Handbook on Environmental Economics

Final Report

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1. ENVIRONMENTAL ECONOMICS

1.1 Introduction

What do people need to know to help them make decisions about managing the ecosystem around them and how their communities can prosper while maintaining or improving the state of the environment? This Handbook, written for the Atlantic Coastal Action Program, provides the foundation for answering these questions by showing how economy and environment interact, the process for addressing a problem, determining the options for dealing with it, and selecting and implementing the most appropriate solution .

Representatives of the thirteen ACAP sites were surveyed and asked about their activities and membership, general perceptions of economics and environment, and to identify some specific environment/economy terms. The full survey can be viewed in Appendix 1. The goal of the survey was to determine the most important environmental projects or concerns at each site, the level of understanding of environmental economics, whether the sites were interested in having a Handbook dealing with the subject, and if yes, what should that Handbook contain?

It was evident that there were some common issues among the ACAP sites to be addressed, such as point-source pollution from sewage or effluent discharge, and non point-source pollution from, for instance, malfunctioning septic tanks. Soil loss and sedimentation as a result of certain agricultural and forestry practices was an important item. Loss of habitat and biodiversity, both on land and in the water, was also a major concern. Given this information, the authors tried to write the Handbook, and in particular the case studies, in a way that included these concerns.

Common ACAP Issues of Concern:

- Point source pollution
- Non-point source bacterial contamination
- Sedimentation
- Habitat and biodiversity loss

Those who responded to the survey also indicated that a broader understanding of environmental economics would help them to put issues into context. Specifically, most respondents were interested in:

1. Knowing how to value local resources and identify how pollution impacts economic value, and;
2. Identifying which types of economic instruments could be applied to local conditions.

Finally, all groups wanted the Handbook to be structured in such a way that they would be able to present it to the general public and to decision-makers so that there could be a clear understanding of how the economic and environmental uses in their watersheds interact, and to determine how one would go about assessing the importance of these linkages. The issues identified above were then used to illustrate a process for:

1. Demonstrating that projects and uses of watersheds which encourage sustainable resource use have value for the community and vice-versa;
2. Determining what that value is and how it can change, and;
3. Presenting these values to the community and decision-makers so that when they are faced with different options, informed decisions can be made based on environmental and economic information.

In this first chapter, we begin by presenting background information on economics and its place in environmental management, a context which most ACAP groups identified as important to them in their work.

1.2 What Is Economics?

"**Economics is the study of how we make decisions regarding the use of our scarce resources**."[1] This clearly indicates that economics is about much more than money or profits. In fact, it is what distinguishes economics from business or commerce, and the two are very different. For instance, in trying to determine the cost of employing someone, a businessperson would look at how much they would have to pay that person for their services. An economist would look at what other activities that person would not be able to do in order to take on this particular job, and value the alternatives, which are the cost of using the scarce resource, which in this case is a person's labor.

1.3 Opportunity Cost

Economics, then, differs from business or commerce in that opportunity cost is foremost in assessing cost and benefits, while a business analysis would only take into consideration the monetary losses and gains.

Because none of the resources on this planet are infinite, we cannot use them without having to make some choices. There is a cost involved in using a resource - any resource - in terms of what other use that resource could have served. This is called opportunity cost. The word here does not specifically mean monetary cost. For instance, if a wetland area is filled in to build a road, you gain a road but you give up the ability of the wetland to function as a filter in the watershed, a habitat for certain species, the land for conversion to other uses such as agriculture, etc..

Economics is about opportunity cost... Because there is not an unlimited supply of resources, there is a cost involved in using a resource in terms of what other use that resource could have served.

1.4 What Is Environmental Economics?

We like to think of ourselves as being above placing dollar values on nature or on things such as human life. But whether we like to admit it or not, the scarcity of resources forces us to make decisions. For instance, we often say that human life cannot intrinsically be measured in terms of money. It is immoral. And intrinsically, it cannot be measured this way. However, in our everyday lives, if we truly practiced this, any time we saw someone dying on the news in a remote place such as Africa, we would take all of our resources - sell our belongings, take with us whatever medicines or food were required, and be on our way to save that life. But in actuality, and in some sense subconsciously, we decide not to do this. Why not? Because resources are scarce. We can't possibly save every human life with the resources we have, and we place a certain value on our own lifestyle and state of well-being. Whether we realize it or not, we are forced to make decisions as to how we will allocate the resources we have access to and control over, as they are limited.

[1] Hird, H. Richard. 1983. Working With Economics. Toronto: Collier Macmillan Canada Inc. pp.3.

Environmental economics is the study of how we allocate scarce natural resources, taking into account people's preferences for a properly functioning environment which supports most human activities

The same applies to the environment. The environment is, fundamentally, the place from where all of our resources derive. The environment is not infinite. The way in which we interact with the environment, then, basically depends upon the how we make choices regarding the use of these scarce resources - or economics. We can use up our resources quickly and deplete them to the point where there is nothing left; we can come to some sort of a compromise as to how we use resources that may deplete them somewhat in exchange for some use we deem important; or we can not touch the planet's resources and most likely perish. Scenarios one and three are rather extreme; although in today's society we often tend toward the first. What is needed is a more balanced approach, one where we do our utmost to protect the ecological functions of the environment, maintain its ability to regenerate, and allow humankind to survive at levels of consumption which allow us to maintain a reasonable standard of living. How do we do this?

"If development is to be sustainable, it must encompass a full appreciation of the value of the natural and built environment in terms of the direct and indirect contribution that environments make to people's well-being."[2] Therefore, environmental economics is the study of how we allocate scarce natural resources, taking into account people's preferences for a properly functioning environment which supports most human activities, a definition not so different from that of economics itself.

1.5 Why Do We Degrade the Environment?

Given that the environment is the basis of all activities, be they ecological, economic or social, why do we undermine it by degrading it? There are at least three basic reasons why we pollute our environment, and in understanding why it occurs, we gain some insight into how we can stop the abuse.

1.5.1 Abundance

While it is true that resources are not infinite, they are in some cases abundant, and this means that they have a certain capacity to absorb some of the damage caused by human activities. Up to a point, then we can pollute our resources (say, for example, a river) and not notice any change in the quality of the resource. But inevitably the time comes when the unseen trade-off we are making becomes apparent.

1.5.2 Externalities

In plain language, an externality is the effect of a decision on those or that which is not party to the decision. Sometimes the activities undertaken by an individual or organization are harmful to the environment, but they don't directly bear the consequences of their actions. For instance, the XYZ Pulp and Paper Company may have smokestacks which release harmful chemicals, but the chemicals may be sent miles away, so that either out of ignorance or non-appreciation, the costs of what the polluter does are inflicted on others but don't directly affect the company. This is known as a negative externality.

Three reasons why we degrade the environment:
Abundance: Capacity of the environment to absorb and hide our impacts;
Externalities: We don't always suffer the consequences of our polluting behavior;
Market Failure: Environmental services are not exchanged in the market and therefore are often not valued and accounted for

[2] Pearce, David, Markandya, Anil and Barbier, Edward B. Bl
Earthscan Publications Ltd. pp.33.

A positive externality occurs when improvements in the environment are made. For example, stream enhancement can result in improved recreational fishing. Although some in the community may not contribute to stream enhancement or habitat improvement, they still benefit due to improved environmental quality and recreational fishing. Often environmental improvements result in a "free rider" situation, where benefits are derived by some, the free rider, who do not contribute to the environmental improvement.

1.5.3 Failure to Value the Environment

The environment provides us with many things. A sense of well-being, aesthetics for us to enjoy, overall support of life on the planet, biodiversity, inputs to many human economic activities. In short, the environment provides us with a lot of services. In many cases we do not place a value on the environment, either because we fail to appreciate or account for the services it provides, or we are morally opposed to doing so. Because of this failure to recognize the value the environment provides to the economy, the services provided by the environment are used as if it has little or no value. If we fail to recognize the value of the services provided by the environment, and treat the environment as if these services are free, then we grossly undervalue what the environment does for us. This failure to account for the value of environmental services is often referred to as "**market failure**".

