

Managing Aquaculture Resources

Introduction

Time: 15 minutes

In this lesson we will explore ways that aquaculture can help meet the U.S. Congress' last key characteristic of sustainable food production systems: **enhancing the quality of life for farmers and for society as a whole.** This is perhaps the most difficult of the seven key criteria for sustainable food production to define and understand. However, throughout the world we see more and more examples of conflicts over resources due to different viewpoints in society about how resources should be used, who should benefit from resource use, and how fair and sustainable resource use can be ensured. Therefore, we will focus on alternative strategies for managing resources, comparing voluntary, regulatory, and economic approaches to allocating scarce resources.

Read the *Background Material on Water Laws, Regulations and Agencies in Aquaculture* (pages 6-9). This information will help you understand the regulatory environment faced by aquaculture farmers. For students with a **9th grade or higher reading level**, you may want to assign this material as a homework assignment. For students with an **8th grade or lower reading level**, we suggest that you explain the concepts included in the material to your students.

Getting Ready

Time: 30 minutes

- Ask each student to partner with the person sitting next to him/her. Give each pair five minutes to share one example of a law, rule, or regulation that influences what they do in their everyday lives. An example might be safety belt laws.
- Tell the students to discuss why they follow the law or rule. Point out that there are three key reasons why people usually obey laws or rules. (1) They agree with the rule and follow it voluntarily. (2) There is a penalty for breaking the rule and people believe that the probability that they will get caught and be punished is significant - a regulatory approach. (3) There is some incentive or reward for following the rule.
- Write each team's response on the chalk board under one of three categories: (1) voluntary, (2) regulated, (3) incentive. Have students analyze the similarities and differences between the laws or rules that ended up in each of the three categories.

Purpose

To compare and contrast voluntary, regulatory, and economic approaches to managing aquaculture resources.

Key Concepts

Sustainable food production systems should enhance the quality of life for farmers and for society as a whole.

Learning Objectives

Students will be able to:

- Describe and provide an example of voluntary, regulatory, and economic approaches to managing natural resources
- Compare and contrast the pros and cons of the three approaches
- Analyze conflict and collaboration using two of the three approaches

Subjects

Social Studies
Science
Government

Doing the Activity

Time: 2 hours

The classroom activity for this lesson focuses on how different groups benefit or lose, depending on how natural resources are managed. This module is designed to focus on the economic analysis of different management options and on collaborative approaches to reaching agreement about how resources should be managed. You may want to point out to students that in the U.S. we have often taken a highly regulatory approach to these issues and ask students to compare these approaches as they work through this activity. We have adapted a case study dealing with different options for managing a mangrove forest (Dixon, J.A.; Scura, L.F.; Carpenter, R.A.; and Sherman, P.B. 1995. *Economic Analysis of Environmental Impacts*. Earthscan, London, England. See pages 133-140, "Mangrove Valuation in Bintuni Bay, Irian Jaya, Indonesia).

- Have students read Student Page 19, *What's All This Fuss Over Mangroves?* and Student Page 20 *Mangroves at Peril -- How Should We Manage Bintuni Bay?* either as a homework assignment or in class, to gain an understanding of the importance of mangroves in marine ecosystems. We have provided you with a large-print description of some of the functions of mangroves that you may want to use to discuss the concepts included in the student reading (page 10).
- To complete the activity students will have to know what the different options are for managing the mangroves. We have provided a large-print description of the management options (page 11) that you can use to explain the options to your class. The same information is provided on Student Page 21. Make sure that students understand the differences between the options before they attempt to complete the activity.
- Students will have to understand what the different groups of stakeholders have to lose or gain in the decision about how to manage Bintuni Bay. The material on pages 12-16 describes how different groups in the area affect Bintuni Bay with their activities and how they use the resources in the bay. You can use these pages to discuss the different stakeholder groups with the students. We have also provided explanations of these groups and their interests on Student Pages 22-26. As you assign students to the different stakeholder groups, make sure that they receive a copy of the student page that describes the group to which they belong.
- Finally, students will have to be able to interpret Table 1, *Summary of Discounted Net Benefits*. This table shows the discounted (taking inflation into account) monetary benefits of the different management options over the next 90 years. For example, consider the column labeled "Local Uses." Under the Cutting Ban option, the mangroves remain as a local resource where people can gather fuelwood or hunt. Since the mangroves are important to many

Materials

Pencils
Copies of Student Pages
Transparencies of pages 10-18

Extensions

What Does Regulation

Cost? Students can research one of the different agencies listed below that farmers typically interact with in establishing and maintaining a commercial aquaculture facility. Each student should find out what the mission of the agency is, when it was first formed, current budget allocated to the agency by public or private sources and how it regulates aquaculture production in your area. Have students develop a poster of their information for a class conference on the role of regulation in aquaculture.

