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For additional copies or further information, contact:
Dr. Stan Peabody, Chief of Party, EPAT/Technical Assistance
1611 North Kent Street, Suite 600, Arlington, VA 22209—USA
Telephone (703) 525-9430 FAX (703) 516-0481

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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WORKSHOP ON THE USE OF ECONOMIC INSTRUMENTS FOR ENVIRONMENTAL MANAGEMENT IN DEVELOPING COUNTRIES

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Use of Economic Instruments For Environmental Protection in Developing Nations

by
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Authors:

Dennis King, Maryland International Institute for Ecological Economics, Team Leader

Pierre Crosson, Resources For the Future

Jason Shogren, Iowa State University

With the assistance of:

Dinesh Aryal, Winrock International

Molly Hageboeck, Management Systems International

Amal Srivastava, Winrock International

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Preface

The EPAT/TA team prepared this paper for the Policy Directorate of the Agency for International Development as a U.S. contribution to the work of the Working Party on Development Assistance and the Environment of the Development Assistance Committee (DAC) of the Organisation for Economic Co-operation and Development (OECD). The original assignment called for the preparation of an outline for a "Best Practices" guidelines paper on Environmental Economics. The outline was reviewed at a meeting of the Working Party in May, 1992, and the assignment was modified. Members of the Working Party instructed EPAT to narrow the focus of the paper to concentrate on economic instruments for environmental protection in developing countries and to develop a background paper for a seminar on the topic. The seminar, sponsored by the Development Center and the Development Co-Operation Directorate of the OECD, was held in Paris in October 1992.

Based on the response to this paper and others presented at the seminar, the Working Party decided to postpone the preparation of "Best Practices" guidelines pending the accumulation of more experience and analysis. In the meantime, member countries have been requested to document experiences in case studies that will serve as a basis for preparation of the guidelines in one or two years.

In the first stage of this work, the EPAT/TA project benefitted from the direction and support of Jeff Schweitzer, A.I.D. Policy Directorate, Russ Misheloff, EPAT Project Officer, Office of Environment and Natural Resources of A.I.D.'s Bureau for Research and Development, and his colleagues, Ken Baum and David McCauley.

Martin Hanratty, Policy Directorate, provided direction for the second stage, when the team benefitted from the superb synthesis, analytical and bibliographic input of Amal Srivastava, summer intern at EPAT, and the subsequent backstopping by Dinesh Aryal, EPAT intern. The team is grateful for such excellent direction and support and looks forward to contributing to further development of this subject through collaboration with other case-study efforts.

Executive Summary

This paper examines the application of economic incentives to environmental management among members of the Organization for Economic Co-operation and Development (OECD) and discusses the potential use of such incentives to limit the degradation of natural and environmental resources in developing countries. This experience among members of the OECD is particularly relevant to the control of environmental pollutants. Due to the nature of their environmental problems, however, the members of the OECD have little or no relevant experience with the use of economic incentives as instruments to protect biological diversity, to encourage sustainable agriculture, or to prevent deforestation in tropical areas. To the extent that economic incentives have been used to address these concerns, the experience is relatively recent.

Environmental protection is a prerequisite for sustainable economic development and a requirement for long-term social and political stability. The argument that environmental protection is a luxury that developing countries can consider only after they achieve their economic goals reflects a short-term perspective. Nations that postpone actions to limit environmental degradation and resource depletion eventually learn that they must make significant investments to undo damage that might have been avoided at far less cost.

Although threats to the environment cannot be ignored, responding to them is not without consequence. Economic development and suitable protection of natural and environmental resources are compatible goals. Nonetheless, when resources are devoted to environmental protection, they may not be available to pursue other development objectives. Like other societal goals, therefore, it is important that environmental protection be purchased at the lowest possible cost. This is particularly critical in developing countries where immediate economic needs (and, frequently, high rates of population growth) combine to make rapid economic development an imperative.

Environmental problems stem from difficulties in establishing clear and enforceable property rights, or rules governing access to resources. Governments apply various policy instruments to compensate for these deficiencies. In dealing with environmental problems, most nations rely overwhelmingly on regulatory policies in which standards are set, as with air and water quality. Engineering or performance rules are then prescribed to force polluters to meet these standards. Such regulations are enforced by threats of fines and other penalties, including imprisonment in some cases.

The regulatory approach has been successful in improving environmental quality. There is evidence that indicates, however, that the costs of attaining additional improvements through regulations are high. Consequently, a different approach, which relies on economic incentives to induce less-polluting behavior, is attracting the attention of policy makers. When implemented correctly, economic incentives can achieve environmental improvement at substantially lower costs than regulatory approaches.

Successful use of economic instruments in developing countries requires that a number of conditions be met. The most important relate to: a) technical knowledge; b) legal structure;

c) competitive markets; d) administrative capacity; and, e) political feasibility. Economic incentives that meet these five conditions reasonably well would have a chance for success. Ideally, as well, success also requires that the incentives be **effective, efficient, equitable**, and **flexible**. Countries vary widely in their abilities to satisfy the five necessary conditions and to meet the four criteria for success discussed in this paper.

This review of economic incentives suggests the following conclusions:

- Economic incentives or regulatory approaches alone cannot solve perhaps the most important single environmental problem in developing countries--the human health effects of polluted water supplies.

- Incentive programs complement regulatory programs rather than substitute for them. Both approaches aim to induce producers and consumers to adopt more environmentally friendly practices. Direct regulations provide more control over pollution with less regard to costs, whereas economic incentives provide more predictability in terms of costs but less control over pollution levels. Only the regulatory approach is appropriate for situations in which the environmental damage is highly localized and threatening. Nuclear wastes provide an example.

- Economic theory indicates that emission charges or taxes and marketable permit systems rank higher than product charges in terms of effectiveness and efficiency and no lower in terms of equity and flexibility. Effective use of emission charges and marketable permits entails more difficult conditions of program formulation, monitoring, and enforcement than do product charges. The theoretical advantages of emission charges and marketable permits relative to product charges might, therefore, be largely offset by practical problems in actual application, especially in developing countries.

- With so much uncertainty about the suitability of economic incentives, a reasonable course for developing countries may be to proceed in three stages. First, initiate a system of product charges to generate revenues. Second, use these revenues to increase knowledge and to build an institutional capacity to cope with environmental problems. Finally, use accumulating knowledge and experience to consider more effective systems for controlling pollution such as emission charges and marketable permits. Direct regulations should be used to control especially threatening sources of pollution throughout this process.

- In many less developed countries, traditional systems of tenure, access rights, and incentives for conservation and efficient long-term resource management already exist. These systems may be deteriorating as a result of population pressure, modernization, and export-based development strategies. The cost of meeting legal, fiscal, administrative, and institutional requirements for implementing an effective economic incentive system based on private property and market competition in some countries may be enormous. In some cases it may be more effective, efficient, and equitable to bolster traditional incentive systems and use them to implement environmental policy rather than to introduce a new system that would require radical changes in traditional systems.

1. Introduction

New Perspectives

Environmental protection is a prerequisite for sustainable economic development and a requirement for long-term social and political stability. The argument that environmental protection is a luxury that developing nations can consider only after they achieve their economic goals reflects a short-term perspective. Nations that postpone actions to limit environmental degradation and resource depletion eventually learn that they must make significant investments to undo damage that might have been avoided at far less cost. Current efforts in Eastern Europe to reverse the effects of industrial and municipal pollution on air, soil, and water illustrate this point.

As the experience of developed countries demonstrates, policies that successfully protect the environment and foster sustainable economic development often require businesses, governments, and households to modify their behavior in ways that can involve some short-term economic sacrifices in order to achieve more desirable long-term gains. Firms must devote their capital resources to buy new equipment, to modify older technologies, or to change production processes to reduce harmful emissions. Similarly, farmers who shift to more environmentally sound practices may find their earning capacity curtailed, at least in the short term.

In less developed countries (LDCs), where the demands for rapid economic development are compelling and where the ability of businesses to pay for environmentally sound methods of production may be limited, it will be difficult for governments to impose environmental policies that appear to constrain economic opportunities. Leaders in these nations are, therefore, under pressure to identify policies that provide an acceptable level of environmental protection while minimizing their cost and the degree to which they act as disincentives to economic progress. The identification of such policies benefits from an understanding of the nature of environmental problems, the economic impacts of alternative environmental policies, and the institutional conditions and societal arrangements that must exist if these policies are to be implemented effectively.

The Problem of Property Rights

If individuals and businesses bore all the costs and reaped all the benefits of their decisions affecting the environment, there would be no need for governments to intervene to protect the environment. However desirable such a situation, it does not exist anywhere. The institutions that control some critical resources, especially air and water, are such that frequently those people or firms who benefit from use of the resources do not also bear the costs--they impose them on others. Environmental policies are needed in these situations to assure that the beneficiaries of resource use are also responsible for the costs.

