

Causal chain analysis

This section aims to identify the root causes of the environmental and socio-economic impacts resulting from those issues and concerns that were prioritised during the assessment, so that appropriate policy interventions can be developed and focused where they will yield the greatest benefits for the region. In order to achieve this aim, the analysis involves a step-by-step process that identifies the most important causal links between the environmental and socio-economic impacts, their immediate causes, the human activities and economic sectors responsible and, finally, the root causes that determine the behaviour of those sectors. The GIWA Causal chain analysis also recognises that, within each region, there is often enormous variation in capacity and great social, cultural, political and environmental diversity. In order to ensure that the final outcomes of the GIWA are viable options for future remediation, the Causal chain analyses of the GIWA adopt relatively simple and practical analytical models and focus on specific sites within the region. For further details on the methodology, please refer to the GIWA methodology chapter.

Strong linkages were identified in the Assessment between Pollution (suspended solids) and Habitat and community modification, as well as between Habitat and community modification and Unsustainable exploitation of fish and other living resources (particularly overexploitation and destructive fishing practices), via benthic trawling and blast and poison fishing (with strong transboundary links through the live reef fish export trade to East Asia). The Causal chain analysis for Habitat loss and community modification thus focuses on these strong linkages.

System description

The key aspects of the system are described in detail in the Regional definition and Assessment above. The Sulu-Celebes (Sulawesi) region is located in the Indo-West Pacific centre of diversity and supports mega-diversity, located near the junction of three major biogeographic zones (Roberts et al. 2002, Cheung et al. 2002). The warm clear waters of the Sulu-Celebes Sea, its active underwater volcanoes, its seamounts, trenches, corals and inter-island passages, its currents and upwellings, constitute an exceptionally rich marine life hot spot. The region supports a significant proportion of the total coral reef area of the Philippines, with some 20 000 km² of coral reefs, and forms part of the 'coral triangle' of highest coral diversity with Indonesia and New Guinea containing more than 500 reef-building species. The Sulu-Celebes Large Marine Ecosystem support around 400 species of algae, 5 species of sea turtles, 22 species of marine mammals and over 450 types of coral (LME 2003). More than 2 500 species of fish occur in the region, many of which are exploited using a large variety of different gears and methods. The fishery is comprised predominantly of pelagic species, mostly tuna (*Thunus* spp.), skipjack (*Katsuanus* sp.), scads and sharks, representing some 80% and 60% of total production of North Sulawesi and East Kalimantan respectively.

For more than 10 000 years, the indigenous population of the region has harvested the sea's seemingly unlimited supply of marine life. The Tubbataha Reef and other coastal areas of the Sulu-Celebes Sea, while serving as important spawning grounds for the entire region, also provide a livelihood for the fishing communities crowding its shores. Population pressure in the local fishing communities, poverty, and a lack of economic alternatives all contribute to the problem. The resources of the region are a source of hard currency for the debt-burdened government. Tourism increases every year and contributes both to the local and to the national economy (LME 2003).

Methodology

The Causal chain analysis was based on the extensive background knowledge and publications of the GIWA Task team and additional information provided by various government agencies, academic institutions, NGOs and other agencies, as cited herein. Some large gaps in information remain. In particular, there is a serious lack of long-term socio-economic data on human resource use patterns.

Causal chain analysis

Figure 18 shows the causal links for habitat modification in the Sulu-Celebes (Sulawesi) region.

Environmental and socio-economic impacts

The key environmental and socio-economic indicators of Habitat loss and community modification are:

- Loss and/or fragmentation of forest cover (Drigo & Marcoux 1999, Burke et al. 2002);
- Loss and/or fragmentation of riparian vegetation and rivers, rice paddies;
- Loss and/or fragmentation of coastal habitats such as mangroves and seagrasses (Chou et al. 2002);
- Loss and/or fragmentation of coral reefs (Alcala & Gomez 1987, Chou et al. 2002, Wilkinson 2002, Burke et al. 2002);

- Increased siltation, with severe levels of suspended solids in coastal waters (Hodgson & Dixon 1988, Cesar 1996, Bate 1999, White et al. 1999, Talaue-McManus 2000, Chia & Kirkman 2000, Burke et al. 2002);
- Increased nutrients in run-off, with blooms of toxic dinoflagellates, linked with sediment-bound nutrient enrichment (Ludwig 1985, Gunnerson & Cuellar 1988, Werner & Allen 2000);
- Ecosystem productivity change including resource depletion, reduction in ecosystem services (e.g. forestry, fisheries), and depletion of targeted and non-targeted species (Atmadja & Man 1994);
- Change in community structure (Chou et al. 1994, Werner & Allen 2000);
- Excessive take of protected species e.g. marine mammals, turtles and giant clams (Rossiter 2002);
- Conflict among resource users (Rossiter 2002).

