
IMPLEMENTING A COASTAL RESOURCES MANAGEMENT POLICY
THE CASE OF PROHIBITING CORAL MINING IN SRI LANKA



International Coastal Resources Management Program
Coastal Resources Center
The University of Rhode Island



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TO THE READER

It is our view that the problem of implementation is the key challenge resource managers face. It is the purpose of this case study to give the reader insight into the realities of implementing technically simple but politically difficult solutions to resource management problems.

The case study which follows provides information about coral mining in Sri Lanka and the challenges it presents for coastal resources management in that country. Coral mining is a prohibited activity in Sri Lanka's Coastal Zone, yet coral mining still occurs. You should read the material presented as if you were a consultant working with the Coast Conservation Department (CCD) of Sri Lanka to solve this problem. The CCD is the government agency charged with managing Sri Lanka's coastal zone and its resources.

Although the case focuses on coral mining, it draws in a considerable amount of contextual information about Sri Lanka. You will find, for example, material on Sri Lanka's history, the history of its coastal program, and information on the country's current political situation. CCD's authority, its organizational strengths and weaknesses, and the steps it has taken to control coral mining are also described. Other areas explored are the socioeconomic aspects of coral mining and the impacts of mining on coral reef habitat and shoreline erosion.

At the end of the case, a series of questions are posed in the section "What Next?" These questions are repeated below and you should keep them in mind while you read and analyze the information which is provided in the case. These questions will provide the basis for discussing the case.

- What were the management techniques used to control coral mining?
- How could existing regulations be enforced more effectively?
- Should existing regulations be changed?
- What non-regulatory initiatives might CCD undertake to make the coral prohibition work?
- What are the reasonable limits of CCD's responsibility to find alternate employment for coral miners?
- What additional information needs to be gathered?
- Should the coral mining prohibition be continued?

This case study presents the situation as it existed in Sri Lanka in 1988. Since that time, the situation has changed somewhat. The reader should not be overly concerned about what actually has occurred in Sri Lanka since the case was written. All "real life" situations change continuously. The reader is not trying to predict the future; rather the purpose of the case is to present insight into the real world of coastal management.

The Authors

INTRODUCTION

The passage of the Coast Conservation Act in 1981 by the government of Sri Lanka marked a new phase in that country's policy towards managing the resources of its coastal zone. The new Act legislated that a Coastal Zone Management Plan (CZMP) be formulated and implemented to govern both the use and protection of Sri Lanka's coastal resources.

Sri Lanka was in urgent need of such a plan. A larger and larger proportion of this small island nation's social and economic life was occurring along its approximately 1,585 kilometer coastline. There was an expanding population, numerous industrial and commercial developments in coastal areas, especially in the west and southwest. This development was immediately felt as an increase in construction. A booming construction industry in the 1970s led to rapid growth of sand and coral mining to provide materials for the boom. Both activities appeared to intensify the impact of natural forces on erosion of the Sri Lankan shore. Sri Lanka's national policy - to hold the line against the sea - relied heavily on physically sheltering threatened shoreline with built structures like revetments and groins. By the 1970s, however, a decade before enactment of the Coast Conservation Act, it was clear that engineering solutions fell short of combatting the combined assault of man and nature on Sri Lanka's coast.

The government agency charged with managing Sri Lanka's coast is the Coast Conservation Department (CCD). Originally organized as a division within the Ministry of Fisheries (in 1978), Coast Conservation was upgraded to department status in January 1984, just 13 months after the 1981 Coast Conservation Act became operational. With limited staff and financial resources, the Coast Conservation Department (CCD) nonetheless has succeeded in carrying out most of the Act's charges including:

- design and implementation of a permit program for activities within a legally defined

coastal zone

- preparation of a national coastal zone management plan
- design and execution of schemes for coast protection

The CCD has also made a concerted effort to control or stop activities degrading the coastal environment (e.g. coral mining, sand mining)

Preparing a plan for the coastal zone by the end of 1986 was an important accomplishment for CCD. The Sri Lanka Coastal Zone Management Plan:

- sets forth criteria for the review of all activities in the coastal zone
- prohibits a limited number of activities including coral mining in the coastal zone
- defines a geographically specific set-back zone for new development
- provides guidelines for the preparation of environmental impact statements for major development activities
- sets forth management strategies for three crucial coastal issues including: erosion management, coastal habitat protection, and historic, archaeological, cultural, and scenic site protection

The CCD's permit program for such coastal activities as sand mining and shorefront construction is proceeding with increasing credibility and effectiveness. Enforcing a prohibition on coral mining has proved much more difficult and politically very troublesome. Not only is the problem continuing to cause environmental problems, but the reputation of the CCD is at stake.

The coral mining prohibition directly affects the livelihood of thousands of individuals engaged in or dependent on that industry. The Sri Lankan government believes it has a responsibility and it is a political necessity to find alternative livelihoods for displaced coral workers. In addition, local police departments who are in charge of stopping illicit coral mining are often either

undermanned, and therefore unable to enforce the prohibition adequately, or reluctant to act in the face of opposing public sentiment.

The challenge of controlling coral mining threatens to undermine the credibility that the Coast Conservation Department of Sri Lanka has built for itself and its projects over nearly a decade. To assure long-term progress towards managing Sri Lanka's coastal zone, the CCD must either enforce the coral mining prohibition or totally change its approach to the issue.

The subsequent pages provide a case study on the coral mining issue and how CCD has already tried to address it.

We ask you to consider what new actions and approaches CCD should take to effectively deal with the coral mining issue?

SRI LANKA AND THE COAST

History, Demographics and Economic Development in Sri Lanka: The civilization of Sri Lanka dates back more than 25 centuries. The first settlers migrated from the Indian sub-continent and were of Sinhalese and Tamil origin. They formed agricultural settlements concentrated in the inland areas of the north around Anuradhapura. In the manner of their homeland, the newcomers used water tanks for crop irrigation. Rice was the principal crop cultivated. Other crops included a variety of vegetables, fruits, and spices. Because marine resources were not in demand, and possibly because of the threat of attack from sea-going nations, the growing population of Sri Lanka remained inland. Although Greek and Arab traders were stopping at the island as early as the 2nd century A.D., its coasts remained virtually undeveloped until the beginning of the colonial period in the 16th century.

The three nations to colonize Sri Lanka, first Portugal, then the Netherlands, and finally England, spent considerable money and effort in developing coastal areas. To these nations, the

seacoast represented an important link with global trade routes, a strategic location to quarter naval forces, and a front line for defense of the island against other would-be invaders. In accordance with their needs, the Europeans fortified coastal areas, particularly around major harbors. Canals and roads were extended to provide easier travel between the coasts and the interior. The ambitious building of the foreigners brought many Sri Lankans to the coastal areas looking for work. This same building program led to more demand for coral lime, used in construction. This led to a specialized occupation for some Sri Lankans as coral miners, an occupation which has supported some families for more than one hundred years.

Thus, during the period when Sri Lanka was under foreign control, a pattern of urban growth along the shoreline was established. By the time of Sri Lankan independence in 1948, a large proportion of the population of the country lived and worked along the island's coasts. The economy of the country was strongly linked with the shoreline. Besides industrial and commercial development in coastal cities, many people relied on fishing for a living, at both the commercial and subsistence levels. Others are involved in construction-related industries such as coral mining and sand mining. In subsequent decades, the number of people living and working along the shore has further increased with the growth of the economy the introduction of international tourism in the 1970s, and the subsequent building boom.

Today, 53 percent (7,895,285 people in 1984) of Sri Lanka's total population (approximately 15 million people) lives within the coastal districts. Coastal districts contain approximately two-thirds of the nation's urbanized lands and 90 percent of all industrialized units. Sri Lanka's coastal waters produce 78 percent of the nation's total annual fish production which accounts for 60 percent of the animal protein crucial to the country's diet. In addition, rich biodiversity reserves are found in coastal waters including: coral reefs, seagrass beds and mangroves.