To understand the root causes of environmental degradation, it is useful to understand the concept of property rights. Well-defined property rights have the following conditions or characteristics:

(a) **Rights are Comprehensively Assigned.** All resources must be either privately or collectively owned, and all entitlements must be known and enforced effectively. Resources for which these conditions are not met will be seen as free to any user and will be overexploited as a consequence.

(b) **Rights are Exclusive.** All benefits and costs from use of a resource should accrue to the owner, and only to the owner, either directly or by sale to others. This applies to resources that are owned in common as well as to resources for which private property rights have been assigned. Absent the principle of exclusivity, there is little incentive for individuals to buy, protect, or improve natural resources.

(c) **Rights are Transferable.** All property rights must be transferable from one owner to another in a voluntary exchange under conditions that are generally perceived to be fair. Otherwise the owner will not have an incentive to conserve the resource beyond the time he or she expects to make use of it. The interests of future generations in the resource would be slighted.

(d) **Rights must be Secure.** Property rights to natural resources should be secure from involuntary seizure or encroachment by powerful neighbors, business interests, or government entities. Otherwise the owner will have an incentive to exploit, rather than improve and preserve a resource while it is in his or her control.

Most environmental problems can be linked, in one way or another, to the failure or inability of institutions, especially governments, to establish clear and enforceable property rights over resources. As an illustration, many people own land and are able to take action when damage is done to it, but they do not generally own the rivers or the air, through which significant amounts of pollution travel. The lack of a clear and enforceable right to clean air thus makes it nearly impossible for people who live downwind from a coal-fired power plant to halt the harm that the plant does to them or successfully to demand a fee, equivalent to the costs they bear, from the operator of the upwind plant. The plant operator does not bear the downwind costs, so he ignores them. He lacks any economic incentive to control combustion emissions or to switch to less polluting practices. Similarly, there may be no legal or institutional basis that allows the downstream users of polluted river water to receive compensation from upstream farmers whose sediments, pesticides, or fertilizers impose downstream costs in the form of contaminated drinking water, poor fishing, or reduced recreational opportunities.

Assuring that property rights are exclusive is especially difficult for air and water, the media that transport the most pervasive and environmentally damaging pollutants. Air and water are transient resources--they move long distances. Accordingly, laws in most countries treat air as open access resource, meaning that no individual or group has exclusive control over it.

Individual or group rights to water often are not open, as with air, but nonetheless are specified to accommodate various, often conflicting, interests, thus giving exclusive rights to no one. For both resources, a fundamental condition for an effective property right is not met.

It is easier to meet the conditions for well-defined property rights for land than for air and water because land stays in place. This characteristic makes it possible for land to meet the requirement for exclusivity, even under conditions of common property ownership. In some LDCs property rights to land, trees, and local water supplies are well developed at the local level and are vested in entire villages or clans rather than in individuals or business interests. In these cases, resource management, by an extended family or a village authority, can conform to well-established, enforceable, and socially efficient rules of access. Village elders, for example, have incentives to consider both current and future costs in making their production and investment decisions, to require individuals to engage in soil conservation or replanting, and to use common property resources within prescribed limits.

Even when the four conditions for effective property rights are met, poverty and lack of alternative economic opportunities can induce poor people to exploit resources at an unsustainable rate, threatening the rights and economic opportunities of future generations.

While the lack of clearly defined property rights may be the fundamental cause of environmental problems globally, the issue is particularly problematic for LDCs. In many of these countries, conditions of access to resources, such as the traditional migratory farming patterns, can make it difficult to ensure **exclusive** rights to many types of resources. In addition, flawed, imperfect, or excessively controlled markets in many LDCs lead to a situation in which rights of **transferability** cannot be assured. Moreover, institutions of governance in many LDCs may not be able to ensure that property rights will remain **secure**.

In sum, the inability or unwillingness to assign property rights are such that solutions to most environmental problems require governments to intervene as an advocate for proper management of natural and environmental resources. As such an advocate, however, governments can choose among a wide variety of policy interventions.

Types of Policy Interventions

Decisions about which policy interventions to choose involve at least two steps. First, governments establish environmental quality goals. The goals can be expressed as a desired level of air or water quality, an annual level of toxic emissions, or some other standard. Second, governments select the policy or set of policies that can best achieve their goals.

Policy alternatives to achieve environmental goals can be placed in two categories: **direct regulations** and **economic incentives.** While these categories are distinct, they also represent points along a continuum. The penalties for violating a direct regulation are themselves disincentives and are frequently economic in nature. A strong governmental role in environmental decision making and enforcement based on **forcing** changes in behavior lies at one end of the spectrum. At the opposite end are policy tools that, while not precluding a role for

government, attempt to **induce** polluters to change behaviors by changing the costs and benefits of their decisions.

Direct regulations attempt to force changes in behavior by establishing production, technology, or emissions standards. To ensure compliance, regulations threaten the use of fines, imprisonment or other punitive measures. Direct regulations typically specify the kinds of technologies that can be used, such as scrubbers on smokestacks to reduce gas emissions, or allowable levels and types of inputs used, such as when limitations are placed on the amounts or kinds of fertilizer and pesticides that can be used. Direct regulations provide governments with a significant amount of control over polluting behavior.

Despite the relative ease with which regulations can be established, they do have several disadvantages. First, regulations often require administrative agencies to become experts in the industry or type of pollution that is to be regulated. To establish appropriate environmental regulations for a steel mill, for example, an administrative agency must be thoroughly familiar with all the processes and technologies associated with making steel. Such expertise is difficult to acquire and retain unless the administrative agency can afford to train an expert or hire someone from a company that makes steel. Second, regulation requires agencies to collect and analyze considerable technical and economic information. Third, direct regulation also constrains the choices that are open to polluters. As just noted, the approach assumes that government administrators know at least as much about the causes of pollution as do those who are responsible for it. Finally, rather than encouraging polluters to develop innovative or cost-effective pollution abatement procedures, direct regulations tend to elicit only perfunctory compliance. More often than not, this compliance comes only after protracted negotiation and threats of enforcement. Indeed, delayed compliance is economically attractive to many firms because they save the expense of investing in what they might consider to be nonproductive equipment.

In contrast, **economic incentives** induce polluters to reduce harmful emissions through the use of such financial instruments as taxes, charges, or subsidies. Such incentives can also be used to create markets for pollution permits through which polluters are allowed to choose between: (a) reducing their own pollution levels; or, (b) maintaining excessive levels and paying other polluters to reduce their pollution below the legal limit. Table 1 summarizes the most common forms of direct regulation and economic incentives.

Both direct regulation and economic instruments rely on an implicit assumption that the public, as represented by the government, has certain rights that can be legally enforced. In principle, it is both easier and more efficient for a government than an individual to exercise rights over transitory resources such as air, water, or migratory fishes. The institutional requirements to do so are significant. In LDCs, the institutional infrastructure needed to implement direct regulations or introduce economic incentives tends to be inadequate and difficult to finance.

2. Economic Instruments for Environmental Protection

This section describes six economic incentives and discusses how they are currently used. Table 2 briefly describes each.

Emission Charges

Emission charges are fees that are imposed on the discharge of pollutants to air, water, or soil, or on the generation of noise. These charges are designed to reduce the quantity of the undesirable product by making polluters pay at least part of the costs of the harm to the environment. Ideally, the charges are established to reflect the damages caused to humans or to the environment. This is difficult to do. The alternative is to impose a charge for every unit of pollution released into the environment. In principle, doing so induces firms to lower their emissions. Reductions in pollution bring with them a reduction in the tax or charge that a polluter must pay. Unlike regulatory approaches that encourage delay in compliance, appropriately established emission charges create powerful incentives to reduce pollution as quickly as possible to the point where the incremental cost of pollution control equals the emission charges the polluter would otherwise pay.

Emission charges also create continuing incentives to develop and adopt newer and better approaches to pollution control. To the degree that individual polluters use emission control approaches that represent least-cost solutions, the aggregate costs of pollution control should be minimized.

Emission charges are used in all OECD countries, where they are normally applied to encourage the control of water, waste, and noise pollution. Only in France have emission controls also been used to discourage air pollution. Elsewhere in Europe, environmental protection agencies appear to believe that emission charges are effective when applied to water pollution but not to air pollution. The relative ease with which sources of water pollution can be identified may help to explain why emission charges are used more frequently for water than for air pollution control.

Waste is the second pollution area in which emission charges are widely applied. Emission charges on sewage take the form of waste treatment charges, since residential, municipal, and industrial wastes are usually treated before they are dumped into lakes, rivers, or oceans. This characteristic facilitates measurement of the volume of waste produced or the volume requiring treatment. Waste-related emission charges vary with the cost of waste treatment.