At the conference have students place their posters on the walls of the classroom. Open the conference telling the students that we are expecting upcoming government budget cuts and president has convened this conference to get advice on which agencies should continue to be funded and which no longer are needed for regulating the aquaculture industry. Divide the students into four groups. (1) Small government team -- taxpayers who do not want to pay any more money for government agencies.

species of fish and shellfish eaten locally, it maintains these populations. Over the next 90 years, economic analysis shows that these local uses will have a value of 399 million dollars. On the other hand, the Cutting Ban option will not permit any commercial wood cutting, so the monetary benefit for "Wood Cut" is zero. Table 2 simply shows the *difference* in net benefit between the cutting ban option and all other management options. We have provided large-print versions of these tables for you on pages 17 and 18 that you can use during class discussion. We explain how to use the tables on Student Page 27 and the tables are included on Student Page 28.

- Divide the students into the five teams listed below. Each group should pick a fun name for their group. The Stakeholder Groups are:
 1. Local harvesters of fish and shellfish
 2. Forestry companies that harvest mangroves
 3. Commercial shrimp producers
 4. Commercial farmers
 5. Government and its supporters
- Give each team 30 minutes to meet and decide which of the four management options to argue for at the town meeting (see below) and why.
- Before the town meeting, the students should prepare their arguments. Have them use drawings, charts, diagrams and other tools to help make their case. Make sure students prepare Student Page 29 before the town meeting.
- Call a town meeting and have the representatives from each group explain their approach and arguments for it in a three-minute presentation. Record which management option each group chooses and their key arguments for the option on the chalk board. Have the students discuss the management options to see if they can reach a consensus. Do two or more groups have similar reasons for supporting their options? Where are the areas of agreement? Has anyone altered their original opinion after hearing all of the presentations? (Note: In this real life case study there is no happy or easy solution. In other words, not every group can win. Have the students discuss other alternatives such as having the forestry companies look for other businesses or a different tree species to use in their products.)
- After the final discussion, have the students vote on the options. Evaluate the impact of this choice on the five different stakeholder groups. Ask the students which group will benefit the most or the least from this choice. As a group, discuss whether

(2) Need government team - taxpayers who believe that many agencies are needed to manage the complicity of aquaculture systems. (3) Future Generations team - representatives of future generations who want to be sure that there are resources left for them. (4) Aquaculture producers team - producers who want to make a living in aquaculture.

It is the job of each team to define what their main concern is about regulating aquaculture. Then the teams should circulate in the room to gather information and rank the top five agencies that they feel must be included for aquaculture to be a sustainable industry. The teams should also gather any information they need for any agency they decide to cut.

Convene the budget session and give each team two minutes to present their case. On the blackboard, make three lists: (1) agree, (2) undecided, and (3) no disagree. List the agencies where all the teams agree (to include it, for example) under "agree." List those agencies where all the teams are undecided under "undecided." If the teams disagree about whether an agency should be included, list the agency under "disagree."

regulation, incentives, or voluntary compliance would be needed to enforce the selected management option.

An Alternative – Develop Your Own Local Case Study

With all the conflicts over resource management that we experience today, there is probably an example in your own community that is of equal or greater interest to your students. You may want to develop your own case study and use it instead of our example from Bintuni Bay. Or, you may want to use our example as a “warm up” to help prepare students to develop their own local case study. In either case, we hope you find our approach useful. If you do, we encourage you to use a similar approach in which the problem is defined, stakeholder groups are identified, different management options are presented, and economic as well as other considerations are considered in arriving at a solution. Good luck!

Quiz Questions

- Give an example of two laws that you follow in your everyday life because there are incentives and list what the incentives are.

Examples include doing chores on time for an allowance, studying hard for an exam for a grade, or a bonus paid for getting to work on time every day for a month.

- What is the difference between surface water use rights in the United States?

Water use rights vary by geographical location. Riparian law applies in the east and prior appropriation in the west in general. However, some states regulate water use administratively. Different laws or regulations may apply to ground water and surface water.

- If you were an aquaculture producer, name two agencies that would affect your operation and explain their role in regulating your production.

Ten of the most common government agencies are listed in the *Extension* for this lesson, *What Does Regulation Cost?* Some are also listed at the end of the *Background Material on Water Laws, Regulations, and Agencies in Aquaculture*.

- List two of the water quality tests used by the EPA (Environmental Protection Agency) for measuring the quality of effluent discharge.

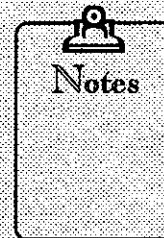
Solids, dissolved oxygen, pH, ammonia-nitrogen, phosphorus, BOD, and toxics are all possible answers.

- True or False: If toxic chemicals are found in the effluent discharge from your aquaculture facilities, but all the other six water quality measures are excellent, you will not receive a fine.

On round two give each team another two minutes to discuss only the agencies in the undecided category. Again record the results on the board under the three categories.

To close the conference discuss with the students what they have learned about regulation, budget decisions, and conflict situations for managing natural resources.

The Background Material lists several agencies involved with aquaculture. For more agencies see the U.S. Dept of Agriculture's 1992 book entitled, *Aquaculture: A Guide to Federal Government Programs in the National Agricultural Library*.



False. There is always a fine or penalty for toxic chemicals in waste water.

Want More Information?

Want to know what all the fuss over mangroves is about? Visit the Mangrove Action Project at:

<http://www.earthisland.org/ei/map/map.html>

Netcoast will teach you all about Coastal Zone Management, including the importance of mangrove swamps, with their on-line tutor:

<http://www.minvenw.nl/projects/netcoast/index.htm>

The Florida Mangrove Gallery has some neat pictures of mangrove habitats. Click on "habitats" to get the story of a drop of water, including what happens to it when it flows past a mangrove swamp.