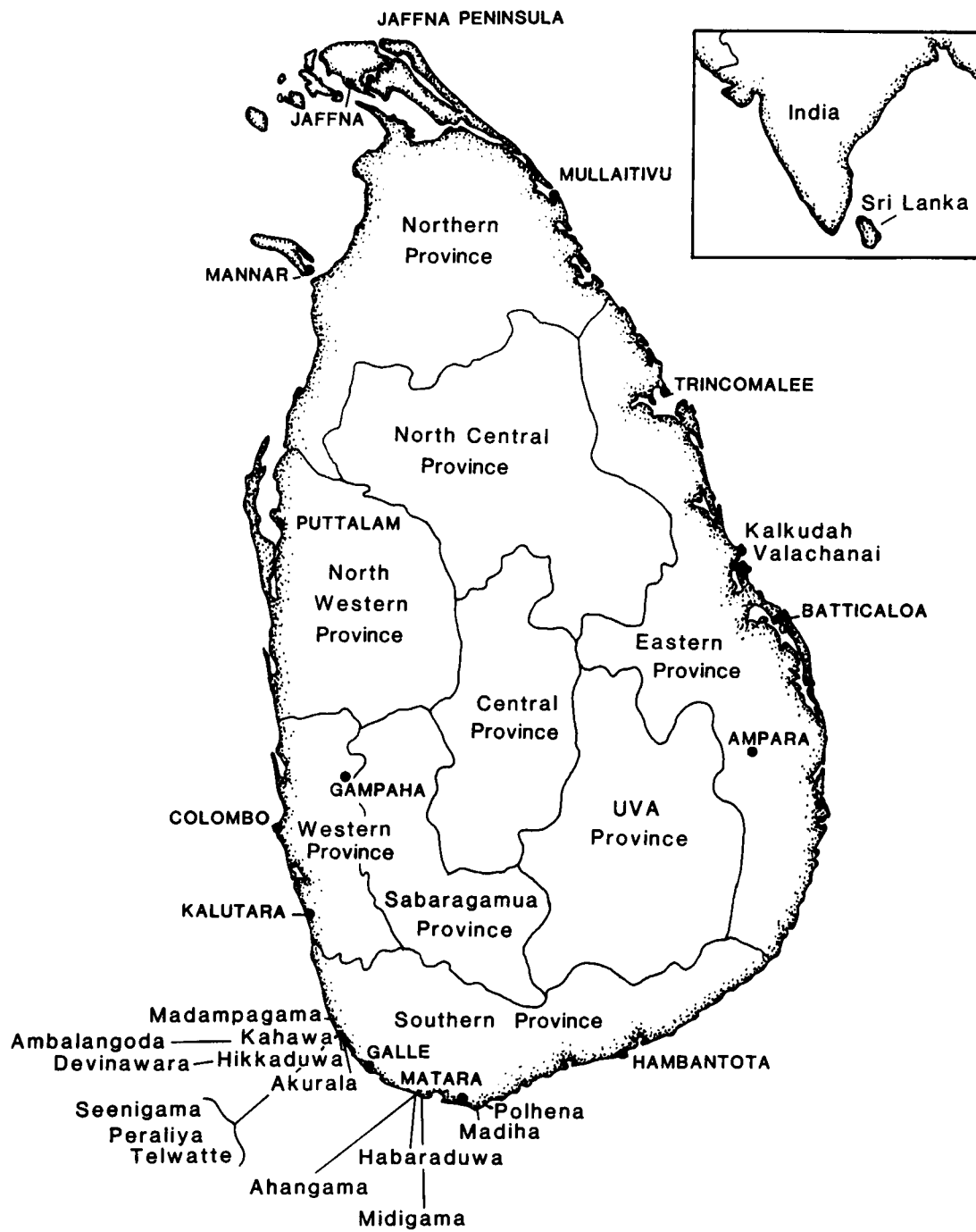


Figure 1. Sri Lanka Coastal Provinces and Place Names.

Source: The National Atlas of Sri Lanka, Survey Department, Sri Lanka.

Infrastructure and Erosion: Of particular interest to the CCD is the tie between the surge in coastal settlement, the location of highways and the railway along the coast, and the consequent increasing impacts of coastal erosion with which Sri Lanka has been confronted since the early part of this century. When in the 1920s a number of important transportation routes were threatened by coastal erosion, the authorities looked for engineering solutions to solve the problem. Engineering solutions, then as now, relied on erecting protective structures to blunt the force of the sea's impact against the shore. Government officials calculated that of the available alternatives, it would be most cost effective to protect existing lines of transportation rather than construct new ones.

The attempt to protect the shore roads and railways with groins and seawalls seemed to work at first. Thus encouraged, government officials in Sri Lanka, as was done worldwide, turned to similar engineering solutions repeatedly over the next half-century. A series of protective structures were built beginning in the 1950s to safeguard expensive waterfront developments such as hotels. Additional structures were built to protect fishing and shipping harbors. With time, however, it has become apparent that man-made structures to combat erosion frequently cause more problems than they avert. From past attempts to stem erosion, the Coast Conservation Department learned that engineering works are an inappropriate answer to many coastal erosion problems and viewing a coastal zone issue such as erosion in isolation of other factors often prevents its effective resolution.

The Political Environment: Coral mining is one of many coastal issues which the Coast Conservation Department must address. In its approach to the coral mining issue, the CCD is interested not only in the technical dimensions of the problem - how coral mining affects coastal erosion and coral reefs, but also in the socioeconomic and political consequences of its policies. The attention which CCD gives to socioeconomic impacts

reflects the emphasis of the Sri Lankan government on the welfare of the public and the political realities of enforcement.

Other critical events have impacted CCD's management and enforcement capability over the last decade. Sri Lanka has been torn by civil strife. This has made it impossible for the central government to have any presence in much of the northern and eastern parts of the country. In addition, during the later part of the 1980s, a large portion of the southern part of the country outside of Colombo also experienced considerable civil unrest. Universities shut down for a number of years, and newspapers reported the burning of buses and post offices as a frequent occurrence. Under these conditions, one CCD officer reported being told by some coral miners in the South not to return to the area to enforce the prohibition on coral mining, and his life might be at risk if he should do so. Though the situation in the South has now stabilized, the north and east remain difficult for central government to govern, and a climate of instability prevails.

THE SRI LANKA COAST CONSERVATION DEPARTMENT

Although the Coast Conservation Department was formed only recently, it is part of a logical progression of Sri Lankan thinking and actions regarding coastal management dating back several decades. Key events in the evolution of coastal management in Sri Lanka are shown in Table 1. Originally conceived as a public works/erosion control agency, CCD has evolved into a coastal resources management agency. The current organizational structure of CCD shows that the largest portion of the organization, however, remains the engineering division. The planning and management unit is small (Figure 2).

CCD Jurisdiction: The Coast Conservation Act No. 57 of 1981 (Appendix 1) gives CCD jurisdiction over specific activities within Sri Lanka's coastal zone. Within the defined coastal zone

(Figure 3), CCD administers and implements provisions of the 1981 Act.

These include:

- issuing permits for all development activities
- the design, implementation, and maintenance of coast protection works including groins, revetements, offshore breakwaters, and beach nourishment schemes
- planning for the coastal region
- identifying and conducting research on coastal problems
- coordinating activities of other government agencies with jurisdiction and responsibilities in the coastal zone

Table 1. Timeline of Coast Conservation Measures in Sri Lanka.

1920s	Attempts to correct coastal erosion with built structures.
1950s	Stepped-up coastal development/increase in rate of erosion.
1970s	Publication of "Coastal Protection in Sri Lanka - A Study and Recommendations for Future Policy," by S.R. Amarasinghe.
1970s	U.N. expert, Frances Gerritsen reports to Sri Lanka government on possible solutions to coast erosion problems.
1976	Coastal Zone Management bill drafted.
1977	Parliament dissolved/new government elected.
1978	Coast Conservation Division created within Ministry of Fisheries.
1981	Coast Conservation Act passed by Parliament.
1983	Coast Conservation Act becomes operational.
1984	Coast Conservation Division upgraded to Department status.
1983-1986	Preparation of Coastal Zone Management Plan.
1986	Draft Coastal Zone Management Plan (CZMP) completed.
1986	CZMP adopted by Coast Conservation Advisory Council.
1987	CZMP presented to the public
1988	Amendment to Coast Conservation Act passed.
1990	CZMP presented to Cabinet of Ministers for adoption.
1990	CZMP approved by the Cabinet.

The original Coast Conservation Act does not specifically address coral mining. By policy and regulation, however, CCD prohibited coral mining within the coastal zone. Section 8 of the 1988 Amendment to the Act, (Appendix 2) specifically makes coral mining, collecting, processing, storing, burning and transporting illegal. The Amendment also clarifies and strengthens CCD's authority and the enforcement tools it has to halt illegal coral mining.

CCD Strengths: In addition to a clear legislative directive to stop coral mining, CCD is fortunate to have a staff which, though small, is experienced and dedicated. The director of CCD, from its inception through 1988 was S. R. Amarasinghe. Mr. Amarasinghe, an engineer who completed advanced training in the Netherlands, was Superintendent of the Coastal Planning Unit of the Colombo Port Commission before becoming CCD Director. In his position as superintendent, Mr. Amarasinghe criticized the *ad hoc* nature of coast protection and planning. Amarasinghe's arguments for systematic coastal planning, presented to the Secretary of the Ministry of Shipping in 1970, and to the full Cabinet in 1971, were instrumental in the process which eventually led to the formation of CCD and the passage of the Coast Conservation Act of 1981.

CCD benefits not only from the ability of its staff, but also from cooperation with outside consultants, both Sri Lankan and foreign. Local associates are frequently connected to local universities. Foreign consultants have been engaged with funds from international donor organizations. The success CCD has had in obtaining grant money has reinforced the credibility of its efforts in the eyes of the public and other government departments. The credibility of CCD gives the agency some leeway in experimenting with new approaches to coastal zone management.

Another skill CCD has displayed is an ability to handle managerial risk-taking. Rather than conceive of itself as an erosion management agency, it defines its objective as coast conservation. In

this context, erosion management is one aspect of a broader mission. The agency also has had to establish a place for itself among numerous government departments with some jurisdiction over the coastal zone. Table 2 summarizes the responsibilities of other key government agencies with authority and jurisdiction in the coastal zone of Sri Lanka. CCD has so far managed to compensate for a limited budget and small staff with professionalism and political finesse.

THE CORAL MINING INDUSTRY AND ITS IMPACTS

In certain parts of the southwestern coastal sector of Sri Lanka, coral has been mined for over 400 years. Coral is the principle source of lime for Sri Lanka's construction industry, supplying about 90 percent of the total lime used. Coral is also

used as an inexpensive source of soil 'sweetener' which reduces the acidity of agricultural soils.