Considerable experience exists with the use of emission charges for waste pollution control. Australia, Belgium, the Netherlands, and the United States all apply emission charges on municipal and industrial wastes. Their experience suggests that the emission charges they have imposed have been too low to be successful from an economic perspective. In both the

Netherlands and the United States, as an example, the charges function primarily as sources of revenue and have little deterrent effect. In contrast, the Dutch Manure Surplus charge appears to be quite effective as a pollution control incentive. The charge is based on the phosphate content of manure, above and beyond the amount farmers are allowed to put on their land.

Charges for noise pollution are also prevalent in OECD countries, but the evidence concerning these charges likewise suggests that they too have been set too low to serve as effective incentives to reduce emissions. These charges are used primarily to raise revenues that are used to compensate people who are subject to certain kinds of noise pollution, such as those living or working near airports.

Product Charges

Product charges are fees or taxes levied on products that are harmful to the environment when used in production, when consumed, or when they or the containers that carry them become waste matter. By increasing the cost of hazardous materials, product charges encourage producers and consumers to substitute more environmentally safe products (that do not have product charges) for less safe ones.

Product charges can serve as economic incentives and can also raise revenue. Revenues from product charges can be used to finance pollution prevention or efforts to restore air, water, or soil quality to acceptable levels. These charges can also be used to finance environmental research and implementation, or they can be added to public budgets without being earmarked for environmental purposes.

Product charges contribute to an integrated life-cycle approach to product development and management by focusing attention on potential environmental costs at each stage of the product cycle: production, consumption, and waste disposal. Product charges can be levied on inputs to production processes as well as on the outputs of those processes.

Theoretically, charges levied on inputs encourage firms to increase their use of environmentally sound inputs at the expense of less sound ones. Product charges can also be levied on raw materials, intermediate products, or input characteristics, such as the lead content of gasoline. Input charges have many variations and are applied extensively in OECD nations. The Netherlands employs what may be one of the most effective product charges--a surtax on oil excise duties. The rationale for the surtax is that the administrative cost of applying a charge to each input would be inordinately high. Consequently, a charge on the energy that is required to process a range of inputs offers a simple and straightforward alternative that is also administratively efficient.

Experience to date suggests that product charges applied to identifiable intermediate or finished products are more difficult to use than when they are applied to production inputs or post-consumption wastes. Nonetheless, some OECD members have instituted product charges on a limited range of products. Norway and Sweden, for example, apply product charges to

batteries, fertilizers, and pesticides, while Italy levies a tax on plastic bags, which manufacturers and importers pay.

Product charges are also used at the waste disposal stage of the production process. The European Community (EC), plus Finland, follow a 1975 EC directive that requires the recycling of waste oils as a means of pollution prevention. In response, Germany applies a product charge to lubricant oils. The amount of waste oil disposed of in ways contrary to regulations dropped to 5,000 tons in 1991, from 92,000 tons in 1989. Italy employs a similar product charge on lubricant oils. It too has been highly successful. Waste oils collected increased from 55,000 tons in 1985 to 105,000 tons in 1986.

In addition to product charges on waste oil, there are other examples within the OECD of product charges being applied at the waste disposal stage. Norway and Sweden impose charges on beverage containers that are harmful to the environment at disposal.

Although product charges may be called economic incentives, a common feature of almost all such charges, whether levied on inputs or outputs, is their apparent lack of impact on polluters' behavior. There is, for example, little evidence that product charges lead to significant reductions in targeted inputs or final products. As a general rule, the evidence suggests instead that charges have been set at levels that make it more cost effective for producers and consumers to pay the charges than to seek alternative inputs or finished products, or to vary their practices with respect to waste disposal.

While product charges have not yet induced behavioral changes of the magnitude desired, they do appear to help governments finance policies and programs to deal with the negative environmental effects of the products on which such charges are imposed. The administrative costs of product charges are usually low, primarily because they can be incorporated into existing tax systems.

Deposit-Refund Systems

With deposit-refund systems, purchasers of potentially polluting products pay a surcharge, which is refunded to them when they return the product or its container to an approved center for recycling or proper disposal. This instrument has the attractive feature of rewarding good environmental behavior. Deposit-refund systems have been in place for many years to control the disposal of beverage containers. These systems can also help to prevent the release of toxic substances into the environment from the disposal of batteries or the incineration of plastics or residuals from pesticide containers. Well-functioning deposit-refund systems can also stimulate the emergence of markets in safe waste disposal. Such systems pay people to look for opportunities to receive a refund. If some people dispose of cans, other people have incentive to find and return them.

Deposit-refund systems for beverage containers are widespread. India, Syria, Lebanon, Egypt, and Cyprus all have the deposit-refund systems for glass, carbonated beverage containers, and France, Germany, Canada, Australia, Switzerland, and the United States have deposit-refund systems for specific kinds of beverage containers.

Finland is planning to include plastic bottles in an extended deposit-refund system, and Denmark, Finland, Norway, and Sweden are examining the possible implementation of such systems for other articles such as batteries with a high content of mercury and cadmium. Norway has used a deposit-refund system for car hulks since 1978. The goal is to reduce the number of cars abandoned and to promote the re-use of car materials. As a result, 90 percent to 95 percent of car hulks are returned in Norway.

Deposit-refund systems have improved waste disposal and have reduced littering. Deposit-refund systems provide economic benefits for good environmental behavior and impose costs on undesirable behavior. These systems also have relatively low administrative costs. Once a deposit is paid, no further significant involvement by governmental authorities is needed.

Marketable Permits

Marketable permits specify a predetermined total level of emissions or emission concentrations within a specified area. Pollution permits equal to the permissible total are distributed among polluting firms in the area. The permits can be traded among plants of a single firm as well as among firms. Firms that maintain their emissions below their allotted level can sell or lease their surplus allotments to other firms or use them to offset emissions in other parts of their own facilities. To ensure that such permits serve their purpose as incentives for behavioral changes, predetermined total emission levels within a given area must be set so that emission permits are relatively scarce. Scarcity makes the permits valuable to polluting firms, thus creating incentives to trade permits among firms.

Marketable permits shift decisions about the design and location of pollution control equipment from government agencies to plant operators. Presumably these operators know far more about their plants' operations than do public officials.

The United States makes limited use of pollution permits for air pollution control. Permit systems developed and implemented at the state level to comply with national ambient air quality standards are considered to be the most important. The U.S. system was developed as part of an effort to implement the U.S. Clean Air Act. At a first step, identifiable spaces in the air, or imaginary "bubbles," are created over sources of air pollution. Total permissible emissions within these bubbles are then determined. Under these predetermined emission limits, shifts are allowed among polluting sources. The system is designed to allow firms to control emissions from those plants where abatement is relatively inexpensive. In contrast, emissions at plants with higher control costs are allowed to continue or even increase as long as the total emissions from all sources within the bubble are less than the predetermined limit. A second intended result is to lower the costs of permissible emissions more than might have been the case if uniform controls were imposed on all sources of similar pollutants.

The bubble approach reduces significantly the need for government agencies to develop expertise in different methods of pollution control. These agencies need only determine an acceptable level of air pollution within the area that the imaginary bubble covers and then be able to monitor emissions within that area. Choices about which sources to control and which pollution control techniques to employ are left entirely to the plants' owners or managers.

In the United States the only case of a marketable permit system to address problems with water quality is in the State of Wisconsin, which has a permit system for waste discharges to the Fox River. The water authorities issue marketable waste discharge permits based on the river's assimilative capacity. To date, however, few trades have occurred.

No other OECD countries have marketable permit systems, although both Germany and the Netherlands are studying and debating implementation of such systems for water pollution abatement.

Despite the apparent advantages of marketable permit systems, evidence from the United States suggests that these permits have not produced significantly greater reductions in emissions than have traditional regulatory approaches. Nonetheless, the unit costs of reductions are less with marketable permits than with regulation. The evidence is ambiguous as to whether permit systems stimulate any more innovation in pollution control technology than do regulatory systems.

Tending to offset this cost advantage, marketable permit systems have apparently proven to be administratively cumbersome. Their application has, at times, been hindered by frequent quarrels about baseline emission levels, the need for government approval at all stages of policy formulation, and the lengthy process in which firms must engage as they exchange proposals for trading permits. In addition, the trading process has technical, financial, and legal dimensions that must be addressed before each trade occurs. As a result, the U.S. Environmental Protection Agency has experienced a substantial increase in its work load and related costs since it implemented its policy in this field. Administrative costs have been high for polluters as well.

Subsidies

Subsidies are financial incentives that governments offer to actual or potential polluters. Subsidies can be used to encourage pollution abatement or to mitigate the economic impact of regulations by helping firms meet compliance costs. Subsidies normally take the form of grants, loans, or tax allowances.

Not all subsidies have positive environmental effects, and some subsidies can promote costly and unsound development. The U.S. Forest Service's "below-cost timber sales," which recover less than the cost of making timber available, provide an example of a subsidy with undesirable consequences. Eliminating subsidies is often an effective way to improve environmental quality without imposing new burdens on taxpayers.