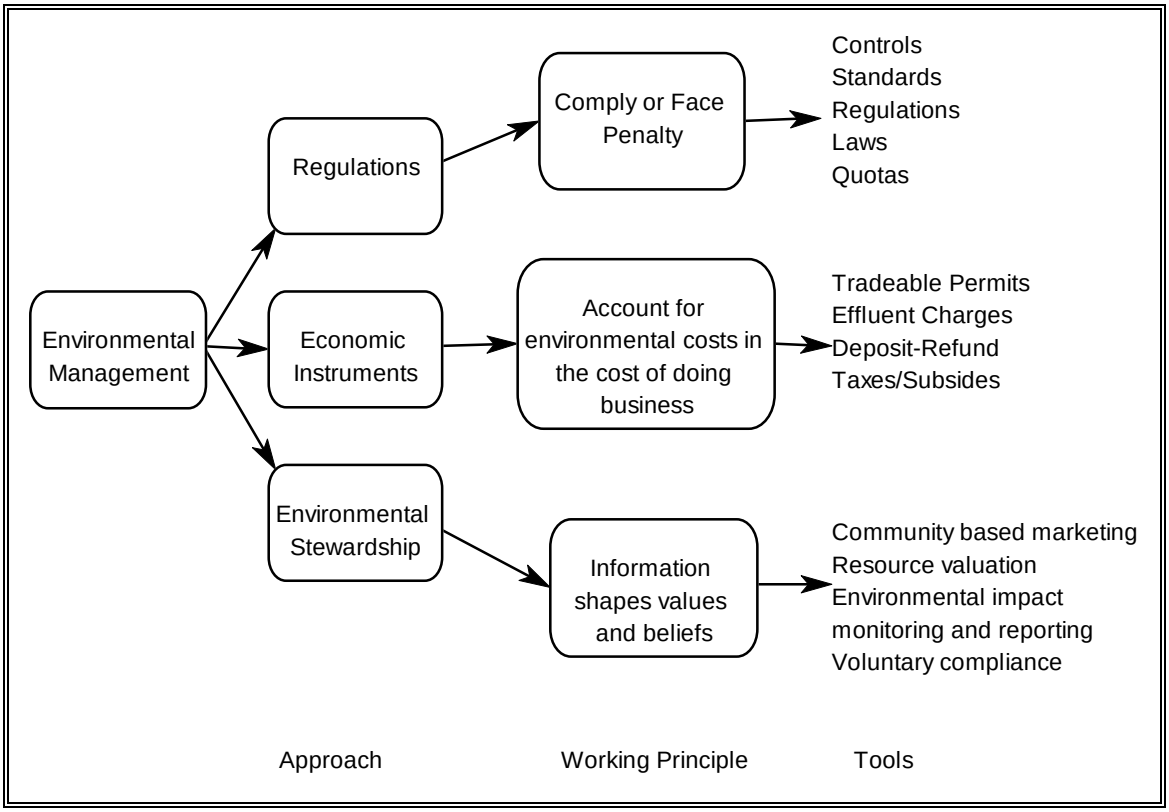
1.6 Economics in the Mix of Environmental Management Approaches

Economics has a long history of defining value, and being used for project decision-making, but it is only recently that economics has been recognized as being useful in environmental management and for correcting for market failure, such as pollution. Thus environmental management, as it is being applied today, consists of a more comprehensive range of approaches. These include:

- The traditional approach, which is direct regulation and governmental intervention;
- Economic instruments, which seek to use market signals to adjust behavior in a socially desirable direction, and;
- Environmental stewardship, which seeks to raise awareness and encourage voluntary action in an environmentally friendly way.

Figure 1 provides a map of the range of approaches to environmental management that are available to us. Each of these will be discussed in detail below.

Figure 1: Map of Environmental Management Framework



Source: Yves Bourassa, Environment Canada

1.6.1 Direct Regulation

Direct regulation commands polluters to follow government regulations and laws so that their environmental impact is minimized

The traditional regulatory approach is referred to as a "command-and-control" approach to environmental management. Although it doesn't so much encourage as dictate environmental responsibility, it has been the primary environmental management approach of most countries. Direct regulation means that some agency that has jurisdiction over an activity puts in place rules such as:

- Quotas on the use of certain resources, such as logging permits;
- Limits the allowable level of certain wastes that can be discharged into the environment, such as municipal sewage, and;
- Bans a producer from using certain substances such as CFCs.

Direct regulation alone has proven to be inadequate to deal effectively with pollution problems. For example, direct regulation must be enforced if it is to be effective, which is costly. It may leave industry with the perception that they are being forced to do something rather than acting in their own interest. Additionally, it may be more difficult for older or smaller industries to comply with the regulations.

The role of ACAP and community groups in instances where direct regulation is sought would be to advocate for the desired regulation by the agencies with jurisdiction over a particular problem, and to educate the public as to why these steps are necessary and encourage their advocacy as well.

1.6.2 Economic Instruments

Economic instruments are tools we can use to encourage people to change their behavior in relation to the use or abuse of the environment

Economic instruments are **tools we use to change people's behavior in relation to their use of a resource.** Imagine that your ACAP group wants to stop effluent from being discharged into a stream. You could value the stream, that is, determine the value of the stream as a source of water for a nearby community, in terms of a fishery it might support, and in terms of the different species of wildlife it supports, etc.. Then, in order to persuade the polluter to stop or lessen the discharge of effluent into the stream, you could tax them based on the amount of effluent they discharge into the stream. The charge would be related to the amount of damage they are causing and the amount of effluent they are discharging. Here the tax is the economic instrument. The different types of economic instruments and how to decide which one to use in a given situation will be discussed further in Chapter 3. It should be noted that economic instruments alone are not the answer to all our environmental challenges, but rather, they can be a useful tool for effecting change, are therefore one of many different ways of encouraging environmental responsibility.

Again, ACAP and community groups' main contribution to the use of economic instruments is to advocate for their use and ensure that decisionmakers and the general public understand the reason for their implementation.

1.6.3 Stewardship

Stewardship, a term that is brought up often in environmental discussions, is a catch-all phrase that primarily means anything that changes the preferences of people for all the services and feelings of well-being the environment provides. Education and training in environmental issues, providing the public with information on the environment and its value (not even necessarily in terms of money), and increasing awareness of how the economy, the community, and social values interact with the environment are all part of stewardship. Stewardship can also include **voluntary compliance** where an agreement is reached with the polluting economic activity to reduce pollution. This agreement does usually not have a legal basis but rather is a negotiated settlement to on on-going environmental problem.

Environmental stewardship is an area where ACAP groups are very strong, and understanding, as well as being able to show, how economic instruments can be used to change destructive behavior, is one of the most important contributions for ACAP groups can make to local resource management.

1.6.4 Valuing the Environment

When there are no markets for many of the functions the environment provides for us (you can't go to the clean air store and buy and sell clean air!), degrading a particular resource can seem to have no cost, so we continue to do it. In order to put a stop to this, and to ensure that before we use a resource in a particular way we have some idea of the gains and losses we are facing, it is imperative to attempt to value the resources that surround us.

This may seem like a difficult task, but it is not an impossible one. There are some services which the environment provides which we do value in monetary terms and buy and sell already - i.e. markets exist for these things. And when the supply of that resource becomes scarce, it's price shoots up, encouraging us to use less of the resource. These are

generally referred to as **tangibles, concrete aspects of a resource that we can attach a monetary value to easily.** However, there are also many aspects of nature and the services it provides which are **intangibles, or aspects of a resource which are not so easily valued in monetary terms,** such as the inherent beauty of a sunrise or the diversity of nature which may allow us in the future to reduce the risk of extinction**.** Chapter 2 will give a more detailed explanation of how to determine the value of resources.

1.7 Conclusion

So far, we have communicated to the reader that, because we have scarce resources, we are obliged to consider what we give up when we use a resource in a particular way. We need to make this same determination concerning the environment, and to date we have failed, for various reasons, to take into account the complete value of the environment to us and to systematically identify that value. As a result, we have put ourselves in a situation where we undertake projects and activities of various kinds which involve the environment without a complete understanding of the consequences, both environmental and economic, of doing so. Knowledge of environmental economics, which gives us the techniques for valuing the environment properly, indicating what we give up and gain in terms of each project we undertake, and how we achieve our desired goals is crucial to sustaining the environment and the human activity which takes place within it.

2. VALUING THE ENVIRONMENT

2.1 Introduction

The purpose of this chapter is to provide ACAP sites (and other community groups) with a tool book of economic techniques for valuing environmental resources. During our survey of the ACAP sites, many stated that knowledge of such techniques would be useful for project decision making, and for showing citizens the economic value of environmental respect. By putting economic value on the environmental resource, ACAP sites will be able to deal with one of their main problems, that of influencing government and private decision makers, that their projects are worthwhile of support on economic grounds. This chapter aims to provide ACAP sites with an understanding of the tools available to put an economic perspective on their environmental problems.

2.2 What Is Resource Valuation?

Resource valuation is simply the valuing of the net benefits that the environment provides and is an extension of benefit-cost analysis. Benefit-cost analysis is a widely used economic decision making tool to assess projects in terms of their potential change in the well-being of society. It involves measuring, adding up and comparing all the benefits and costs of a public project or program. If the sum of the benefits are greater than the sum of the costs, then the project can be said to be desirable to society. Resource valuation is an extension of benefit-cost analysis, where the analysis is framed in the context of the natural environment.

We complete a resource valuation to assist in decision making. For example, say an estuary is being polluted by poorly managed septic systems, leading to bacterial contamination. The costs of cleaning up the septic tanks are easily measurable, but what about the benefits? This is the purpose of resource valuation, to incorporate the value of the environment into the decision making analysis by measuring these benefits. This is achieved by using several techniques, which are discussed later in this chapter.