Traditionally only relic reefs¹ behind beaches were mined. The impacts associated with mining relic, non-living reefs inland from the shore are negligible and not of particular concern to the government. But, as the construction industry rapidly expanded in the late 1960s and 1970s, so did the coral mining industry. The expanded industry began exploiting new sources of coral, including collecting coral debris from the beach and breaking and collecting the reef itself. With these new mining activities came new and significant problems.

¹ Relic reefs are geological formations. They are ancient reefs which, because of the geological process of shoreline accretion and change, are now found inland from the shore and buried under sand.

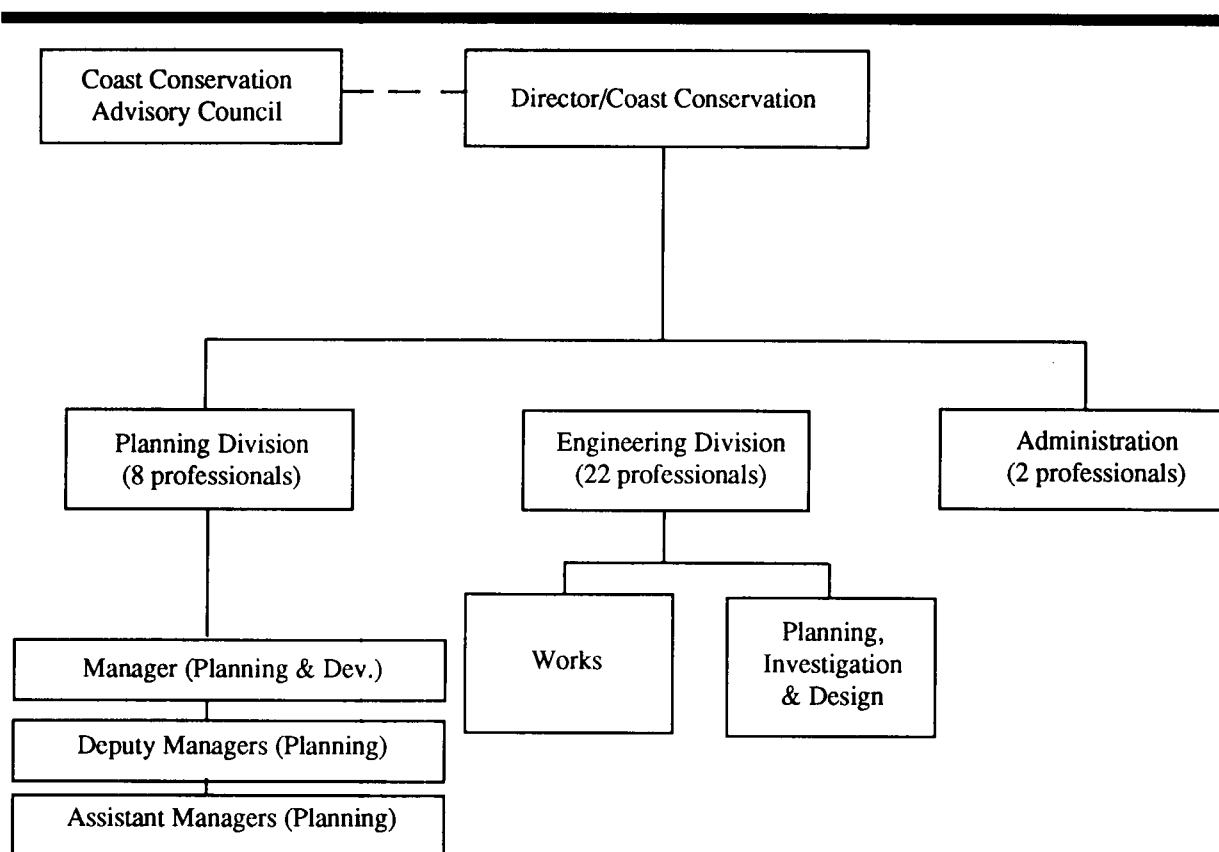


Figure 2. Sri Lanka Coast Conservation Department Organizational Chart.

Source: SLIDA, A Review of the Planning Division of the CCD, Sri Lanka Institute for Development Administration, January 1990, 9.

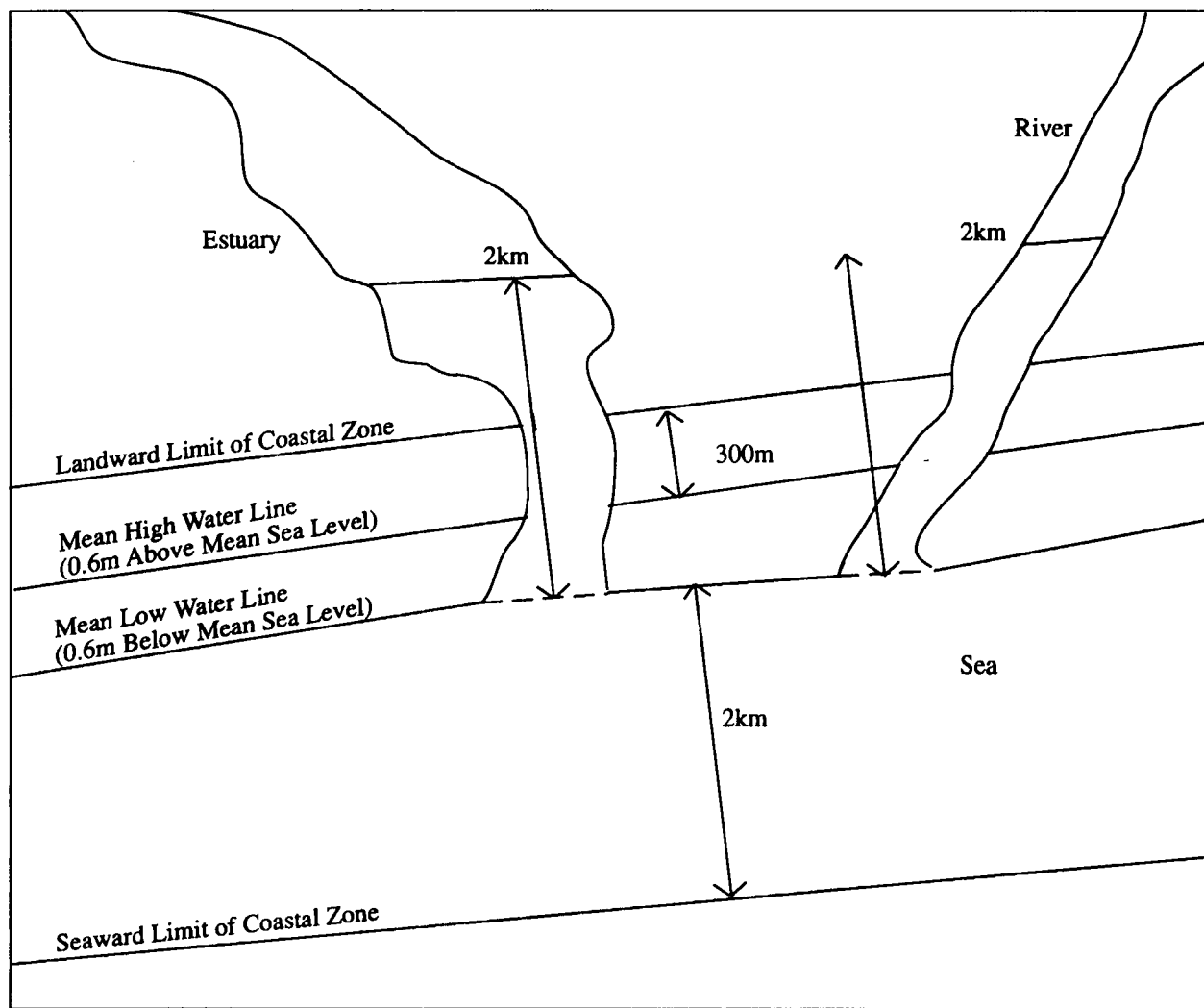


Figure 3. The Sri Lanka Coastal Zone.

The "Coastal Zone" is defined in the Coast Conservation Act as...

"That area lying within a limit of three hundred meters landwards of the Mean High Water Line and a limit of two kilometers seawards of the Mean Low Water Line and in the case of rivers, streams, lagoons, or any other body of water connected to the sea either permanently or periodically, the landward boundary shall extend to a limit of two kilometers measured perpendicular to the straight base line drawn between the natural entrance points¹ thereof and shall include waters of such rivers, streams and lagoons or any other body of water so connected to the sea."

¹By definition, the natural entrance points are defined with respect to the mean low water line.

Source: Sri Lanka Coastal Zone Management Plan, Coast Conservation Department, Colombo, Sri Lanka, 1990, 2.

Coral Mining and Erosion: Both coral debris collection from the beach and reef breaking can increase shoreline erosion, a serious coastal problem in Sri Lanka. Erosion occurs along many sections of the coast (Table 3). Coral debris is one source of beach material for Sri Lanka's beaches. By collecting large amounts of coral debris from the beach, the amount of material available for beach nourishment is reduced, accelerating erosion either locally or down drift. Reef breaking reduces the size of the fringing reef and its natural ability to absorb the energy of breaking waves. Without the protecting reef, the full force of waves strikes the shore, thus increasing the rate of erosion.