Immediate causes

Modification of terrestrial and coastal habitats

Suspended solids

Habitat loss and community modification caused by suspended solids are severe in rivers, streams and coastal waters throughout most of the region (Hodgson & Dixon 1988, 1992, Bate 1999, Talaue-McManus 2000, Chia & Kirkman 2000, Burke et al. 2002). This may be attributed to severely altered land cover, especially in the southern Philippines. This has been modelled by the Reefs at Risk in Southeast Asia Project (Burke et al. 2002), which estimated sediment risks (relative erosion rates) impacting coral

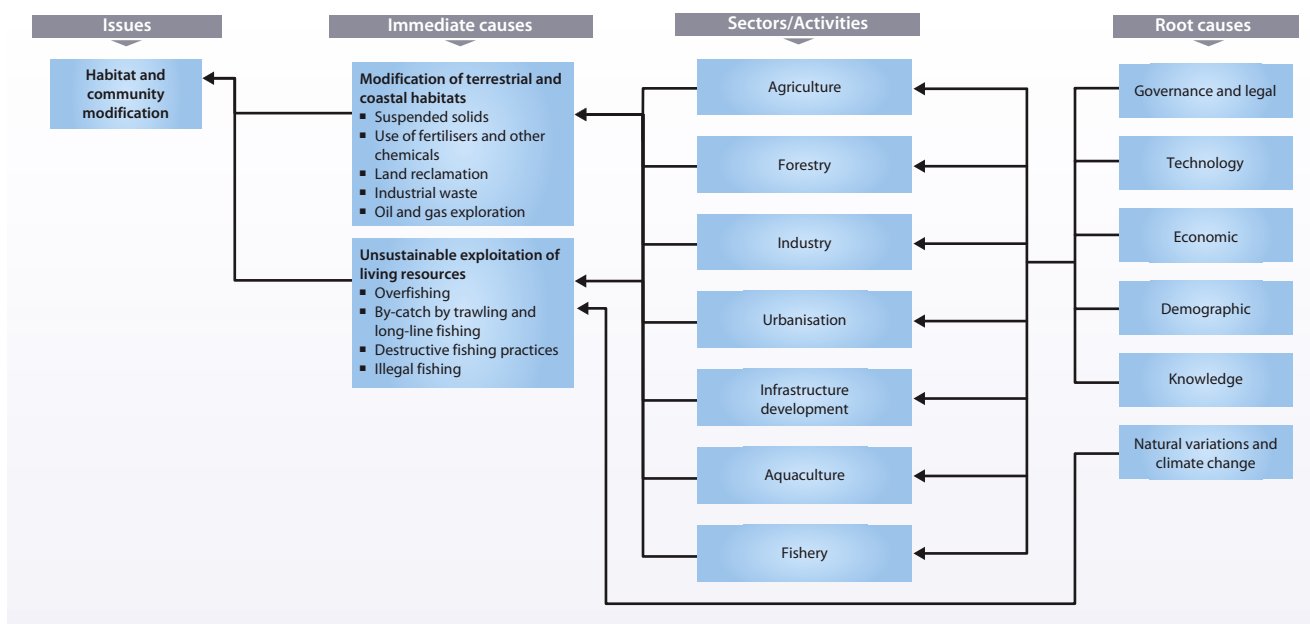


Figure 18 Causal chain diagram illustrating the causal links for habitat and community modification in the Sulu-Celebes region.

reefs, including observations from ReefCheck database, and ICLARM ReefBase (Figures 6 and 7 in the Assessment). Constructions on some shoreline areas, such as those along Alona Beach and other locations in Pangalo (Philippines), are causing shoreline erosion (White et al. 1999). The removal of portions of the structure of fringing reefs (e.g. corals for lime in cement production, dredging of lagoons etc.) has also resulted in greater erosion and sedimentation on a local basis (Cesar 1996). Excessive sedimentation (e.g. Sapijan Bay, Philippines) has also been attributed to extensive mussel and oyster culture (Young & Serna 1982).

