING ACTIVITIES; AN EXAMPLE

The scores for silt from dredging (provided as an example in Table 5) were assigned by participants at a workshop, and apply only to the area under consideration. The participants decided that dredging occurred in only a small area (score 1) but was carried on over more than half of the year (score 3). Silt was believed to have low toxicity (score 1) but have a major effect on ecosystems, including corals, and on community fishers' ability to catch seafood (score 4). Effects of the ecosystem and communities are usually the most difficult to score in the absence of evidence but participants felt that their assessment was reasonable. It should be noted that if silt was also derived from another source, say erosion, this must be listed in another row (with silt/erosion entered in the row heading) and the effects quantified separately.

Table 5: Non-fishing impacts on ecosystems.

Agent/ source	Non-fishing impacts on ecosystems scored as: 0 (no impact), 1 (slight), 2 (minor), 3 (moderate), 4 (major), or 5 (severe)				
	Spatial exposure	Temporal exposure	Hazard effects	Social impacts	Total
Silt/dredging	1	3	1	4	9
Silt/erosion					
etc.					

Spatial exposure – How much of the coastal area is affected? Small areas to entire coast?
Temporal exposure – How long does the impact last; over what time period? One week to entire year?
Hazard effects – How dangerous are the impacts on ecosystems? How toxic? How much?
Social impacts – How much are coastal communities impacted by degraded ecosystems?

All agents and sources are listed in the row headings. Each agent/source is scored from 0 (no impact) to 5 (severe impact) in relation to temporal exposure, spatial exposure, hazard effects and social impacts. Scores attributed to silt from dredging are from a workshop and relate only to the particular area considered.

It has often proved useful to familiarise people with the common types of impacts affecting coastal ecosystems. Figure 9 has been used for this purpose and also as an 'icebreaker' at workshops with participants from a variety of non-science backgrounds.

There is a range of other identification and prioritisation approaches and tools available. If a community or promoting agency is more familiar with a different method to those outlined here, then that method should be used. For example, the Pacific Islands Forum Fisheries Agency (FFA) has used a 'risk assessment' methodology for Pacific tuna fisheries and FAO also uses this approach for certain fisheries. Reference to this approach is provided in Bibliogrphy and useful resources.

BOX 9: AN ICE-BREAKER – RECOGNISING AND MANAGING ENVIRONMENTAL IMPACTS

Figure 9 may be used as an 'icebreaker' to make participants from diverse and non-science backgrounds familiar with common impacts on coastal ecosystems in Pacific Island countries. The figure shows one side of a small, hypothetical island that has forests, a river, an estuary, mangroves, beaches, fringing reefs, a lagoon and a barrier coral reef. There is a community and a small town, in which there is rapid development, separated by the river.

Livelihoods and income generation on this part of the island are based on tourism, forestry, farming and fishing. A large riverside pig farm is based in the hills behind the coast and tree clearing along the riverbank is common. Resorts in the town provide employment for some people from the community and there are plans to build more resorts. There is also a proposal to construct a solid earthen causeway across the river to connect the village community and the town. The coastal community relies on fish stocks associated with the estuary and fringing reef and has been complaining about declining fish catches. Surveys show that corals on fringing reefs on the left-hand side of the island are dying.

Participants were asked to discuss the issues depicted in Figure 9, decide on the possible causes of environmental degradation and declining fish catches and suggest how the recognised impacts could be managed and controlled.

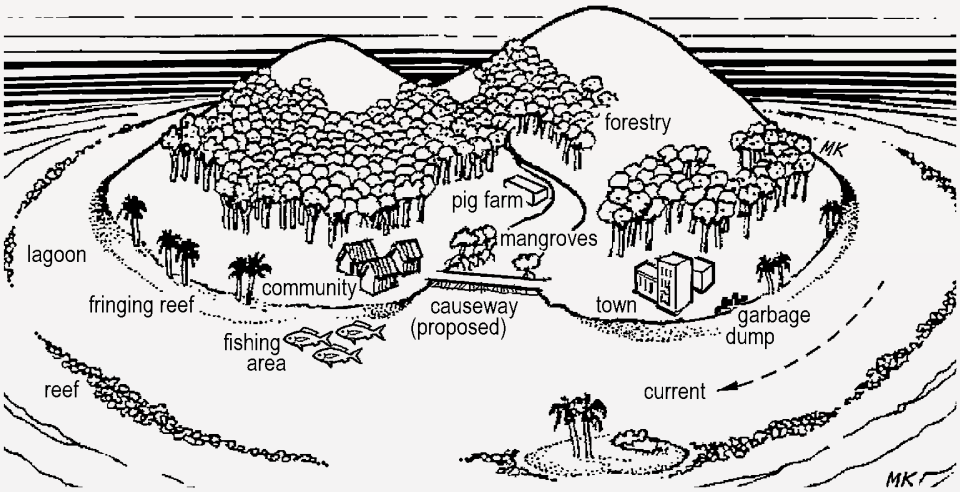


Figure 9: A hypothetical island with some sources of agents (stressors; pollutants) affecting a fringing reef and fish catches of a coastal community.

2.2.4 Develop community goals and objectives

A goal is a formal statement detailing the desired results of a project. For example, the overall goal of a community-based project may be to restore the health of coral reefs and fish stocks in the managed area.

An objective is a formal statement detailing the desired outcome of management. The community operational objectives will be related to the overall goal and will address the key issues identified and prioritised by community members (Section 2.2.3). For example, if a high silt load in coastal waters was identified as a high priority threat to corals and fish stocks, an appropriate objective would be 'to reduce silt in coastal waters'. In general, an objective should be achievable within available resources and within a defined time frame. A later stage would involve determining the management actions required (see management actions in Section 2.2.5) and deciding on ways of measuring progress towards achieving the objective (see indicators and performance measures in Section 2.2.6).