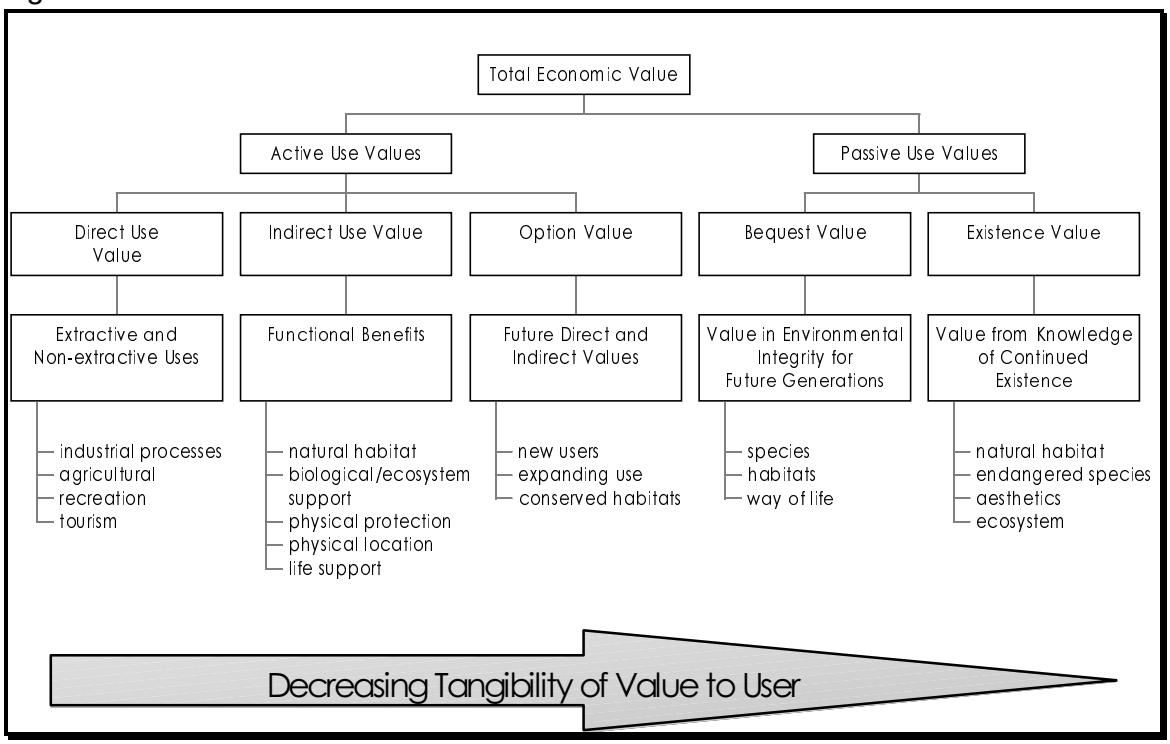
- A Cost Benefits Analysis involves adding up and comparing all the benefits and costs of a public project or program.
- Resource valuation is an extension of benefit-cost analysis, where the analysis is framed in the context of the natural environment or ecosystem

The environmental benefits that are measured in resource valuation can be divided into two categories- *active values* and *passive values*, which together make up the **Total Economic Value** of the resource. Active values are the benefits we receive from resources and services that the environment provides. For example, we harvest shellfish that the environment produces, and we drink fresh water that is cleansed by wetlands. The passive values of the environment are the intrinsic values we hold from the knowledge of its continued existence at a certain environmental quality as well as the benefits of leaving resources for future generations. As the environment is degraded of we lose habitat, a loss of value results because we have lost environmental attributes that are valued by some in the community.

The unit of measurement for comparing benefits of the various use and passive values is usually money. Money is chosen for ease of comparison- it is the simplest means of comparing the benefits that various resources provide. See Figure 2 below for a taxonomy of value or total economic value.

The taxonomy of value, or total economic value, is presented in Figure 2. Values on the right of the chart are less tangible, that is, it is more difficult to quantify in monetary terms, the value an individual places on the existence of endangered species for example. The main reason for the inability to quantify these real and positive values is that intrinsic values are based on individual's willingness to pay. However, markets for these values do not exist, and other approaches, such as survey based questionnaires, must be used in valuing.

Figure 2: Total Economic Value



2.3 How Do You Use Resource Valuation?

Resource valuation can be used to determine the Total Economic Value (TEV) of the local environment. For example, by applying a dollar figure to all the active and passive use benefits that a watershed provides, it is possible to understand a wider scope of value that the watershed provides to the local community. Knowing the total economic value of a resource or how that value changes with changing levels of pollution will allow ACAP sites to present a comprehensive indication of economic value to their environmental management plans.

Resource valuation can also be used with benefit-cost analysis to compare environmental projects and determine their worth on economic grounds. If the change in the value of the resource is greater than the cost of the project, then the project should proceed on economic grounds. This technique is useful for determining the benefits of remediation for example.

2.4 Environmental-Economic Linkages

An important contribution of resource valuation is that it provides a framework to identify and understand environmental-economic linkages between various types of resource use. Back to the watershed example, all uses of that watershed provide value, which contribute to the total economic value (as discussed earlier). However, some uses of the watershed preclude or impact on the value of other uses- these are the environmental-economic linkages. A watershed that has sewage flowing into it is providing value since it is disposing of wastes. The value of this service can be measured by its opportunity cost- the costs saved from not having to construct and operate a sewage treatment plant. However, using the watershed in this way might raise fecal coliform levels and preclude shellfish harvesting and recreation activities- a reduced benefit from the watershed. By conducting a resource valuation on the various uses of the watershed, it is possible to determine the monetary linkages between various resource uses.

By polluting the environment and thus changing the environmental quality of a watershed, some uses of the watershed may preclude and constrain other uses or may impact on the value of other uses...this concept is environmental-economic linkages

To understand the environment-economy linkages it is important to first know the biophysical linkages that exist in the ecosystem. This means investigating the various environmental processes and how they impact on each other. For example, in an estuary where sedimentation as a result of forestry is a challenge, it is necessary to determine the effect of cutting trees near stream banks, and how this contributes to erosion and ultimately sedimentation of the estuary. The increased sedimentation will impact trout habitat and populations, and therefore catch rates for local anglers. Changes in catch rates result in changes in the pleasure experienced by the angler. Changes in the pleasure of a trout fishing day for an angler represent changes in their willingness-to-pay, in dollar terms, for a day of fishing.

Resource valuation is simply a logical extension of the environmental quality and monitoring work that all ACAP sites are doing in their project work. Knowing the biophysical linkages between uses in the watershed is the first step that must be completed in a resource valuation. Therefore, many ACAP sites are already prepared to conduct resource valuations utilising their existing environmental data. Once the linkages are known it is possible to determine the economic consequences of pollution (or remediation) using the environmental information.

Many ACAP sites are *already* prepared and qualified to conduct resource valuations utilising their existing environmental data

By valuing the resource and determining the various linkages between uses, it is possible to include the economic value of resources into the decision making context. Consequently a more holistic approach is allowed in support of environmental management planning.

2.5 The Resource Valuation Framework

A framework has been developed by EnviroEconomics, Eastern Charlotte Waterways Inc. and Environment Canada, Atlantic Region, in the document ***Modelling Environment-Economy Linkages***, which provides a step-by-step framework for valuing resources. Using this framework, it is possible to value environmental resources, and also measure the loss in value as a result of environmental pollution. For example, the framework can be used to help identify the benefits of remediating bacterial contamination in an estuary. This is done by measuring the value of the resources in the estuary at current levels of pollution, and then

comparing this with the expected change in value as a result of remediation. The steps in the framework described and are listed below:

1. Identify Environment-Economy Objectives within Decision Making Context.
2. Identify and list Key Uses and Ecosystem Functions.
3. Establish Workable Linkages Between Uses and Functions.
4. Categorise Uses and Determinants of Value.
5. Develop Appropriate Valuation Techniques by Uses.
6. Determine Total Economic Value.
7. Analyse Options for Achieving Program Objective.

* Data collection throughout each step.

In keeping with the purpose of this chapter, the remainder will focus on Step 5, Develop Appropriate Valuation Techniques by Uses.

In determining TEV you must assess all the costs and benefits of the problem to be addressed or the decision to be made. For the purpose of deciding whether or not a project should go ahead or when faced with limited project budgets, however, it might only be necessary to determine some minimum value- i.e. it is often enough to justify a project simply on the more easily measurable benefits without using surveys to determine intrinsic values that people have for maintaining a high quality environment.

2.6 The Techniques

The first four steps in the resource valuation framework (above) can be completed by the ACAP sites. The purpose of this section is to provide community groups with an introduction to Step 5 - Developing Appropriate Valuation techniques. Many of these valuation techniques can be completed by the ACAP sites, though it might be useful to enlist the assistance of a resource economist.

The techniques to be discussed are: the Productivity/Production Approach, Intermediate Good Method, Preventative Expenditure Approach, Alternate Cost Method, Contingent Valuation, and Access Cost Technique.

2.6.1 Productivity/Production Approach

One commonly used method for determining the value of resources is the productivity/production approach. Using this method, the change in productivity/production of an environmental resource is measured to determine the benefits of the remediation project. This method measures use value, and is usually only applicable for resources that are extracted such as shellfish. The price that the shellfish sells for is used as a proxy for the minimum value of that resource in its environment minus the costs of harvesting that resource.

To use this method in a benefit-cost analysis of a project, it is necessary to determine the linkage between the proposed project and the impact on resource productivity. The change in productivity is then translated to a dollar figure using the market price. If the value of the resource change is greater than the cost of the project then the project should proceed.

To use the change in productivity method in a benefit-cost analysis and resource valuation, it is necessary to determine the linkage between the proposed project (remediation or new point source) and the impact on resource growth and productivity

This method could be used to measure the benefits of remediating effluent in an estuary. For example, one benefit might be the expected increase in shellfish in the estuary. The size of this increase, multiplied by the market price for shellfish, is the dollar value of increased shellfish production. In this example, it is necessary to establish how shellfish production changes for varying levels of effluent.

The strength of this approach is that it easily transfers changes in environmental productivity to dollar values. It is the most commonly used approach by community groups and can easily be completed by ACAP sites as long as the environmental economic linkages are known.

This approach is difficult to use when the resource does not have a market value, since it is difficult to translate the productivity/production benefits to dollar values. Also, this approach is limited to those example where the biophysical linkages are understood.