Coral Mining and Coral Reefs: Sri Lanka's coral reefs are concentrated in seven locations around the island (Figure 4). They grow slowly and are endangered by activities which remove more coral than is accumulated each year (2 to 20 cm.). Thus, a sustainable harvest of coral is believed by all experts to be impossible. Conserving reef habitat is essential because reefs serve a number of important functions, including protecting the shore against waves, providing a habitat for commercially valuable marine organisms, and serving as an important marine resource for tourism.

Characteristics of the Industry: In 1985, the CCD commissioned a special study of the coral-based lime industry and the socioeconomic impacts of a prohibition on mining. A synopsis of the study is found in the Annex. Key facts about the coral industry are as follows:

1. In 1984, the last year for which data are available, 18,059 tons of coral lime were mined, about 58 percent (10,527 tons) of it illegally from the coastal zone (Table 4). Illegally mined coral comes from relic coral mines located on land within the coastal zone, from coral rubble on the beach, and from mining live coral at sea.

2. Coral mining directly employs about 1,200 people along the southwest coast where most mining occurs. An additional 4,700 people are directly or indirectly dependent economically on lime production. The percentage of these workers dependent on the "illegal" industry in the coastal zone is not known, but is thought to be over half.
3. Coral mining is geographically confined to a few locations in Sri Lanka. Eighty-eight percent of those employed in the coral mining industry reside in the Hikkaduwa-Ambalangoda, Midigama-Ahangama, or Polhena-Matara areas along the south and southwest coast.
4. Those individuals engaged in the illegal coral mining industry in the coastal zone make a good living. Miners earn about 8,000 rupees (in 1987 this was equivalent to US \$320) during the four month mining season. This is equivalent to the average annual per capita income in Sri Lanka; and coral miners typically pursue other occupations during the other eight months of the year. Comparatively, earnings of land-based legal miners are much less.
5. CCD is required by law to find employment for any workers displaced by a CCD coral mining prohibition.

ALTERNATIVES TO CORAL AS A SOURCE OF LIME

While coral is currently a major ingredient of Sri Lankan lime, it is not indispensable to the manufacturing process. Producing high quality lime from crystalline limestone, dolomite, and miocene limestone is possible and certainly adequate for construction purposes, an important point since construction needs account for as much as 92% of lime use in Sri Lanka. Substitutes for coral are inadequate only where the chemical composition of the lime is at issue, and this is infrequent. Land deposits of coral can supply the small fraction

(8%) of total lime demand which requires coral lime.

Mining coral substitutes currently is not economically competitive. Collecting miocene limestone presents the greatest challenge. Major miocene limestone deposits are found on the Jaffna Peninsula in the northwest region of Sri Lanka (Figure 4). Deposits cover about 800 square miles and are quite deep. The areas where the stone is located, however, are heavily vegetated jungle regions which are almost inaccessible. Costs for mining and transportation of the material appear, under current conditions, to be too high to permit manufacture of competitively

priced lime. Sri Lanka's crystalline limestone deposits are also substantial. They are found along the southeastern coast and extend through the Sabaragamua and Central Province into the northeastern (Figure 4) region. These deposits are readily accessible and pose no major transportation problems. Further study of the location, chemical composition, and production costs for these limestone deposits is necessary, however, before any attempt is made to use them in lime manufacture on a large scale.

Table 2. Principal Government Agencies with Authority and Jurisdiction in Sri Lanka's Coastal Zone.

Thirty-two government agencies have jurisdiction over coastal areas and resources in Sri Lanka. Responsibilities of key agencies are summarized as follows:

- **Coast Conservation Department (CCD):** Planning, development, and regulatory jurisdiction from 2 km seaward to 300 meters landward of mean high water, with extended authority where inland waterbodies meet the sea. Responsible for building shoreline protection structures. Issues permits for coastal development activities on the basis of their location, impact on the coastal zone, and applicable policies of the Coastal Zone Management Plan.
- **Central Environmental Authority (CEA):** Principal coordinating agency for environment-related activities. Carries out environmental and educational programs. Establishes national environmental standards. Responsible for preparing a National Conservation Strategy, and overseeing Sri Lanka's environmental impact assessment process.
- **Urban Development Authority (UDA):** Planning and regulatory authority over building specifications within one kilometer of the coastline. Develops land use plans for coastal settlements experiencing rapid growth.
- **Ceylon Tourist Board:** Planning authority for tourist facilities and development.
- **Ministry of Fisheries and Aquatic Resources:** Management authority over fishery resources and the development of the fishery industry.
- **Ceylon Fisheries Harbors Corporation:** Responsible for fishery harbor development.
- **Ports Authority:** Supervises port development and management.
- **National Drainage and Water Supply Board:** Responsible for drinking water and sewer facilities.
- **Greater Colombo Economic Commission (GCEC):** Fosters economic development of the country by promoting foreign investment within the Republic. The GCEC has authority over approximately 415 sq km of coastal land on the outskirts of Colombo where it manages two export processing zones.

IMPLEMENTING THE PROHIBITION ON CORAL MINING

It should be noted that while illegal coral mining is relatively limited in geographic scope, that it is only one of multiple causes of both increased erosion and coral habitat destruction, and that the prohibition on coral mining in the coastal zone will cause a relatively small group of Sri Lankans to lose their livelihood, this issue has dominated the public's attention for almost a decade. In some respects the government's attention to repercussions of the mining prohibition seems out of proportion to the problem. Since CCD was given the responsibility of "solving the problem," agency staff have spent many hours dis-

cussing the socioeconomic and political dimensions of the problem, and it has become symbolic of CCD's ability to manage the coastal zone.

The southwestern coastal zone has been the geographic focal point of CCD concern. CCD has taken many steps to implement the prohibition on coral mining activities in this area. Consistently, from 1978 onward, the agency has attempted multiple initiatives in close succession. Intensive efforts to locate and assess alternatives to coral-lime began as early as May 1979. During the same period, CCD began work on plans to provide alternative employment for laborers in the coral mining industry. Shortly thereafter, in June 1979, CCD decided to carry

Table 3. Coastal Erosion and Accretion in Sri Lanka

Sector	District	Coastline in km	Erosion % of coast	Erosion rate m/yr	Accretion % of coast	Accretion rate m/yr	Net Erosion m/yr	Net Loss 1000m ² /yr
West	Puttalam	300	30-40	0.3-0.4	30-60	0.0-0.1	0.2-0.4	60-120
	Gampaha	40	60-70	N.A.-1.0	10-20	0.0-0.1	0.9-1.0	35-40
South- West	Colombo	40	40-50	0.0-0.1	N.A.*	N.A.	0.0-0.1	0-5
	Kalutara	40	70-80	0.1-0.5	20-30	0.0-0.1	0.0-0.4	10-20
	Galle	75	70-80	N.A.-0.3	0-10	0.0-0.1	0.2-0.3	10-20
South	Matara	55	N.A.-90	0.9-1.0	N.A.	N.A.	0.9-1.0	40-50
	Hambantota	135	40-50	N.A.-0.2	10-20	0.0-0.1	0.1-0.2	20-30
East	Ampara	110	40-50	N.A.-0.2	10-20	0.0-0.1	0.1-0.2	20-25
	Batticaloa	100	N.A.-60	0.1-0.2	N.A.-20	0.0-0.1	0.0-0.2	10-20
North- East	Trincomalee Mullaitivu	210	N.A.-40	N.A.-0.2	10-20	0.2-0.3	N.A.-0	10-0
North	Jaffna	275	60-70	N.A.-0.3	0-20	0-0.1	0.2-0.3	30-90
	Mannar	155	60-70	NA.-0.5	0-20	0-0.2	0.3-0.5	70-80
ALL COUNTRY		1,585	45-55	0.30-0.35	10-25	0-0.15	0.20-0.35	300-500

Above erosion/accretion data are based on interviews with long-term residents of respective coastal reaches. Wherever possible the accuracy of these personal experiences have been cross checked by comparing available maps. These figures should be treated as indicative.

*N.A. not available

Source: Master Plan for Coast Erosion Management in Coastal Zone Management Plan, Sri Lanka Coast Conservation Department, Colombo, Sri Lanka, 1990, 20.

out a census of workers in nearshore and reef mining activities. They also asked the government Geological Department to submit a survey report on inland coral deposits in the southwestern coastal zone.

By July 1979, CCD had outlined an action plan for developing alternative sources of lime. The plan included the following key elements:

- that all state organizations involved in building activities use a government-produced cement substitute for coral-based lime
- that a program be developed in Matale District for producing dolomite-based lime.
- that the Greater Colombo Economic Commission, which has authority over the export processing zones on the outskirts of the capital, allocate 500 jobs as alternative employment for coral miners
- that other alternative employment for displaced miners be created by building two new power loom textile centers, one at Akurala and a second at Habaraduwa, providing fishing boats, developing the fiber industry to give dependents of coral miners a way to earn supplementary income, and constructing a synthetic textile mill at Ratgama

In late 1979, CCD got a boost from the highest levels of Sri Lankan government. Both the Presi-

dent and the Prime Minister issued important letters of support. The President urged his Ministers to help CCD implement the prohibition on coral mining, but no action was taken. The Prime Minister directed the Ministry of Local Government, Housing and Construction to withdraw all permits for the operation of lime kilns within the coastal zone, but operation continued. At the end of 1979, CCD ran a one-day seminar in Ratgama to educate coral miners about coral mining issues. While awareness increased, compliance did not. Further meetings with government officials, lime kiln owners and miners produced similar results. CCD concluded it had been given the responsibility, but not the authority to stop coral mining.