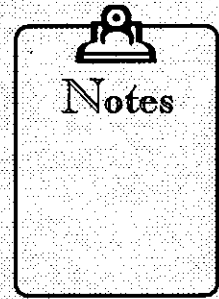
<http://www.sptimes.com/aquarium/FA.2.1.html>

The Mangrove Replenishment Initiative is trying to replant mangroves. They can tell you all about the ecological importance of mangroves.

<http://mangrove.org/>

World Conservation Monitoring Center is developing an atlas of maps of all the mangrove swamps in the world. See if it's done yet:

http://www.wcmc.org.uk/infoserv/marine/mc_mang.html



Background Material on Water Laws, Regulations and Agencies in Aquaculture

Where Do Water Laws Come From?

There is no one, uniform set of laws governing use of water in the United States. The rights that you have to use surface water for aquaculture depend on where you live in the country. There are three different kinds of legal systems that regulate how water is used.

In the eastern states, **riparian law** is followed. This means that you must own the land next to a body of water in order to have the right to use the water. Riparian law originated from English Common Law in a time when water was plentiful. Therefore, riparian law does not specify how much water can be used. As water has become scarce in many of these states, there has been considerable disagreement about how to define “reasonable use” of a waterway. According to the original law, you could take as much water as you wanted if you owned the land. Today, this is much more problematic. Just imagine trying to use water to start a fish pond near a stream that already has an electric plant guzzling millions of gallons of water right upstream!

A system called **prior appropriation** is used in the western states. In this system, the first person to claim the right to use water has a right to use it, regardless of land ownership. In these states, land ownership does not mean that you necessarily have the right to use the water on your land. When the western states were first settled, people tried to follow riparian law. However, water was scarce and problems arose from gold miners trying to divert water for mining. By 1860, some new way of giving water use rights to people was clearly needed. Water rights followed the same “first come, first served” rule that governed mine claims. The state still “owned” the water, but individual people had a right to use the water from the source where they had a claim.

Other states, such as Florida and Minnesota, developed an **administrative regulatory system** to govern water use. In this system, different water

uses are assigned a priority. For example, in Minnesota, domestic use has first priority, consumptive uses of less than 10,000 gallons per day second priority, irrigation or agricultural processing third priority, hydroelectric power generation fourth priority, and so on. In Minnesota, a farmer who needs water to build a fish pond has a higher priority water use than a hydroelectric plant. In Florida, the state is divided into five water management districts. Each water user must acquire a permit from his/her local water management district to be able to use water.

Do all of these different water use rights also give you the right to pollute the water? The answer is *no*. In order to stem water pollution problems from point-source discharges throughout the country, the Clean Water Act was passed. It sets standards for effluent quality and rates of discharge into water bodies.

Water use rights for ground water are different from those for surface water. If the water is **percolating**, which means that it is not connected to a surface stream, a separate set of laws comes into play. Why have two different sets of laws? In many cases, using ground water is like mining water because it is not easy to replace ground water. Most states specify that a landowner has “reasonable use” rights to the ground water on his/her property. However, there is a lot of debate over what is “reasonable use” of ground water on private property. The Safe Drinking Water Act, administered by the Environmental Protection Agency (EPA), sets the standards for treatment of ground water on public land. The question remains whether the government should be able to regulate how you use water on your private land. What do you think?

Agencies and Aquaculture

The newness and small size of the aquaculture industry has led to conflict among regulatory agencies that work with health, clean air and water, and environmental protection. These agencies have

often tried to make regulations for aquaculture by simply revising existing agricultural laws, without taking into account how different this food production system is from most others. For example, the industry involves many different species, including catfish, trout, shrimp, crawfish, salmon, tilapia, ornamental fish, oysters, and clams, just to name a few. Each of these species has different natural resource requirements and produces different impacts on the environment. The Aquaculture Act of 1980 called for better coordination of the various regulations affecting aquaculture.

Regulations

Water use, effluent discharge, production, and marketing are the four areas of regulations that typically affect aquaculture. There are many water use permits which may be required for a fish farmer. Some examples are ground and surface water, wetlands, well, access permits to a water body such as a water column lease, waterway and pond construction permits, and water quality certification. Depending on the state, aquaculture production facilities that use less than 10,000 gallons of water per day may be exempt from some or all of these regulations. What is the case in your state?

Effluent discharge is regulated by the National Pollutant Discharge Elimination System (NPDES) of the EPA. Permits are needed, based on the type and size of your facility. For example, warm water aquaculture production systems such as catfish, crawfish, striped bass, baitfish, and ornamentals which produce more than 10,000 pounds of fish per year and discharge effluent for more than 30 days per year must have permits. In contrast, cold water systems (salmonids) that use more than 5,000 pounds of feed, produce more than 20,000 pounds of fish per year, and discharge more than 30 days per year need permits.