2.6.2 Intermediate Good Method

If a resource is not bought and sold in the market, then it of course will not have a market price. However, the resource might be used in the production of another good that is sold, and the value of the resource is measured by its contribution to the market price of this intermediate good. The value of the resource can be measured by the increase in productivity that results from its use.

To use this method of valuation in a benefit-cost analysis, it is necessary to know the linkage between the environmental resource and the good that is sold. The change in productivity is measured using its market price, and this value is used as a proxy value for the resource.

For example, the intermediate good method can be used to measure the value of an integrated pest management program in agriculture. The benefit may be the increased farm production that results from the program. The market value of the change in production is used as a measure of the benefits of the project.

The intermediate good method is best used for resources that do not have a market value, but are used in the production of another good. This method can be used by ACAP sites, as long as the link between the resource and productivity change in the intermediate good are known.

2.6.3 Preventative Expenditure Approach

The value people are prepared to spend on preventing damage to themselves or the environment is a minimum estimate of the value they place on environmental quality. This technique is referred to as preventative expenditure because it is a measure of potential loss of use values before damage occurs. All the costs that are incurred to prevent damage in the future are summed to give a dollar value that is less than or equal to the value that people place on the resource.

For example, this method can be used to estimate the minimum value of farmland where a sea wall has been constructed to prevent erosion. The cost of building the sea wall must have been the minimum value that people place on the soil that would have been eroded without the wall.

To use this technique, two things must be known: the value of the preventative expenditure; and the amount of protection that is afforded the resource in question. In the sea wall example, this means the sum of all costs, and the amount of soil that would have been eroded.

2.6.4 Alternate Cost Method

The Alternate Cost Method of resource valuation attempts to value benefits that the environment provides by the cost of replacing that benefit. The sum of all costs to replace the benefit is inferred as the value of the resource.

For example, a watershed provides potable water for a community, and would need to be replaced should it be contaminated. The alternative would be to construct and operate a water treatment facility, or pipe in the water from another source. The cost of these alternatives is the inferred value of the services that the watershed currently provides.

To use this method it is necessary to determine the annual cost of the next best alternative and use this as a proxy for the value of the resource. Care must be taken when using this technique because it must be proven that their exists the willingness to pay for the alternative.

This method is only applicable when it is clear that the alternative cost will be incurred as a result of the loss of environmental services.

2.6.5 Contingent Valuation

Contingent valuation is employed when people's preferences cannot be determined in a market and consequently must be determined using hypothetical (contingent) questions. The community is asked their willingness to pay for the preservation, continued existence or improvement of an environmental resource. The method is usually a survey or questionnaire where respondents are asked to rank their preferences or state how much they are willing to pay for each alternative.

To use this method, it is necessary to identify the resource to be valued as well as alternative uses. A survey should be used to determine a rank of preferences and/or a willingness to pay for each alternative. The surveys are then aggregated to determine a total value of the resource.

This is the only method that can measure both use value and passive value of environmental resources. It can be used, for example, to measure the value that people put on a public park, or on the continued existence of a forest. A survey to determine these values might ask community members how much they would be willing to pay in increased taxes for the preservation of a parkland area.

The main advantage of this method is that questions can be designed to exactly match the attributes of the policy being considered.

2.6.6 Access Cost Technique

The access cost technique measures how much people pay to gain access to a resource and infers this as its minimum value. This technique is best suited for valuing the recreation use of resources such as lakes, parks, beaches etc.

To use this technique, it is necessary to measure all the costs of accessing the resource, including travel cost, time cost and user fees. The summation of all these costs must be less than or equal to the value of the benefits of the resource- otherwise it would not be used. Therefore, the summation of the costs must be the minimum value of the resource.

This technique can be used to measure the value of a park for example. The access costs associated with the use of the park are the user fees and travel expenses such as gas et cetera. The sum of these costs for all those who use the park is its total value.
The strength of this technique is that it provides a means of measuring the recreation value of many environmental resources. A weakness is that it might tend to undervalue the resource.

The purpose of looking at these techniques was to provide a means of valuing environmental resources so that their economic value can be included in decision making

2.7 Conclusion

The purpose of looking at these techniques was to provide a means of valuing environmental resources so that their economic value can be included in decision making. Most of these techniques are not difficult and could be completed by ACAP sites, though the assistance of a resource economist might be helpful.

The reason for valuing environmental resources is to have on hand data which will indicate their contribution to our lives and economy, so that we may more effectively lobby government and citizens for needed changes. This is achieved when the economic costs and benefits of pollution and remediation are revealed after conducting a resource evaluation.

The next chapter will look at economic instruments that can be used for achieving remediation goals.

3. ECONOMIC INSTRUMENTS AND IMPLEMENTATION

3.1 Purpose of this Chapter

We have seen in Chapter 2 the various ways to value resources so that we can compare the costs and benefits of taking one approach to an environmental situation over another. Once we decide which approach to take, we have tools available to us to change behavior so that it is more consistent with our goal. Basically, there are three ways to achieve an environmental goal: using economic instruments, regulations and stewardship. The purpose of this chapter is to acquaint ACAP groups with **economic instruments, or the tools which are available to encourage changed behavior** on the part of the polluter, keeping in mind that no one approach works in isolation. Generally some combination of the three must be in place and supporting each other to facilitate implementation of an environmental project.

3.2 Economic Instruments

What exactly are economic instruments meant to do? Economic instruments are simply methods of ensuring that the reasonable costs and benefits of an activity are taken into account. They are based on the Polluter Pays Principle and the User Pays Principle, which means what you would expect it to. The individual, firm or organization responsible for pollution should pay the cost of the damage their actions cause. In the case of the user pays principle, those demanding a product whose production causes pollution should pay the full cost of using the resource, which would include the cost of the environmental damage. Economic instruments therefore are meant to cause the individual, firm or organization responsible for pollution to take into account costs they inflict on everyone else and the environment that do not directly affect them, but nonetheless are costs. **Making them responsible for these costs will then cause appropriate changes in their behavior toward the environment and others.** This is the role of economic instruments in environmental management.

3.3 Types of Economic Instruments

I. Price-based Instruments

These are tools used when a market already exists for something. This type of instrument alters the price of something so that more environmentally responsible purchases or behavior is encouraged.

Product Charges or Taxes

Apply a charge or tax on a product which, in its production, pollutes or damages the environment. The tax or charge should force the polluter and the people buying the product to pay a cost approximating the cost of the pollution. For instance, anyone releasing pesticides into the environment should be charged or taxed at a rate which is estimated to include the full cost of the damage that the pesticides cause to the surrounding environment, the health of others, etc.

Emissions Charges or Taxes

Same as above, only the government or some other agency determines how much pollution in "acceptable", and any emissions over that level get taxed or a charge is applied.

Subsidies and Grants

This is a positive incentive, assuming it rewards "good" environmental behavior by giving a certain amount of money to those performing responsibly. A subsidy could also be rewarding unacceptable behavior, for instance the use of chemical fertilizers has been subsidized in the past, which means that it is less expensive to use them, so their use was encouraged and had negative effects on the environment.

User Fees
Those using a resource are charged a fee proportional to the full cost of using it, so that they recognize that it is a scarce resource and change their level of consumption accordingly.

Tax Allowances
Basically, a tax break given to a firm or individual to reward them for some environmentally friendly behavior such as installing abatement equipment.

Tax Differentiation
Taxing more heavily an activity that degrades the environment than one that does not.

Depletion Taxes
In the case of non-renewable resources, the more and the more quickly you use it up, the more you pay for it.

Deposit-Refund Systems
Meant to encourage people to reuse or recycle products by charging them extra when they use a potentially polluting product, then rewarding them for recycling or reusing the product by returning to them a portion or all of the charge.

II. Transferable Property Rights

Used in instances where there is no market for an environmental good. Since there is no market, you create one by assigning ownership to the firms or individuals involved.

Tradable Permits
Closed Tradable Permits:

For instance, if you have many factories in an area polluting the air, the government can set a maximum emission that is tolerable, dividing it among the factories. Then the firms can either reduce the amount of pollution they create and sell their "right to pollute" or pay for a permit. Being allowed to pollute becomes a commodity that can be bought and sold, so you have created a market, and once you have a market, you can take into account the benefits and costs of doing something through pricing. This may sound as if we are encouraging pollution, but in fact we are limiting it and encouraging firms to pollute even less, because the less they pollute, the greater their possible gain from selling their allotment to another firm. By creating ownership we internalize the emission and therefore account for the costs and benefits associated with the emission.

Open Tradable Permits:

Function in the same way that closed permits do, except that unlike in a closed system, there is no allocation of polluting rights. Proactive companies are encouraged to voluntarily participate and have their responsible behavior recognized by the receipt of credits for

reducing unsustainable behavior, for instance the Voluntary Challenge Registration programs in New Brunswick.

3.4 Which Economic Instrument Should I Use?

Economic instruments can be powerful tools for changing behavior, but there are a few things that ACAP groups should keep in mind about them. Firstly, the authority to put an economic instrument in place generally is beyond the scope of an ACAP group's mandate, except in the case of an open permit. The probable and important contribution to be made by an ACAP group in terms of economic instruments, this being the case, is to be able to identify a problem, research it, determine which economic instruments would be useful, and then strongly lobby for the use of the instruments. This provides the public, stakeholders, and government or other agencies which do have the power to put the instrument in place with another option in environmental management.