Subsidies are widely applied in OECD nations, with Australia and the United Kingdom as exceptions. In most OECD countries, subsidies come from environmental taxes, fees, permits, and charges rather than from general tax revenues. Revenues raised from environmental improvement are used to ease the burden on industry of financing especially helpful improvements.

- France provides subsidies to encourage industry to reduce water pollution. The French system relies on loans rather than grants.

- Italy subsidizes the recycling of solid wastes, and it favors industries that commit themselves to reducing waste.

- The Netherlands subsidizes industries to promote compliance with environmental regulations, to encourage research, and the installation of equipment to control pollution.

- Sweden subsidizes a Fuel Environment Fund with charges on oil and fuel gas cleaning. Revenues from emission controls for fuel combustion and waste incineration also contribute to the Fund.

- Germany finances its subsidy programs with revenues from the public budget. These programs have two primary purposes: (a) to facilitate the implementation of environmental programs; and, (b) to assist small firms that might experience problems with cash flow because of sudden additional capital requirements for pollution control systems.

- The United States collects little in the way of charges to reduce air and water pollution and does not earmark collected funds to subsidize pollution control. The Federal government has subsidized the building of municipal wastewater treatment plants from general tax revenues. Over the last fifty years the U.S. government has also spent billions of dollars to subsidize part of farmers' costs of soil conservation.

Bond and Liability Systems

With these systems, firms post monetary bonds before operations begin, and forfeit the bond if their activities cause unacceptable environmental harm or if they pollute in excess of acceptable levels. Despite their apparent simplicity, bonds and liability systems are used in only a few OECD countries. Performance bonds are less common than noncompliance fines and are applied primarily in cases of clear environmental damage, such as with surface mining. Australia, Britain, Norway, Sweden, Finland, and the United States use variations of these two instruments.

Noncompliance fees have had little effect in Australia, Norway, and Sweden because the fee typically is less than the potential economic value of noncompliance. Consequently, most

cases involving noncompliance in these countries have to be resolved through adjudication, thus raising the overall costs of administering fee systems. In Britain, Finland, and the United States an attempt has been made to set such fees equal to the damage that has occurred historically, and these systems have been somewhat more effective.

3. Evaluative Criteria

Judgments about the usefulness of various economic instruments should be based on the extent to which they meet four performance criteria: **effectiveness, efficiency, equity, and flexibility.** Regardless of an instrument's theoretical appeal, it will fail if it is ineffective in reducing pollution damage and resource depletion, is unacceptably inefficient in accomplishing these goals, violates strongly held social canons concerning equity, or lacks the flexibility to change with shifting economic, technological, and environmental conditions. Sufficient experience exists with marketable permits and emission charges, so it is possible to apply the four criteria to these two instruments.

Effectiveness

Effectiveness is defined as success in achieving stated objectives in pollution reduction and resource conservation. Both short- and long-term perspectives are important in judging the relative success of alternative instruments in encouraging technical and institutional innovations that reduce pollution or conserve resources.

Marketable permit systems establish a fixed maximum quantity of allowable pollutant emissions in a specified region. Typically the costs to firms in meeting this standard are highly uncertain. Nonetheless, the amount of emission reduction that marketable permit systems are expected to achieve can be estimated with reasonable accuracy, as the difference between pre-policy emissions and the emission standard. This difference provides an acceptable measure of effectiveness in most cases.

Emission charges are the opposite of marketable permit systems in the sense that they set a specific price, or charge, for emissions, but usually leave considerable uncertainty about the amount of emission reduction that will be achieved. It is noteworthy, however, that many emission charges are not set sufficiently high to motivate polluters to reduce their emissions. Consequently, polluters simply pay the charge and do not reduce emissions. Under such circumstances the amount of emission reduction is quite predictably zero. By almost any standard of performance associated with environmental improvement, such revenue-generating emission taxes have little apparent effect.

In terms of narrowing the difference between actual emissions and the emission standard, marketable permits would appear preferable to emission charges. Permits offer more predictability about and greater control over the decline in emissions. If there is more concern about the cost of emission controls than about emission levels, the comparison does not so clearly favor marketable permits, as the following example suggests:

- If health or environmental risks associated with small changes in the level of pollution are perceived to be high and the cost of pollution reduction is fairly predictable, it may be prudent to exercise more control over emissions and let

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costs respond. This would favor a marketable permit system where a public policy maker would establish the overall level of emissions.

- If there is significant uncertainty about the cost of reducing emissions and health and environmental risks change gradually as emission levels change, the prudent decision may be to use charges that offer more predictability in terms of industry costs and accept more uncertainty about the level of pollution reduction that will be achieved.

Emission charges established at appropriate levels are likely to be more effective than marketable permits in reducing pollution. This occurs because, in principle, emission charges create greater incentives for firms to innovate in pollution abatement technology or to consider other ways to reduce pollution that are less costly than the means presently employed. A firm that pays a tax on each unit of pollution can always reduce its tax burden and increase profits if it can find a way to reduce its pollution. The firm has an incentive to develop and adopt a lower cost approach, which would both increase its profits and reduce pollution.

A similar incentive exists with marketable permits but a firm's profits are not tied as directly to pollution reduction as with an emissions charge because permit systems are based on a fixed amount of permissible pollution. As long as firms stay within the permissible limits they can pollute as much as before and keep the additional profits accruing from improved pollution abatement. Alternatively, firms can sell pollution permits. There is incentive to reduce pollution control costs but no direct incentive to reduce pollution. Only if the regulatory agency becomes aware of and uses the innovations as a justification to reduce permissible pollution will an innovation result in less pollution. This is a more cumbersome and uncertain technique for encouraging innovations that reduce pollution than emission charges. This occurs because the latter approach gives firms a direct financial incentive to develop abatement-cost reducing, and hence, pollution-reducing innovations.

Note that this argument for the greater effectiveness of emission charges relative to marketable permits is based on theoretical discussions, not experience. In point of fact, neither approach has been widely used to reduce emissions. Thus, it is not clear that the effectiveness advantage of emission charges would be realized in connection with practical applications of this instrument. Surveys of the application of economic incentives within OECD countries have found little evidence that any of them stimulate innovations in pollution abatement technology. As noted above, the likely explanation is that most charges are not sufficiently high to motivate polluters to change their behavior. This situation may change if policy makers increase emission charges and reduce allowable emission levels.

Efficiency

Efficiency is desirable because it implies that objectives are achieved at the lowest possible cost. In principle, marketable permits and emission charges are equally efficient. In practice, however, the efficiency of the two systems can differ significantly, depending on the characteristics and source of the pollution. The critical issue here is the cost of monitoring and

enforcement. An emission charge requires the continuous gathering of data on the quantities of emissions from sources to be controlled. Government agencies must also have the administrative capacity to use the data to set appropriate charges and to collect them. Agencies managing marketable permit systems, in contrast, need to establish the "rules of the game" for the operation of the permit market, must monitor the transactions occurring as permits are traded among firms, and must be able to assure that the firms selling permits reduce their emissions appropriately. With marketable permits, an agency must bear the costs of the initial organization of the marketing system, which is itself a complex and potentially expensive task. If the number of firms in the marketing system is large, continuous monitoring and enforcement requirements can be costly. Of course, if the number is too small, there may not be enough firms in the system to assure a competitive market in permits, and the system will be inefficient.

The lack of real experience with either of these systems makes judgments about their relative efficiency highly uncertain. Drawing mostly on the U.S. experience, there is some evidence that there are more cost savings with marketable permits than with emission charges. In LDCs, however, the scarcity of technical and administrative skills in policy agencies, the shortage of financial resources, and limited institutional and administrative resources to monitor and enforce emission controls probably strengthen the case for price-based interventions, such as emission charges, over quantity-based interventions, such as marketable permits. Price-based instruments provide greater certainty regarding abatement costs and do not usually require the establishment of new administrative systems because most countries already have ways of charging for or taxing relevant commodities. In contrast, however, many LDCs probably would need to create new and relatively unfamiliar administrative and institutional apparatus in order to implement and manage a system of marketable permits.

Equity

Economic incentives have implications for equity, which involves the distribution of economic and environmental costs and benefits among members of society. These distributive consequences raise issues of equity, both within and across generations. Such issues are a major concern for policy makers, especially in LDCs. A useful example of the equity issue involves the difference between a charge and a subsidy to control pollution. Incentive schemes can be designed to either tax or subsidize polluters to reduce emissions. Under the polluter-pays notion of equity, polluters should pay the costs of clean-up or of compensating victims. With subsidies the reverse is true and, in effect, the public pays polluters through subsidies to change behavior. The public then receives benefits in improved environmental quality. The use of emission charges is consistent with the polluter pays principle but raises additional equity questions related to how government agencies will use the revenues collected, and whether these agencies will be even-handed about collecting charges. In situations where common property or open-access resources become less accessible, concerns about equity may require attention to whose traditional rights will be abridged.