In working with communities, there are various tools available to encourage community groups to consider threats and propose mitigating actions. One such tool is the problem–solution tree, which has been used widely by SPC in promoting discussions in communities as part of CBFM programmes. The method involves a trained facilitator recording community views either on a whiteboard (Figure 10), with cards stuck to a sheet of paper or any other method that is easily visible to the participants. Participants are encouraged to state a key problem, consider its causes and propose mitigating solutions. The procedure, which is similar to the 'problem tree' used by the LMMA Network is described in Box 10.

This process is also similar to the 'conceptual models' and 'results chains' used by many conservation groups (see References and further reading). The facilitator and community should use whichever method they are most familiar and comfortable with.

Figure 10: A facilitator from the promoting agency uses a whiteboard to construct a problem–solution tree based on information supplied by community members.

BOX 10: USING A PROBLEM-SOLUTION TREE TO ADDRESS COMMUNITY ISSUES

The method involves a trained facilitator recording community views. The tasks of community participants are as follows.

- Participants decide on a key problem that is affecting the adjacent coast, marine ecosystem and fisheries. This is entered on the board or sheet a little way down from the top in row two of the problem-solution tree (Figure 11).
- Participants state the effects that the problem has on the community. This is entered in row one at the top of the problem-solution tree.
- Participants consider the causes of the problem. There may be several causes and these are entered in row three of the problem-solution tree.
- Participants decide on the solutions for each cause. These are entered in row four of the problem-solution tree.
- Participants discuss what actions can be taken to put each solution into effect. This may take some time and more than one meeting. There may be more than one action for each solution and these are entered in row five of the problem-solution tree.

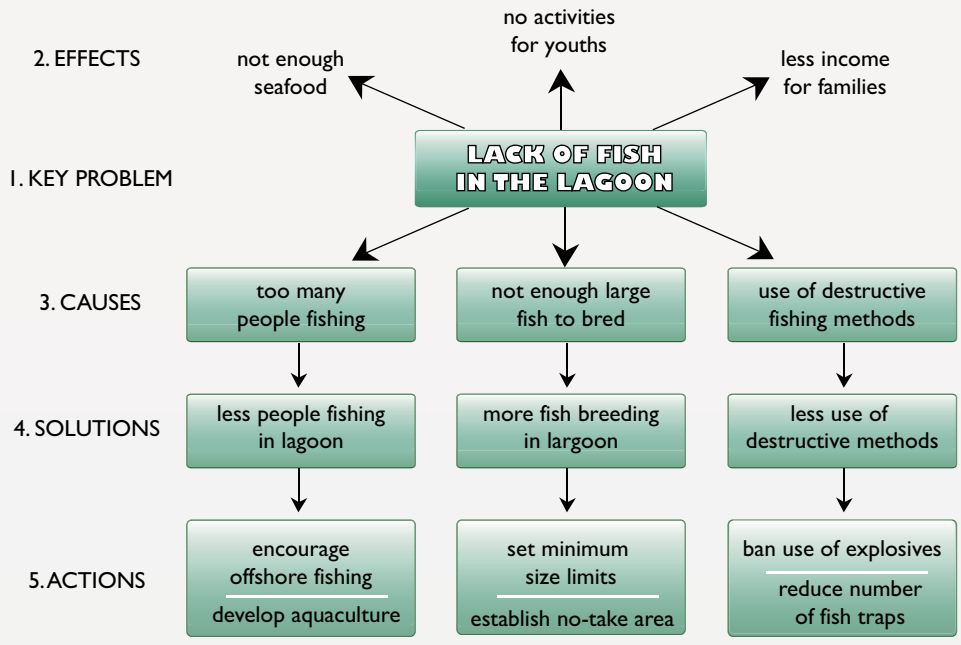


Figure 11: A simplified example of a problem–solution tree completed by a community.

The process begins with step 1 (key problem) before proceeding in the numerical order shown. All information is provided by community participants, with a facilitator recording the information.

2.2.5 Determine management actions and responsibilities

Once objectives have been agreed on, there remains the task of deciding what needs to be done. Management actions are the measures required to achieve an objective; the SPC process uses the term 'undertakings' for management actions and in some conservation projects one or more management actions are referred to collectively as a 'strategy' – a group of actions required to reduce threats. In fisheries management, actions can include technical measures such as placing restrictions on the type of fishing gear used and imposing closed seasons to protect spawning stocks.

In most cases, there will be several management actions that could address a particular objective and a list of these could be assembled through brainstorming sessions with members of the target community assisted by relevant government agencies. Community engagement tools such as the problem-solution tree can be used to encourage community members to propose management actions that would solve particular problems. For each objective, it is useful to prepare a list of all possible management actions with particular attention given to their ease of application, likelihood of success, feasibility and cost. An example from an SPC workshop at which community members and other participants proposed management actions to address a non-fishing objective is shown in Box 11.

BOX 11: PROPOSING MANAGEMENT ACTIONS

In an example used later (in Section 2.2.6), a stated objective was 'to reduce silt in coastal waters'. Participants identified the causes of siltation as foreshore erosion, terrestrial runoff, sand mining and excessive coastal development (dredging and reclamation). In the absence of any precise information on which of these causes produced the most silt, they relied on local and anecdotal information. They proposed a number of management actions that they believed would address these issues and achieve the objective. In deciding on management actions, the most practical, cost-effective and least disruptive measures were listed first.