Keep in mind that the states have the authority to modify the requirements for permitting. All but nine states have developed their own regulations. A few states have simplified the permitting process into one form which saves the aquaculture producer lots of time and money. As we learned in the lesson on water quality, solids, dissolved oxygen, pH, ammonia-nitrogen, phosphorus, BOD, and toxics are

usually monitored. Waste water discharge costs money. Many places have an annual discharge fee based on flow rates (\$1 per 1,000 gallons) and a discharge application or fee (\$50 to \$1,000). A fine or penalty will be charged if toxic chemicals are found in the water.

Production permits are to assure the public that your aquaculture facility will not spread any parasites or pathogens, disrupt natural ecosystems by introducing exotic species, or damage existing agricultural and industrial operations. Usually, the State Fish and Game Department controls permitting. Types of permits include aquaculture, importation, transportation, species, propagation, collection, and stocking permits. In many states the aquaculture permit also covers all sales and marketing permits. However, in other states it does not and additional permits are needed for wholesale fish dealers, retail sales, processing, restaurants, and fee fishing.

Unforeseen Consequences of Regulations

Managing natural resources is a very complicated activity. Policy planners, resource managers and government regulators try to include the needs of both people and the environment when designing regulations. Assessing natural resource use involves researchers who collect current data on the state of the natural system and the people who use it, a list of different management options and predictions of how each management option will impact both the natural resource and as many of the people who depend on the resource as possible.

Unfortunately, there are many conflicts and compromises because natural resources are not capable of sustaining every use that we may demand or two different groups of people want to use a resource in ways that are not compatible. For example, one forest can not be used for both paper production and as a park if one group of people wants to harvest all the trees at once while another group of people wants to create walking trails. Sometimes even after we have carefully sorted out all the different needs of people and limitations of natural resources to arrive at a new regulation, we have not predicted all the effects of implementing the regulation. How many times have you planned

something that did not work out exactly as you had planned?

Let's look at an example of the impact of several new regulations in the marine fishing industry on coastal communities in Florida. Commercial inshore net fishing has been a way of life for the past two to three generations of people living along Florida's coastline. However, Florida's population is growing very rapidly. As more people have moved to Florida, the number of sport or recreational fishermen has increased to over four million.

In order to conserve fisheries stocks, regulations on fishing gear, time on the water and species fished were enacted from 1989 to 1993 for commercial inshore net fishermen, but not for recreational fishermen. The result has been that a growing number of commercial net fishermen are having a very difficult time earning a living from fishing (S. Smith. 1995. *Social Implications of Changes in Fisheries Regulations for Commercial Fishing Families*. Fisheries 20(7):24-26). Many are not able to pay the bills, have stopped their health insurance policies to minimize expenses, and their wives are working at outside jobs instead of assisting with fishing. In some communities a net ban was voted on and passed which eliminated commercial net fishing altogether. One woman summarized her experience with the increasing regulations:

"There are thousands of people who are depending on fishing to feed their families and provide a roof for them to live under. I think that the people on these commissions don't have to worry about that. They are very well educated and have good backgrounds and their families will always have a place. They will always have good food and they don't have to worry about it. They don't see my three little girls. When they pass these laws and they take another \$100 a week out of their mouths, they don't see them" (Smith, S. and M. Jepson. 1993. *Big Fish, Little Fish: Politics and Power in the Regulation of Florida's Marine Resources*. Social Problems 40(1):1-11).

As development continues to expand, more and more decisions will have to be made about how to manage natural resources and who will benefit. The impact of these decisions could have a tremendous

impact on the sustainability of aquaculture as an industry.

Some Federal Agencies that Affect Aquaculture Production

National Oceanographic and Atmospheric Administration (NOAA) - National Marine Fisheries Service (NMFS). NMFS has been mandated to design the Model Seafood Surveillance Project which is "a program of certification and surveillance to improve the inspection of fish and seafood consistent with the hazard analysis critical control point system (HACCP)."

U.S. Army Corps of Engineers. They become involved in aquaculture primarily where construction of ponds in wetland areas is concerned. Also, they become involved when a physical structure is to be placed in navigable waters that would conflict with dredging or navigation matters.

U.S. Food and Drug Administration - Investigation. Their primary involvement is seafood inspection, including the aquaculture industry. They inspect seafood processing plants for sanitation, farms for drug/chemical compliance, pesticide contamination, and sanitation, and feed mills for illegal ingredients and aflatoxin in the feed. As part of the inspection, FDA may inspect labeling for truthfulness in presented product information, including net weight and use of additives (e.g., adding sodium tri-poly phosphate to increase water weight).

U.S. Department of Agriculture (USDA) - Agricultural Research Service (ARS). ARS maintains several research laboratories throughout the U.S. where they gather scientific research information and distributes that information nationwide in a monthly publication called *Agricultural Research*.

U.S. Department of Agriculture (USDA) - Natural Resource Conservation Service (NRCS). This service has helped the aquaculture industry by providing assistance to farmers in pond site selection, design, and construction.

U.S. Department of Agriculture (USDA) - Animal Damage Control (ADC) - (part of Animal and Plant

Health Inspection Service (APHIS) under USDA. ADC's goal is to help solve problems that are caused when wildlife cause damage to agricultural, urban, or natural resources or present a threat to public health and safety. The ADC became involved in aquaculture because of bird depredation on aquaculture resources, primarily fish. Most of the birds that cause the depredation are classified as migratory and are therefore protected under the Migratory Bird Treaty Act.