The common practice of slash and burn agriculture has depleted much natural forest, particularly in low-lying and coastal areas, exacerbating the impacts of land-based activities on coastal areas (FAO/UNDP/UNEP 1994). More than 80% of the original forest has been destroyed in large areas of the Philippines (Figure 7 in the Assessment) resulting in increased soil erosion and nutrient run-off.

The lack of balance between logging and replanting of trees, ultimately results in soil erosion and run-off, leading to increased suspended particulate matter in the waterways. The logging of rainforests (Drigo & Marcoux 1999) has contributed to major reduction in their cover, species population sizes and soil erosion, the latter leading to increased sediments and suspended particulate matter in waterways. In the Philippines, the loss of coral reefs was caused by huge quantities of silt linked directly to deforestation (Werner & Allen 2000). It is estimated that 60-80% or possibly more of the mangrove resources in the Philippines is lost (Atmadja & Man 1994).

Use of fertilisers and other chemicals

A related problem is chemical pollution, with chemical transported with sediments into waterways. The indiscriminate use of chemicals in the agricultural sector, including chlorinated pesticide residues from rice paddies such as Aldrin, Dieldrin, Lindane and Endrin, have led to high levels in the water column and sediments in Manila Bay (GIWA region 54 South China Sea) and Segara Anakan (GIWA region 57 Indonesian Seas), exceeding allowable limits set by national agencies (Gunnerson & Cuellar 1988, Ludwig 1985).

Land reclamation

Continuing developments along the watersheds and coastal zones are causing the loss of natural communities with permanent destruction having reduced the surface area of original land cover by more than 80% (Burke et al. 2002). Ports and harbour developments usually involves reclamation and channel dredging. Coastal reclamation and associated mangrove destruction are among the primary causes of loss of coastal habitats (Cesar 1996, White et al. 1999).

Mangrove forests, which are important nursery habitats, have been cleared for timber collecting and for use in prawn farming operations (Chua et al. 1989, FAO 2000). Aquaculture, including the shrimp farming industry (covering 500 000 ha) (Chua et al. 1989), has been one of the major causes of habitat modification and destruction in the region (Down to Earth 2001). In the Philippines, less than one-third of the original mangrove forests are now left (Chua et al. 1989). In Indonesia, up to 1 million ha of land, mostly mangrove forests, were allocated by the government for the shrimp hatchery industry. By 2001, about 70% of the shrimp farms had been abandoned because the operators found them unsustainable due to the high concentrations of chemicals and the destruction of the mangrove habitat.

Industrial waste

Industrial development affects marshes, swamps, rice paddies and riparian belts, and have led to more wastes being dumped into critical habitats, such as mangrove forests, contributing to the loss and fragmentation of 60-80% of Philippine mangroves.

Oil and gas exploration

Although not a major impact at present the potential for oil spills to adversely affect the ecosystems in the region is high. Caution and good management practice must be exercised in current and future exploration initiatives, including the Shell Company's multi-billion dollar Malampaya Gas Project (on Palawan province, Philippines) (Werner & Allen 2000).

Unsustainable exploitation of living resources

Overfishing

Overfishing impacts on habitat loss include widespread changes in community structure, widespread removal of brood stocks (FAO 2000), local extinctions, and has also contributed to fishers' incentive to use destructive methods (e.g. bombing) to catch the remaining fishes (Chou et al. 1994, Werner & Allen 2000). Most stocks have already been exploited beyond their maximum sustainable yield (Burke et al. 2002, FAO 2000, Wilkinson 2000). Sharks are also caught, erroneously depicted as by-catch, in trawling and long-line fisheries.

By-catch from trawling and long-line fishing

Although trawling was banned in Indonesia in 1980 (Sardjono 1980), with the ban successfully reducing overall fishing effort in western Indonesia and reallocating some of the inshore resources toward small-scale fisheries (Pauly 1989), it still is widely practiced in the region. This has caused extensive direct damage to rare and endangered species of marine mammals, including dugong, and turtles.