- The planting of trees along hill slopes and the foreshore by the community was chosen as the most acceptable and cost-effective way of preventing foreshore erosion.
- Restricting sand removal and mining on local beaches was thought to be a more difficult undertaking because of the involvement of community members in the mining operation.
- The final management action was to ask government to place restrictions on foreshore development by not allowing building projects within 200 metres of the high tide mark.

All management actions must include reference to those responsible and the time frame required for their implementation. Different management actions will be the responsibility of the community, the promoting agency or other agencies.

Many desirable management actions will be impractical because of the cost. For example, the high level of sewage-derived nutrients in coastal waters could be dealt with by connecting all houses to a centralised treatment works. However, this action would be extremely expensive and cheaper alternative management actions, such as the use of composting toilets or septic tanks, would have to be considered.

Some management actions designed to address one objective may address other objectives and may render some management actions redundant. For example, the management actions for an objective 'to allow fish stocks to recover' may include banning the use of poisons as a fishing method. This management action would also assist in addressing another objective designed to protect coral reefs. The interactions of management actions can be considered through use of some graphical depictions including conceptual models and results chains. More details can be found in Conservation Measures Partnership (2007) *Open standards for the practice of conservation* – see References and further reading.

Although many management actions will require government support, many others can be applied by the target community acting on its own. A list of common management actions implemented by communities in Samoa is shown in Table 6. Some of the actions require technical advice from government agencies (e.g. on minimum size limits for fish and the placement of community-owned no-take areas) and all depend on the community's ability to carry out the actions and enforce regulations. Community fisheries by-laws may be required to allow one community's management actions and regulations to be applicable to offenders from outside the community (see Section 2.1.5).

Table 6: Community management actions and regulations in communities in Samoa.

Management action	Percentage (%)
Banning the use of chemicals and dynamite to kill fish	100
Banning the use of traditional plant-derived fish poisons	100
Establishing community-owned no-take areas	86
Banning traditional destructive fishing methods (e.g, smashing coral)	80
Organising collections of crown-of-thorns starfish	80
Enforce (national) mesh size limits on nets	75
Banning the dumping of rubbish in lagoon waters	71
Banning the commercial collection of sea cucumbers (Holothuroidea)	41
Banning the capture of fish less than a minimum size	41
Banning removal of mangroves	27
Restricting the use of underwater torches for spearfishing at night	21
Banning the removal of beach sand (sand-mining)	14
Placing controls or limits on the number of fish fences or traps	< 10
Prohibiting the collection of live corals for the overseas aquarium trade	< 10
Banning the coral-damaging collection of edible anemones (Actinaria)	< 10
Protecting areas in which palolo worms, *Eunice* sp, are traditionally gathered	< 10

The establishment of no-take areas (in which fishing is not allowed) is increasingly being used as a fisheries management tool in Pacific Island countries (Box 12). From a community viewpoint, a key motivating factor is the belief that these areas will result in improved catches of seafood in nearby fishing areas. However, no-take areas must be carefully designed and located to have a chance of achieving this aim. No-take areas that are positioned in areas of bare sand and coral rubble, for example, are unlikely to be of much value in terms of either conservation or increased seafood production. Generally, no-take areas should be large to be effective,

although some smaller and linked no-take areas are believed to enable a significant proportion of larvae to disperse to surrounding fished areas. Subsistence fishers in Samoa, for example, appear to have benefited from a network of no-take areas managed by individual communities. However, promoting agencies should avoid raising unreasonable expectations in communities.

BOX 12: NO-TAKE AREAS

No-take areas are areas in which fishing is not allowed. In the Pacific, no-take areas may also be called fish reserves or marine protected areas. The term no-take area is preferred because its meaning is clear. In the context of CEAFM, a community-owned no-take area may be established within a managed area, as shown in Figure 6.

The fisheries benefits of banning fishing in an area are usually stated as being related to the maintenance of the natural age structure of the stock and the protection of the spawning biomass. No-take areas may also encourage the aggregation of some species, presumably attracted by the growth of algae and other food species. The possible movements of individuals out of a no-take area are summarised in Figure 12. Larvae will drift and may become distributed over an area referred to as the 'dispersal envelope'. Drifting larvae will be affected by net current flow across the area, and the dispersal envelope may take up an elliptical shape. This emphasises the importance of positioning a no-take area such that prevailing currents will maximise larval drift and settlement in depleted areas. However, fish larvae may be able to detect the presence of, and to swim towards, reefs several kilometres away and this suggests that larvae from no-take areas may actively move to, and repopulate, nearby reefs.

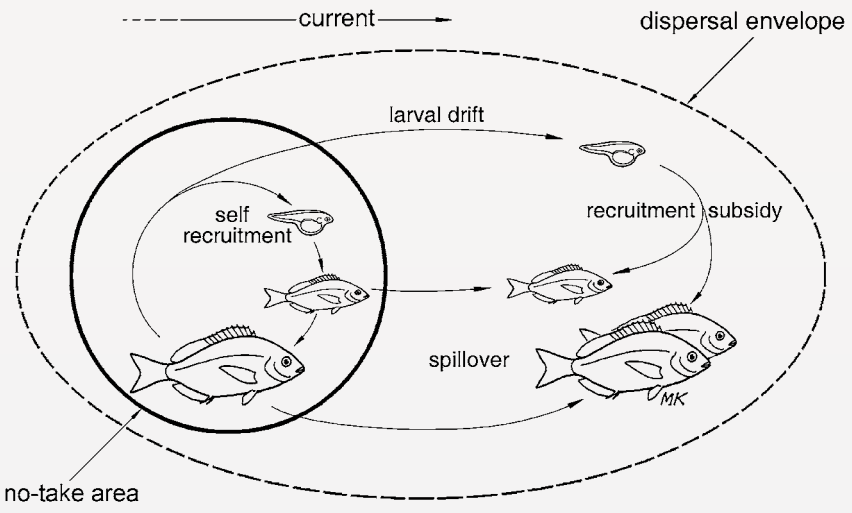


Figure 12: Larvae produced in a no-take area (heavy circle) may either settle within its boundaries (resulting in self-recruitment) or drift within a dispersal envelope stretching away from the no-take area. Areas outside are also enhanced by spillover – the net movement of juveniles and adults from the no-take area.