Equity requires that the distribution of cost burdens imposed by economic instruments be considered carefully. This includes attention to a fair distribution of costs among businesses, consumers, and workers. Equity across generations is also important in the sense that economic

incentives should avoid unfairly foreclosing options and imposing excessive costs on future generations. A critical issue related to equity is whether the revenues from a charge system should be used to compensate victims for damages, to clean and restore the environment, to provide funds for the general treasury, or for some other purposes.

The direct burden on the polluting community is often associated with changes in profits and with industry-wide competitiveness, both domestically and internationally. If an instrument raises costs such that products are no longer competitive in national or world markets, industry profits will decline and some businesses may go bankrupt or move to other countries. In principle, economic incentives are more efficient than direct regulations and should impose a lighter burden on an industry. If the objectives of pollution reduction or resource maintenance are consistent across instruments, the equity consequences should also be consistent across instruments. For example, the initial distribution of permits among firms, including whether they are granted to individuals or groups or sold to the highest bidder, has distributive consequences. If a few firms are given the majority of marketable permits, these firms will have an obvious advantage over competitors.

In the case of emission charges, some firms pollute less than others because of different local conditions or because of differences in the relative availability of low- versus high-polluting fuels. If all are charged according to their emissions, firms in areas where they pay lower charges will have an advantage over firms in other areas. Location will also affect the amount of environmental damage caused by a given level of emission, so uniform emission charges, in some cases, may be inequitable.

Understanding equity implications requires exploration of how the costs of an economic instrument can be shifted "forward" from affected firms to consumers in the form of higher prices or "backward" in the form of lower wages to workers or lower prices paid for raw materials. The ease with which a firm can shift the cost burden depends on competitive conditions in input, labor, and product markets. If there are a large number of consumers with limited substitution opportunities and only a few producers, the costs will probably be passed "forward" and consumers will face higher prices as a result of policy action. In contrast, if there are a few consumers with readily available substitutes buying from a large number of producers, each firm will have to accept lower profits or try to impose the costs of the economic instrument to workers or suppliers. In this sense, the burden of the policy will follow the path of least economic resistance, which in LDCs may have significant equity consequences.

Intergenerational equity is always a contentious issue in resource management. Concern about intergenerational equity often focuses on the depletion of natural resources. A subsidy, for example, that encourages depletion of a resource, whatever its short-term justification, would likely reduce the amount of resources available to future generations in ways that can be viewed as inequitable. The challenge, then, is to establish an equitable trade-off between the welfare of present and future generations while recognizing that many in the present generation are poor and have a legitimate claim to a faster, not slower, rates of economic development. When governments design economic instruments for environmental and natural resource management, they need to understand and be as explicit as possible about intergenerational consequences and the tradeoffs that are being made.

Flexibility to Achieve Objectives

An economic instrument should be adaptable to changes in markets, technology, knowledge, and social, political, and environmental conditions. Given the difficulty of achieving any objective, the instrument should be sufficiently flexible to accommodate several iterations of use. The degree of flexibility in an emission charge depends, for example, on the ability of the policy maker to react quickly to a change in emissions and on whether agencies have the legal authority to change charges. If altering a charge requires several levels of authority, the change might be too late to be effective. Concerns about flexibility also require that charge systems be indexed to inflation. In countries where prices inflate 50 percent to 100 percent every year, for example, a fixed emission charge would soon lose whatever effectiveness it has in reducing pollution or generating revenue. A charge system that incorporates indexation for inflation would be more flexible than one in which the administering agency is required to obtain authority to adjust the charge each year.

By contrast, a permit system allows the price of the permits to be set by transactions among firms participating in the system. These prices automatically adjust to changing economic, technological, and inflationary conditions insofar as these changing conditions affect the decisions of participating firms and their emission rates. For example, if a new technology to reduce emissions is developed, the permit market would reflect this change through shifts in the supply and demand for permits. This would, in turn, affect permit prices. Because of these characteristics, marketable permit systems may prove to be more flexible than emission charges.

4. Necessary Conditions for the Use of Economic Instruments in Developing Countries

Certain conditions are required before economic incentives can be used effectively to promote environmental protection. These conditions, summarized in Table 3, include: an adequate knowledge base; a strong legal structure; competitive markets; administrative capacity; and political feasibility. Conditions in LDCs differ significantly, so no attempt is made to determine which alternatives are most useful in these countries. Instead, the discussion highlights questions policy makers in LDCs should ask before attempting to develop and apply incentive systems.

An Adequate Knowledge Base

Effective use of economic incentive instruments in developing countries requires that policy makers and the firms subject to incentive systems have access to an adequate knowledge base and the technical capacity and skills to make use of it. The required knowledge includes:

(a) An understanding of the costs and benefits of alternative environmental policies and a recognition of who gains and who loses because of their adoption;

(b) Data on the quantity and quality of environmental assets and resource stocks, who has access to them, and their current and projected rates of use;

(c) Assessments of technological and institutional opportunities and constraints in the production of goods and services and in pollution abatement; and,

(d) Information about substitution possibilities that would allow both policy makers and the regulated community to assess potential trade-offs between more or less environmentally harmful products and production processes.

Achievement of the necessary knowledge can require substantial investments in human resources. No system of economic incentives, no matter how well sophisticated technology supports it, can be administered and enforced effectively if the people responsible for managing the system lack the necessary know-how.

Economic incentives are also likely to be ineffective when the objectives they are expected to achieve are not clearly stated or when the legal authority that underlies an instrument is not firmly established through environmental legislation. Such legislation must specify the chain of authority, the range and assignment of jurisdiction, and the legal standing of the affected parties. Policy makers also need to specify which indicators of improvement in environmental quality and human welfare will be used to judge success. This, in turn, requires baseline assessments of environmental and resource quantity and quality against which progress can be measured.

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Businesses will also need information, especially about the opportunities provided or eliminated through the use of economic incentives. These incentives, if they are set at levels high enough to change behavior, must be expected to produce modifications in the use of inputs, technology, or in the ways that current technology is used. The knowledge base of the regulated community, therefore, must be adequate to specify and evaluate the technological constraints and the relative costs of alternatives and to recognize opportunities.

A Strong Legal Structure

The effective use of economic instruments in environmental policy requires an enforceable legal structure that defines property rights and resource tenure regimes clearly, provides the legislative authority to use the instruments, and specifies who has legal standing and jurisdiction in the use of the instruments.

In many less developed countries the characteristics of property rights or tenure regimes that define access conditions to a resource may be unfavorable for effective use of economic incentives. In particular, instruments based on private property may not be effective under conditions of open access, common property, or traditional or centrally controlled property systems.

As noted in Part I, an effective property rights' scheme requires that the rights' holder be able to transfer the rights, control access to the resource, receive all the benefits, and bear all the costs associated with its management. Under this definition ill-defined or conflicting property rights' structures will not produce the set of access claims necessary to allow economic incentives to work effectively. As an illustration, open access regimes fail to satisfy the property rights' condition that the rights' holder can deny access.

Common property regimes in which the rights to access are clearly defined and enforced could be responsive to economic incentive instruments. These systems may be weakened in lesser developed countries, however, because of pressures related to population growth, technological change, and the increasing commercialization of resource-based production.

Under state property regimes the condition that the rights' holder alone receives the benefits and bears the costs of managing and resource is often violated. In fact, evidence from both more developed and less developed countries, particularly in Eastern Europe, indicates convincingly that resource managers operating under state property regimes do not pay the costs of poor management. Under such regimes, the tenure of managers is typically dependent on their political connections rather than on their merits. Not surprisingly, such managers do not always receive or send the correct sets of incentives and usually do not manage resources wisely.

Competitive Markets

For economic incentives to be effective, prices and competition must play a meaningful role in a nation's economic structure and in the decisions of those who are responsible for

pollution. Unless competitive markets exist, for example, attempts to create a market for permits will be futile. Economic incentives are most advantageous, relative to direct regulations, in situations in which there are a large number of buyers and sellers. Such instruments operate most effectively with competitive markets as well as differences in the cost of reducing pollution. These conditions do not exist in many rural areas where some important environmental problems are found.

Other markets, such as those for credit, liability, and insurance, also play a key role in the use of environmental instruments. Firms short of capital, for example, will find it difficult to comply with requirements for environmental bonds unless they have access to credit markets. Without such markets, economic incentives that require cash outlays could give a competitive advantage to large firms over small firms or to foreign-owned firms over local firms.

Administrative Capacity

Four key administrative conditions must be considered when examining the use of an economic instrument. These include the capacity of governments to: (a) design and administer the instrument; (b) monitor experience with it; (c) enforce the conditions of instrument use; and, (d) modify the instrument in response to changing conditions.