In most cases, the major contribution to be made by an ACAP group in terms of economic instruments, is to be able to look at a problem, do some research, determine what economic instruments would be useful in a given situation, and put forth the group's ideas to the public, stakeholders, and government or other agencies which do have the power and jurisdiction to put the instrument in place.

At some point ACAP groups might decide that their mandate should include the implementation and administration/monitoring of economic instruments on behalf of government, industry or the general public, but that is an issue that must be worked out by the interested parties.

In any case, now that the different types of economic instruments have been presented, how do we choose which economic instrument is most appropriate for a given situation? Listed below is a step-by-step approach we have developed as a rough guide to the key steps to be followed in selecting an economic instrument.

1. **Identify the problem to be solved**. As an example, say that the problem is a smokestack releasing unacceptable levels of pollutants into the air. Any unaccounted costs of the problem should be identified as well.

2. **Be Creative and Think**. Look back on your own experience in this area and consider the types of economic instruments that exist. Which would you use? Keeping in mind that economic instruments are simply tools to change behavior by making people realize the full extent of the costs they are incurring, what do **you** think would cause people to change their behavior? Regardless of the list of instruments that have been tried in similar circumstances in your specific problem area, seek to provide a creative solution to identifying unaccounted costs.

3. **Identify Proven Candidates**. Do some research, or check with other environmental organizations or environmental economists to see what instruments have been used before to deal with this kind of problem. Possibly tradable permits and emission charges have been tried for this type of problem in the past.

4. **Evaluate Economic Instruments**. From these deliberations you should have a short list of two or three economic instruments which might be tried. Below are criteria for assisting you in assessing whether or not the economic instruments you have in mind are feasible when it comes time to implement them. It may seem like a long list to go through each time you are assessing an economic instrument, but now that you have a short list of instruments it will not be as time consuming, plus the points raised here can be crucial in ensuring that the economic instrument functions to its full potential. Any environmental policy, including direct regulations, which is put into place has to be assessed on some basis, not just economic instruments, and these criteria should therefore be used to study the feasibility of any type of environmental policy.

Regardless of the list of instruments that have been tried in similar circumstances in your specific problem area, seek to provide a creative solution to your problem

- **Achieve Goal at Lowest Cost.** In economic terms, this is called efficiency. Simply put, will using a particular economic instrument accomplish what you want it to and use up less resources to do so than some other instrument or method?

- **Equity.** Everyone should know the rules, be able to find out who they apply to and how they will apply, and it should be evident that the rules are being enforced fairly. All polluters should bear a proportionate amount of the burden or benefits resulting from the use of the economic instrument. In short, it should be fair.

- **Flexibility**. Does the economic instrument allow polluters choices in the ways in which they meet certain standards or reduce their polluting activities, i.e. does it encourage initiative and innovation on their part? It is unlikely that at the beginning of any project you will have perfect information or understanding of how it will work. Once a program is underway and we get some indication of how it works, is the economic instrument used going to be flexible enough so that it can adapt given this new information?

- **Financial Viability**. Can polluters and the agencies responsible for administering the instrument afford to implement it?

- **Public Understanding and Acceptance**. Does the general public agree with the goal being pursued and the way you are going about realizing it? Have they been educated about the problem and economic instruments? If not, cooperation or compliance could become a challenge.

- **Administrative Feasibility**. Is there any organization or agency in place to implement the instrument? What level of government, for instance, would do so? Do the resources exist to implement the instrument properly in terms of staff to monitor the progress of the instrument, to enforce it, to collect possible proceeds from the instrument?

- **Legal Constraints.** Are there laws which would have to be put in place and then enforced in order for the instrument to work? Are there laws already in place which the implementation of the instrument would conflict with or could even be based upon?

- **Priority Industries/Sectors.** Is the economic instrument you are considering the one best suited to the industry or sector under consideration?

- **Compatibility with Current Regulations**. As noted above, one should determine what regulations are currently in place and then decide which instrument would perform the best together with these regulations.

Whenever faced with a decision as to which economic instrument to use, these nine points will provide a rough idea as to some of the pros and cons of using each instrument, and allow you to decide which one overall has more advantages and fewer disadvantages than the others.

5. **Narrow Choice of Instruments** . Now you can choose the economic instrument which is the most feasible in this situation. After you have selected the most promising candidate, you may want to investigate the selected economic instrument in more detail by using the above criteria.

6. **Advocate Choice of Instrument**. Once this has been done, your primary role as an ACAP group is to advocate for this economic instrument to be put into place by government or other agencies which have the power to do so, and to educate the public as to why you believe this is the best way to achieve behavioral changes to meet your goal.

3.5 Financing Sustainable Development

Economic instruments can actually generate funds to pay for projects which aid the environment, i.e. the ETF in New Brunswick. The funds will be available to the agency which administers the instruments, which is generally a government agency. ACAP groups, if they decide that it is a course of action they would like to take, could negotiate to administer the economic instrument in question and be the recipient of the funds to finance their work. However, it is more likely that the role of the ACAP group will be to understand how funds generated by economic instruments are dealt with and allocated, so that they may advocate for the efficient use of these funds.

For instance, proceeds from user fees can be put back into maintaining and administering a program to correct abuse of a resource, say water pollution. There are three ways in which the funds earned from the application of economic instruments can be allocated:

- Recurrent Cost Budget, meaning that the proceeds from any fees, taxes etc. become the budget for financing the cost of the economic instruments program, mainly in the form of supporting the environmental management institution that administers the program.

- General Revenue or Accounts, where any proceeds of the economic instruments program go into general government revenue and are not necessarily used for environmental management. Therefore it is useful to have specified from the beginning what will happen to any income generated from the use of economic instruments.

- Revolving Funds, where any proceeds an industry, organization or individual generates in paying user fees, producer taxes, etc. are put back into the industry for environmental management purposes. Here the responsibility for environmental management falls more squarely on the shoulders of the source of the environmental degradation.

3.6 Conclusion

We have seen the various methods for integrating the unaccounted costs of environmental degradation into the activities or operations of those responsible, directly or indirectly, for these costs. Now that we have been exposed to criteria for choosing which economic instrument should be used to best address a problem, it will be instructive to see how the theory applies to real environmental challenges.

4. CASE STUDIES

In order to illustrate how the contents of the Handbook are relevant to each ACAP group, we asked each group what the most important issues were facing them, and the impact of these problems. From this information we have presented three broad case studies which encompass a problem faced by each of the ACAP groups interviewed. The intent was to identify the problem, the ACAP sites which it affects, the environment/economy linkages, valuation techniques for resources involved, and economic instruments which would apply in each case. Finally, experience with economic instruments in similar cases and references for further reading are included. These case studies are presented below.

4.1 Case Study #1: Non-Point Source Bacterial Contamination

4.1.1 Environmental Problem

Many watersheds, bays and estuaries[3] are faced with bacterial contamination from non-point sources of pollution. Control of non-point sources can be particularly challenging from an environmental perspective given the potential to have a large number of small sources contributing to the bacterial contamination.

Economics can assist in addressing non-point source pollution by providing information about the costs and benefits of the problem so that informed decision- making can be conducted. Once the costs and benefits of the options available to address the problem have been identified and understood, economic instruments can then be identified which best target the sources of the bacterial contamination. The section on resource valuation will include these costs and benefits. A discussion of potential economic instruments will be provided in the third section along with some useful information sources.

4.1.2 Relevant Sites

Although bacterial contamination is relevant for al sites, it is most relevant for the following sites: Miramichi, Annapolis, ECW, Madawaska, Pictou and St. Croix.

4.1.3 Resource Valuation and Relevant Approaches

This section will present a general overview of the types of economic approaches that can be used to assist decision-making.

4.1.3.1 Identify Environmental Problem within Decision Making Context

The first step in applying a economic decision-making approach to environmental management and environmental projects is to identify what it is the economic analysis can accomplish or should aim to accomplish. The questions asked in the beginning of the exercise will set the tone for the entire analysis. In the case of bacterial contamination, a number of information and decision making objectives can be achieved by identifying some fundamental costs and benefits. These include:

- What are the costs of remediating sources of bacterial contamination?

[3] Through out this discussion we use a variety of terms to descibe the “target area” of the analysis. This can range from the entire watershed down to a small part of an estuary. Coastal zone is often used as a generic descripter.

Depending on the scope of the study, a range of non-point sources could be identified and the costs of reducing bacterial contamination from these sources determined.

- What are the benefits of remediation?
  The benefits of remediation stem from improvements in environmental quality brought about by a remedial project or activity. As bacterial contamination is decreased and water quality improved, other economic activities can experience increases in the level of activity. The increase in the level of activity or value is the benefit of the remedial activity. That is, with a remedial activity, an increase in the level of economic activity would occur and that increase can be considered the benefit stemming from the remedial activity.

These types of costs and benefits provide the foundation from which the economic analysis is based. There are three ways to approach the analysis, these being to conduct a **Resource Valuation**, determine **Costs and Benefits**, or conduct a **Cost-Effectiveness Analysis.**

Resource Valuation

A resource valuation would identify and attempt to value the externalities of the bacterial contamination. Put simply, how does bacterial contamination impact other economic uses within a coastal zone? To answer this question, the valuation would first seek to identify all of the activities being conducted in a coastal area and then determine how these activities are impacted by bacterial contamination.