Figure 19 Nudibranches, Mabul Island, Malaysia.
 Upper left: *Chromodoris coi*. Lower left: *Glossodoris stellata*. Upper right: *Hypselodoris* sp. Lower right: *Hypselodoris bullocki*.
 (Photo: N. Coleman, ReefBase)

Destructive fishing practices

The widespread and repeated use of destructive material and equipment to fish for marine resources has caused severe ecosystem fragmentation, and has obliterated much of the marine life in many areas in the region (Johannes & Riepen 1995, Burke et al. 2002). The readily available material used to manufacture bombs and other destructive methods have contributed to their widespread use. Many fishers feel obligated to use dynamite and other destructive methods to catch the remaining fishes (Ming et al. 1994, Werner & Allen 2000). Trawling has negatively impacted seagrass beds, muddy and sand-gravel bottoms and fringing coral reefs. On Coron Island in the Calamain group (Philippines) over two-thirds of the island's coral reefs have been damaged by cyanide fishing, resulting in the people increasing their consumption of birds, monkeys and wild pigs (Werner & Allen 2000). The impacts of reef degradation on coral biodiversity have been documented by Edinger et al. (1998). The negative effects of muro-ami, blasting and poison fishing, have destroyed large areas of coral reef throughout the region (Pet-Soede & Erdmann 1999, Pet & Pet-Soede 1999, Burke et al. 2002).

Blast fishing is widespread (Alcala & Gomez 1987), and has reduced coral cover by 50-80% in Indonesia (Chou 2000). Similarly, in the Philippines, the strong decline in *Acropora* sp. coral is thought to be due primarily to human impacts, particularly blast fishing (Alcala 2000). A similar situation has occurred in Malaysia, where there may be more than four bomb blasts per hour in many offshore reef areas (Chou 2000). Reef bombing occurs regularly, and has been attributed to increasing competition among fishers and corresponding declines in catches. Alcala (2000) has provided an overview of blast fishing in the Philippines.

The full extent of poison fishing in the region is unknown (Johannes & Riepen 1995, Burke et al. 2002), because it targets some of the most pristine and isolated coral reefs where observations are limited. However, it is clear that many reefs in the region have been targeted for the live fish food trade in Hong Kong and mainland China, initially using potassium cyanide or sodium cyanide and more recently using poisons derived locally from plants. Weber (1998) assessed the status of some 200 fisheries around the world and concluded that the live reef fishery of Southeast Asia is one of the most threatened fisheries on the

planet. Live reef food fish trade is a lucrative industry where reef fish can fetch prices of up to 100 USD/kg. According to unpublished data from the International MarineLife Alliance, cyanide is widely used to capture both live reef food and ornamental aquarium fish. The ornamental and aquarium trade is an international, multi-million dollar industry with 36% of the global trade coming from Southeast Asia (Burke et al. 2002). Between 1996 and 1999, the share of the United States ornamental fish market coming from Southeast Asia increased from 67% to 78% (unpublished data from US Fish & Wildlife Custom declarations). The current harvesting practice of the trade is unsustainable (Burke et al. 2002). Cyanide fishing remains the predominant technique for fish capture in Southeast Asian countries. The economic benefits for fishers are minimal. In the Philippines, for example, fishers who supply the aquarium trade typically earn only about 50 USD per month (Spalding et al. 2001). Less destructive techniques, such as net capture, are on the rise as a result of retraining efforts but they have not yet overtaken cyanide fishing as the practice of choice (Burke et al. 2002).

Illegal fishing

Illegal tours by collectors have resulted in the marine environment being 'picked clean' of turtle eggs, giant clams and seashells. The Tubbataha Reef are not free from intrusion and destruction. Both Tubbataha Reef and Turtle Island have fallen prey to the destructive practices of people selling turtle eggs, thereby endangering the continuing existence of these turtles. Local extinction, according to the WWF, is imminent. In 1995, the Philippines Department of Environment and Natural Resources (DENR) revealed that coral cover and fish density in the reef are "decreasing at an alarming rate" despite the site's official status as a protected National Marine Park.

Massive destruction of marine mammals, sea turtles and fish has been reported from trap nets placed in the Manado area, North Sulawesi, Indonesia. The illegal fishing was believed to be operated by a joint Taiwanese/Indonesian venture. Between March 1996 and February 1997, it is estimated that catches included some 1 424 Manta rays, 18 Whale sharks, 312 other sharks, 4 Minke whales, 326 dolphins, 577 Pilot whales, 789 Marlins, 84 turtles and 9 Dugongs (Rossiter 2002). For more information on illegal fishing in Indonesia see Box 7.

Root causes

Governance and legal

Lack of stewardship

Although the 'tragedy of the commons' (Hardin 1968) is understood by regulators, the issue of property rights is unresolved in most areas and so the problems inherent in common property resource use remain unsolved, especially in remote areas. This is compounded by the next root cause.