2.2.6 Define indicators and performance measures

The next stage of the management process involves translating each objective into a r**eference target level** which represents an optimum or desirable position or situation. A r**eference limit level** represents an undesirable level. It is always desirable to set reference levels using a precautionary approach which involves setting reasonable limit reference levels, and taking firm actions when these are approached. It is also necessary to define an **indicator** which can be used as a measure of performance: this is a variable that can be measured and whose values and fluctuations reflect the situation in relation to the objective. These concepts are best illustrated by an example based on SPC workshops (Box 13).

BOX 13: USING INDICATORS AND PERFORMANCE MEASURE; A FISHERIES EXAMPLE

Following a community's concern about the low catch rates of a previously abundant fish, fisheries agency staff completed an underwater visual census (UVC) that confirmed that the abundance of larger fish was less than 5 per 100 square kilometres (m^2). Consultations with the community suggested that catching small fish and excessive fishing were both likely causes. The objective, therefore, was to increase the number of mature fish to a desired level. The indicator, in this case, is the abundance of mature fish (above a defined length) per 100 m^2 determined by UVC surveys.

The target reference level was set to correspond to a desirable level of spawning stock abundance. In an unexploited area within a no-take area with similar ecological characteristics and habitats, the abundance of mature fish was estimated at 18 mature fish per 100 m^2. A desirable level for the exploited area of concern was believed to be two-thirds of that in the unexploited area (i.e. 12 mature fish per 100 m^2). A limit reference level, which represented a dangerously low number of spawners, was set at 6 mature fish per 100 m^2. The objective, indicator, reference levels and proposed management actions were listed as shown in Table 7. The management actions were listed with those that are most practical and easiest to apply and enforce entered first (see Section 2.2.5).

Table 7: The objective, indicator, reference levels and management actions relating to the exploitation of a fish stock.

Objective	Indicator	Reference levels	Management actions
To increase numbers in the spawning stock	Number of mature fish per 100 m^2 determined by UVC surveys	• Target: 12 fish per 100 m^2 • Limit: 6 fish per 100 m^2 CHECK if reasonable	a) Impose size limits b) Reduce fishing effort c) Establish no-take areas

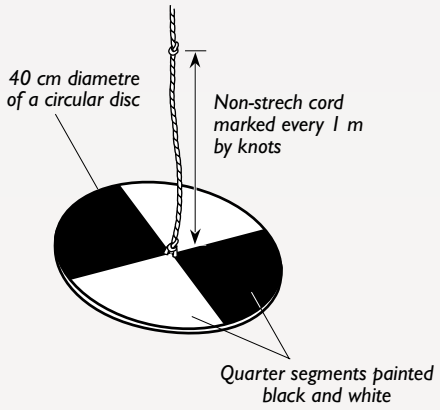
Other ways of setting out the information in Table 7 include the 'template for a monitoring plan' used in *Open standards for the practice of conservation* – see References and further reading, Conservation Measures Partnership (2007).

Indicators and reference points can also be used for addressing socio-economic issues and non-fishing impacts on ecosystems. For an objective to develop alternative sources of income, for example, an appropriate indicator would be the number of new community enterprises. If the objective was to increase household income, the indicator could be the percentage change in the average income of households.

A non-fishing example is presented in Box 14 based on a workshop example in which participants addressed the problem of high silt loads in coastal waters. Information from communities had suggested that turbid or silty seawater was responsible for driving fish away from traditional fishing areas and was affecting coral growth.

BOX 14: USING INDICATORS AND PERFORMANCE MEASURES; A NON-FISHING EXAMPLE

The **indicator** chosen was the visibility or turbidity of seawater as it was known that this could be easily and cheaply measured. (Although reduced visibility in water could have other causes, such as plankton blooms, silt was believed to be the main cause of cloudy water.) The most practical way of measuring visibility in seawater is by using a simple instrument called a Secchi disc, which can be made from weighted marine plywood in a local workshop (Figure 13, top). The disk is lowered into the water until it is no longer visible and a first depth reading recorded; it is then hauled in until it becomes visible and a second depth reading is recorded. The mean of these two readings is taken to measure the visibility. Because of the lack of technical equipment in most Pacific island countries, choosing an indicator that can be measured by using basic equipment has much merit.



The problem in this case was in setting the appropriate **target reference level** corresponding to a desirable position — in this case, water that is sufficiently clear not to reduce fish numbers, kill coral and have other effects on the ecosystem. In some cases, an examination of the literature, which can often be done on the Internet, will provide some guidelines for setting a reasonable target. In the case of silt, a study in Guam which related the abundance of herbivorous fish to visibility in seawater (Figure 13, bottom) was used as a guide to set a target reference point of 20 metres (m) visibility. The **limit reference level** was set at 12 m visibility which represented an undesirable situation that would trigger immediate management action.