To determine this, we must understand how different levels of environmental quality change the level of value associated with an economic activity which relies on environmental quality. A relationship must therefore be developed where changing levels of bacterial contamination as measured by some water quality parameter, say fecal coliform, could be linked to changing levels of economic activity. That is, we are seeking to determine how a change in the level of water quality, positive or negative, would result in a change in level of economic activity and therefore value of the economic uses in the coastal zone.

Central Question:

- Has the level of economic activity increased or decreased due to environmental quality change and by how much?

Main Objective:

- Estimate a base value of the economic activities using a natural resource and then determine how value changes in the coastal zone if bacterial contamination levels change.

Cost Benefit Analysis

A cost benefit analysis would be used to answer a specific question: should remedial activities be conducted and are they beneficial from a societal perspective? To answer this question, we must first identify what it is we are proposing to do in terms of remedial options and then cost those options in terms of their opportunity costs (what are we giving up to so that we can implement a control option).

Similar to a resource valuation, we must also develop an environmental-economic linkage between the implementation of a remedial option, the resultant change in bacterial contamination, and the changes in the level of economic activity. These changes in the level of economic activity which result from a remedial action are the benefits of the remedial activity/project. When the sum of the benefits of remediation are compared with the sum of the cost of a remedial activity, an indication of the societal desirability of the project from an economic perspective is gained. Are the costs of remediation greater than the benefits? If yes, then the project is not desirable from an economic perspective.

Central Question:

- Are the costs of reducing bacterial contamination with a selected remedial activity less than the benefits gained though water quality improvements with the remedial activity?

Main Objective:

- Determine if remedial activities are desirable from a societal perspective (all costs and benefits) by determining the costs of remediation and the subsequent benefits gained through improvements in environmental quality.

Cost-Effectiveness

A cost-effectiveness analysis would identify the most cost-effective approach to achieving an environmental target or goal. In the case of bacterial contamination, all the non-point sources of contamination would be identified, and then the costs of remediation determined. These costs would be compared to their impact on water quality and bacterial contamination, and the remedial approach which had the greatest impact at the lowest cost would be chosen.

Central Question:

- What is the least cost approach to reducing bacterial contamination in the coastal zone?

Main Objective:

- Estimate the costs and performance of remediating significant sources of bacterial contamination and rank the options in terms of their cost-effectiveness.

4.1.3.2 Environmental-Economic Linkages and Uses

As we can see from the above discussion, a major emphasis in a resource valuation and indeed any economic analysis used for environmental management decision-making is to understand the biophysical linkages between economic uses of the coastal zone. In the case of bacterial contamination, what sources cause bacterial contamination? How much do they contribute to the ambient or prevailing level of bacterial contamination? How do reductions in emissions from significant sources change the level of bacterial contamination in the area of interest? And finally, how does this affect the environment in the area?

Once the biophysical information is collected and analyzed, the economic analysis seeks to integrate the concept of environmental quality and change into the determination of value, and costs and benefits. The economic analysis can therefore be considered as a logical extension of the collection and analysis of environmental quality and impact information.

Once predicted environmental quality change and impacts information associated with a remedial activity are known, the linkages to other economic uses of the area of interest/coastal zone can be identified. Once these environment-economy linkages are known, we can begin to identify how economic activities might be at a different level with different levels of environmental quality.

4.1.4 Value Techniques

To illustrate some valuation techniques, we will select some common economic uses of estuaries and watersheds and then discuss how they would be valued.

Tourism/Recreation

The coastal zone, and watersheds in particular provide a variety of opportunities for recreation. Value for recreation and tourism could be determined by identifying a person's willingness-to-pay (WTP) for a recreational day, or their expected amount of expenditures for recreation on that day. The total number of activity days per year is then multiplied by the WTP to determine the value of the recreational activity. For bacterial contamination in watersheds, two sources of changed value exists: lost activity days due to the restriction/closure of certain activities due to high fecal coliform levels; and lost value due to a change in the willingness-to-pay for a recreational activity.

Recreational Closures

Activities can be prohibited if fecal coliform levels exceed certain standards developed by Environment Canada. If fecal coliform levels exceed these standards, that beaches may be closed, or other water contact activities prohibited. Closures can result in a loss in value since people will not conduct the activity or have to choose an alternative location. If they go somewhere else, there could be lost value since their first choice, the closed area, is no longer available.

WTP Changes

Changes in the WTP for a recreational activity are influenced by a number of factors including environmental quality, scenic attributes, and success in fish or hunting. It follows, therefore, that changes in those things that provide satisfaction and enjoyment for the individual while conducting a recreational activity result in changes in the WTP for a recreational experience. As water quality deteriorates, the satisfaction gained from a day of fishing may decrease. This decrease in the WTP for a recreational day at decreased water quality levels is an economic loss.

Measuring this loss can be difficult since no market prices exist which can be used to determine the WTP for a recreational day, or environmental attribute. No transaction takes place where we can observe what someone sells and purchases an environmental attribute for, and therefore no indication of the WTP for the attribute can be gained from observing market transactions. To determine WTP, a survey is usually developed which asks people their WTP for recreation days and then asks additional questions based on water quality. Water quality deterioration would be expressed in terms of allowable activities and bacterial contamination.

Remedial Costs

Cost of remediation would be determined by using engineering and market price cost information (i.e. what is the cost to service a septic tank or fence in a pasture and provide a source of water away from the stream for livestock). Different costs will exist based on the

target reduction in bacterial contamination that is sought. Costing this can be straight forward and involve making a number of telephone calls to determine the costs off reducing bacterial contamination from a representative source of contamination and then adjusting the cost within the local context.

Remedial costs may also involve the implementation of a new awareness program to change behavior or another type of program that may not be aimed at providing a direct solution to the bacterial contamination. In this case, the expected change in behavior and subsequently bacterial contamination would be identified and the cost of the program used to determine cost. Any costs incurred by those who have been targeted by the program would also have to be covered. For example, a septic tank servicing awareness program could result in an increase in the number of septic tanks that are serviced in a community. The remedial cost is this case would be the cost of the program and the estimated cost increase in servicing that resulted from the program.

Commercial Fisheries

Many watersheds have commercial fishery operations based within them. If operations such as shellfish harvesting or aquaculture are taking place, an understanding of the impact of bacterial contamination on the growth and productivity of the resources must be obtained. Once this is known, the difference in production levels or carrying capacity with and without the bacterial contamination is an estimate of the existing cost of pollution or the possibility of a benefit with remedial activities. The closure of fisheries due to high bacterial contamination levels, or the need to transfer shellfish out of areas with high bacterial contamination before they are shipped to market are both areas where costs can be experienced.

4.1.5 Economic Instruments

Economic instruments are intended to change the behavior of individuals by providing signals through the market which encourage people to act in a way which is socially desirable. This could mean that incentives such as subsidies or rebates could be provided so that septic tanks are serviced or best management practices are implemented on farms.

Charge-rebate (deposit-refund) from Septic Tanks

Incentives are provided through mechanism such as tax-rebate schemes. Under this scheme, septic tank owners would be taxed at a rate equal to the cost of servicing and inspecting a septic tank. Rebates would be offered to those who could prove that they have their septic tanks serviced on a regular basis. The tax can be a added to the municipal tax bill thus eliminating some of the costs of designing and implementing a new compliance program.

Open Tradable Permit

Septic tank owners would voluntarily participate in a program where they would receive a credit of some type, for instance lower taxation rates, if they have their septic tanks serviced on a regular basis.

4.1.6 Useful Further Reading - Reports and Studies

Economic Instruments

For a good discussion of potential economic instruments for septic tank control see the document prepared by the St. Croix Estuary Project. *Options for Managing On-site*

Wastewater Disposal Systems in the St. Croix Coastal Zone: Focus on Economic Instruments. 1994.

Also see Wood, Waller, Salah, Hall, and Foster. *The Use of Economic Instruments For Water Quality Management The Case of Pictou County, Nova Scotia*. Report prepared for Environment Canada.

Valuation of Recreation
See Wood, Waller, Salah, Hall, and Foster. *The Use of Economic Instruments For Water Quality Management The Case of Pictou County, Nova Scotia*. Report prepared for Environment Canada.

This report outlines how recreational value changes with different fecal coliform levels.

Resource Valuation, Septic Tanks and Remediation
See a report prepared by Sawyer EnviroEconomic Consulting for Eastern Charlotte Waterways Inc.. *Resource Valuation Project*. 1995

4.2 Case Study #2: Point Source Pollution from Municipal Waste Water/Industrial Waste

4.2.1 Environmental Problem

Many ACAP sites reported that their most significant environmental problem is point source pollution originating from municipal waste water and also from industrial wastes. The purpose of this case study is to examine this problem using the environment-economy framework. It will be accomplished by a general case study, but using specific examples from various ACAP sites to highlight points.

Municipal waste water causes environmental problems because it usually contains sewage, leading to bacterial contamination (fecal coliform) of the water way. Most of the industrial waste encountered by ACAP sites emanates from pulp and paper mills, leading to contamination of the waterway. Both of these point source problems have many impacts including:

4.2.2 Relevant Sites

- In Humber Arm, Newfoundland, bacterial contamination of the bay from municipal sewage precludes most forms of related economic activity.

- In St. John's Newfoundland, sewage discharge has caused a major pollution problem in the harbour, impacting on tourism, downtown property values and general perception of the harbour.

- Madawaska in New Brunswick has both sewage and pulp and paper effluent discharges into its river, limiting fisheries activity, recreational uses and potentially affects the potability of water in a nearby lake.