With the Coast Conservation Act becoming operative in 1983, CCD developed permit procedures, and, by policy and regulation (see Appendix 1, Section 12), made coral mining a prohibited development activity within the legally defined coastal zone.

CCD Policy on Coral Mining: The Sri Lanka Coastal Zone Management Plan, which was prepared by CCD in 1986 and adopted by the Cabinet in 1990, states:

“It is the objective of the CCD to preserve and where possible restore coral reefs.

Table 4. Coral Collected for Lime Production from Sri Lanka's Southwestern Coastal Area in 1984.

Location of Coral Collected	Amount (in metric tons)	Total Harvest (% of total)
<i>Relic Reefs on Land</i>		
• inland of the coastal zone	7,532	42
• within the coastal zone	2,868	16
<i>Coral Rubble on the beach</i>		
• within the coastal zone	5,377	30
<i>Live Coral at Sea, from the Reef</i>		
• within the coastal zone	2,282	12
Total	18,059	100

Policy 3.2.3.1 Breaking of reefs, collecting of debris and mining of coral is prohibited in the Coastal Zone.

Policy 3.2.3.2 The socio-economic impacts of the coral mining prohibition will be mitigated through CCD coordination of inter-agency efforts to provide alternative employment to displaced coral miners.

Policy 3.2.3.3 Alternative sources of lime will be sought to meet the requirements of the construction and agriculture industries.

Policy 3.2.3.4 Areas where reef restoration will impede erosion and provide additional habitat will be identified."

Implementing the Prohibition: At a meeting with police officers of the Galle and Matara Districts in 1984, the police told CCD that the Act required additional provisions if CCD's policy was to be enforced. As stated, the policy and laws behind it allowed police to stop only those "caught in the act of mining coral." Throughout 1984, CCD labored to reshape the Coast Conservation Act to address the officers' criticisms. Discussions with the Attorney General and Legal Draftsman led to amendments. Section 8 of the 1988 Amendment to the Coast Conservation Act (Appendix 2) strengthened CCD's authority to stop coral mining. The amendment specifically prohibits coral mining in the coastal zone and imposes severe restrictions on the removal, possession, storing and processing of coral and the operation of lime kilns in the legally defined coastal zone.

Where possible, CCD has aggressively worked with police to seize illegally mined coral, and to resettle and re-employ coral miners. A police raid in the Galle District netted a cache of illegally mined coral, as did a September 1989 raid undertaken in the Galle and Matara Districts. Destroying illegal kilns in the coastal zone was seriously considered by CCD, but ultimately rejected as too politically provocative.

As part of CCD efforts to shift coral workers to other employment, agency staff met in March 1986, with 300 coral mining families. CCD officials proposed that these families resettle at the Mahaweli agricultural areas. The families indicated willingness to resettle, but in October, when 41 families received plots in the first phase of the resettlement scheme, only 9 families accepted lands assigned to them. CCD continues to refine resettlement plans in the hopes of making them more attractive to coral miners.

The agency is also exploring other work alternatives, including "toddy" (a local wine made from coconut sap) tapping, the fishing industry, and employment in the aquaculture industry. Discussions were held with miners in late 1986 regarding potential employment in the aquaculture industry, however, aquaculture employment does not offer financial returns on a par with coral mining. Experience with giving coral miners boats for fishing has also had problems - some boats were used to mine coral. CCD has been unable to get other agencies to give priority attention to the employment generation issues of the miners.

The coral mining community is aware - because of CCD education efforts and the publicity surrounding coral mining - that the industry is unsustainable and causes damage to important resources. This knowledge, however, has not been enough to change behavior.

THE POLITICAL IMPORTANCE OF PROHIBITING CORAL MINING

The prohibition on coral mining has become an important aspect of the CCD program. Coral mining is prohibited because coral reefs are valued - as a natural first line of defense against the erosive forces of the sea, as a habitat critical for fisheries production, and as an economically valuable asset for tourism. It is important to remember, however, that coral mining is only one of a number of factors responsible for Sri Lanka's eroding coast. Nonetheless, this broader

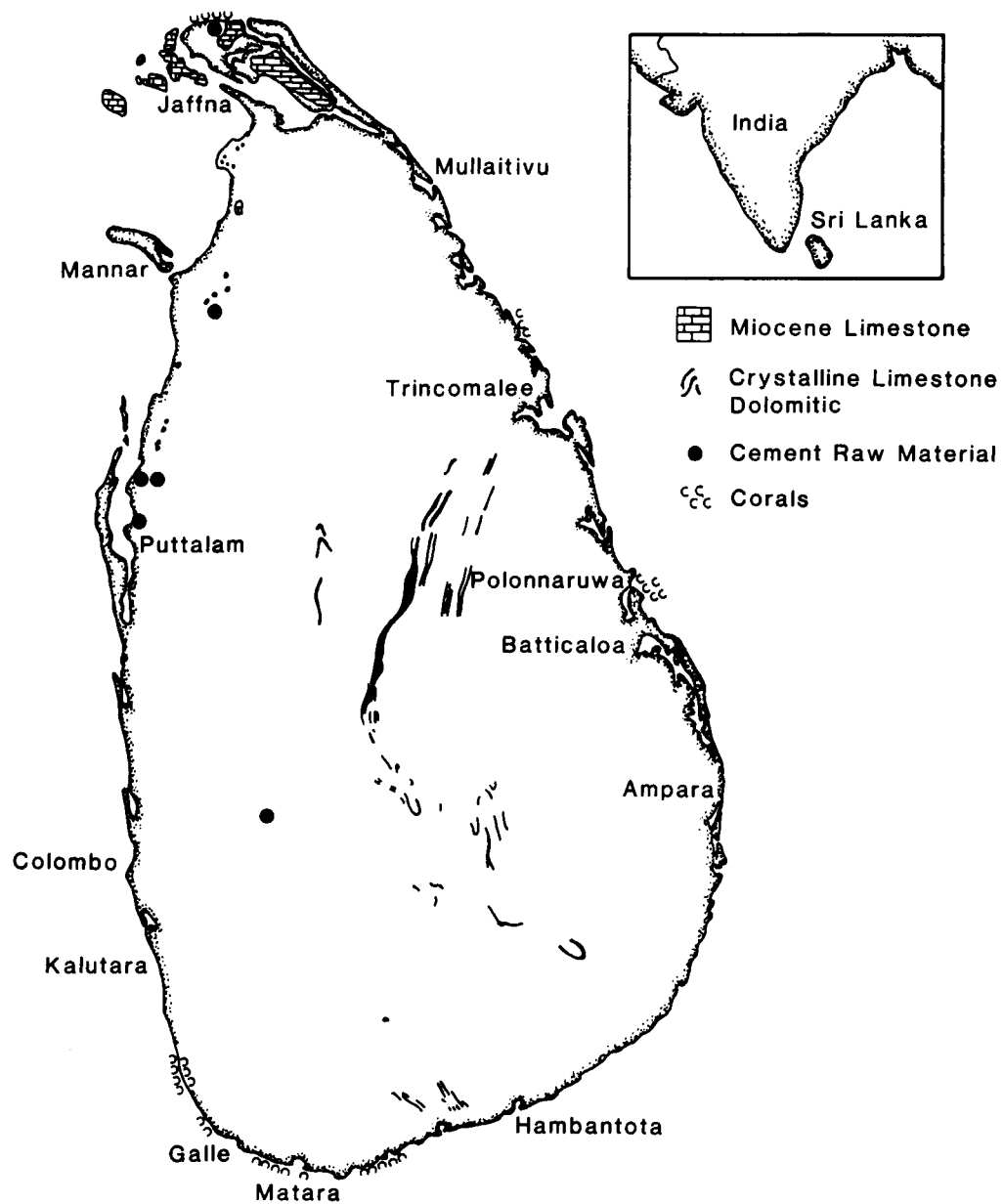


Figure 4. Mineral Resources and Coral Reefs in Sri Lanka.

Source: The National Atlas of Sri Lanka, The Survey Department, Sri Lanka, 27.

perspective is counterbalanced by the symbolic dimensions of making the prohibition on mining work. By prohibiting coral mining, CCD has put its credibility on the line. It must prove that its regulations are meaningful and that the Department has the will and capability to see them enforced. Though only a fraction of Sri Lanka's coast, economy and work force are affected, CCD's very limited staff continues to devote much attention to implementing the coral mining prohibition.

WHAT NEXT?

In determining what to do next, CCD has asked you, its expert consultant, to advise them as they try to answer the following troubling questions:

- Assess the management techniques used to date and advise on how existing regulations could be enforced more effectively
- Should existing regulations be changed?
- What non-regulatory initiatives might CCD undertake to make the coral prohibition work?
- What are the reasonable limits of CCD's responsibility to find alternate employment for coral miners?
- What additional information needs to be gathered?
- Should the coral mining prohibition be continued?

PLEASE GIVE CCD YOUR ADVICE.

ADDITIONAL READING

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CORAL MINING IN SRI LANKA



Mined coral on the beach.



A coral kiln used for lime production.



Coral stockpile ready for burning in the kiln.



Coral lime being transported.