U.S. Department of Agriculture (USDA) - Agricultural Stabilization and Conservation Service (ASCS). Aquaculture is not considered agriculture by ASCS and ponds are not considered farm land, so aquaculture enterprises do not qualify for ASCS programs except under unique circumstances. The emergency feed program implemented during drought includes aquaculture only if the farmer is raising a crop such as corn, that can be used as a feed source directly from the field (soybeans would not be eligible because they are not used directly as feed).

Discussion Questions

What are the sustainability issues in managing Florida's marine fisheries?

What do you think the impact of new water regulations to limit number of gallons used could have on pond operators? What about tank systems?

What Do Mangroves Do?

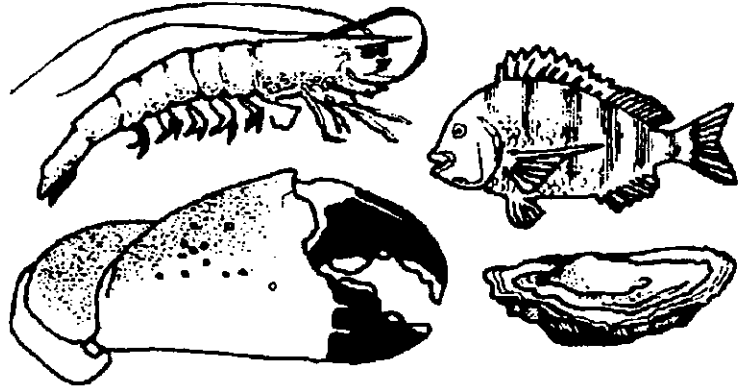
- **They are the basis of a complex marine food chain.**
- **They create habitat where many organisms breed, including fish and shellfish.**
- **Their prop-like roots make places where the young of many species find protection from predators.**
- **They filter and assimilate pollutants from the land.**
- **They help prevent coastal erosion.**
- **They improve water quality.**
- **They stabilize bottom sediment.**

The Options

Option	Description
Cutting Ban	The total mangrove area (304,000 ha) is maintained in a virgin state.
20-Year Clear Cut	The total harvestable area of 240,000 ha (the other 64,000 ha cannot be harvested for technical reasons) is cut over once only during a 20-year period of time.
30-Year Rotation, 80% Selective Cut	80% of the total harvestable area is cut over and over again on a 30-year rotation; that is any one place will be re-cut once every thirty years.
30-Year Rotation, 25% Selective Cut	25% of the total harvestable area is cut over and over again on a 30-year rotation.

Local Harvesters of Fish and Shellfish

Local people eat large amounts of fish and shellfish. The mangroves are the place where many of these organisms reproduce or



spend part of their life. If the mangroves are destroyed, the amount of fish and shellfish available for local consumption will decline.

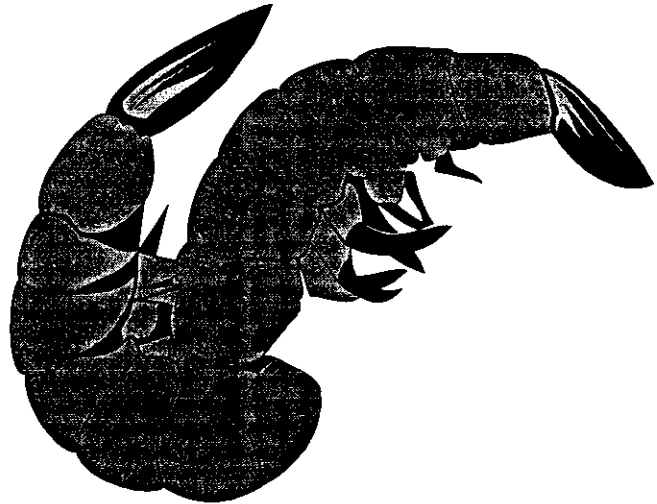
Forestry Companies

Forestry companies have begun to harvest mangroves commercially in recent years. They cut down the trees and chop them up to make wood chips which are used in many wood products. The forestry companies are the largest local employer.



Commercial Shrimp Producers

Commercial shrimp production, or mariculture, has become much more important in Bintuni Bay in recent years. Shrimp producers are not yet cutting down many



mangroves to make ponds for their shrimp. However, this has happened on a very large scale in many other countries and in other parts of Indonesia. Shrimp producers depend on catching juvenile shrimp in the mangroves to stock their ponds. Local people catch them and sell them to the commercial producers, providing an important source of income for many people.

Commercial Farmers

Commercial farmers are having problems with erosion in Bintuni Bay.

The sediments that wash off of their farm land have negative effects on the mangroves and

on many of the organisms that live in the mangroves. The mangroves, on the other hand, help prevent shore erosion and they filter out some of the materials that are carried in the runoff from the land.



Government and Its Supporters

The government wants to put a ban on cutting mangroves.

They would like to make a nature reserve. Many local people, other people in Indonesia, and environmental organizations around the world

support this plan. They argue that the vital roles that the mangroves play in marine ecology and in preserving biodiversity make preserving the mangrove forest the number one priority.