- In Cape Breton, the Sydney tar ponds pose one of the most significant environmental risks in the Atlantic region, with potential impacts on human health.

In all of these examples, point source pollution affects environmental resources which in turn affects the economic uses of the environment. These uses all have value that is negatively impacted by using the environment for waste disposal. The environment-economy objective in these cases might be to remediate the pollution to allow for other uses of the environment- and thus increased economic value. The investigation that needs to take place is an evaluation of the costs of sewage treatment (or industrial waste treatment) versus the benefits of increased environmental health (and consequently increased economic health). If it can be proven that the societal benefits outweigh the costs, then remediation should occur.

4.2.3 Resource Valuation and Relevant Approaches

4.2.3.1 Identify Environmental Problem within Decision Making Context

Valuation of resources can be an essential component of strategic decision making. This is true since knowing the value of various resources, it is possible to compare various courses of action and determine which makes the most sense both environmentally AND economically.

The economic question where there is point source pollution is: Should remedial options be pursued which reduce bacterial contamination or industrial waste, in order to allow other uses such as water contact recreation, irrigation, etc.? Three decision making approaches can be identified:

(1) Valuation of the estuary, harbour or river based on different levels of bacterial or industrial contamination, and;
(2) Determining the costs and benefits of reducing bacterial or industrial contamination in the estuary, harbour or river;
(3) Conducting a cost-effectiveness analysis of remediating bacterial or industrial contamination.

To investigate using the first approach, a **resource valuation** of the waterway is conducted, including an analysis for varying levels of pollution. Decision making is based on how the total economic value of the waterway changes. If the total economic value of the water way is increased with remediation, then it will be considered socially beneficial. Note that costs of remediation are not considered using this method.

To investigate using the second approach, a **benefit-cost analysis** is conducted to determine if social well-being is improved with remediation (i.e. benefits greater than costs). Both the environmental-economic benefits AND the costs of remediation are considered. The costs in the analysis are the resources required to remediate bacterial or industrial contamination.

The third decision-making approach (**cost-effectiveness**) seeks only to determine the least costly method of achieving a given environmental objective.

Resource valuation is an important component of the first two methods of decision making since it is in using this technique that benefits are measured and total economic value determined.

4.2.3.2 Environmental Economic Linkages and Uses

The environment-economy approach adopted in this case study seeks to identify how the benefits derived by society from the environment (the river, estuary or harbour) can change when environmental quality (water) changes. To do this it is necessary to first identify the potential human uses from which benefit is derived. Some potential uses of the waterway are found below:

Sewage disposal
industrial waste disposal
Fishing
Aquaculture
Recreational fishing
Shellfish harvesting
Irrigation for agriculture
Tourism
Swimming
Boating
Scientific

Existence value

Once the uses have been confirmed, linkages between these various uses and the level of pollution must be established. If point source bacterial contamination is considered to be the environmental problem, it is necessary to determine the linkage between increased bacterial levels and the other human uses. For example, water contact recreation such as swimming is usually prohibited when bacterial levels exceed a certain concentration. Therefore the sewage disposal use prohibits the swimming use. In St. John's, there may be a linkage between downtown property values and the level of sewage flowing into the harbour. In Madawaska, the use of the river for sewage and pulp and paper waste may limit the use of the river for fisheries and recreation.

Once the type of linkage and its magnitude have been established, it will become clearer how the different uses of the environmental resources impact on each other. Next, it is necessary to value those uses that have a strong linkage to pollution. Ideally, the valuation will attempt to indicate values for varying levels of pollution to give a clear picture for decision makers. In this way, it will be possible to determine if remediation would result in net benefits to society.

4.2.3.3 Valuation Techniques

There are several valuation techniques that can be used for each use, and the most appropriate are listed below. Each of these techniques are useful for completing a benefit-cost analysis or determining total economic value.

Productivity/Production Method
The productivity/production technique can be used to measure the value of, or change in value of such uses as: fishing, aquaculture, and shellfish harvesting. To use this method, it is necessary to estimate the amount of the resource in the ecosystem. Value is determined by multiplying the total size by its market price or a better equivalent.

Intermediate Good Method
The intermediate good method can be used to measure the value or change in value of such uses as: Irrigation for agriculture. A clean waterway will allow the use of the water for agriculture. The value of this benefit can be measured by determining the increase in agricultural production as a result of the cleaner water.

Alternate Cost Method
The alternate cost approach can be used to measure the value of sewage and industrial waste disposal. The purpose of this method is to determine the value that the waterway provides in its current use. To use this method, it is necessary to determine the cost of alternative methods of disposal- for example a sewage treatment plant. The cost of this alternative is inferred to be the value of the waste disposal service that the environment currently provides.

Contingent Valuation
The contingent valuation technique can be used to measure the value of: recreational fishing, tourism, swimming, boating, and existence value. This method is useful when there is no obvious market price for the use to be valued. Surveys can be completed that ask users how much they would be willing to pay for a day of fishing, boating, swimming or simply knowing that the resource exists. Tourists can be surveyed to determine how much environmental quality affects their decision to visit a region.

Access Cost Method

The access cost technique can be used to value: recreational fishing, tourism, swimming, and boating. The value is measured by determining the cost users incur to use the resource, including travel costs and time costs. The sum of these costs are inferred as the MINIMUM value that the user places on the resource.

4.2.4 Economic Instruments

There are several different types of economic instruments that could be used to encourage or induce individuals to choose activities that reduce harmful impacts or increase beneficial impacts on the environment. They include:

Subsidies/grants: To firms that change their production methods so that the quantity or type of pollution is reduced. For example, subsidies could be provided to firms that treat emissions before discharging.

Emission Charges or Taxes: A charge levied, based on quality or quantity of emissions, against firms that pollute rivers.

User fees: User fees that charge consumers per volume of water used- so that less is wasted and dumped into rivers and harbours.

Tax Allowance: A tax allowance for either firms or home-owners that implement measures to reduce wastes going into rivers and streams.

4.3 Case Study #3: Sedimentation

4.3.1 Environmental Problem

Many ACAP sites are faced with sedimentation as a major environmental problem, in some cases the environmental problem in their area. Sedimentation results from practices which result in loss of, or at the very least the acceleration of, soil loss over that which naturally occurs. Chief among these practices are overly-intensive or inappropriate agriculture and deforestation. Sedimentation in turn can result in changes in agricultural productivity off of the original farm site, damage to fisheries as the sediment chokes and pesticides invade waterways, habitat damage for wildlife and aquatic life, decreased recreational opportunities in waterways, and the disruption of shipping and other waterway transportation.

Sedimentation is the process by which soil and any fragmentary materials it contains are deposited in, and settle to the bottom of, waterways. Agriculture contributes to this process when crop practices which cause erosion are implemented, such as when land is not left to fallow long enough to restore its fertility and its ability to hold in nutrients and soil molecules, and when hedgerows are removed as they act as a windbreak to prevent soil from being blown off the land and hold soil and nutrients, which prevents excessive runoff of soil particles. Forestry similarly contributes to this process through encouraging soil loss by removing trees which hold in soil and nutrients and break wind which blows off soil cover. Downstream, sedimentation results in the blocking of waterways which can be interfere with transportation and shipping, recreational uses of waterways (for example, boating) and the destruction of habitat for fish, shellfish and other aquatic life.

4.3.2 Relevant Sites

The ACAP sites where sedimentation has been described as a problem include: **Bedeque Bay** and **Cardigan Bay** in Prince Edward Island, where soil loss has been identified as a major concern due to the intensive agriculture and to some extent deforestation which occurs in the area. In New Brunswick, forest harvesting by private woodlot owners and the resultant damage to fish habitat was identified as a major concern by the **Miramichi** ACAP group. The **L'Etang** group also has concerns about sedimentation as it impacts negatively waterway and the shellfish industry there.

4.3.3 Resource Valuation and Relevant Approaches

4.3.3.1 Identify Environmental Problem within Decision Making Context

Now that we have stated the problem to be remedied - sedimentation - and provided some background to the issue, it is important to talk about what kind of practices or projects could be undertaken to reduce the amount of sedimentation, and their impact on the ecosystem surrounding it, which in turn supports life functions and all economic activity in an area.

Some projects which could be supported or may already be underway on the ACAP sites include soil conservation projects which encourage the planting of non-erosive crops, changing crop rotations and fallows to give the soil a "rest", the planting and maintenance of hedgerows to prevent soil simply blowing off the land, and changes in forest harvesting practices such as selective cuts and leaving buffer zones alongside the banks of waterways.

Once it is determined which sort of projects are likely to be the most effective in combating sedimentation, it is helpful to follow some sort of process which will allow us to evaluate whether or not the project will be helpful. The usual criteria for this is to determine if the benefits of going ahead with the project are greater than the costs. In order to do this we need to be able to identify the ways in which the environment and economy will interact when the project is implemented, and then assign some sort of value to these interactions so that we can determine the costs and benefits of going ahead with the project. This gives us a basis for making decisions about proposed activities or projects as they relate to soil use. The following section will look more closely at the valuation of resources which is the basis for making decisions as to the merit of environmental management projects.

Three decision making approaches have been identified in the two preceding sections which apply here as well:

(1) Valuation of the ecosystem in question;
(2) Determining the costs and benefits of reducing sedimentation in the area;
(3) Conducting a cost-effectiveness analysis of remediation options.