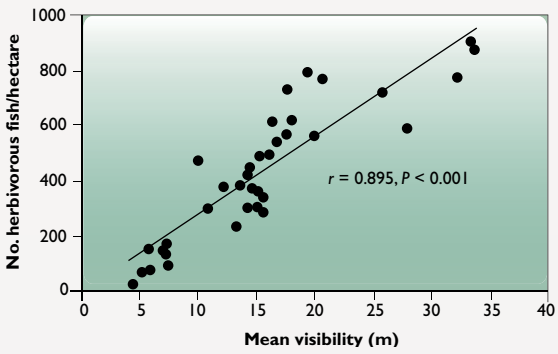


Figure 13: Top; a Secchi disk; Bottom; the relationship between the abundance of herbivorous fish and mean visibility in seawater (m) in Fouha Bay, Guam (from Wolanski et al. 2004).

The objective, indicator, reference levels and proposed management actions were listed in a table as shown in Table 8. The management actions for this example were discussed in Section 2.2.5.

Table 8: The objective, indicator, reference points and management actions in relation to the presence of a high silt load in coastal waters.

Objective	Indicator	Reference levels	Management actions
To reduce silt in coastal waters	Transparency of sea water	• Target: 20 m visibility • Limit: 12 m visibility	a) Tree planting to reduce erosion b) Reduction in sand mining c) Controls on coastal development

2.2.7 Produce a community-owned management plan

A CFMP, which should incorporate steps 2.2.2 to 2.2.6 in this section, is produced and owned by the community and is prepared with the assistance of the promoting agency. The plan lists the community management actions or undertakings and those that require inputs from the promoting agency and other agencies. CFMP must be written in the local language in non-technical terms although it may be translated into English for the information of others. In general, CFMPs include:

- a statement by a community leader
- the names of all the community members involved
- the names of all the promoting agency staff involved
- a background of the village's marine environment and fisheries
- a map of the community managed area (completed with community members)
- details of existing tradition-based controls on fishing and those that will be continued or strengthened in actions taken by the community (see following point)
- undertakings and actions to be taken by the community
- support to be provided by the promoting agency and other agencies.

Table 9 provides the elements that could be including in a CEAFM plan.

Table 9: Elements of a CEAFM plan.

The authority under which the plan was developed (the community and the promoting agency)
a. Background, description and history of the fishery Description of the area to be managed (the managed area) • the area to be managed (the managed area) • the ecosystem, including sensitive areas, critical habitats, etc. • stakeholders (especially the community) • the resources (main target species) • fishing gear and methods used • the process leading to plan (see Section 2.1.7).
b. Policy goals and community values Broad economic, social and ecological aims (usually set by the government) should be clearly stated with a brief history of how policies have changed. Key community generic objectives (values) should also be identified

c. Identifying threats to achieving policy objectives and community values

Current and foreseen threats to the ability of the country and the community to achieve stated policy goals and the community objectives/values should be assessed by identifying and prioritizing key issues related to ecological well-being (key species and ecosystem features); social well-being (at the community and national levels) and the ability to achieve (governance and external drivers).

d. Objectives and reference points

Practical-level community objectives – the expected results of implementing the plan – should be clearly presented. Target reference levels – the desired positions in relation to the objectives – must be defined.

e. Management plans

The plan of action needed to achieve specific objectives.

f. Actions and risks

The specific management actions or undertakings (including those of the community, the promoting agency and other agencies) required to achieve the objectives must be detailed. Standardised formats include tables such as Table 6. Risks and remedial actions can be included in the table; these state what will be done when planned actions do not get results or the situation changes. The timing of planned actions should be included. The plan must identify those responsible for carrying out each management action.

g. Monitoring, control and surveillance

A programme for regularly monitoring and evaluating results against the target reference point must be included (see Section 2.4). Systems for enforcement must be detailed. In the case of CEAFM, local regulations will be enforced by the community, but broader controls on more distant damaging activities will have to be the responsibility of government agencies.

h. Evaluating, reporting and communicating

The timing and format of a review of performance must be included in the plan. Performance can be measured as the vertical distance between the reference point and the indicator (see Section 2.4). Reviews must be conducted in conjunction with the stakeholders who may be in a position to suggest improvements if necessary.

i. Financing the plan

The cost of implementing the plan, including the costs of surveys, research, management actions, monitoring and enforcement, must be presented.

Although the draft CEAFM plan may be typed and produced at the office of the promoting agency, it must be returned to the community for checking and approval. As the plan is an important community document, its appearance and presentation should reflect this. The final draft of the plan should be bound in a printed cover for presentation to community members and leaders.

2.3 Formalising and implementing a community management plan

The CEAFM plan should be given some legal formality to be widely recognised by the public and government agencies. The large degree of cooperation between government agencies required to address CEAFM makes this most important.

An important document in this regard is the SPC-facilitated *Pacific Islands regional coastal fisheries management policy and strategic actions* (known as the Apia Policy) in which authorities agreed to take steps to achieve healthy ecosystems and a sustainable stock of fish. At present, the recognition of an EAF is not commonly an integral part of national fisheries policy and legislation. This leads to several deficiencies in current resource management regimes, such as weak cross-sectoral cooperation and the inability to deal with broad issues, including ecosystem degradation. Ideally, national legislation needs to be adjusted, particularly to formalise the arrangement between fisheries and other government agencies. At least, community plans must be endorsed by the authorities involved.

As well as actions taken by communities, the successful implementation of a CEAFM plan will depend on actions taken by other agencies responsible for human well-being and non-fishing activities. Broader threats to ecosystems, including those related to forestry, agriculture and development, required more broad-based expertise from a multi-agency group such as E-MAG described in Section 2.1.4.