Policy makers must provide the staff and financial resources to research, design, and administer a proposed instrument. There will likely be a tradeoff between designing a simple system that can be implemented with limited effort that does not yield the desired outcome, and a complex system that is capable of yielding "optimal" results but is beyond the administering agency's capabilities. Polluters will also need staff and funding to incorporate the effects of such incentives into their decisions about production, investment, and pollution abatement.

Once an economic incentive scheme is in operation, the staff and funding must be available to monitor behavioral changes in the polluting community and its environmental effects. In the case of environmental pollution, monitoring of this sort requires an understanding of the complex transport systems of pollutants (e.g., through surface and ground water or through short-range and long-range air transport) as well as the eventual fate of environmentally harmful substances and relevant exposure and dose-response relationships. The level of effort required for a successful monitoring scheme will depend primarily on the size and geographical distribution of those subject to the incentive scheme. Often, there are also costly technological requirements associated with monitoring. These include inspections, the preparation of evidence, environmental audits, the training of inspectors and, perhaps, area monitoring of environmental conditions that involve remote sensing or on-the-ground field investigations. In some cases, it may be possible to shift responsibility for some of these tasks to the community subject to incentives through reporting requirements. Such an approach eases the burden on government agencies but imposes the same costs on the economy and requires the same level of effort and skill.

Finally, agencies must be able to enforce their policies. Staff and funding will be required to select the criteria that will determine noncompliance and the appropriate enforcement response

including fines, imprisonment, and other civil and criminal penalties. The legal basis for enforcement must be established and in operation before an instrument can be used. Poorly drafted and unenforceable policies can render an economic instrument practically useless and engender disrespect for the government among the public and the business community.

Political Feasibility

Economic incentives are useful only when they can be applied. Their application requires the acceptance of the instrument by government, the community of prospective polluters and, in a growing number of cases, by nonprofit organizations who represent the victims of environmental degradation. The political feasibility or acceptability of a particular policy instrument will depend on the interaction of these often-conflicting forces.

In situations where the regulated community knows that some policy action will be enacted, the least political resistance will be directed at the policy alternative that imposes the least costs regardless of whether it is likely to work. In seeking political support, therefore, policy makers need to resist following the path of least political resistance. For this reason, it is useful to identify stakeholders who might gain from a proposed policy response. They can include victims of environmental degradation, whose political support can be solicited. It is also important to recognize that regulators themselves often have a vested interest in the current system of direct regulations. This system is the focus of their current employment, and proposals to control pollution in new ways could require new skills and employ new technologies. This could result in a competing bureaucracy.

Overcoming these and other political obstacles to the use of economic instruments is difficult. Those attempting to introduce economic incentives need to develop a dynamic perspective, recognizing that the seeming insuperable political obstacles they face today can be overcome tomorrow through persistent efforts to inform all concerned about the advantages of using economic incentives to find low-cost solutions to environmental problems. Unforeseen events, such as an environmental disaster, also can strengthen political forces to favor economic instruments.

The Relation Between Necessary Conditions and Economic Incentives: Some Examples

The knowledge base needed for effective use of emission charges depends on the nature of the problem and, to a significant extent, on the purpose of the policy intervention. If an emission charge is intended only to raise revenue to support other environmental activities or support a nation's treasury, the necessary knowledge base is much lower than if the charge is intended to alter polluting behavior. A revenue-raising charge can be selected on the basis of political feasibility. If a charge is to alter behavior, however, it must be set somewhere near the cost of installing pollution abatement technology or of shifting to less polluting techniques. This will require information about available technologies and industry costs. According to economic theory, a socially optimal emission charge would be set equal to the incremental value of

environmental damages. Accurately estimating the value of environmental damage, however, is difficult and can require a large investment in human resources and information-processing capabilities.

For marketable permits, the requirements for technical knowledge are lower, but responsible government officials must have sufficient knowledge to design the market. This includes knowing how to establish the time frame of the permits, such as weekly or monthly; knowing the kinds of information required to assign permits fairly; knowing how monitoring data will be obtained and tested; and knowing what the inspection schedule should be. The polluting community will also need knowledge on these topics if it is to decide intelligently whether to buy or sell permits or to enter or leave certain industries.

Marketable permit systems need a legal structure to define a set of property rights that allow permits to be traded. Once the rights are established, government officials must assure that these rights are well defined and enforceable and that the terms of exchanging them are carefully specified. In contrast, the use of emission charges may not require a new regime and an unfamiliar new institution. Most countries already have at least some legally empowered structure that can levy and collect taxes.

Market structure will be a more important consideration for permits than for charges. If an explicit market exists, the emission charge can be added to the price of the product regardless of whether the market is competitive or a monopoly. For the permit scheme to work effectively, however, there must be a large number of potential buyers and sellers. A competitive market is, therefore, more important for a permit scheme than for emission charges.

Administrative capacity can be a constraining factor for emission charges and marketable permits. The policy maker must determine if specific emissions have been measured correctly and if an appropriate charge has been paid. In the case of marketable permits, monitoring is complicated because of the potential exchange of permits. Enforcement officials must ensure, for example, that when permits are sold there is a corresponding decrease in the seller's emissions.

Practically speaking, emission charges may be more politically acceptable than marketable permits. Taxes have a long history in all nations and in many contexts, so the introduction of another charge will not be much different than what has always taken place. In contrast, creating a new market and somewhat contrived market for pollution permits is less familiar and can threaten policy makers and the businesses subject to the permit systems. In many LDCs market power is not shared equally, and there may be a history of businesses or foreign interests manipulating the market. This is another reason why there may be more resistance to marketable permits than to emission charges.

5. Problem Characterization and Control Point Analysis

Problem Definition

It is important to identify and characterize an environmental problem before considering which policy instrument to use to address it. This means linking observed or statistically determined increases in health or ecological risks or declines in environmental resources with particular sources and types of pollutants. Health problems caused by intestinal viruses, for example, can be caused by contaminated municipal water supplies or by the poor quality of alternative water sources used when municipal water supplies are inadequate or are disrupted. Respiratory problems can also be the result of poor outdoor air quality due to vehicle emissions. In some LDCs a more important source of such problems is poor indoor air quality due to the use of wood-burning stoves. Declines in local fishing may be due to upstream pollutants, water diversion by upstream farmers, local overfishing, or changes in fishing practices. Understanding how behavior affects the environment is critical in choosing an appropriate policy instrument. The following questions must be answered:

(a) **What**

- Is the problem associated with public health, ecological risks, environmental amenities, or resource depletion?
- Is the problem linked to specific emissions from known sources or from nonpoint sources of pollution?
- Are the sources of pollution homogeneous or are there many different kinds of sources? Are they concentrated or geographically dispersed?
- Are pollution reduction costs similar for all sources?
- Does the problem require a public response or can it be decided b stakeholders if there is some forum where they can negotiate?

(b) **When**

- Is the problem immediate? Does it constitute a clear and present danger, is it impending or, perhaps, speculative?
- Is it possible to deal with the problem by taking partial steps now or is full action required immediately?
- How great is the uncertainty about the problem and about the risks of delaying action?

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- What are the costs and risks associated with waiting for additional information or additional resources to study the problem further?

(c) **Where**

- Should the problem be addressed at the local, regional, national, or international level?

- Does the scope of the problem determine the level of institutional overlap or centralization required? If not, why not?

(d) **How**

- Are the pathways by which the perceived environmental problem generates "people-level" impacts understood?

- What measures might potential victims take to avert, minimize, or mitigate impacts? What incentives affect their choices among the alternatives?

(e) **Who**

- Which stakeholders stand to gain or lose from the policy action? Which stakeholders would be in a position to gain competitive advantage or exert more political or economic power if the policy is implemented?

- Which stakeholders are in a position to support or block efforts to initiate a policy intervention or have it work effectively?

- Is it possible to organize those stakeholders who stand to gain from an intervention in a way that will provide more support for the policy intervention?

- Are there possibilities to mitigate special hardships, perhaps by offering subsidies to offset costs for certain segments of the regulated community?

Environmental Control Point Analysis

Once the sources and impacts of the environmental problem are understood, a simple analytical framework can be structured to help decide how and where to intervene with a policy response. In most cases the physical source of the problem will be linked to emissions into the environment or to withdrawals from the environment. If such sources are relatively few in number and easily identifiable, such as smokestacks, it should be possible to intervene directly at those **points of emission** with an emissions tax. In many LDCs there will be many different nonpoint sources, such as small farms, that may be difficult to identify. Likewise, these nonpoint sources may exist in remote, inaccessible locations so that intervening directly at **points of**

emission is impractical. In such cases it may be more effective to intervene at **points of exchange** where firms buy inputs that are used in a polluting activity or sell outputs that result from such an activity.

Figure 1.