SRI LANKA'S CORAL MINING INDUSTRY¹

HISTORY

The British colonial administration of the island undertook considerable commercial development of the Sri Lankan coast towards the end of the 1800s and the beginning of the 20th century. Many inland residents moved to the coast in search of work in the cinnamon, toddy, and related industries. The subsequent decline of the cinnamon industry and impact of the temperance movement on the toddy industry were major blows to the growing coastal population. During the same period, however, the increased demand for housing along the coast proved a boom to the construction industry. To meet the demand for housing, the construction industry required increased quantities of lime, a major building material. Since coral was an ingredient in lime-making and was available along the shoreline, some coastal residents turned to coral mining for their livelihood. The coral mining industry quickly established itself as a significant economic sector and public monies were spent to provide support services. As early as 1895, for example, trains were transporting coral lime from a special railway yard built at Hikkadawa for that purpose. Those involved in coral mining gained in status and respect as the industry developed economic importance.

DEMAND FOR CORAL

As much as 92 percent of Sri Lankan coral lime is used as plaster in building. This figure is derived from a survey of 228 public officials, businessmen, and private citizens who purchase lime regularly. Based on the survey, about 74 percent of lime used in construction is purchased by private sector institutions, 14 percent by private citizens, and 3.5 percent by one government institution-the Building Materials Corporation (BMC). The remaining 8 percent of lime is purchased by government institutions and departments other than the BMC, specifically the Ceylon Ceramics Corporation, the Sugar Corporation, the Fertilizer Corporation, and the Cement Corporation. These institutions must have coral lime for their purposes because of its chemical composition. In contrast, however, lime from coral substitutes amply meets construction requirements where 92 percent of the coral lime is presently used.

EXTENT OF CORAL

Coral in Sri Lanka occurs in the form of sea reefs and land deposits. Land deposits are from relic reefs. There are two principal zones of land deposits, the first to the south, between Ambalangoda and Devinawara, and the second in the east, from Valachanai to Kalkudah (see Figure 3). In the southern zone, coral mining conflicts with several other general categories of land use activity. These activities include provision of tourist services and natural habitat preservation. The living coral reefs of Sri Lanka are more scattered than its land based coral deposits, with some overlap between zones of land based coral deposits and living coral offshore reef areas. During colonial times, only land deposits were mined. Now coral fragments are collected from beaches and living coral reefs are mined to keep up with demand from the construction industry.

¹ A synopsis of the Report: *Socioeconomic Survey of Those Engaged in the Coral Industry on the Southern Coastal Zone from Ambalangoda to Dikwella*. A. Premaratne, Coast Conservation Department, Colombo, Sri Lanka, July 1985.

WORK PATTERNS

The work patterns of many in the coral industry are tied to the monsoon season. During months when work is available, coral industry workers collect coral an average of 20 days per month. Those who work on land spend additional days per month digging the pits from which land coral is removed. Only kiln owners and workers who mine coral on land have work 12 months per year. The majority of coral miners work along the beach and offshore and are therefore unable to work when the weather and waves are excessively rough. Of the 58 percent of miners employed on the beaches and off the coast, only 18 percent are able to work between seven and nine months per year. Shorter work periods, (less than six months per year) are more common. The workday of coral miners based on land is generally eight hours or more. Other coral miners work days are of varying length depending on sea conditions.

QUANTITIES MINED

It is difficult to estimate how much coral is mined annually in Sri Lanka. Approximate figures are available for the southwestern and southern coastal belts where most coral is mined. Data on the amount of coral mined is available only from 1984 for the nation's southwest sector. Land based coral mining was estimated to be 10,400 tons of which 2,868 tons were taken illegally within the coastal zone. Coral collected from beach areas totaled 5,377 metric tons. Coral removal from the sea totaled 2,282 metric tons. A total of 18,059 tons of coral was collected, of this 7,532 metric tons or 42 percent was legally mined outside the coastal zone and 10,727 metric tons or 58 percent was illegally collected from within the coastal zone (Table 4).

LIME PRODUCTION IN THE SOUTH

Data available for kiln operation in the coastal districts allows study of the lime production industry and its relation to coral mining. The construction of additional lime kilns inevitably increases the demand for coral. Permits were required for kiln operation in the coastal zone prior to the Coast Conservation Act of 1981. Issuing permits for kilns was one way to control the number, and hence the demand, for coral. Review of permitting policy, however, indicated that many kilns were being built without permits.

1. Kiln Ownership: Most of the kilns in the coastal zone are operated by their owners. About 25 kilns, however, belong to absentee owners who lease them to operators. The absentee owners have relatively little power in the local community. The owner-operators, on the other hand, have a reasonable amount of political leverage since they are well-off and typically support three workers apiece.
2. Location of Kilns: Most kilns are built close to shore to reduce transportation costs. Along the southern coast, for example, 65 percent of all lime kilns are located in the area defined as the coastal zone by the Coast Conservation Act (Table A-1). The location of kilns in proximity to coral mining activities simplifies the process of selling coral once it is collected.
3. Frequency of Kiln Operation: In the study area, many kilns (61 percent) operate throughout the year. Another 10 percent produce lime most of the year (nine to twelve months), and 14 percent are in use for six to nine months. Year-round kilns tend to be in the Werallana-Akurala zone, with

occasional year-round kilns established in the Midigama-Ahangama area. Kilns built in the Madiha-Polhena vicinity, another important coral mining district, are generally run for less than 12 months per year. Most kilns do not have a regular weekly schedule. The amount of lime produced at a time by a given kiln depends on its size and whether it is filled to capacity. The best available estimate puts average lime production per kiln load at 631,680 pounds.

4. Cost of Raw Materials for Lime Production: The traditional method of lime production in Sri Lanka requires coral, seashells, and mangrove, coconut, or other trees for firewood. The most important raw material used is coral. Prices paid for a cart load of coral at the kiln door vary considerably, but are typically 100 to 200 rupees per load depending on the quality of coral collected. There are also regional variations in price that depend on the ease of collecting or mining coral. Generally it requires seven full carts of coral for one kiln-load of lime. The other major expense for lime production is the cost for fuel wood, typically about 700 to 800 rupees per kiln-load.

INCOME OF CORAL MINERS

1. Income from Land Coral Mining: Mining coral outside the coastal zone is not illegal. Conditions for those who dig coral in coral mines landward of the coastal zone are not considered good. Mine workers have regular work but at low wages, with daily earnings ranging from 15 to 30 rupees depending on age and sex. Yearly income for a male between 25 and 50 years old is about 6,000 rupees. Mine workers are the most dissatisfied group of coral workers since their wages are not commensurate with the difficulty of the work and the length of the working day (frequently 10 hours). While mine owners argue that their coral mines should remain open because they provide a living for many workers, the workers themselves feel exploited and express strong interest in other employment. Many who collect coral illegally on the beach or from the sea do so to avoid working in the coral mines.

2. Income of Sea Coral Miners: Those who mine coral at sea earn high incomes during the four months when they can pursue their trade. Sea miners' earnings over these four months generally total 8,000 rupees, considerably above the normal civil service salary. Averaged out over the year, however, the sea miners' salary would be low, only 667 rupees/month. In fact they earn more than 667 rupees/month because they engage in other trades during the eight months when they cannot mine coral. Besides high return for labor over a short time period, sea coral miners enjoy both the risks and rewards of self-employment.

3. Income from Removing Coral Debris: Removal of coral debris from the beaches is illegal but widespread. How much an individual can make by picking coral off the beach is determined by the number of collectors competing for the same coral, the amount of coral to be found, and the quantity of coral which can be found from other sources in the same region. Other factors which influence earnings are the age and sex of the collector and the hours per day that the individual devotes to picking coral. Many children and women collect beach coral on a part-time basis during the hours they are not engaged in school activities or household duties. As a rule, however, earnings of both men and women engaged in picking beach coral full-time can be considerable. In the Hikkaduwa-Akurala region, for example, earnings of 12,000 rupees for eight months are common. Workers in the Midigama-Ahangama area frequently earn even more, sometimes as much as 18,000 rupees over eight months. Not surprisingly, picking beach coral is a popular source of income and supplemental earnings in those areas where there is a plentiful supply of coral and less competition to gather it.

4. Earnings of Coral Mine Owners: Mine owners earn a good return on their investment. The profit depends on the thickness of the coral vein they own and the labor required to mine it. Usually a mine owner spends 100,000 rupees to buy one fourth acre of land. He must also lay out capital for engineers to remove water from mining sites and for the wages of, on the average, 50 to 100 laborers. On a daily basis this outlay is estimated at 1,000 to 1,500 rupees.

5. Earnings of Kiln Owners: Owning a kiln is more profitable than owning a coral mine. The going rate for a bag of lime from the kiln is about 30 rupees. One kiln load generally produces 140 bags of lime or 4,200 rupees worth of lime per kiln load. After subtracting production costs of 3,340 rupees, kiln owners are left with an 860 rupee profit per load. At the rate of only four loads per month, kiln owners net 3,440 rupees/month or 41,000 rupees/year. While not all kilns are operated as frequently as 4 times a month, all kiln owners are believed to make a yearly profit in excess of 25,000 rupees.

6. Wages of Kiln Workers: Kiln workers do not share their employers' good fortune, averaging only about 600 rupees/month, or 7,200 rupees/year. Furthermore, they may spend up to 15 hours a day at physically demanding labor. Workers' health is endangered by the taxing nature of the work and by fumes and dust produced during kiln operations. As a result of low pay and poor working conditions, many kiln workers are favorably inclined to changing jobs if good alternative employment was available.