2.4 Monitoring performance; reviewing and adapting the plan

There is a need to evaluate and monitor how well, or otherwise, the management strategies are performing in relation to the objectives. This involves the monitoring the indicators (described in Section 2.2.6). The value of plotting an indicator is that progress (or lack of it!) in achieving the objective can be followed over time. A non-fisheries example of monitoring performance is given in Box 15.

The plan, management actions and the results of monitoring must be reviewed by the promoting agency in conjunction with members of the community concerned. Deficiencies in the plan must be addressed at this stage. If monitoring results suggest that an objective is not being achieved, management effectiveness (or governance issues) should be examined – are management actions being taken as agreed? Are regulations being enforced? If management has been effective, the next step is to consider taking different or additional management actions to achieve the objective. This is one of the principles of adaptive management.

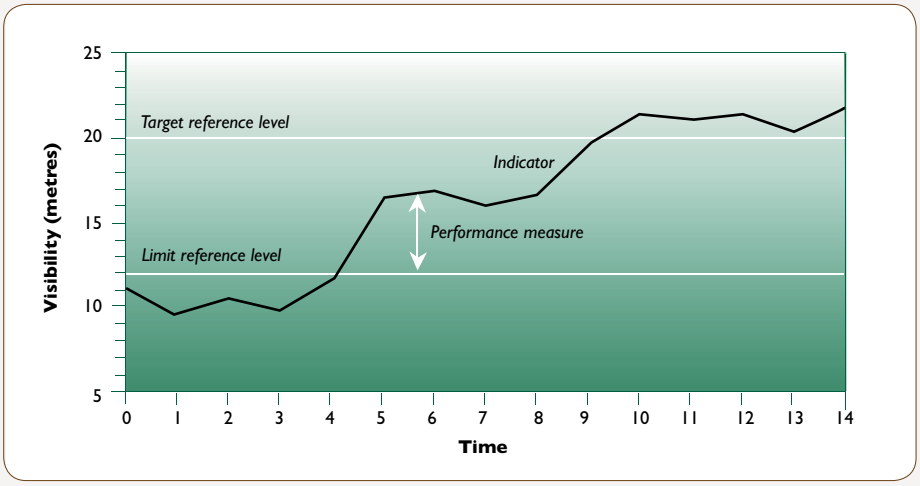
The promoting agency will need to assist communities in reviewing their conservation and fisheries management efforts after a period of time (say, after six or twelve months, or after a significant triggering event, such as a cyclone). Reviews should seek to measure how well communities are carrying out the activities listed in their management plan (how well are community regulations being enforced) and how well the promoting agency and other involved agencies are supporting the community management plans. As well as formal periodic reviews, facilitators and community leaders should continually monitor management effectiveness by noting simple governance measures such as the number of infringements of community rules and actions taken; this could provide an 'early warning' of problems before there are any changes in the ecological indicators described in this section.

Reviews are also important in that a promoting agency with limited resources will have to rationalise its work if there is a large number of communities involved. Options may include dropping poorly performing communities from the programme.

BOX 15: MONITORING PERFORMANCE; A NON-FISHERIES EXAMPLE

In the example given in Box 14, the objective was to reduce silt in a particular area of the coast to less damaging levels. The **target reference level** was set at 20 m visibility and the **limit reference level** was set at 12 m visibility, at which point drastic management actions would be urgently applied.

The **indicator** used was the visibility in seawater as measured by the use of a Secchi disc and this variable was plotted over time (Figure 14). Community actions to plant trees along riverbanks and foreshores provided a steady rise in the indicator after time 3 and restricting sand mining on local beaches at time 8 resulted in a further rise in visibility.



Performance is measured as the vertical distance between the indicator and the target reference level. Successive management measures were introduced at times 3 and 8.

Figure 14: Values of an indicator (visibility in seawater in metres) over time.

If sometime in the future, the indicator once again decreased towards the limit reference level, some additional pre-planned actions would have to be taken. Besides the failure of management actions, other factors, including natural disasters such as cyclones and tsunami, could provide triggers for the application of additional management measures.

3. REQUIREMENTS FOR THE EFFECTIVE IMPLEMENTATION OF CEAFM

Requirements for the implementation of a broad-based approach to managing ecosystems and fish stocks in PICs include the following.

3.1. An appreciation of the vital role of marine ecosystems

In many PICs, government priorities often lie with commercial fisheries that provide foreign exchange. Subsistence fisheries provide food security, ongoing health benefits, and a reduced requirement for imports of less healthy foods. In addition, if market values are applied, the subsistence catch is often of a much higher value that catches from export fisheries. A programme of public and government awareness-raising is required to ensure that the benefits of healthy coastal ecosystems are widely known.

3.2 The enforcement of existing regulations

Due to lack of funds and capacity, the regulations of fisheries agencies are poorly enforced in communities that are distributed over relatively long coastlines and on many smaller islands. The implementation or strengthening of community-based fisheries management will encourage communities to accept responsibility for imposing and enforcing controls on fisheries and ecosystems as well as ensuring compliance with existing laws.

3.3 Continuing community commitment

Once a community has prepared its CEAFM plan, it is responsible for taking actions and enforcing regulations listed in that plan. However, it is unlikely that a community will sustain management actions without some support, at least in the short to medium term. In particular, post-management-plan activities must include regular contact with communities and the provision of technical advice. Communities having recently completed management plans may feel disappointed and 'let down' if staff of the promoting agency discontinue visits.

Scientific or other advice may be required for several proposed community activities. Examples include the positioning of a community-owned no-take area and the development of new fishing methods. Training could include fish handling and marketing. It should be noted that the agency must target the most appropriate community group, which may be women in the case of fish handling.