Box 7 Illegal fishing by foreign vessels in Indonesia.

For decades now, Indonesia's rich and extensive marine natural resources have been plundered at will by foreign fishing vessels. Some operate under official licenses (purchased from Indonesian middlemen) and even fly the Indonesian flag, while others simply poach the vast archipelagic seas, bolstered by the slim chances of encountering Indonesian Navy vessels and the knowledge that they can usually pay their way out of any inconvenient situations that might arise if they do. Many are said to simply work with the various enforcement agencies that should be preventing their activities. As fish wars erupt between nations all over the world, Indonesia must realise and protect what is potentially its most sustainable and valuable natural resource, its fisheries. In acknowledgement of the importance of this issue, Minister Sarwono recently suggested that the losses in revenue accrued to the Indonesian economy as a result of foreign fish stealing may top 4 billion USD. In the case of North Sulawesi, while the Taiwanese trap net was eventually taken down (due to the actions of Minister Sarwono, then Minister of Environment), foreign fleets continue to threaten Bunaken National Park, albeit in a less direct manner. The Bunaken fishermen increasingly report conflicts with foreign tuna fishermen, and are now actively vandalising foreign fishing gears when they encounter them (such as long line radio buoys, fish aggregating devices, etc). The Bunaken fishermen face a double whammy, with Filipino boats actively poaching the waters just northwest of the park, while Taiwanese, Korean and Hong Kong boats (with official licenses) work the seas to the north and east of the park. The latter have greatly increased in number since the spread of violence in Ambon, when a number of foreign fleets relocated from Maluku to Bitung as their home port. Unfortunately, as these bigger and more technologically advanced foreign fleets decimate North Sulawesi's stocks, the Bunaken fishermen must travel further and further to catch fish (often 3-5 hours travel outwards by wooden speedboat from the island), and now increasingly resort to spear fishing and gill netting on Bunaken's heavily touristed reefs in order to catch fish to feed their families. Tourism and fishing, once compatible, are now increasingly enemies. In large part due to the activities of foreign fishing fleets.

(Excerpted from: NRM Headline News 2000)

Adequate policy but inadequate implementation/management, resources and capacity to execute the law

In Indonesia, Malaysia and the Philippines, marine resource management and exploitation are, in theory, already controlled by extensive policy and regulatory frameworks. However, several recent reviews have all indicated that the major problem is not lack of policy but lack of implementation, worsened by lack of coordination among agencies, ambiguity in policy statements and lack of a clear framework or support mechanisms to enable policies to be implemented effectively (e.g. Kahn & Fauzi 2001). This problem is common throughout many of the developing countries of Southeast Asia (Chua 1989), where regulating protected areas, forestry and fishery operations, including implementing sound management policies, is often hindered by lack of financial and human resources support for on-site management, surveillance/enforcement. Bunaken National Park offers a classic case-study (Box 8).

The typical chronic lack of surveillance and enforcement resources is exacerbated by the fact that many destructive activities are carried out in remote places, whereas enforcement capability is often based in urban areas. This has led to unregulated land-clearing, illegal use of pesticides and other chemicals in the agricultural sector, and to large-scale illegal commercial fishing operations, including those targeting reef fish, beche-de-mer and shark for cash sales to satisfy an increasing global market demand (Johannes & Riepen 1995, Cesar 2000).

Box 8 Lack of financial support for protected areas in Indonesia: Bunaken National Park.

After its establishment as a park, Bunaken National Park enjoyed initial support for five years (1992-1996) from the USAID-funded Natural Resources Management Project (NRMP). This initial support included development of a park management plan, stakeholder consultations, mooring buoy installation, several baseline biological and socio-economic surveys, and limited procurement including an office automobile and several patrol boats. The park has a management office with a staff of approximately 40 (including the park head, park rangers and administrative staff), and is under the authority of the Indonesian Department of Nature Conservation (PHKA) in the Ministry of Forestry. As a national park, it receives an annual operating budget that averages 75 000 USD per year, enough to pay for salaries, office operational costs and at most one water-borne patrol per month. Unfortunately, enforcement funding from the national park office was virtually non-existent during the latter half of the 1990s; the annual budget for the park included funding for a single half-day patrol per month. Despite the park's conservation status as a national park, it has continued to suffer a slow degradation over the last decade for a variety of reasons. As with almost all reefs in Indonesia, the park's reefs continue to be damaged by blast and cyanide fishing, destructive net fishing, live coral collection for house foundations, plastic trash accumulation, and anchoring. Additional enforcement problems in the park include tourist damage from reef walking and poor diving practices, mangrove cutting for sale of firewood, and violations of the zonation system (e.g. fishing in core conservation zones).