4.3.3.2 Economy/Environment Linkages

The linkages between the environment and economy in the context of sedimentation have already briefly been touched upon in section 4.1.1. We will specify them here with the aid of a diagram to illustrate clearly the linkages. This step can be applied in any situation where an ACAP group would like to begin a resource valuation regardless of the problem to be handled.

Forestry ------> Soil Loss ------> Sedimentation ------> Waterways

Agriculture ------> Soil Loss ------> Sedimentation -------> Waterways

The economic activities of forestry and agriculture depend upon the soil resource for their productivity and existence. It is not beyond the realm of possibility that the two activities might be beneficial for the soil in some ways, but in the current example they are contributing greatly to the loss of soil due to insufficient cover because of deforestation which removes that which binds the soil and holds it in place, and due to the growing of crops which are erosive, poor fallowing and crop rotation practices, etc. This results in sedimentation, or the soil being blown off the land or running off the land via streams due to rainfall, and being deposited into the various waterways in the environment - streams, rivers, bays etc.

Resource Uses

Now that we have identified broadly the interaction between certain economic activities and the environment, it is time to become more specific as to the current uses of resources within the environment and potential uses which would be supported by the proposed project. The following table will illustrate these uses for each ACAP site dealing with sedimentation as a major concern:

Bedeque Bay

Actual	Potential
Agriculture	Increased Agricultural Productivity
Forestry	Habitat Rejuvenation
Shellfish Harvest	Increased Shell Fishery Productivity
Recreation/Tourism	Increased Use of Waterways for Recreation/Tourism

Cardigan Bay

Actual	Potential
Agriculture	Increased Agricultural Productivity
Forestry	Habitat Rejuvenation
Shellfish Harvest	Increased Shell Fishery Productivity
Recreation/Tourism	Increased Use of Waterways for Recreation/Tourism

Miramichi

Actual	Potential
Forestry	Fish Habitat Rejuvenation
Fishery	Increased Fishery Productivity
Recreation/Tourism	Increased Use of Waterways for Recreation/Tourism

L'Etang

Actual	Potential
Forestry	Increased Aquaculture Productivity
Aquaculture	Fish Habitat Rejuvenation
Shellfish Harvest	Increased Shellfish Productivity
Recreation/Tourism	Increased Use of Waterways for Recreation/Tourism

4.3.3.3 Valuation Techniques for Resources

In the section above we identified actual and potential uses for the resources which relate to the project in question. The next step is to be able to value those resources. It would be a good idea at this point to review Chapter 2, which listed the various methods for valuing resources, then to look at the uses for resources we have listed above and to try to match the most suitable method to the use.

Here we will go through this exercise for each use listed above, not by site, in order to avoid repetition.

Changes in agriculture and its productivity as the result of changes in soil loss brought about by the proposed project could be measured by the **Intermediate Good Method**. The soil resource itself bought and sold in the market, but it is an input into crops which are sold

and do have a market price, and by calculating the value of increased or decreased (as the case may be) production we can infer the value of soil conservation from the project.

The same can be said for forestry with regard to the value of the soil. Also, decreased forestry can result in habitat rejuvenation and the value of that in terms of people's preference for being able to observe and enjoy restored habitat and the wildlife, plant life, aquatic life, etc. it supports can be measured by using the **Contingent Valuation Method,** or conducting a survey in the community to determine how much the public is willing to pay for the preservation, continued existence or improvement of the habitat currently being extensively modified or under threat of destruction from deforestation.

The value of a fishery or shell fishery or aquaculture, and its potential value given certain levels of change in sedimentation in each area can be determined using the **Productivity/Production Approach.** This approach is fairly straightforward, the price that fish or shellfish sell for is used to approximate the minimum value of the fish or shellfish in their environment. Therefore should the project increase the fish or shellfish harvest by a certain amount, that amount is then multiplied by the market price of fish or shellfish to determine the change in value which will result when the project is in effect.

In order to value recreational use of waterways and the value of tourism in the area, the **Access Cost Method** is generally applied. The goal is to find out how much people are willing to pay to use a resource for recreation or tourism, and from this we infer that this is the minimum value of the resource. To use this method you have to think of all the costs to people of accessing the resource, and then add them all together to come up with a total value. These costs would include the costs of travel to get to the resource, the cost in terms of the time it takes for people to get to the resource, and any user or admission fees they must pay in order to gain access to the resource (for instance a fee charged to enter a national park in order to access the waterway for boating, recreational fishing, observing nature, swimming, etc.). The list of costs above may not necessarily include all possible costs given different situations, but ACAP groups familiar with their own areas are likely to be able to think of other costs that people incur to access nearby resources for recreation or tourism.

These are a few of the ways in which resources can be valued, and most ACAP sites could do a preliminary valuation of resources using these techniques which would then give them information to present to the community at large who would be affected by potential projects, or to other stakeholders or decision-makers to give them an idea of the impacts of the project which the ACAP site is proposing or supporting.

There are many valuation methods and those who are interested in learning more about them can refer to the attached bibliography for further reading and examples of these techniques.

4.3.4 ECONOMIC INSTRUMENTS

4.3.4.1 Economic Instruments Which Apply to the Sedimentation Issue

Keeping in mind that economic instruments are ways of changing the price of something so as to encourage or discourage its use, economic instruments in this case would include anything that would alter the cost of agriculture or forestry so as to prevent soil loss and sedimentation. The economic instruments which will be suggested are not the only ones that are available, and it would be a useful exercise to think of any measures that accomplish the same thing - the knowledge that ACAP group members have of each area and situation puts them in the best position to think of new ways of changing behavior through incentives.

Several economic instruments could be applied to this issue, and have been in other cases around the world and here in Canada. A **product charge or tax** on agricultural produce or logs at various stages of processing which would take into account the cost of sedimentation caused by agriculture or deforestation would encourage people to buy less of a good produced or harvested using unsustainable practices and more of good produced in a more environmentally friendly manner.

Targeted land taxes which could vary with such factors as slope, proximity to waterways, size of holdings, degree of forestation, and land use have been suggested to remedy problems of soil loss in other parts of the world, for instance in Thailand, but the general idea is applicable to the Atlantic region as well. Since the cause of the soil loss is unsustainable land uses, taxes for undesirable practices or rebates for desirable practices would encourage farmers or foresters to behave more sustainably.

Subsidies or grants to farmers who, for instance, leave land in fallow longer, or maintain or plant hedgerows, act as a positive incentive to encourage them to decrease the amount of erosion and therefore sedimentation that is initiated on their land. The same would apply to private woodlot owners who practiced a more selective cut and left buffer zones along waterway. One of the drawbacks of this approach is financing - other instruments, for instance taxes, generate revenues to continue programs.

Tax allowances (tax breaks) could be given to farmers who can demonstrate that they have followed soil conservation practices, the same would be true for private woodlot owners who could demonstrate improvements in their harvesting processes.

In a similar way, those who continue to farm or forest in such a way that they are causing excessive erosion and sedimentation could be taxed at a higher rate (**tax differentiation**) than those who are not, thus decreasing the net incomes of those who do not work to conserve soil more so than those who do. The tax may be seen as a transfer payment to compensate for abuse to society.

Depletion taxes are also a possibility. Because soil forms at very slow rates it is in some ways considered to be a non-renewable resource. Anyone who depletes this resource could be taxed to reflect the fact that soil has a value and they have just destroyed it. The drawback here is that monitoring is required to pinpoint the level of soil loss and you have to be able to attribute that soil loss to a single source. The positive side of this instrument is

that the tax can be set to a level which pays for the monitoring and administration required to put an economic instrument of this type in place.

Work done in Indonesia and other areas where agriculture on steep slopes is prevalent (and as a result so is erosion and sedimentation) indicates that the **terms of access to credit** (i.e. loans) for farming could be set up in such a way so as to reward those who practice soil conservation with better terms on loans than are given to those who do not. The difficulty with this is persuading creditors to use this as a criteria for the rewarding of and calculation of interest rates on loans, as this can sometimes be seen as "interference" with private transactions.

4.3.5 Experience with Economic Instruments for Reduction of Sedimentation

Much of the case work to date on issues of soil conservation as they relate to agriculture and forestry were done for developing countries, but the main thrust remains the same no matter where the economic instruments to change the amount of erosion and sedimentation were applied or proposed**.**

On the Indonesian island of Sulawesi where forests were being cleared to make way for agriculture, coastal siltation was threatening an important coastal fishery**.** Land taxes and replanting incentives were put into place to encourage afforestation and the establishment of a greenbelt zone (buffer) which had been destroyed. This seemed to have the desired effect, i.e. it induced landowners and forest harvest operators to reforest the area, especially the buffer zone, which reduced the amount of siltation occurring and therefore relieved some of the stress on the commercial fishery.

In Sarawak, Malaysia, a differentiated royalty scheme was put into place along with monitored regulations for a selective cut, which is basically a differentiated tax as discussed above, combined with regulation, in the hopes that the incentive to the forestry sector would be to reduce the amount of deforestation and as a result erosion. And the result was indeed less environmental degradation, plus there was an increase in revenues which, when it was allocated back into the community, improved environmental management in the area. The forests there were reported to be less damaged than those in other comparable areas (Sabah and Indonesia).

Indications are good, therefore, that the use of economic instruments has been successful in changing damaging behavior in the agricultural and forestry sectors, although the application of economic instruments to environmental problems is a newer phenomenon and in order to gage the longer-term effects, we must continue to implement and observe!

4.3.6 Useful Further Reading - Reports and Studies

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