3.4 Cooperation between government agencies and other partners

Many of the issues that threaten marine ecosystems are outside of the mandate of government fisheries agencies and require the involvement of wider expertise and many different government agencies. However, the lack of cooperation between different government agencies, which often compete rather than cooperate with each other, is a constraint in many countries.

The multi-agency group (in these guidelines called E-MAG) should be established with some legal legitimacy and authority. Whatever mechanism is used, E-MAG must be given the recognition and standing that suit its important role. Considering the many non-fishing threats to coastal ecosystems, and their crucial role in providing food security and social benefits, it may be no exaggeration to regard this group as one of the most important in the country.

3.5 Funding and staff requirements

Establishing CEAFM is not without cost. The promoting agency will need funds to hire and train community facilitators as well as provide for transport to targeted communities. In some countries with communities distributed over many islands, transport costs can be considerable. Although set-up costs may be high, there are long-term benefits in a reduced necessity for governments to enforce national laws, a reduced demand for imported protein and in associated health benefits. There are also community costs involved, including those associated with enforcing community rules.

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Appendix A

Useful websites

All accessible on the Internet as of 13 February 2010

www.conservationmeasures.org

The Conservation Measures Partnership (CMP). Includes the Open standards for the practice of conservation; the Rosetta stone of project management systems; and The World Conservation Union (IUCN)–CMP Unified classifications of direct threats and conservation Action.

www.conserveonline.org/workspaces/cap/

The Conservation Action Planning (CAP) resources website. CAP is widely used by numerous government agencies, environment groups, universities and local communities around the world. ConserveOnline is a "one-stop" on line, pulic library, created and maintained by TNC in partnership with other conservation organizations.

www.fao.org

The Food and Agriculture Organization of the United Nations. A source of extensive publications on an EAF.

www.LMMAnetwork.org

The Locally-Managed Marine Area (LMMA) Network. Publications available include a guide to supporting community-based adaptive management. Provides access to the LMMA Network community storybook; a collection of lessons, tips and experiences shared during the community exchange session at the 2008 LMMA Network-wide meeting held in Fiji Islands.

www.miradi.org

Miradi: Adaptive management software for conservation projects. A user-friendly program that allows nature conservation practitioners to design, manage, monitor, and learn from their projects to more effectively meet their conservation goals.

www.reefcheckaustralia.org

Reef Check Australia. Provides details on coral reefs, climate change and surveys.

www.spc.int

The Secretariat of the Pacific Community (SPC). various relevant publications available online; provides access to a SPC/TNC booklet providing basic information on EAF and what it means to the Pacific (Preston 2009b, above).

www.sprep.org

The Pacific Regional Environment Programme. Various relevant publications available online.

Appendix B

Glossary of terms

The use of standard terminology is recommended in order to communicate effectively and enhance understanding. In these guidelines, the protocol has been to use FAO terminology (see the FAO website in Appendix A) and secondly SPC terminology. Conservation groups have been working to standardise their terminology, particularly with respect to the various management systems used (see the Rosetta stone section of the Conservation Measures Partnership website in Appendix A).

Access right: A right that, in the context of CEAFM, recognises a community's exclusive access to resources within a traditional or assigned management area.

Allee effect: The requirement that some species need to be part of a relatively large population in order to reproduce successfully.

Artisanal fishery: A small-scale, traditional and low-cost fishery in which relatively small vessels (if any) take catches, often consisting of a great variety of different species, that are sold and consumed locally.

Biodiversity: The variability among living organisms from all sources and the ecological complexes of which they are part. This includes diversity within species and ecosystems.

Bioerosion: The breaking down of substrates, usually coral, by the actions of various living organisms referred to as bioeroders.

Brackish water: A mixture of sea water and fresh water (as occurs near the mouths of rivers).

Bycatch (or by-catch): Part of the catch taken incidentally in addition to the target species: some or all of it may be returned to the sea as discards, usually dead or dying.

Ciguatera: Fish poisoning resulting from the consumption of fish that have accumulated toxins produced by particular very small (microscopic) plants or phytoplankton species, including the benthic dinoflagellate, *Gambierdiscus toxicus*, which is found in association with coral reefs.

Community-based fisheries management (CBFM): Arrangements under which a community takes responsibility, usually with government or NGO assistance, for managing its adjacent aquatic environment and species.

Conceptual model: A diagram that represents relationships between key factors that are believed to impact or lead to one or more conservation targets. A good model should link the conservation targets to threats, opportunities, stakeholders, and intervention points (factors – threats, opportunities, or targets – in a conceptual model where a team can develop strategies that will influence those factors. It should also indicate which factors are most important to monitor (from Conservation Measure Partneship Open Standards (see the website in Appendix A)).

Critical habitats (or key habitats): Habitats that are crucial in the life-cycle of species; for fisheries these may include nursery and spawning areas such as estuaries, mangroves, seagrass meadows and reefs.

Customary marine tenure (CMT): Legal, traditional or de facto control of land, sea and resources by indigenous people.

Discards: Fish and other marine species released or returned to the sea, usually dead or dying.

Ecosystem: An organizational unit consisting of an aggregation of plants, animals (including humans) and micro-organisms, along with the non-living components of the environment.

Eutrophic (of a body of water): Water so rich in nutrients that it encourages a dense growth of plants, the decomposition of which uses up available oxygen and therefore kills animal life.

Facilitator: A person that makes a task more easily achieved; in the context of this document, a person that helps a community through a planning process.

Fish: Used in these guidelines as a collective term that includes molluscs, crustaceans and any aquatic animal which is harvested.

Fishing effort: The amount of fishing activity on the fishing grounds over a given period of time. Effort is often expressed for a specific gear type, e.g. number of hooks set per day or number of hauls of a beach seine per day.