LOCATION OF POTENTIAL CONTROL POINTS

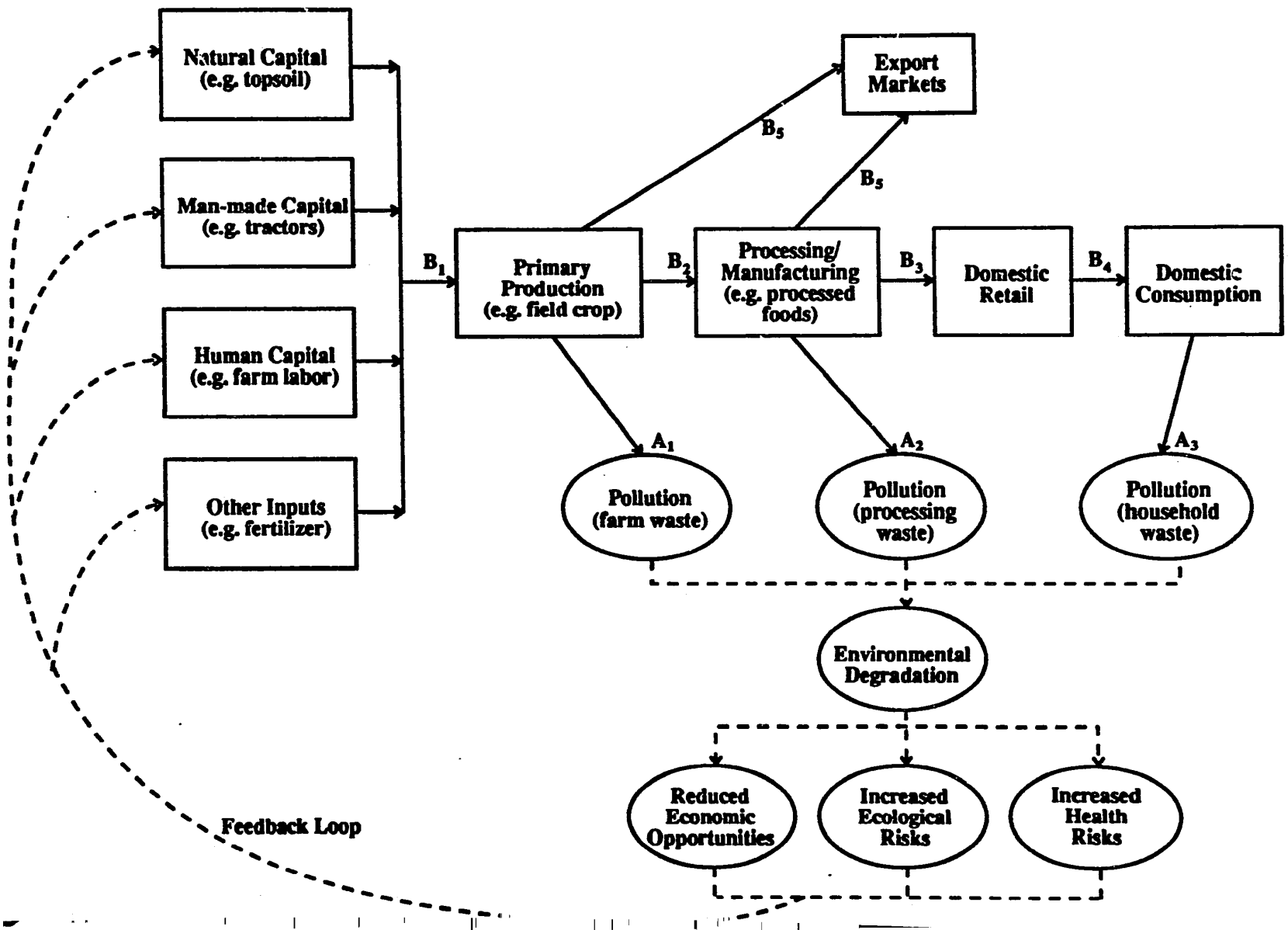

Figure 1 depicts the economic linkages in a typical production-processing-distribution-consumption-disposal system and provides an overview of how environmental impacts are generated and how they "feedback" into the economic system. It also displays **points of emission** and **points of exchange** where opportunities exist to intervene in the system with economic instruments that discourage environmentally damaging behavior. The environmental control points in Figure 1 are:

Points of Emission

- A_1 Emissions by primary producers (e.g., nutrient runoff)
- A_2 Emissions by processors/manufacturers (e.g., waste)
- A_3 Emissions by consumers (e.g., household waste, packaging)

Points of Exchange

- B_1 Input markets (e.g., fertilizer)
- B_2 Primary product markets (e.g., field crops)
- B_3 Wholesale product markets (e.g., vegetables)
- B_4 Retail product markets (e.g., canned vegetables)
- B_5 Export markets (e.g., raw or processed products)

Pollution is shown in Figure 1 to result directly from production, processing, or consumption activity. Economic incentives might be introduced at these **points of emission**, A_1, A_2, and A_3, in an attempt to influence polluting behavior directly. Opportunities also exist to change incentives by introducing economic instruments at various **points of exchange**, B_1 through B_5, such as primary, intermediate wholesale, retail, and export markets.

Opportunities to introduce economic instruments at **points of exchange** may be double what they are at the **points of emission** because they may be focused on either the buyer or the seller. In the case of an input charge, for example, a per unit fee might be levied on the manufacturer or seller of environmentally harmful fertilizer or it might be imposed as a charge on the buyer of fertilizer. Alternatively, a per unit tax might be imposed on the sellers of products grown with fertilizer, or it might be imposed on the buyer of these products. Whether the charge is levied on the buyer or the seller can have a significant effect on the incidence of the charge, that is, who actually pays and how frequently, and on the effectiveness of the charge, that is, how much it reduces environmental damage. If a seller of fertilizer chooses to absorb all or part of a charge imposed on him, rather than transfer it to buyers, the demand for fertilizer and fertilizer use will decline by less than if the tax were applied to buyers directly.

Selecting an Intervention Point

Whether a particular control point is suitable for a policy intervention depends on:

- The number, concentration, and diversity of pollution sources
- Technological linkages between inputs, outputs, and emissions

- The number and concentration of buyers and sellers in input and output markets
- The relative market power of buyers and sellers in input and output markets
- Prevailing legal, institutional, and administrative structures
- Political resistance to charges not imposed on polluters or resource users
- The incidence of the charge -- whether producers, processors, consumers, workers, or others will pay the charge

An Illustration of Environmental Control Point Analysis and Its Application

A dramatic decline in harvest rates in a local subsistence fishery alerts the local authority to a possible environmental problem. The authority establishes that the problem is local because it is not occurring throughout the river basin or at a watershed level. The authority investigates the problem's cause and eliminates overfishing, toxic substances, and habitat degradation as possible explanations. Eventually the problem is linked to nutrient runoff from local farms.

As a result of a program to subsidize the use of fertilizer, hundreds of small local farmers are applying excessive amounts of fertilizer to their fields. What is not absorbed by crops or volatilized to the atmosphere eventually reaches the local water body. There it creates algal blooms, which eventually die and decompose, reducing the supply of oxygen available to fish. For local farmers to maintain the same level of productivity with reduced fertilizer applications, they would need to spend additional time and money testing the nutrient status of the soil and applying fertilizer more frequently and only as needed.

Through consultation with technical experts and discussions with such stakeholders as farmers, fishermen, households, and local leaders, the local authority determines that a policy intervention is warranted. Rather than impose regulations that restrict the amount of fertilizer that farmers can apply, the authority decides to introduce an economic incentive system that encourages farmers to reduce the amount of fertilizer they use. The alternatives considered include:

- An Emission Charge per unit of nutrient runoff paid by each farmer (See A_1)
- An Input Tax per unit of fertilizer bought or sold (See B_1)
- An Output Tax per unit of farm product grown with fertilizer (See B_2), or on wholesale or retail sales of fertilizer-produced food (See B_3 and B_4)
- An Export Tax on raw or processed fertilizer-produced food (See B_5)
- Marketable Permits to generate a specific amount of nutrient runoff (See A_1) or to buy or sell fertilizers (See B_1)

- Subsidies for farmers to perform more frequent soil testing and to apply fertilizer at more frequent intervals as needed

Policy Selection

Due to the large number of farmers and the difficulty of measuring nutrient runoff from individual fields, a direct tax on emissions is considered impractical. For these same reasons, and because the farmers are homogenous and face similar sets of costs and revenues, a system of marketable permits is also considered unworkable. Farmers sell in many local markets in remote parts of the region, so the cost of monitoring farm shipments and imposing an output tax on produce grown with fertilizer would be too costly and cumbersome.

The local authority decides to lobby strenuously at the national level for the elimination of the subsidy on fertilizer and to override it at the local level by imposing a tax on local purchases of fertilizer. This could result in economic hardships for some small farmers. Consequently, a decision is also made to use revenues from the fertilizer tax to subsidize the testing of soil and the hiring of farm labor to apply fertilizer on all farms less than five hectares in size. It is understood that the fertilizer tax could put local farmers at a competitive disadvantage in national and international food markets. These external markets account for only 10 percent of local farm sales, so this is considered an acceptable cost.