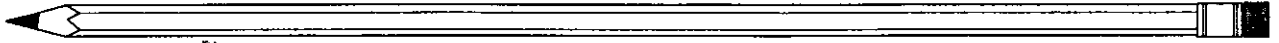


**Table 1. Summary of Discounted Net Benefits Results
Over the Next 90 Years
(Millions of Dollars in 1991 constant prices; discounted at 7.5%)**

Choice	Local Uses	Erosion Control and Water Quality	Wood	Shrimp	Agri-culture	Biodiversity	Total
Cutting Ban	399	145	0	1,016	546	131	2,237
Clear Cut (20 years)	295	102	756	824	440	74	2,491
80% Select Cut	339	119	532	908	487	95	2,481
25% Select Cut	383	138	166	986	530	120	2,321

Table 2. Marginal Change from the Base “Cutting Ban” Choice

Choice	Local Uses	Erosion Control and Water Quality	Wood	Shrimp	Agri-culture	Biodiversity	Total
Cutting Ban Base	399	145	0	1,016	546	131	2,237
Clear Cut (20 years)	-104	-43	+756	-192	-106	-57	+254
80% Select Cut	-60	-26	+532	-108	-59	-36	+244
25% Select Cut	-16	-7	+166	-30	-16	-11	+84



What's All This Fuss Over Mangroves?

What Are Mangroves?

Mangroves are trees that form forests along the seashore in tropical and sub-tropical environments in many parts of the world. Their roots grow out of the sides of the trunk of the tree from a height that may reach several feet above the water line. They look like they're propping up the tree. Mangroves are **halophytes**, plants that can live in salty conditions. That's why they prosper in the brackish and salty waters of estuaries, lagoons, and bays.

What do Mangroves Do That's So Important?

Mangroves are an important part of the ecology of coastal zones. The Mangrove Replenishment Initiative lists six of the most important beneficial effects mangroves have on marine ecology:

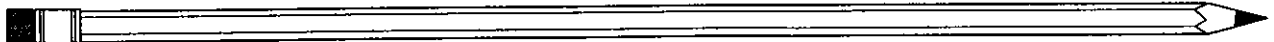
- They are the basis of a complex marine food chain
- They create habitat where many organisms breed, including fish and shellfish
- Their prop-like roots make places where the young of many species find protection
- They filter and assimilate pollutants from the land
- They help prevent coastal erosion
- They improve water quality
- They stabilize bottom sediment

The Initiative describes how critical mangroves are to the food chain. They say:

"The tree is the foundation in a complex marine food chain and the detrital food cycle. The detrital food cycle was discovered by two biologists from the University of Miami, Eric Heald and William Odum, in 1969. As mangroves leaves drop into tidal waters they are colonized within a few hours by marine fungi and bacteria that convert difficult to digest carbon compounds into nitrogen rich detritus material. The resulting pieces covered with microorganisms become food for the smallest animals such as worms, snails, shrimp, mollusks, mussels, barnacles, clams, oysters [and other species]. These detritus eaters are food for carnivores including crabs and fish, subsequently birds and game fish follow the food chain, culminating with man. Many of these species, whose continued existence depends on thriving mangroves, are endangered or threatened."

Are Mangroves in Trouble?

Yes, they are. Mangroves are being destroyed all over the world. Sometimes they are cut down for their wood. In other cases, they are cleared to make space for marine aquaculture, or **mariculture**, especially for making ponds to raise shrimp. In other cases, urban or tourist development of beach-front property causes the trees to be cut.





Mangroves in Peril How Should We Manage Bintuni Bay?

Bintuni Bay is located in Irian Jaya, Indonesia. According to the Food and Agriculture Organization (FAO) of the United Nations, Indonesia is the world's tenth top fishing nation. Indonesians catch 2.7 million metric tons of fish and seafood each year. It is a coastal area with 304,000 ha of mangroves. The map on the page 30 shows where Indonesia is in the world, and points out Irian Jaya and Bintuni Bay.

There are many different *stakeholders* or groups of people with a common goal or interest who use the resources of Bintuni Bay. **Commercial shrimp producers** in the area earn over \$35 million annually from cultured shrimp. **Commercial farmers** have cleared 15,000 ha to grow their crops and erosion contributes to the problems in the Bay. There are 3,000 **local residents** who use the mangroves to make things and who harvest fish and shellfish from the Bay to eat. **Forestry companies** cut mangroves and chop them up to make wood chips. The **government and its supporters** would like to conserve 267,000 ha of the Bay, including most of the mangrove forest and some of the Bay itself, by establishing a nature reserve. The Bintuni Bay Nature Reserve would benefit many people in the country by preserving the unique biodiversity of the ecosystem for future generations. You will be assigned to one of the five different groups of stakeholders. You will receive a description of how you use the Bay -- and perhaps of how you contribute to the Bay's problems. Read it carefully.

There are several different possible management strategies for Bintuni Bay. Each will have a different impact on the various stakeholder groups that use the Bay's resources or contribute to the problems in the Bay. Four management options are currently being considered. A town meeting to decide which plan will be used is scheduled for next week. You will be one of a group of people representing your stakeholder group. You need to figure out which management option is best for you and for the people of Bintuni Bay in general and argue for it at the town meeting. The different options are described on page 21.