WILLINGNESS OF CORAL WORKERS TO CHANGE EMPLOYMENT

The willingness of coral miners to seek other employment depends on a number of factors. One factor is where they work. In the Madampagama and Kahawa area, for example, miners express interest in alternative employment. Coral mining in this area is done on land, often outside the coastal zone. Daily income of the miners is variable. In the Telwatte, Seenigama and Peraliya areas, on the other hand, coral is mined both on land and in the sea, with industry-related activities concentrated in the coastal zone. Many lime kilns are also in operation here. Since most coral workers in the area do well financially, they are not interested in alternative employment. In yet another location, the Midigama-Ahangama zone, an area of combined land and sea mining, workers are leaving the coral industry in substantial numbers.

A second factor affecting willingness to seek other employment is the length of time a worker's family has been connected with coral mining. Families settled in one area and engaged in coral mining for several generations are likely to resist pressure to change their employment if they suspect adverse effects to their income or social status may result. Recent entrants to the industry may be more ready to accept other employment. Prior to the 1981 Coast Conservation Act, coral miners were required by law to apply for coral mining permits. Of those engaged in coral mining, approximately 43.7 percent were authorized to work under the permitting system. While the majority (63 percent) of this group are from families traditionally engaged in coral mining, 37% have independently turned to coral mining for their livelihood. Almost three-quarters of this latter group has been mining since 1975.

A third element which bears on how miners feel about leaving the coral industry is their age and educational level. Older miners question their ability to learn new skills or to make the other transitions required in the course of changing occupations. Less educated miners may find that there

are few employment alternatives open to them. They are hesitant to consider even those jobs available because of the relatively high earning standard that the coral industry offers them. The income from mining is so high that it has even attracted a small number of high school graduates. In general, workers in the coral industry tend to be young - fully 58 percent in the industry are under 35 years of age, 75 percent are under 45 - and less educated. Roughly 75 percent of coral industry workers have a ninth grade education or less. Another 24 percent have studied beyond ninth grade.

Another factor which workers must weigh in contemplating employment change is the effect such change will have on their dependents. The effect on workers' dependents is at least in part related to the number of dependents, age, and educational level. According to statistics compiled by the Coast Conservation Department, coral workers' dependents are most often their children. Workers' children constitute almost four-fifths of all dependents fully or partially supported on coral mining income. Of this group, 47 percent are under age 15 and, for the most part, seem still to be in school. A few of the older children are still in school as well, but the majority seem to be unemployed. Some (a small fraction) have already begun working in the coral industry themselves. Workers may hesitate to stop mining coral because of the potential disruption to their children's education or to their ability to feed their families. Where not only the head of house but other family members also sometimes mine coral, a transition to work other than coral mining may be especially burdensome.

EMPLOYMENT ALTERNATIVES

CCD has been directed to find alternate employment for coral miners. It is interesting to note that this mandate has been given to CCD rather than to some other government agency. The assignment of the task to CCD stems from the level of concern felt in Sri Lanka for displaced workers. By mandating CCD to care for displaced coral miners, the government ensures that CCD will consider the welfare of workers in coastal industries in the process of managing Sri Lanka's coastal resources.

Whether coral miners can find alternate employment is dependent on a number of factors, including the skills and experience of the individual worker. One group with suitable skills for alternate employment is the 9 percent of coral workers who use income from coral mining to supplement earnings from their principal occupation. These workers, then, are already qualified to work at other occupations besides coral mining. Workers in business, fishing, and agriculture are most likely to engage in coral mining as a sideline. Devoting more time and effort to their primary employment may allow such workers to stop mining coral without excessively adverse affects on their living standard. Those who are principally employed in coral mining but who also work outside the industry form a second group with skills which should help them find alternate employment relatively easily. Unfortunately, changing occupations may prove a frustrating experience for many coral miners operating in the coastal zone, especially for those with limited skills and/or education.

The most popular solution for assisting coral workers to leave the industry is undoubtedly the proposal that they turn to fishing. Many in the Akurala-Kahawa district favor the construction of a fisheries harbor in the area. They argue that the facility would allow a majority of coral industry workers to stop mining and become fishermen. Experience, however, has shown this not to be a good alternative. A program to give miners boats was implemented, however, in many cases the boats were used for more efficient coral mining rather than fishing.

Of those involved in the coral and lime industries, coral workers are the group in the most vulnerable economic position. Deprived of their income from coral mining, many would be hard-pressed to find alternate employment without government assistance. The least vulnerable group economically (20 percent of those in the coral and lime industries) includes lime transporters and sellers, and kiln owners. This group, overall, is now in a stable economic position. In some cases, they may be able to take advantage of coral substitutes to continue their present business. A second large segment of this group will be able to divert their capital to other commercial enterprises.

Table A-1. Location of Lime Kilns in the Southwest Coastal Zone.

Location	No. of Kilns	Percent
<i>Within the Coastal Zone</i>	134	65
<i>Outside the Coastal Zone</i>		
Between the landward limit of the coastal zone and the Colombo-Galle Matara main road	15	7
More than 1/4 mile from the beach	46	22
Particulars not available	13	6
Total	208	100

Table A-2. Duration of Employment in the Coral Mining Industry (1985).

Period	Number Employed	Percent
1-3 years	160	35
4-6 years	114	25
7-9 years	46	10
>10 years	137	30
Total	457	100

TRAINER'S NOTES

EXPERIENTIAL LEARNING AND THE CASE STUDY APPROACH

Most adults learn by experience. As professionals move through their careers, they must continually make decisions in real time about management issues within their area of responsibility. The most valued managers are those with experience, who have learned what works and what does not work in the real world. They reflect on their past experiences, generalize and infer lessons from their experiences, then apply these lessons to similar situations. This produces more effective behavior and improved performance the next time they encounter related issues. Trainers refer to this cycle as the experiential learning process, and it is considered the most effective approach for adult learning.

Case studies attempt to mimic the real world experiential learning process by simulating real life situations, albeit in a condensed and simplified version. As with teaching mathematics and physics, a key to success in teaching coastal management in the classroom is practice with problem exercises. Students need exposure to a number of resource management issues and problems whereby they can exercise their analytical problem solving abilities. Case studies in coastal management are most useful after students have obtained basic knowledge about coastal ecosystems and the concepts of resources management planning.

This case study on coral mining is an exercise which requires students to practice their problem solving abilities. The coral mining issue itself is not the important element of the case. The problem could just as well be conversion of mangroves to shrimp ponds, estuarine pollution and water quality management, or tourism development and coral reef protection. What is important is the problem solving process, sorting through and utilizing information, addressing ambiguities and uncertainties, thinking through the potential consequences of alternative actions, and finally, deciding on a course of action. The coral mining case also focuses on the specific problem of implementing a prohibition of a specific activity within the legally defined coastal zone.

The case study method is used widely in professional business and public administration education programs. The Harvard Business School pioneered the use of case studies in their Masters in Business Administration program and has produced numerous articles promoting the use of the case study method. While most of their literature is about business management cases, the approach and techniques described are transferable and applicable to resources management case studies. Harvard publications¹ that are helpful reading if you are interested in learning more about this method include:

Teaching and the Case Method, by C.R. Christensen

Hints for Case Teaching, by B.P. Shapiro

The Role of the Instructor in Case Method, by K.R. Andrews

Case Method Teaching, by R.E. Corey

¹ Available from the Harvard Business School, Publishing Division, Operation Department, Boston, MA 02163 USA

THE ROLE OF THE INSTRUCTOR

A number of factors lead to success when using case studies. The instructor needs to set a tone at the beginning of a course which informs all participants that discussion is expected. To do this, the instructor needs to emphasize his role as a facilitator. This means the instructor keeps the discussion focused, stimulates discussion by asking questions, and allows students to explore and discover on their own. A good facilitator does not try to impose his own viewpoints as the only right answers, as this can stifle discussion. The instructor can and should voice his own opinion or comments as an informed observer and expert, and invite contrary viewpoints to be argued. This also helps stimulate discussion. One measure of a successful discussion is if students do more talking than the instructor.

Different teachers have different styles and approaches with which they feel most comfortable. There is no one right way to use this case or the method in general. Each instructor and group of students are different. The case may run well with one group of students one day and not well the next, for no apparent reason. Using case studies as a teaching method takes time and requires patience. The first time an instructor uses this method is most difficult. Instructors learn from their experiences and get better at using the case study teaching approach each time it is used.

Concerns are often raised as to the applicability and transferability of training methods and management techniques across cultures. We have used case studies with national groups in Latin America, Asia and the United States, as well as in mixed classes with students from a variety of cultures. It is our belief that the case study approach can be used successfully anywhere. The group dynamics and means by which communication and discussion occur will, however, vary in different settings. Creative instructors and trainers in other cultures can adapt this case and its presentation so that it is an appropriate and effective learning technique in the context of their own culture and socio-political situation.

USING THE CORAL MINING CASE STUDY FOR TEACHING COASTAL RESOURCES MANAGEMENT

A. Purpose

The purpose of this case is to provide students with an opportunity to exercise their analytic capabilities to assemble and sort through information in order to formulate recommendations for a government agency. Students are challenged to think critically and try to solve a pressing resources management problem. This is precisely what real coastal managers do every day. Its purpose is not to have students memorize facts and figures concerning Sri Lanka's coastal zone management program or about coral mining.

B. Target Audiences

This teaching case study is designed to be used in a classroom setting. It can be used by university students in a graduate program or in short courses and training programs on natural resources and environmental management for government managers, private sector representatives or non-governmental organizations.