Following the implementation of this intervention, the farm bureau reports that the new system costs the local economy $50,000 per year in reduced farm income and higher local prices for farm products and that farm exports are now only 5 percent of farm sales. The fishery bureau reports that improvements in local fisheries result in annual economic benefits of $100,000 including increased incomes to fishermen, lower fish prices and increased opportunities for recreational and subsistence fishing. The system costs $50,000 per year to administer.

Level of Government Intervention

Just as intervention with economic instruments can occur at various points in the market, intervention can also occur at different levels of government. In general, as the scale of an environmental problem increases the responsibilities of national authorities increase and those of local and regional authorities diminish. At one extreme, such as with the local water pollution problem just described, the problem would most appropriately be left to the local authority, perhaps with general guidance and some technical assistance from regional or national authorities. Local authorities are likely to be better informed about the problem and its causes and consequences than those at the regional and national levels. Local authorities would also have a more direct interest in finding a cost-effective solution to the problem. Nevertheless, if a local problem is experienced throughout the country, it could create a national problem. National authorities must then assume responsibility for such problems as widespread soil erosion.

National authorities will need to enlist local authorities to take advantage of local knowledge and to economize on scarce administrative resources available at all levels of government.

A number of conditions must be met for joint national-regional-local undertakings to succeed, but one is fundamental: those in subnational government agencies must see it in their interest to cooperate in the effort. Although cooperation will vary widely among countries, one point is critical. If local or regional authorities are asked to incur costs to implement programs, their support will be directly proportional to the compensation they receive from polluters or from higher levels of government. For example, if the national authority imposes a product charge that local authorities will collect, their enthusiasm for the charge will depend on what portion of the charge they can keep to cover their costs. Local and regional authorities may respond to a sense of large national purpose, but they are never indifferent to the costs and benefits that accrue to them.

6. Conclusions

Direct regulations usually provide control over pollution and little control over the cost of pollution control. Economic incentives, in contrast, provide more predictability in terms of the costs of pollution control but less certainty about the level of pollution reduction that will be achieved. Where environmental or public health risks are significant and pollution control is more important than controlling costs, direct regulation may be appropriate. Where environmental problems are less threatening or less immediate, a more gradual and efficient strategy can rely on economic incentives.

Except for some new experiments in Eastern Europe, the United States is the only country to use marketable permits. The scale of this effort is small. Permits seem to achieve significant cost savings over comparable regulatory programs. Reductions in pollution due to permit-based systems result from the lowering of total allowable pollution, which is technically a regulation, rather than the market-based aspects of such programs.

Among economic instruments, theoretical arguments indicate that emission charges and marketable permits rank higher than product charges on effectiveness and efficiency criteria, and rank no lower on the basis of equity and flexibility.

In practice the effective use of emission charges and marketable permits would impose more difficult conditions of program formulation, monitoring, and enforcement than product charges. As a result, the theoretical advantages of emission charges and marketable permits relative to product charges may be largely offset by practical problems in actual application.

Application problems may be significant in developing countries where the fiscal and administrative capacities of governments are already strained and immediate needs of the people are compelling. Under these conditions, a promising course of action may be to proceed in three stages: (a) initially design environmental policies around product charges set so as to generate revenues rather than change behavior; (b) use the resulting revenues to increase knowledge and institutional capacity to cope with environmental problems; and, (c) build on the accumulating knowledge and experience to move into more direct approaches, such as emission charges and marketable permits. Direct regulations can be used to control pollution until the economic incentives are in place and working.

In many LDCs traditional systems of tenure, access rights, and incentives for conservation and efficient long-term resource management already exist. These systems may be deteriorating as a result of modernization and export-based development strategies. The cost of meeting the legal, fiscal, administrative, and institutional requirements for implementing an effective economic incentive system based on private property and market competition in some LDCs may be enormous. In some cases it may be more effective, efficient, and equitable to bolster traditional incentive systems and use them to implement environmental policy rather than to introduce a new system that would require radical changes in traditional systems.

Tables

Table 1. Environmental Policy Alternatives

Direct Regulation	
Engineering Standards	■ Regulate technology (e.g., require scrubbers on smokestacks to reduce gas emissions.)
Performance Standards	■ Require that plants operate in certain ways or at certain times require certain emission/output ratios.
Quantity Limits	■ A quota on overall emission levels or harvest levels.
Ambient Standards	■ Standards of environmental quality that must be met, (e.g., BOD of receiving water or sulphur dioxide concentrations in air)
Prohibitions/Sanctuaries	■ Preclude certain activities or the use of certain inputs (e.g., certain pesticides) or prevent access to certain areas
Economic Incentives	
Emission Charges	■ A tax applied per unit of pollution (e.g., carbon tax).
Depletion Charges	■ A tax applied per unit of harvest (e.g., stumpage fee for timber).
Product Charges	■ A tax applied to products used in a polluting activity or to products that result from polluting activity.
Deposit-Refund Systems	■ Essentially a tax on unreturned environmentally harmful products (e.g., containers, batteries).
Marketable Permits	■ Emission/harvest permits that can be used, sold, or leased.
Information Systems	■ Public disclosure of pollution, naming of polluting firms, green labelling, etc.
Other Tools	
Assurance Bonds	■ A payment that is returned if environmental damage does not occur.
Strict Liability	■ Polluters are liable for paying victims and restoring damage regardless of negligence.
Assign/Enforce Rights	■ Full allocation and enforcement of rights to environmental goods.

Table 2. Types of Economic Incentives for Environmental Protection *

Emission Charges	■ For the discharge of pollutants into air, water, soil, and on the generation of noise. ■ Calculated on the basis of the quality and quantity of pollution generated. ■ Have been used mainly to fund environmental control programs rather than to provide incentives to reduce pollution.
Product Charges	■ Charges on inputs to or outputs from environmentally damaging production processes to encourage change. Examples: a tax on high sulphur coal or on disposable batteries.
Deposit/Refund	■ Deposit is collected upon sale of potentially polluting products and a refund is offered for return of the container, item, or substance.
Marketable Permits	■ Overall level of emissions is set in an area. ■ Permits to pollute are allocated to polluting firms in the area. ■ Firms that keep their emissions below their permitted level may sell or lease their surplus allocation. ■ Offsets: all new emission sources in the area are offset by a reduction of emissions from existing sources. ■ Bubbles: allow routine shifts in emission limits among existing plants if total emissions under the bubble do not increase. ■ Netting: allows changes in emissions from different sources within a plant or firm so long as there is no net change in emissions.
Subsidies	■ Financial assistance or price supports offered as an incentive to encourage pollution abatement or to help defray the costs of complying with regulation. ■ Usually in the form of grants, loans or tax allowances. ■ Consider also the removal of government subsidies that promote environmentally unsound activity, e.g., water use, fertilizer application, and "below-cost timber sales."
Other Systems	■ Liability systems--polluter is liable for damages and restoration. ■ Assurance bonds--potential polluter puts up bond that is forfeited if pollution limits are exceeded. ■ Information systems, consumer education/green labeling. ■ Reassign rights--individual or community rights (ownership, easement or access) assigned to resources that are currently open access or publicly held resources.

* The terms charges, fees, and taxes are often used interchangeably but can have somewhat different meanings. In this report the term charges is used when a regulated entity is required to pay for emissions to or withdrawals from the environment or for using environmentally damaging products.

Table 3. Five Necessary Conditions for Effective Use of Economic Instruments in Environmental Policy

Condition	Key Characteristics
Knowledge	■ Of how economic activity affects the environment ■ Of how changes in the environment affect economic activity ■ Of how to formulate and implement incentive programs (regulatory agencies). ■ Of how to respond appropriately to regulations (regulated community).
Legal Structure	■ Ensure clear and enforceable property rights in resources. ■ Provide legal authority to use economic instruments.
Competitive Markets	■ Reasonable number of buyers and sellers. ■ Prices are responsive to changing conditions of resource scarcity.
Administrative Capacity	■ Capacity to design and initiate economic incentive programs. ■ Capacity to monitor compliance with programs. ■ Capacity to enforce compliance.
Political Feasibility	■ Capacity to overcome potential resistance to economic incentive programs. ■ Responsiveness to stakeholders.

Table 4. Evaluative Criteria for Economic Instruments in Environmental Policy

Criteria	Characteristics
Effectiveness	■ Degree of success in achieving environmental objective (e.g., reducing emissions to a target level).
Efficiency	■ Degree of success in achieving objectives at the lowest possible costs in terms of lost sales, incomes, jobs, economic opportunities, and administrative implementation.
Equity	■ Degree of success in achieving objectives with a fair and ethical distribution of costs within the current generation and between current and future generations.
Flexibility	■ Ability to adjust the instrument in response to changing economic, technical, political, and environmental conditions.

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