Indicator: A measurable variable whose values and fluctuations reflect the state of a fishery in relation to some objective and its reference point. If the objective is a particular level of spawning stock biomass the obvious indicator is the spawning stock biomass itself or some measurable index of it (such as catch rate of sexually mature individuals).

Input control: Management measures used to control the time and place as well as the type and/or amount of fishing in order to limit catches and fishing mortality.

Integrated coastal management (ICM): A process for the management of the coast using an integrated approach, involving all stakeholders and all aspects of the coastal zone.

Legal instrument: A broad term that includes any accord or law (for example convention, treaty, agreement, decree, act of parliament, regulation) that creates binding obligations for states, entities or persons to which it applies.

License limitation: The restriction of fishing to those people, fishing units or vessels holding licenses in a fishery.

Limited entry: A common management tool in which the government issues a particular number of access or use licenses to fish, thereby limiting the number of participants in the fishery.

Managed area: In CEAFM, the geographic area containing the resources to be managed; often the traditional area over which a local community or communities have control.

Marine protected area (MPA): A protected marine intertidal or subtidal area set aside by law or other effective means; it provides degrees of preservation and protection for important marine biodiversity, resources and habitats depending on the degree of use permitted. Fishing may be regulated and could be prohibited in some part or all of an MPA. In some Pacific island countries, the term is often used imprecisely to denote a no-take area in which fishing is prohibited.

Maximum legal size: A regulation which specifies the largest captured individual that may be retained; usually justified on the grounds that larger individuals produce a greater number of eggs and are often less marketable than smaller individuals.

Maximum sustainable yield (MSY): The highest theoretical equilibrium yield that can be continuously taken (on average) from a stock under existing environmental conditions without significantly affecting the reproduction process. Its use as an objective is dangerous, but has commonly been used as a limit.

Minimum legal size: A regulation which specifies the smallest captured individual that may be retained; usually justified on the grounds that growth of smaller individuals eventually produces a greater harvestable biomass, and that the size of the spawning stock is increased.

Mitigate: To make milder or less intense or severe; in this manual, to moderate the effects of damaging impacts on ecosystems.

No-take area: An area in which fishing is not allowed.

Nutrients: In the context of the marine environment, dissolved food material (mainly nitrates and phosphates) required by plants to produce organic matter.

Open access fishery: A fishery with no restriction on the number of fishers or fishing units.

Output controls: A management measure aimed at controlling the characteristics of the catch and landings. Such limits may include limitations on the weight of the catch and the allowable size, sex, or reproductive condition of individuals in the catch.

Over-exploitation or overfishing: A stock that is exploited at a level above the sustainable limit, beyond which there is a high risk of stock depletion and collapse.

Phytoplankton: Small plants, which drift in the sunlit surface layers of the sea.

Pollutant: Anything that degrades the environment.

Pollution (marine): The introduction by humans, either directly or indirectly, of any substance (or energy such as heat) into the sea which results in harm to the marine environment.

Precautionary principle: The principle that the lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation where there are threats of serious or irreversible damage; the application of prudent foresight that reduces or avoids risk to the resource, the environment and the people.

Problem-solution tree: A community or group engagement tool that can be used by a facilitator to encourage community members to identify problems and suggest solutions.

Property rights: A degree of resource ownership by an individual fisher, group or community.

Quota: A limit on the weight or total number of fish which may be caught from a particular stock or in a particular area.

Recruitment: The addition of a cohort of young animals to a population.

Reference point: The state or value of some indicator (say spawning stock size) which corresponds to a desirable position (a target reference point) or an undesirable position (limit reference point) that requires urgent action.

Results Chains: A graphical depiction of a project's core assumption; the logical sequence linking project strategies to one or more targets. In scientific terms, it lays out hypothesized relationships (from Conservation Measures Partnership Open Standards, see website in Appendix A).

Rotational closures: A management system in which a fishery, or parts of a fishery, are closed to fishing on a rotational basis.

Scope: The broad parameters of what a project will involve and affect including a description of the geographic area, the stakeholders, the fisheries, critical habitats and the issues on which a project must focus.

Septic tank: An underground tank in which the organic matter in sewage is decomposed through bacterial activity.

Sewage: Waste matter, particularly human faeces and urine, conveyed in sewers which are part of a sewerage system.

Spawning aggregation: A grouping of a single species of reef fish that has gathered together in greater densities than normal for the specific purpose of reproducing.

Stakeholder: Any person or group with a legitimate interest in the conservation and management of the resources being managed. In the case of CEAFM, the local community or communities and the national government and its agencies will be the key stakeholders. Other stakeholders could include private companies involved in tourism, agriculture, forestry and fishing.

Subsistence fishery: A fishery in which the catches are shared and consumed directly by the families of the fishers and community members rather than being bought by sellers at the next larger market.

Target species: The resource species at which a fishing operation is directed.

Territorial use rights in fisheries (TURF): A spatial user right that may be assigned to individuals and/or groups to fish in certain locations, often historically based on long-standing tradition.

Total allowable catch (TAC): The total catch permitted to be taken from a fisheries resource in a year.

Traditional fishery: A fishery that has existed in a community for many generations and in which customary patterns of exploitation and management have developed.

Trophic cascade: Changes in the relative abundances of species in different tropic levels caused by the change of abundance of one species at one trophic level; e.g. if species A is removed by fishing, its prey species B may increase, and B's prey may subsequently decrease.

Trophic level: A feeding level containing organisms that obtain their nourishment in a similar way and from a similar source.

Wetlands: Low-lying terrestrial areas that are flooded by tides and either contain or are saturated with water. Examples include salt marshes, coastal swamps and mangrove forests.