(Source: Excerpted from Erdmann & Toengkagie 2003, Erdmann et al. 2003)

Unresolved issues regarding access to living resources

The views of local fishermen and foreign fishing fleets are often counter to those actions deemed necessary by government regulators, such as restricting license numbers, areas for fishing activities, and total allowable catch limits. Given the regional nature of the industry, restrictions by regulation can take considerable political will and stakeholder agreement on the scientific advice before they can be implemented. Again taking Bunaken National Park as an example, the majority of local fishermen are today small pelagics fishers, a situation that augurs well for conservation efforts within the park. Since these fishermen are not targeting reef fisheries, there is great potential for coexistence of fishing and marine ecotourism. Unfortunately, foreign fishing operations are threatening to damage both of these important sectors of the North Sulawesi economy. In 1997 and 1998, the now infamous 'Curtain of Death' Taiwanese trap net that stretched across the Lembeh Strait decimated migratory pelagic fish and marine mammal stocks in North Sulawesi (as discussed above). Not only did Bunaken fishermen see the effect in their daily catches, tourism also suffered with the number of sightings of dolphins, manta rays and other diver favourites plummeting. This led some of the local fishermen to an increased focus on reef fisheries and the use of illegal destructive methods. See also Box 9.

Technology

Technology developments

There have been major improvements in the technology available for commercial fishers, particularly foreign fleets, to increase effective fishing effort and exploit a wider range of marine habitats. These include employing more powerful vessels, better depth and bottom

Box 9 Lack of control of illegal fishing by foreign vessels in Indonesia.

Although the issue of foreign fleets either operating under license or poaching in Indonesian waters has been acknowledged as a problem for years, it seems that neither officials nor academics took this problem seriously until recently. This lack of concern apparently stems from a number of common misconceptions that many officials seem to harbour, including: Indonesian fishermen are too poor and ignorant and their fishing gears not advanced enough to effectively harvest fish stocks, Indonesian fishermen are ineffectual seamen and do not have what it takes to stay at sea and really fish; and Indonesian fishing boats are not advanced enough.

Combined with the idea that Indonesia's fisheries resources are underexploited, many fisheries officers and government officials seemed to feel that Indonesia might as well have foreign vessels help with fishing lest all those extra fish go to waste. These misconceptions were reinforced by consecutive Suharto-era Repelitas (five year plans) that inevitably called for more intensive fishing effort and official fisheries statistics that predictably showed a perfect increase in catches in line with the demands of the Repelitas. While it is not true that Indonesia's fishermen are unable to effectively harvest Indonesia's fisheries, it is true that they are generally at a great competitive disadvantage compared to foreign fleets who use high technology, unsustainable (and often illegal) fishing gears such as trawl nets, drift nets and massive long-lines to decimate pelagic and demersal fisheries throughout the archipelago.

Corruption, greed and government short sightedness has meant that foreign fleets are generally given the green light to plunder Indonesia's most valuable stocks (sharing a minuscule portion of their profits with a few corrupt government officials), while Indonesia's traditional fishermen are increasingly marginalised and left to fight for the scraps. This in turn has led to increased environmental degradation and a decreasing quality of life in many coastal villages as fishermen turn to destructive techniques to make a living and put some fish on their collective plates.

The grave situation in relation to illegal fishing of the region's fish stocks, particularly by foreign vessels occasionally utilising poor local fishers, has led to policy recommendations for total closure of Indonesia's seas to foreign fishers: close Indonesia's seas completely to foreign fleets and allow Indonesian fishermen only to catch Indonesian fish. After five years, the situation can certainly be reassessed. If there is strong scientific evidence for surplus fish production (i.e. underexploited stocks), then the issue of exports can be re-examined. But only in a sustainable manner in which Indonesian fishermen catch the fish that are exported. There is simply no justification for foreign fleets to operate in Indonesian waters. Bigger, more technologically advanced fishing fleets are not better only more efficient at speeding the collapse of a fishery.