The Options for Managing Bintuni Bay

Option 1: The Cutting Ban

Under this option, the entire 300,000 hectares of mangrove forest in Bintuni Bay will be placed under a cutting ban. A total of 260,000 hectares will be put into a nature reserve, which would include 140,000 hectares of mangrove and 60,000 acres of the Bay itself (all areas to the 10 meter depth line). The 140,000 hectares of mangrove forest that would be inside the reserve would be protected forever. The remainder of the mangrove forest includes 64,000 hectares of mangrove that cannot be harvested using current technology and 96,000 hectares of mangrove that can be harvested, but would not lie within the boundaries of the reserve. These 96,000 hectares would be saved from cutting now under the cutting ban, but would not have the permanent protected status of the mangrove forest included in the reserve.

Option 2: A 20-Year Clear Cut

Under this option, the total 240,000 hectares of harvestable mangrove forest would be cut over once during the next 20 years. None of the forest would be maintained in a virgin state. No one knows what would happen at the end of the 20-year period. People could decide not to cut again, they could allow any mangrove that had regrown to be cut again, etc.

Option 3: A 30-Year Rotation, 80% Selective Cut

Under this option, 80% of the total harvestable area of mangrove forest would be cut down over the next thirty years. The remaining 20% would be left in a virgin state. Mangrove forest regrows in Irian Jaya in about 30 years. The 80% that is cut would therefore be cut every thirty years; that is, any one hectare will be re-cut once every thirty years.

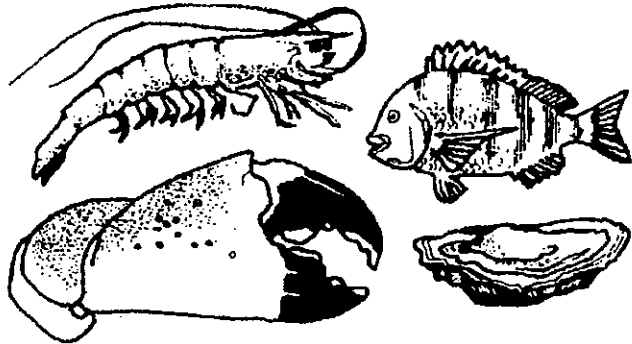
Option 4: A 30-Year Rotation, 25% Selective Cut

Under this option, 25% of the total harvestable area of mangrove forest would be cut down over the next thirty years. The remaining 75% would be left in a virgin state. Again, any one hectare in the area where cutting is allowed would be re-cut every thirty years.

Hello! We're the _____

We are local people who depend greatly on the plants and animals in Bintuni Bay for our very lives. There are 3,000 of us living along Bintuni Bay. We make so many things from the mangrove trees that it's hard to name them all. We make the spoons we use to eat and the combs we use in our hair. Many of our medicines come from plants in the mangrove forest.

Without the trees, we wouldn't have any furniture in our homes! And we eat many fish and shellfish that grow up in the mangrove forest. Without the trees making shelters for these animals, they wouldn't have any place to grow up! A lot of us earn some money by trapping juvenile shrimp that we sell to the shrimp producers to stock their ponds. Many people look at the mangrove forest and say, "It's just a swamp. What good is it?" But for us, it's critical to our lives.



Hello! We're the _____

We're all members of the Bintuni Bay Forestry Producers' Association. A lot of people have been criticizing us because we make our living from selling chipped mangrove wood. But they're not telling you the whole picture. First, we're proud to provide jobs for so many people here in Bintuni Bay. We're the biggest employer and many families could not survive without the wages they earn working for us. Second, mangroves are a *renewable* resource. They grow back in 20 or 30 years. We don't see any reason why the people of Bintuni Bay should have to do without the steady income that can come from our businesses over the next 50 years. The mangroves will grow back. Finally, we're very concerned about the environment. We are very careful in our logging to cause the minimum possible environmental damage.



Hello! We're the _____

We're the proud producers of Bintuni Bay Shrimp.

Our product is exported all over the world. It has a very good reputation for flavor and size. We all grew up here in Bintuni Bay and most of us were poor. Our shrimp farms have allowed us to earn a living for our families and to provide employment for many other people in our community, too. We buy



juvenile shrimp from local people who trap them in the mangrove swamps that grow along the bay. This provides an important source of income for these people. Furthermore, we're helping the environment. Commercial shrimp boats are criticized by many because they are so wasteful. Many fish and other organisms that cannot be sold are caught by the big commercial fishing ships. They're just thrown away -- wasted. By raising shrimp, we're helping reduce the need for wild-caught shrimp. It's true that a couple of the new ponds that we just built required cutting down some mangroves. But our ponds are small. They won't cause much cutting.

Hello! We're the _____

We're the commercial farmers here in Bintuni Bay. We produce a lot of the food that is eaten in Irian Jaya and in other parts of Indonesia, too. We are not rich people, but we've been upstanding members of this community for seven generations. We are careful in our farming operations to use as few chemicals as possible and to prevent erosion. Some people criticize us because they say soil



sediments and chemicals in the water from our farms are hurting the mangrove forests in Bintuni Bay. We think the damage we cause is minimal. We would just like to point out that we earn our living by selling the food that we raise. A lot of people right here in Bintuni Bay eat our food. We're concerned about the growing government interference in our farming operations. And this reserve looks like just one more example of the government stepping in where it's not needed.