C. Guidelines for Session Planning

Assignment of the Case: To be successful in using this case in a teaching setting, it is important that students be prepared for the discussion. Therefore, they must read the case prior to its presentation

and discussion (the week prior to or evening before classroom discussion). One professor who used this case required written answers to the “What Next” questions (located at the end of the case) to be handed in at the beginning of the class period. This was effective and ensured that students completed the background reading and thought about the questions ahead of time. In addition, the “homework assignment” was counted as part of their grade.

It is useful to review the Sri Lanka Coastal Zone Management Plan as context prior to introducing the coral mining case study, or have a reference copy available for the students. (Copies of the Sri Lanka Coastal Zone Management Plan may be obtained from the Coastal Resources Center or the Sri Lanka Coast Conservation Department²). However, the case contains sufficient background information so that it can be run effectively by itself.

Suggested Structure and Timing of the Classroom Session: A total of two to three hours of time is needed for the entire session. The case's facts and events can be presented by the instructor in a short lecture of approximately 20-30 minutes prior to discussion. The rest of the time should be programmed for discussion (a minimum of 30 minutes to as much as two hours).

It is suggested that this case be used with groups of no more than 20-30 participants. In larger groups, with participants who seem reluctant to initiate discussion, or with individuals new to the case study approach, smaller discussion groups may be preferable. The smaller groups can each be given a few of the questions to discuss in detail and then report back to the large group their findings and recommendations. Alternatively, each small group can answer the same questions and then the different recommendations from each group can be compared and discussed. This format usually requires more time to implement with at least 30 minutes for the smaller group discussion, an additional 30 minutes for the smaller groups to report back to the larger group, and some additional time for a large group discussion and wrap up. Since this approach requires each small group to select a spokesperson to report back to the larger group, it allows students an opportunity to make a presentation to their peers and respond to questions. Short student presentations provide another useful experience, as coastal managers must often speak in public meetings and defend their decisions and actions to both the public and their superiors.

As part of the final large group discussion and wrap up, it is important both to analyze CCD's specific situation, as well as draw linkages and generalizations from the Sri Lanka case to other coastal management situations.

D. The Physical Setting

The classroom's physical arrangement can help to facilitate discussion. Chairs and tables in a U-shape or circle are preferred to the typical classroom arrangement of rows that all face towards the instructor. The U-shape or circle makes it easier for students to talk to each other and the instructor. With rows all facing forward, students tend to always reply to the instructor in front of them instead of talking with each other.

E. Facilitating the Classroom Discussion

While there are not necessarily right and wrong answers to the questions posed in the section of this

² University of Rhode Island, Narragansett Bay Campus, Narragansett, RI USA 02882 or the Coast Conservation Department, Maligawate Secretariat, Colombo 10, Sri Lanka.

case entitled “What Next,” to possible answers which could be expected from the students or which the instructor may wish to raise for discussion are listed below. **They should not be given to the students prior to discussion, but may be handed out afterwards.** Alternatively, you may wish to record, type up and hand out to the students their own outputs about what to do about the coral mining issue.

1. *What were the management techniques used to date?*

Management techniques used:

- Prior to the Coast Conservation Act, coral mining was regulated through permits, much the same as sand mining is today.
- Coral collection and mining became a prohibited activity in the coastal zone after the adoption of regulations by CCD. Coral collection in the coastal zone is allowed by permit for research purposes.
- A number of non-regulatory management initiatives were taken by CCD, including a public education program that included a series of meetings with kiln operators, coral miners, and local police. These efforts were initiated after the coral mining prohibition was a CCD policy.

2. *How existing regulations could be enforced more effectively?*

- Increase community education to support law enforcement efforts.
- Attain directives from the police commissioner allowing local police to give high priority to coral mining violations.
- Educate judges, magistrates, and police that illegal coral mining is a serious crime.

3. *Should existing regulations be changed?*

For example:

- CCD should phase out coral mining activities over a period of years rather than try to enforce an immediate prohibition.
- Regulations should not change again so soon after the 1988 amendments. The government must give current regulations a chance to work.
- Regulation of coral mining could be implemented by licensing coral miners in selected areas, limiting the amounts removed, strictly enforcing the prohibitions in the critical habitat areas, allowing coral mining in the coastal zone from land based relic reefs, and allowing the collection of coral rubble on the beach but, not live coral from offshore.

3. *What non-regulatory initiatives might CCD undertake to make the coral prohibition work?*

For example:

- Community education is needed to change the political context and make enforcement possible.
- Other groups that depend on reefs (tourism, fisheries) need to organize themselves to politically balance coral miners.
- A participatory planning process might be initiated to address coral mining within an overall management and development plan for the areas where mining occurs.
- CCD should head a concerted inter-agency effort to develop alternative lime sources.
- The government could consider implementing incentives or taxing alternatives, including imposing taxes on coral-based lime, or providing subsidies to locally produced non-coral

based lime, or allowing for the importation of similar quality lime while at the same time subsidizing its price if it is of higher cost than locally produced coral lime.

4. *What are the reasonable limits of CCD's responsibility to find alternate employment for coral miners? (Will more people begin coral mining in an attempt to be included in re-training programs?)*

For example:

- CCD should not have to find alternative employment as this is not part of the agency's primary mission and mandate. It is a no win situation. CCD should create high level ministerial pressure to get a social service agency designated as lead on this aspect of the coral mining prohibition strategy.

5. *What additional information needs to be gathered?*

For example:

- CCD needs to design and implement a study on the amount of coral mined, the number of miners, the change in reef condition where mining occurs, beach erosion rates where mining occurs, and lime utilization by the construction industry.
- A simple monitoring system to determine trends in mining and impact.
- Specific information on the negative impacts of coral mining needs to be obtained.

6. *Should the coral mining prohibition be continued?*

For example:

- Allowing coral mining to continue may be seen as a sign of weakness or failure of CCD to carry out their mandate. It could lead to an increase in coral mining in existing mining areas as well as in new locations around the country. A programmed phase out period for coastal zone coral mining might give miners and kiln operators time to adapt and seek alternative employment.
- Mining of live coral from the reef corals could be prohibited, while collection from relic reefs and coral rubble found on the beach allowed.
- Coral mining could be regulated like sand mining, and the amounts of coral extracted, location and number of miners restricted.

F. Generalizing about Designing and Implementing Coastal Management Programs from the Coral Mining Case Study

While coral mining is a coastal management issue found only in a few countries worldwide, this case study illustrates some of the problems of implementing a use prohibition. The environmental and resource management problem is easily defined, but finding a workable management solution is much more difficult and elusive. The lessons concerning the difficulties of implementation, which are learned from this case, can be applied anywhere in the world by individuals developing national, regional or local coastal management programs. It is important to include in your closing remarks and discussion of the case, generalizations concerning issues of implementation, and application to other country situations with which students are familiar.

This case study can be analyzed in the context of the entire process of designing and implementing a coastal management program: defining and analyzing management issues, understanding the management framework, and turning policies into action. The following outline can be used as a

discussion guide (or potential exam essay questions) for placing the CCD experience in the more general framework of coastal management program planning, design and implementation.

1. *Defining and Analyzing the Management Issue:*

- What is the physical problem?
- What is the political issue?
- Is coral mining an issue due to increased shoreline erosion, the destruction of coral reef habitat or both?
- Has CCD defined the coral mining issue too narrowly?
- What difference does it make how a management issue is defined?

2. *Understanding the Management Framework:*

- What authority does CCD have to stop coral mining?
- What are the constraints in the authority which CCD has and which reduce its ability to enforce the coral mining prohibition?
- Does CCD have or require additional support from other agencies to stop coral mining?
- Stakeholder³ Analysis:
 - What groups of people are affected by this issue? (e.g. kiln operators, miners, police, fishermen, beach hotel managers, etc.)
 - What is each group's interest?
 - What is the relationship of each group to the other?
 - What pressures can each group bring to bear on CCD?
 - How can the various stakeholders for a specific issue be mobilized to help solve the management problem.

3. *Turning Policies into Action:*

- What special implementation problems are there with prohibited activities?
- What tools are available for increasing compliance to prohibited activities? (e.g. vigorous enforcement, social pressure, economic incentives, etc.)
- How could the lack of enforcement of a prohibited activity affect an agency's other program activities?
- Should enforcement of prohibited activities be directed at the supply or demand side of the industry (i.e. in the coral mining case, should enforcement activities be directed at miners, kiln operators or lime buyers and why?)

4. *Application of the Coral Mining Case to other Geographic Locations and Issues:*

- What lessons from this case are applicable to CRM in you locality or in other countries?
To CRM in tropical countries; in developing countries; or in industrialized countries?

³ Stakeholder is a term which refers to groups or individuals who have an interest in the management issue, utilize or compete for the use of the resource with others, use the same area where the resource is located, have an economic interest in the decisions to be made, or have authority or jurisdiction for management.

PROMOTING THE CASE STUDY APPROACH FOR TEACHING CRM

As a teacher or trainer you should feel free to revise and modify the proposed method of using this case study based on your own experience with it. Feedback and comments on how you used this case and its effectiveness as a learning and teaching tool would be appreciated. We are also interested in innovative ways you have adapted it, and we would like to hear about other cases on CRM issues and problems you may have developed or used, and are willing to share with other educators in the field. You should also feel free to copy any or all sections of this case for student use, or for other instructors who are interested in using it, as long as proper reference is made to this publication.

We hope you and your students will have as much enjoyment with this case as we have had using it in the classroom, and in the process, learn more about the challenges faced by coastal management practitioners.

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