(Source: Excerpted from: NRM Headline News 2000)

assessment systems, deeper towing of demersal trawl nets, and access to better meteorological information, both aerial and acoustic searching for fish schools and GPS position fixing. In some fisheries, such as long-lining, the practice of cooperative (or 'pack') fishing is also common.

Knowledge

Lack of education/awareness, conservation ethics and perceptions

Those who participate in habitat destruction often lack awareness and appreciation of the environment and its renewable services, attributable to both a lack of education, poverty, and/or desperation. In relation to destructive fishing, there is often a perception amongst fishers that the use of destructive methods is better because it yields a bigger catch for the least amount of effort. This has resulted in an increase of bombing, poison and other destructive methods. Alternatively, at the other end of the financial scale, extremely wealthy, unscrupulous persons and international fishing organisations are able to flout the law because of corruption, usually employing poor fishers to conduct the illegal activities. See also Box 9.

Inadequate investment in scientific assessments and management

As with most regions world-wide, there has traditionally been inadequate historical field data, particularly on fisheries impacts to ecosystems, CPUE, stock recruitment relationships and the life history characteristics of the target species and their role in the ecosystem, the 'synecology' of the fisheries (e.g. see Jackson et al. 2001). Coupled with the lack of field data have been serious inadequacies in the theory of both ecosystem and fisheries management, which are only now beginning to be addressed through an ecosystem based management approach.

Economic

Market demand

The ready available market demand for seafood may inadvertently create a group of willing fishers who will use any fishing methods to achieve goals of maximum yield at the minimal effort. Similarly, forest logging of tropical rainforest timbers is a highly lucrative export industry, bringing large amounts of foreign currency, and with high potential for misconduct among corrupt officials. This is in some cases also closely linked to urban and residential developments. As such, new buildings (commercial and residential) will often put demands on the industry to log more. The lack of accountability and responsibility in all parties exacerbates the situation.

The market demand for more fishes has also led to a change of focus for artisanal fishers, where they once concentrated on sustenance, they now rely on small-scale commercial fisheries for their livelihood (Ingles 2000), with positive and negative impacts on the environmental and socio-economic aspects of habitat loss and community modification.

Economic growth

Governments and private sector, particularly in developing nations, are often driven by the need for faster economic growth but at the expense of natural resources and the environment.

Demographic

Population growth and poverty

When coupled with other issues, such as rural 'landlessness', population growth will erode the gains obtained from conservation measures, such as banning illegal land clearing and fishing methods, within a few years if no provisions are made to provide for alternative income opportunities. Population growth has also increased coastal developments leading to beach erosion and high sedimentation (Burke et al. 2002), and needs to be addressed across all sectors.

Poverty, often associated with overpopulation, is a major root cause that drives most issues identified in this analysis. The dependence of millions

of poor people in the region on their natural resources is so strong that every available resource will be extracted at all cost. Providing additional and/or alternative livelihoods is crucial but can be difficult as the people need to be convinced that they would get a better deal with a new initiative. An example of this is blast-fishing, whereby the fishers need to be convinced that a new (less destructive) method will yield the same if not better catch than blast fishing. Thus, extreme poverty has forced people to continue fishing despite resource depletion. As the situation worsens, fishers will resort to use of all methods to catch the remaining fishes, indicative of Malthusian overfishing (Pauly et al. 1998).

Natural variations and climate change

Major shifts in climate, such as ENSO, can cause changes of several orders of magnitude in breeding and recruitment success for many species, including commercial species. As global climate change accelerates, it is predicted that there will be wider fluctuations in climate with more intense drought periods followed by more intensive rain and storm events. Also, there is the possibility of shifts in ocean currents that could disrupt many breeding cycles.

Conclusions

The most significant root causes affecting Habitat loss and community modification in the region are population growth, poverty, economics and market trends. Population growth is impacting on migration, urbanisation, lack of employment and poverty, all of which, in turn, place greater pressure on services from the environment (e.g. fisheries) and contribute to increased pollution and damage to habitats. Lack of policies supporting sustainable development and/or lack of enforcement of those that are in place as well as corrupt and/or illegal practices also follow from population growth.

Economics and market trends drive the burgeoning and unsustainable use of resources and also influence corruption and illegal practices. Coupled with the population boom and migration to coastal and urban areas, market trends create a dangerous mix of driving forces that do not augur well for the future. Most importantly, the resource owners themselves must be persuaded that long-term sustainability is a much better option for the future development of the region, than short-term gains that are being made at the expense of irreversible damage to the environment.