Hello! We're the _____

We all belong to a coalition that supports the government's idea of putting a cutting ban into place and making a permanent nature reserve here in Bintuni Bay. There are many organizations and people in our coalition. They include the Bintuni Bay Watchers right here in Bintuni Bay, the national Indonesian Defenders of the Trees, and international organizations like Mangrove Defense International. The mangrove forest here in Bintuni Bay is world known for its

biodiversity. Thousands of birds of many species live there. It plays a critical role in the marine food chain. Cutting down this forest is just gaining a short-term economic benefit at the cost of destroying a natural resource that can never be replaced. And don't let them kid you about those rotation plans. Once you cut a forest, it's never the same. We think the people in Bintuni Bay who want to cut the mangroves should find other ways to make a living. How about setting up an ecotourism business? That would save the mangroves *and* provide a living for local people.





Preparing Your Case

It's time to prepare your case for the town meeting. Now you need to decide which of the four management options is best for you -- and best for the people of Bintuni Bay as a whole.

In these times of cost-cutting and tax payers revolts, you're going to need to argue economics as well as sentiment and logic. How do we know which strategy is better economically? One way is to calculate the *net benefit* of different management options. Economists calculate net benefits to compare the benefits obtained from different production systems or management options. Benefits include ecological factors such as maintaining water quality as well as tangible products such as the wood chips produced from cutting mangroves. Costs include machinery, fuel, and labor used to harvest the wood chips, as well as reduced fish breeding sites due to soil erosion. A negative number means that the costs outweigh the benefits. The *net benefit* is the benefits minus the costs. We usually want to know the net benefit of different options for some date in the future. In the case of Bintuni Bay, economists have looked at the net benefits of four management options 90 years from now. As we all know, inflation often occurs over long periods of time. If inflation does occur, the value of one dollar printed in 2050 will not be same as the value of a dollar printed today. To take this into account, economists figure a discount rate into their calculations, based on what they think the inflation rate may be. In this case, economists used a rate of 7.5%.

Now look at Table 1 on the next page, *Summary of Discounted Net Benefits*. It shows the four management options on the left and six functions of the Bintuni Bay mangrove forest on the top. The numbers in the boxes are in millions of dollars. They tell us the net benefit or value of each function of the mangroves over a 90 year period. As you can see, different options produce different net benefits. For example, a cutting ban produces a net benefit for local uses (hunting, fishing, etc.) of \$399 million. It also produces a high net benefit in terms of the biodiversity that is preserved, \$131 million. However, since no trees are cut, no wood is harvested and the net benefit from this option for wood is zero. Use the information in Table 1 to help prepare your argument for the town meeting. You need to decide which of the different functions of the mangrove forest are important for your group and then look at how the different management options affect the net benefit for those functions. Table 2 *compares* Options 2, 3, and 4 to the cutting ban option. It shows whether the net benefit for each function of the mangrove forest goes up or down, compared to banning cutting. For example, the 20-year clear cut option *reduces* the net benefit for local uses by \$104 million over 90 years. However, it *increases* the net benefit for wood production by \$756 million.

In preparation for the town meeting, fill out page 28. This will help you organize your arguments. Be sure to answer question number three. Remember that other people are going to have other positions. You need to think about how you can select an option that will help everyone. This makes reaching a compromise more probable.

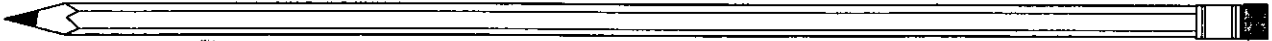
Prepare a three minute position statement. Use charts, tables, drawing, or diagrams to help make your points. Select a member from your group to make the presentation at the town meeting.

**Table 1. Summary of Discounted Net Benefits
Over 90 Years
(Millions of Dollars in 1991 constant prices; discounted at 7.5%)**

Choice	Local Uses	Erosion Control and Water Quality	Wood	Shrimp	Agri-culture	Biodi-versity	Total
Cutting Ban	399	145	0	1,016	546	131	2,237
Clear Cut (20 years)	295	102	756	824	440	74	2,491
80% Select Cut	339	119	532	908	487	95	2,481
25% Select Cut	383	138	166	986	530	120	2,321

Table 2. Marginal Change from the Base "Cutting Ban" Choice

Choice	Local Uses	Erosion Control and Water Quality	Wood	Shrimp	Agri-culture	Biodi-versity	Total
Cutting Ban Base	399	145	0	1,016	546	131	2,237
Clear Cut (20 years)	-104	-43	+756	-192	-106	-57	+254
80% Select Cut	-60	-26	+532	-108	-59	-36	+244
25% Select Cut	-16	-7	+166	-30	-16	-11	+84



Justifying My Choice

My Stakeholder Group Is: _____

1. The Biggest Problem My Group Has:

2. The Best Management Option For My Group Would Be:

Reasons Why:

3. The Best Management Option For Everybody:

Reasons Why:

