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ENVIRONMENTAL REGULATION AND USE OF ECONOMIC INSTRUMENTS FOR ENVIRONMENTAL PLANNING AND MANAGEMENT : AN OVERVIEW

by

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DISCUSSION PAPER IN NATURAL RESOURCE ECONOMICS NO.15

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FOREWORD

Identification, measurement and valuation of environmental impacts represent a first step in dealing with the pressing environmental concerns of today. Ways and means of achieving that first step are discussed in a previous Discussion Paper in this series. In this fifteenth Discussion Paper Dr Meister deals with the next logical step in environmental management. This is the use of regulations and economic instruments to control activities and to induce decision making (by consumers and producers) to conform to socially desired goals in terms of environmental quality.

In the early 1970s, when government interventions were extended to include environmental protection, the authorities in most industrial countries turned to regulatory controls as a matter of course - either to create new laws and regulations or to adapt existing legislation. These regulations have in many situations served well and have considerably expanded over time. However, it has been recognised that in other situations regulations have achieved little and often at great cost. This recognition has led to the development of new approaches to environmental policies, based on a more 'economic' approach. The underlying basis of this approach is that for environmental resources to be allocated optimally, these resources should be priced properly (through charges or marketable permits) and not be 'free' resources.

In this Discussion Paper the three main approaches to environmental control - regulation, pollution charges (and subsidies) and marketable permits - are discussed. Also covered are pricing policies that prevent the production of pollutants, in contrast to just dealing with 'end-of-pipe' residuals. In the concluding section, the macroeconomic implications of environmental control, especially in terms of economic growth, are briefly discussed.

As in the previous Discussion Paper, there is a bias towards problems of developing countries, even though most of the policy examples are drawn from developed countries. The material in this Discussion Paper was put together for a series of lectures given by Dr Meister at workshops on Environmental Impact Assessment and Economic Analysis, organised by the United Nations Environment Programme (UNEP).

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CHAPTER I

1.0 ENVIRONMENTAL REGULATION

Environmental planning and management is essential in all countries because protection of the environment, disposal of waste, or prevention of environmental degradation does not occur automatically. It is as a recent article in The Economist stated, "markets cannot say useful things about disposing of waste." The same article continues by discussing why not, and discusses how Government has a role to play in achieving environmental control. It says,

> "No garage, selling you a new car, has reason to care where you dump it at the end of its life. But let the government impose a tax on new cars, refundable with interest when the car is scrapped (as in Sweden and Norway), and the garage may make money by offering to recycle old chassis. What is true for old bangers is true for the effluent from a chemical plant, or the fumes from a power station. Leave companies alone, and they will regard water and air as free dumping grounds. If they are to take account of the smell along the river or the fog over the town, governments will have to step in. Only the state can make the polluter pay the full cost of polluting" (The Economist, 1988).

Effective and efficient control requires in the first place good information on the cause and extent of environmental degradation. In a previous discussion paper (Meister, 1990) analytical techniques are discussed that enable the identification and measurement of environmental impacts. Environmental impact assessments, for example, identify effects and rank the impacts, Benefit Cost Analysis measures and evaluates the benefits and the costs associated with the impacts (and their control) and mathematical and econometric models (partial and general equilibrium) deal with the spatial and macro-economic aspects of these impacts and provide information for spatial investment and planning. All this, to get information on:

1) the extent of environmental impacts resulting from economic activities, development projects, or policies;
2) the social and economic consequences for the region's or nation's growth and standard of living; and
3) the cost of ways and means to minimize those impact.

The aim, therefore, is not just identification and measurement but control and implementation. The existence of environmental problems means that there is a need for social control, i.e. inducement to curtail or moderate the harmful impacts of activities or to enhance the beneficial ones. In this discussion paper ways and means to control activities and to induce private decision making to conform to socially desired goals in terms of environmental quality, are discussed. This, of course is not something new. Control has been exercised in many countries for many years, and much has been learned about different control approaches, and much has been achieved in terms of environmental quality. But as Portney (1986) states, "now that the largest volumes and the most visible forms of pollution are under partial control, national environmental policy is beginning to address different needs, to accommodate new knowledge, and to adapt to changing views of governmental responsibility." Some of this is reflected in a renewed emphasis on the use of market instruments and adherence to the 'polluter-pays principle'. This will be discussed in more detailed in later sections of this paper.

Instruments for environmental control can be classified as follows (Baumol and Oates (1979):

Approaches to Environmental Policy

Part I: Policy Instruments

1. **Moral Suasion** (publicity, social pressure, etc.)

2. **Direct Controls**
   a. Regulations limiting the permissible levels of emissions
   b. Specification of mandatory processes or equipment

3. **Market Processes**
   a. Taxation of environmental damage
      (i) Tax rates based on evaluation of social damage
      (ii) Tax rates designed to achieve preset standards of environmental quality
   b. Subsidies
      (i) Specified payments per unit of reduction of waste emissions
      (ii) Subsidies to defray costs of damage-control equipment
   c. Issue of limited quantities of pollution "licenses"
      (i) Sale of licenses to the highest bidders
      (ii) Equal distribution of licenses with legalized resale
   d. Refundable deposits against environmental damage
   e. Allocation of property rights to give individuals a proprietary interest in improved environmental quality.

4. **Government Investment**
   a. Damage prevention facilities (e.g. municipal treatment plants)
   b. Regenerative activities (e.g. reforestation, slum clearances)
   c. Dissemination of information (e.g. pollution-control techniques, opportunities for profitable recycling)
   d. Research
   e. Education
      (i) Of the general public
      (ii) Of the professional specialists (ecologists, urban planners, etc.)

Part II: Administrative Mechanisms

1. **Administering Unit**
   a. National agency
   b. Local agency

2. **Financing**
   a. Payment by those who cause the damage
   b. Payment by those who benefit from improvements
   c. General revenues

3. **Enforcement mechanism**
   a. Regulatory organisation or police
   b. Citizen suits (with or without sharing of fines)

Source: Baumol and Oates (1979, pgs 218-219)

Although the whole table has been reproduced here, not all of the techniques will be discussed in this paper. The ones to be discussed are:

1. direct control (or command-and-control policies),

2. market based policies such as:
   a. pricing policies (taxes, subsidies, deposits etc.), and
   b. tradable permits.

These approaches, which appear under a wide variety of different names, are not mutually exclusive as will become evident in later discussion. It will be seen then that often a mixture of instruments provides the most feasible, politically most acceptable, and economically the most efficient way to control environmental pollution.

After the discussion of principles and applications of these types of instruments, in the final sections of this discussion paper, there will also be a discussion of the macroeconomic impacts of environmental regulations, and the financial implications of different instruments. These later sections will be relatively brief because some of this material will be covered in the discussion of the individual instruments.

CHAPTER II

2.0 COMMAND-AND-CONTROL POLICIES

Around the world, environmental authorities have relied primarily on direct controls to regulate the polluting activities of industry and individuals, or as Bohm and Russell (1985) state after their brief discussion of the history of environmental control, "The fact remains, however, that over the long sweep of history direct regulations (prohibitions, specifications of behaviour, non marketable permits to discharge) have been the instruments of actual choice for dealing with pollution, whether from geese in village brooks or petroleum refineries on major rivers."

Under the system of direct control, each polluter must abide by rules, developed at various levels of government, that specify the allowable levels of emissions and/or the technology to be used at each source of pollution (e.g. best practicable control technology currently available, and best available technology economically achievable). The approach involves: a) direct regulation through a permit mechanism, where the permit includes conditions such as the specification of discharge limits, the specification of production processes (technology), the specification of the quality of input materials to production, the specification of performance in reducing discharges, e.g. 95% collection efficiency; b) a monitoring and enforcement programme to ensure that the sources are complying with the conditions specified in the permit; and c) various types of economic incentives. For example, a regulatory system in air quality management can be defined operationally as consisting of the following element.

1. development and promulgation of ambient air quality standards to be achieved - in the U.S., the National Ambient Air Quality Standards (NAAQS);
2. development of guidelines defining (a) "appropriate" levels of discharges of gaseous residuals for various types of activities; and (b) the various physical measures, e.g., input raw materials, production processes, residuals modification equipment, that would enable achieving those discharge levels;

3. grant of a permit in which the conditions the discharger is to meet are specified, e.g., in terms of raw material input specifications, discharge limits, process specifications, air pollution control equipment performance standards, and product standards;
4. development and promulgation of operational definitions of compliance and noncompliance, with respect to the conditions specified in the permit, e.g., procedural deficiencies, permit compliance schedule violations, and violations of standards, such as discharge, input quality, process, pollution control equipment performance, and product;
5. establishment of conditions for obtaining variances;
6. specification of the self-monitoring and reporting requirements imposed on the activity;
7. design and execution of the monitoring, inspection, sampling, and data analysis procedures of the regulatory agency; and
8. the availability, types, and modes of imposition of sanctions against noncomplying dischargers. (Hanf and Downing, 1983)

Examples of this type of approach can be found in most countries round the world, both in the control of point-source and non-point source pollution.
Thus water- and air- quality management in the U.S. is based on a permit system.

Example. Water pollution control in the U.S.
According to the 1972 Water Pollution Control Amendment the effluent standards were to be implemented in two stages. By 1977 industrial sources, as a conditions of their permit, were required to meet effluent limitations based on the "best practicable control technology currently available". In addition all publicly-owned waste treatment plants were to have achieved secondary treatment by 1977. By 1983 industrial sources were required to meet effluent limitations based on the presumably more stringent "best available technology economically achievable" while publicly-owned waste treatment plants were required to meet effluent limitations which depended upon the "best practicable waste treatment technology". This second prong in the two-pronged approach involved financial support for the construction of waste treatment plants.

In other countries, water pollution is achieved by receiving water standards. These are set and permits are issued to firms discharging their effluents in the waters. If the permits are not adequate for the firm's requirements, then it is up to the firm to put into place waste treatment facilities. For example, many meat slaughter houses, dairy factories and dairy farms in N.Z. cannot meet the standards set by the permits. Hence most of them have put into place effluent ponds (aerobic and anaerobic) and on land disposal (spraying) of effluents.

Air-quality policy is also based on a permit system in Europe and Japan. In the area of non-point pollution control examples are not as abundant. One area in particular, that of soil erosion, still depends very much on voluntary compliance. However, also here, command-and-control regulations are put into place. These regulations are of two kinds:
a) design standards that specify what actions must or must not be taken by landowners, such as prohibition of certain land uses on particularly erosive lands, specification of management practices that must be employed, or preparation of a sediment control plan with certain required management practices for certain land use combinations;
b) performance standards which, in contrast, would make no restrictions on land use, but would place limits on gross erosion or on the quality of sediment entering the water body.

Most examples of this type of regulation are found in the West, Oceania, and Japan (for examples in the agricultural sector see OECD, 1989). However also in Asia and on the African continent, institutions are put into place (often modelled after European and American examples) which manage and control the environment. In the countries where these legal and institutional frameworks exist, implementation of control is often beset with problems of ignorance, inadequate numbers of, and poorly trained, staff; poor inter-agency co-ordination; and low budgets. Notwithstanding all that, however, also in these countries there are successes that can be reported where control has had a significant influence on the management of environmental resources and the quality of the environment (Banks, 1988).

The advantage of the regulatory approach (or the command-and control approach) is seen in its ecological incidence. If the quality target is properly set and if private dischargers or emitters do not violate the relevant laws, then the quality target will be reached. This argument makes the regulatory approach very attractive to environmentalists. Also, there is evidence around that there has been improvement in ambient environmental quality where this source-by-source approach has been used. However, while having achieved the noted improvements, the command-and-control tool has also been severely criticised for being cumbersome and cost-ineffective and for inhibiting industrial development. It is these shortcoming of the command-and-control approach that has led to much intellectual effort into developing new approaches for environmental control. This development has led to greater emphasis on market instruments to change behaviour. These new instruments are seen as alternatives for control, either alone, or in combination with command-and-control approaches. Vos and Opschoor (1988) give three reasons why, especially OECD countries, have anew decided to look at economic instruments for environmental control. The reasons are:

1. In most countries scarce funds (government and society) and continuing environmental problems have put a new emphasis on the search for efficient and effective instruments for environmental control. Economic or market instruments have, at least in theory, the ability to do so.

2. The eighties are, in many countries, characterised by a search to diminish government involvement in society, or "deregulation". Market instruments appear to have less government involvement and leave more freedom to those being controlled.

3. In some areas of environmental control there is a shift away from curative to preventative management. Also there is a desire for greater integration between planning for the environment, traffic, agriculture etc. Market instruments may offer new possibilities here (Vos and Opschoor, 1988).

It is outside the scope of this paper to discuss the finer details of all these instruments or raise the debate "charges vs direct control". The literature on this is enormous and is well summarised in, among many others, the two references given above (see also Anderson et al.,1977). In what follows the major categories of market instruments will be discussed and where possible, examples of application will be given.

While discussing these instruments it is important to keep the following criteria for evaluation in mind:

1. Will the instrument effectively achieve the environmental goal?
2. Will the approach be cost-effective; i.e. will it achieve the environmental goals at the least cost (to society at large)?
3. Will the instrument provide relevant government agencies with the information they need?
4. How easy (or costly) will monitoring and enforcement be?
5. Will the instrument be flexible in the face of change? When changes occur in tastes, technology, or resource use, will the policy accommodate these changes and remain effective or will it be in danger of becoming ineffective (or even counterproductive)?
6. Will the instrument give industry positive, dynamic incentives? For example, will it encourage firms to develop new, environment-saving technologies or encourage firms to retain existing, inefficient plants?
7. Will the economic effects of the instrument be equitable distributed?
8. Will the purpose and nature of the instrument be broadly understandable to the general public?
9. Will the instrument be politically acceptable, and feasible in terms of implementation? (Stavins,1989)

Where appropriate, the instruments and application to be discussed will be tested against these criteria.

CHAPTER III

3.0 MARKETS AND PRICES

Economist think of environmental degradation as an economic problem, a consequence of a flaw in the market system that can and should be corrected. The market, and the price mechanism, signals to consumers what the cost of producing a particular product is, and to producers what consumers' relative valuations are. However, many environmental products, services and resources do not get represented in the price mechanism. This effectively amounts to them being treated as 'free goods', i.e. they have zero prices. The result of this is that too much of these zero-priced goods will be used and resources and environments will become degraded.

In the production of economic goods and services, some amount of the environment is 'used up'. Trace gases 'use' the atmosphere and troposphere as a waste sink; municipalities, farmers, and industries use rivers and coastal waters as cleansing agents for sewage and effluent, and so on. The cost of producing any good or service therefore tends to be a mixture of priced inputs (labour, capital, technology) and unpriced inputs (environmental services). The market price for goods and services does not therefore reflect the true value of the totality of the resources being used to produce them. The result of that is that markets (without any controls) will fail to allocate resources efficiently.

There are two ways in which markets can be restored so as to ensure that environmental services enter into the market system more effectively. First, markets could be created in previously free services: i.e. all natural areas could charge entrance fees, coastal zones could be placed under private ownership with the owners charging for the use of coastal waters as sewage dumps, and so on. This is the full privatisation option. The second option is to 'modify' markets by centrally deciding the value of the environmental services and ensuring that those values are incorporated into the prices of goods and services. This is called the market based incentives approach.

It is this latter option that will be discussed in more detail in the sections following. The rationale for concentrating on the second option is simply that many environmental functions cannot be handed over to private ownership - the ozone layer, the oceans, the atmosphere are examples.

3.1 THE POLLUTER PAYS PRINCIPLE

The principle of 'polluter pays' is based on the economic concept of removing the divergence between private and social costs. For example, a factory may use a nearby river to dispose of its effluents. If there are no regulations, the use of the river is free and disposal of effluent to the factory is free. The firms decisions regarding production levels will be based on the marginal private cost of production. The marginal social cost of production is equal to the marginal private cost plus marginal external costs. These latter are the cost to society of having a polluted river (reduced aesthetics, fewer recreational opportunities, fish kill etc.). The aim of the polluter pays principle is to make the factory pay for the marginal external cost.

In practice this is often not easy to achieve simple because it is difficult to place monetary values on those costs. Procedures for doing this in some cases have been discussed in a previous discussion paper (Meister, 1990), but there are many other cases where monetary valuation is not feasible and/or politically and socially not acceptable. In those situation, in stead of aiming to get the factory to pay the marginal external cost (and hence achieve economic efficiency in resource allocation), policies are designed in terms of 'acceptable' levels of pollution (standards). Then, the Polluter Pay Principle (PPP) is formulated in broader terms of making the polluter bear the cost of achieving those standards. This is clearly spelt out in the Guiding Principles of the OECD concerning the international economic aspects of environmental policies:

"The Polluter-Pays Principle

1. Environmental resources are in general limited and their use in production and consumption activities may lead to their deterioration. When the cost of this deterioration is not adequately taken into account in the price system, the market fails to reflect the scarcity of such resources both at the national and international levels. Public measures are thus necessary to reduce pollution and to reach a better allocation of resources by ensuring that prices of goods depending on the quality and/or quantity of environmental resources reflect more closely their relative scarcity and that economic agents concerned react accordingly.

2. In many circumstances, in order to ensure that the environment is in an acceptable state, the reduction of pollution beyond a certain level will not be practical or even necessary in view of the costs involved.

3. The principle to be used for allocating costs of pollution prevention and control measures to encourage rational use of scarce environmental resources and to avoid distortions in international trade and investment is the so-called "Polluter-Pays Principle". This principle means that the polluter should bear the expenses of carrying out the above mentioned measures decided by public authorities to ensure that the environment is in an acceptable state. In other word, the cost of these measures should be reflected in the cost of goods and services which cause pollution in production and/or consumption. Such measures should not be accompanied by

subsidies that would create significant distortions in international trade and investment.

4. This principle should be an objective of Member countries; however, there may be exceptions or special arrangements, particularly for the transitional periods, provided that they do not lead to significant distortions in international trade and investment." (OECD, 1979)

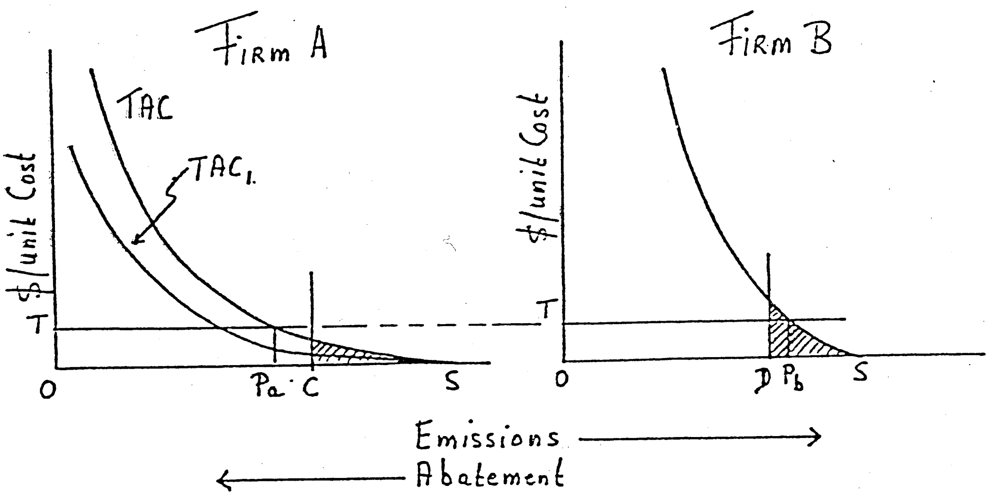
If this principle is accepted in general, then the next task is to find ways and means to implement this principle i.e. to achieve those acceptable standards at minimum cost. To look for the cheapest way of doing this makes sense, and is wholly consistent with the idea of sustainable development, since it both ensures that acceptable environmental standards are achieved and avoids wasting resources on expensive approaches.

It is with this in mind that we now turn to some specific market based incentive approaches.

3.2 POLLUTION CHARGES/TAXES

Charges are set, often with different objectives in mind. Ideally charges should be set, as discussed above, at the estimated marginal cost of human, biological and environmental damage produced by an extra unit of pollution (i.e. the marginal external cost). When used in this way, the charging scheme attempts to alter the level of pollution towards an economic and environmental optimum. However because of the difficulty associated with the estimation of damage functions, an alternative approach has been to set standards and use charges to achieve those standards (i.e. a mixture of regulation and economic incentives). This will lead to improvement of environmental quality but will only by chance achieve the optimal level of control. In a third situation the major objective of charges has been to raise sufficient revenue to compensate pollution-sufferers or to finance a programme of anti-pollution works.

Whatever the objective, and however implemented, the principle underlying the charging system remains the same. The discharger, if 'rational', will expand (or put into place) effluent treatment facilities to the point where the marginal cost of the treatment is equal to the charge on the marginal unit of pollution. Or, as demonstrated in the figure below, the two dischargers, A and B, facing a similar charge but having different marginal abatement cost curves, will reduce emissions (or discharges) by different amounts. A will put into place pollution control facilities leading to abatement of SPa while B will only abate SPb. A uniform direct control rule that both should reduce pollution by one-third would clearly lead to a much higher total cost of abatement. Abatement is therefore inefficient in the sense that firm A can abate PaC at a lower cost than firm B can abate PaD. An effluent charge OT shows the efficient solution.



The inefficiency argument implies that resources are wasted. Thus, the opportunity costs are too high. Since the costs of environmental policy will have an effect on the target level, inefficient abatement implies less environmental quality. Therefore, the regulatory approach reduces the chances for an effective environmental policy (Siebert, 1981).

The basic reason why charges are likely to be better than 'command-and-control' techniques is that charges enable a polluter to choose how to adjust to the environmental quality standard (as demonstrated in the graph above). Polluters with high costs of abating pollution will prefer to pay the charge. Polluters with low costs of abatement will prefer to install abatement equipment. By making abatement something that 'low cost' polluters do rather than 'high cost' ones, charges tend to cut down the total cost of compliance.

Example. Deleware Estuary Study. Quoted in Tietenberg, 1988. (Based on work reported in A.V. Kneese and B.T. Bower, 1977)
In this study a simulation model was constructed to capture the effects on ambient dissolved oxygen content of a variety of pollutants discharged by a large number of polluters into the river at numerous locations. In addition, this model was capable of simulating the cost consequences of various methods used to allocate the responsibility for controlling effluent to meet dissolved oxygen standards.
Four options were analysed:

1. Least-cost (LC) - an ambient charge or permit system.
2. Uniform treatment (UT) - a percentage reduction in effluent standards by all polluters.
3. Uniform emission charge (UEC).
4. Zoned effluent charge. All dischargers in a zone would face the same emission charges, while dischargers indifferent zones could face different emission charges.

Table. Cost of Treatment under alternative programs.

DO objective ppm	LC	Program UT (millions dollars per year)	UEC	ZEC
2	1.6	5.0	2.4	2.4
3-4	7.0	20.0	12.0	8.6

Source: A.V.Kneese, 1977, p.164, Table 16

The findings were that for control of water pollution, the UT strategy does not increase the cost substantially. For either dissolved oxygen objective, the costs are roughly three times higher. Also of interest is the fact that the zonal system results in costs that are quite close to the minimum for the higher DO objective, while the UEC does not. Even rudimentary attempts to take location into account may make a big difference for water pollution just as it does for air pollution.
The work shows that the desirability of economic incentives seems as evident for water-pollution control as it is for air-pollution control. It is only in recent times, however, that regulatory reform in water-pollution control is following the same path as the one followed in air-pollution control.

Three of the major arguments in favour of charges, given in the literature, are:

1. they provide a continuing incentive for movement towards optimal discharge (in the figure above, if a firm through research and development or technological advance, can lower the TAC curve to say TAC1, it will have an incentive to do so because it can save money doing so);
2. since in a given zone the charge for a given pollutant is the same for all discharges, pollution reduction to obtain a given environmental quality objective can be achieved at minimum cost;
3. it is a firm expression of the almost universally-acceptable Polluter-Pays Principle (OECD, 1985, p.79).

Examples of charges in general can be found in most countries. However they often do not have the desired characteristics of a charge policy as outlines above, neither are they implemented with those objectives in mind. For examples we find charges on:

-inputs such as pesticides and fertiliser. In Sweden a 25 per cent input levy is being used as a means of partially financing extension, advisory services and research into the reduction of agricultural pollution. Experience with similar input taxes also exists in Finland and Austria. At low rates, however, their direct effect on consumption appears to be negligible. No country has yet introduced high input taxes, but, in several countries, taxes of the order of 100 per cent to 200 percent have been discussed. In West Germany a fertiliser tax of that nature has been discussed. Bonnieux and Rainelli (1988) look at the efficiency of such a tax and conclude that "fertilizer taxation, as far as crop farming is concerned would cause a smaller loss in the profitability than a decrease in the price of crops, so such a program is

feasible, otherwise it is efficient at least for arable- and cereal-oriented farming. The operation of the 'polluter pays' principle would encourage a decrease in the level of output and a price increase for intensive livestock production, for which effluents closely depend on output." Such taxes would have a substantial impact on farm income. In The Netherlands a general levy on manufactured feed has been introduced to make farmers contribute to the cost of conducting research and providing advisory services to overcome nitrate and phosphate pollution from intensive animal husbandry.
Other examples are a tax on lead in petrol and a differential pesticide tax (as suggested for pesticide control in New Zealand).

-outputs or residuals. A tax on outputs is not used often, especially not in Agriculture although it is indirectly done through reducing prices for surplus production. However we do have charges on things like bottles (and this will be discussed further in the section on deposit schemes). Another example is the proposed differential car tax, based not on engine size but on the dirtiness of exhausts. (The Economist, 1989b). Taxes on residuals are of course the most common and we find in them in air, water and noise pollution. Some of the latest proposals in this area are a charge on industry and motorists for each kilo of acid they produce, and a carbon tax, to discourage the use of fossel fuel.

-the use of pollution treatment facilities - user charges(collective water treatment, collection of household wastes) etc. In most of these situations the charges are only there to collect revenue and do not result in a change in use behaviour. Many examples of such applications can be found in the OECD countries. One of the earliest examples is the collective treatment facility of the Genossenschaften in the Ruhr area (to be disussed below). Firms using the collective facility were charged on the waste load they contributed. Because the charge is in terms of money per unit of waste, this looks very much like an effluent charge. However, the objective of the charge in this case was simply one of revenue or cost-recovery.

-administrative charges. These are chiefly aimed, partly or totally, at funding systems of licensing and licence monitoring. Many countries apply them, e.g. in a charge on registering new chemical products (Norway) or pesticides (New Zealand) or for the cost of studying and authorising acitivity which will cause pollution (Sweden).

The whole argument for charges is that they are socially desirable instruments because of the reasons given above, i.e. incentive, minimum cost, polluter pays. The Ruhr example is therefore not a good example of a true effluent charge. And, as Bower et al. (1981) point out, neither are many of the other schemes found in Europe. In their book, they analyse two examples of charging systems, one in France and one in West Germany (with variants of those in other countries). They point out that these schemes are not 'true' effluent charge schemes in that they start with a standard, and then use effluent fees and subsidies to achieve the standard. The conclusion they come to is:

"It is clear that there is nothing necessarily infeasible about combining standards, charges, and subsidies, and making charges work --at least to the extent of collecting money. That is, the political and administrative feasibility of instituting a charge per unit of discharge has been demonstrated. On the other hand, the French and German systems tell us very little of relevance to the 'model' effluent charges usually proposed. The very features that seem to make for feasibility differentiate these systems from those in which a charge is used to stimulate directly the attainment of a desired ambient quality standard. These features, to summarize, are:

the revenue (subsidy) need basis for the charges;
the relatively low levels of the charges (though this is changing very rapidly);
the rule of thumb method of charge assessment.

In the longer run a different conclusion may prove warranted. To the extent that: 1) incentive effects are heightened by gradual substitution of measurement for rule of thumb assessment; 2) charge levels rise because of the need to subsidize more and larger treatment and sewerage projects; and 3) monitoring is put on a sustained and systematic basis; it may begin to be possible to see the dynamic effects ascribed to charge instruments i.e. the encouragement of technological developments in the direction of less residuals-intensive production processes, cheaper or more efficient treatment methods, and so forth" (Bower et al. (1981), p. 25).

The implications of the above comments are not that nothing has been achieved in terms of environmental quality. A recent OECD report quotes other authors who clearly have observed improvements in environmental quality in some areas due to the charge schemes in place (OECD, 1985). To discuss this in a bit more detail, and to see an example of 'the dynamic effects ascribed to charge instruments' actual occurring, the case of the Dutch Water Quality Policy is instructive here.

Example. Effluent charges can work; The case of the Dutch Water Quality Policy (Bressers, 1988)

The Dutch system of water quality charges had originally been designed to fulfil a revenue raising function. The level of the charges was tied to the cost of operating and building new treatment plants. And also in Holland, many doubted whether these effluent charges had any regulatory effect at all (i.e. leading to changes in the behaviour of firms with regard to discharges and creating incentives to continue to look for improvement of discharge control).

The principles behind the Dutch water quality policy were threefold:
1. A 'backstop principle'. This was the main goal. It meant that pollution control efforts were aimed at reducing the total amount of existing pollution, without accepting a pollution increase anywhere, i.e. to make surface waters cleaner.
2. A preference for combating pollution at source, i.e. aim to reduce the amount of pollution contained in industrial waste water rather than removing this pollution after discharge.
3. A 'polluter pays' principle. This is the basis for the effluent charge. Each firm in the Netherlands has to pay a fee according to the amount of pollution it produces. The amount of pollution is calculated in pollution units called 'population equivalents'. A population equivalent is defined as being equivalent to the amount of organic pollution in waste water normally produced by one person, defined as 180 g of oxygen demand on a combined basis of COD and nitrogen. For industrial wastes the loading in units is calculated as:

$$[m_3(\text{mg/l COD} + 4.57 \text{ mg/l N})]/180$$

The fee per pollution unit has risen sharply since the charge system came into effect (moving from about $4/unit to about $15-20/unit). The fee varies according to the region within which the firm is located. These regional differences are not, however, based on different environmental conditions or quality objectives, but rather reflect regionally different costs of building and operating sewage treatment plants.

The Dutch system of charges has been in operation since 1970 and is very extensive. Because its objective was revenue gathering rather than being a market instrument, it did not replace the official intervention strategy of direct regulation using permits.

Evidence for the years 1975-1980 indicates that substantial reductions have been achieved in organic pollution (19,670,000 population equivalents (p.e.'s) to 14,331,000 p.e.'s by 1980 or 27%) and heavy metals, which reduced by approximately a half in the period involved (although there were large regional differences). The question analysed by Bressers was, "were these reduction due to the water quality programme and particular due to the effluent charges?

The conclusion reached after time series analyses, supplemented by analyses studying alternative explanations for reductions in pollution per product unit (technical development, increased value of waste material, increased environmental awareness by population and consumers, better information etc.), was that the level of pollution reduction achieved was clearly attributable to the policy pursued. Next the analyses turned to answering the question which aspect of the policy has the most impact. First a statistical analysis was completed which was followed by an expert assessment (policy implement and people from the regulated industries). From both analyses, charges emerged as by far the most influential instrument, and the charges levied were the decisive factor in the decisions to take abatement measures. The conclusion therefore was that effluent charges can work.

Can this Dutch example serve as some kind of lesson to other countries? The answer is "yes", given some conditions. None of the circumstances in the Dutch situation as specifically Dutch. The important conditions refer to the legitimacy and credibility of the charge, and the risk regulated parties run of being sanctioned. The factors of implementation and enforcement influence the behaviour of the regulated parties and, consequently, the effects of the policy on the environment. The fact that the scheme started off as a revenue raising scheme, helped to overcome social opposition and to motivate the implementers as they were collecting their own money needed for the construction. The information problem was solved by, in the first instance, not charging the millions of household and small industrial polluters in proportion to the actual pollution they caused.

Charges were based on an expertly calculated coefficient table. This permitted the probable amount of pollution to be estimated accurately, for each branch of industry or sector, on the basis of easily obtainable data such as the amount of water used by the firm, the amount of raw materials it processes and so on. However, the incentive to reduce pollution remained intact. Companies that felt that they were overrated on the coefficient table could request their effluent to be sampled and to be charged on the basis of the result. These pragmatic adjustment made it possible to implement the charges at the cost of only a few per cent of the total revenue, without diminishing the instrument's regulating power.

With regard to the enforcement, in the first few years, there were various appeals against imposed charges but, as the charges had been established in accordance with the rules, these were all turned down.

The Dutch case shows the potential of the effluent charge instrument. Even though not implemented as outlined in the theory, its effects have shown to be similar to the ones expected from the economic literature.

3.2.1 Other examples.

In what follows, some examples of actual and proposed charge schemes will be mentioned. This discussion will be brief, simply to show the wide variation of application. Most examples are taken from Anderson et al. (1977); Vos and Opschoor (1988); and Opschoor and Vos(1989). The theory underlying all of the examples is the one outlined above, however the objectives of the examples discussed vary widely.

- East German Air Emission Charges. East Germany established a programme that levies charges on emissions of 113 different air pollutants. The charges are paid by every source whose emissions of a charges pollutant exceed the national emission standard. Costs are not allowed to be passed on to the consumers, and revenues are used for air pollution control planning, environmental improvement, and compensation for those injured by air pollution.

- Japan's Compensation Law. The law sets up a systems of environmental charges designed to finance the payment of compensation to individuals who suffer health damage as a result of air or water pollution. The charge levied on a discharger is based on certain health costs arising from the pollution for which the discharger is responsible. As Anderson et al. state "perhaps the most important consequence of the compensation law is that it has demonstrated that a large-scale charge system designed to internalize some of the more egregious external costs of pollution can be implemented successfully (Anderson et al., 1977).

- Examples of failed US proposals for the introduction of effluent charges. A proposed national tax on lead in gasoline (1970); a proposed 1970 citizen's initiative in Maine that put a BOD effluent charge on the ballot as a referendum item; a 197 proposal for a national effluent charge based on biochemical oxygen demand; a 1972 sulphur dioxide emissions tax proposal to control emissions from stationary sources; and the 1972 Vermont Law establishing effluent charges for organic discharges in natural waters;(Bohm and Russell, 1985).

- Czechoslovakia water quality effluent tax. This tax is based on the amount of BOD and suspended solids and is used to maintain water quality at predetermined levels. Charges are based on the operating costs of available treatment systems. As these costs do not reflect capital costs, they are too low to provide an inducement to investment in treatment facilities. Revenues are returned as subsidies for investment in treatment facilities.

- Municipal sewage treatment charges. Found in most western European countries, the USA and Oceania.

- In the area of solid waste there are charges in the form of beverage container deposits (to be discussed later) and product charges combined with recycling incentive taxes (not implemented, New York)

- In land use there are congestion charges, as found in Singapore.

- In France there is a system where a tax is levied on the collection of domestic waste. The level of the tax is determined by the amount offered. However, this true application of an effluent charge, is now found to be too cumbersome, and is replaced in many regions by a tax related to land values.

- With regard to noise there are airport noise charges, as found in Japan (The charges vary according noise level, and the time at which the noise is produced). A similar application can be found in Switzerland. In Japan the revenue is used to reduce the impact of noise on people in the neighbourhood by soundproofing measures.

- In the area of toxic waste there are toxic waste charges (Japan)

- In the Netherlands, a charge is proposed on manure surpluses. It is expected that the charge will be high (not used as a marginal financial pin prick) and that it will have significant effect on farmer behaviour (i.e. an allocative effect).

- In Australia, New Zealand, the U.K. and the USA, the main charge system in operation takes the form of charges on industrial emissions into municipal waste-treatment facilities. These systems are cost recovery type operations, but over time the basis for charging has become more specific and now relates more to the characteristic of the waste load. They still however are not true effluent charges, but are a mixture of standards and charges. Unit costs to be used are derived in various ways, generally using costs in the previous year as a basis. However, to derive unit costs requires an allocation of system costs to the elements in any given sewer charge formula. Such allocation are more or less arbitrary; e.g. the assumption is made in Atlanta that the cost of treating a unit of BOD_5 equals the cost of treating a unit of TSS (Hufschmidt et al., 1983).

With these sewer charge systems, there are often additional constraints as to what can be discharged in the municipal system. The question arises as to why firms should not be allowed to discharge at will and pay the fair costs of treatment incurred? The arguments for not doing so, given by Lowe and Lewis (1980), are that (in the particular situation of the U.K.):

1. Certain substances could endanger the fabric of the sewers or inhibit the process of treatment; these must be prohibited in order to avoid large costs being imposed upon other users.
2. There is the problem that in the short run there is limited capacity. In the long run capacity can be increased but in the short run there could be peak load problems hence restrictions on volume.
3. Some substances, for example heavy metals, impose additional costs of treatment but are included in the normal charging equation in order to avoid the computation and measurement problem becoming too complex. Heavy metals also cause sewage sludge to become unsafe for dumping on land. Therefore heavy metals are prohibited. (Lowe and Lewis, 1980)

3.2.2. Conclusion

In conclusion, the statement by Bohm and Russell quoted earlier in this section still holds true, direct regulations have been and still are the major instruments for dealing with environmental pollution. Although many examples have been quoted of forms of effluent charge systems, most of these do not have the efficiency characteristic of a pricing mechanism. The level of discharge has often been set a priori and the charge has had no allocational consequences unless it induces some dischargers to leave the area (Rose-Ackerman, 1983). All this is not to say that the charge systems discussed have not been effective. The previously quoted OECD report (1985) comments that the role of the charging systems in regard to the efficiency objective seems unproven, but that experiences in the USA, Canada, Japan and Europe (see the Dutch example above), show significant effects in terms of environmental improvement. Notwithstanding all that, the search for more efficient and effective instruments has continued. It has been especially in the U.S. system, that pollution control has moved away from charges and direct control toward modern versions of the consent or permit approach, i.e. a marketable permit system. These will be discussed in section IV.

3.3 SUBSIDIES, TAX RELIEF AND DEPRECIATION

The philosophy behind tax relief, subsidies and similar measures is straight forward. Pollution control costs money. You either force people to do it (direct control or effluent charges) or you pay them to do it. Payments can be of two types, either as a subsidy per unit of reduction in waste emission or as a grant tied to pollution-control equipment expenditure.

These instruments have received much criticism. Although they provide a carrot and therefore, hopefully, a greater chance that pollution control facilities will be put into place, the whole concept flies in the face of the accepted principle that the polluter pays (Barde, 1989). In particular, with subsidies (and so with tax incentives), activities that should not be operating (from a social desirability point of view) are kept alive.

Experience round the world has been that equipment tied subsidies has led to capital intensive pollution control facilities. These were good for public relations, but often were not run very efficiently because the subsidies did not offer inducement for effective use of the equipment (Baumol and Oates, 1979, p. 249). In N.Z. tax deductions were widely used for the installation of abatement facilities for dairy shed effluent facilities. However, if not monitored these soon became expensive edifices. Harrington et al. (1985) list the following undesirable effects subsidies may have:

1. They can provide payments to people to do things they would have done anyway.
2. They can distort the mix of inputs used to achieve the desired objective (the capital intensive programmes mentioned above).
3. Once established, subsidy policies are extremely difficult to revise or abandon.
4. All subsidy programmes have the problem of defining the baseline against which future performance is to be measured.
5. A subsidy programme can have unintended effects that negate some or all benefits. These unintended effects have plagued agricultural programmes in the past. An example of this is discussed by Kirby and Blyth (1987) when discussing the economic aspects of land degradation in Australia. In the next section, some of the problems they noted are discussed further.

3.3.1. Subsidies and soil erosion control

In the control of land degradation (erosion) input subsidies (such as direct subsidies on structural works, concessional credit programs offered by state soil conservation services, and tax concessions for certain capital expenditures relating to land degradation) are a popular form of intervention. However, some of the problems mentioned above also occur here.

First, land degradation is the result of many interacting management practices, and rarely is there a close correlation between one input and the degree of degradation. If only a subset of management inputs or practices is subsidised, the production decisions of land users will be distorted and reflect a bias toward the particular subsidised input or practice. For example, the availability of concessions exclusively for structural work may lead to excessive investment in works relative to other management practices.

Secondly, subsidies lower the private opportunity cost of land degradation by reducing the costs of repair. Hence, they provide an incentive to adopt practices which are relatively more conducive to land degradation, thereby offsetting to some extent the direct effect of the subsidised activities in reducing degradation. For example, if, in response to a subsidy for contour bank construction, farmers find it profitable to increase stocking rates, the reduction in soil loss may be less than expected. Similarly, the existence of subsidies for soil conservation may cause the development of erosion-prone marginal land for agriculture, or its transformation from grazing to crop production, where in the absence of the subsidy the land would remain relatively undisturbed. In each of these cases, the subsidy encourages land management practices which carry the risk of increased rates of land degradation.

A third problem with subsidisation of particular inputs or techniques is the resultant reduction of incentives to develop and apply new conservation technologies. In addition, subsidies provide an incentive only when there exists some private benefit from the subsidised action. In cases where the proportion of private benefits to social benefits of an activity is relatively small (e.g. tree planting to alleviate dryland salinity), large rates of subsidy, perhaps approaching 100 per cent of the cost, may be required.

Kirby and Blyth (1987) consider the use of penalty taxes on the activity generating externalities. However, because of the difficulty associated with measurement of say soil loss, this may not be feasible as yet although using average information based on the Universal Soil Loss Equation may be a way out. But with less than perfect information the best approach may be one that combines standards with incentives (Chisholm, 1987). In a recent report looking at fiscal measures to achieve environmental objectives in Australia, the committee stated that with regard to land degradation, "taxation incentives will be most effective in encouraging soil conservation in areas where the private financial returns for soil conservation are highest. The type of soil conservation activity most likely to be affected by taxation measures is that which requires the expenditure on works of a capital nature which generate private returns sufficient to be considered a reasonable investment. This is most likely to apply to land degradation caused by water erosion at least when capital works are accompanied by changes in land management. Other types of degradation are less likely to be controlled unless the concessions available are substantially greater than those necessary to induce water erosion control." (Commonwealth of Australia, 1987)

3.3.2. Conclusion

The evidence, as presented above, suggests that the effectiveness of subsidy programmes (including other fiscal measures) for pollution control varies. This especially so when subsidy incentives are used on their own. When combined with charges as in some of the Dutch programmes discussed, it was concluded that "subsidies did not seem very effective from a preventive point of view" (Mensink et al. 1988). However when applied to non-point pollution, fiscal measures or subsidies may be the only way to achieve some control.

It needs to be concluded then that one has to be very careful with using subsidies to achieve environmental objectives. There may be particular areas where subsidy programmes may have a role, e.g. in situations where the benefits of the programme are wide spread. In such a situation, a subsidy programme may be easier to enact than other programmes. Also, because of the diffusion of costs, subsidy programmes have political attractiveness.

3.4 DEPOSIT-REFUND SYSTEMS

Charges and marketable permits require that discharges can be monitored. In some situation this may not be feasible, i.e. when the sources of environmental degradation are numerous and/or mobile. Situations like these may be e.g. the release of freons from automobile air conditioners; improper disposal of mercury batteries or waste lubrication oil and other hazardous material by individuals; or littering be it beer can or abandoned cars. To assign liability in these cases is difficult because proof of guilt is hard to establish. In such situations a deposit-refund system may be a better instrument.

The system is straight forward. Placing a tax (deposit) on an item implies that the potential injurer is subjected to a charge in the amount of the potential damage or to a refund if certain conditions are met, e.g. proof that a product is returned to a specified place or that a specified type of damage has not occurred. Thus a price is put on the use of the environment and a (negative) price if this right is not used. Deposit-refund systems may perform better than alternative instruments in that:

(a) they also work when the act of environmental degradation is not directly observable or when the potential injurers are numerous and/or mobile,
(b) they simplify the proof of compliance in some cases,
(c) they specify the (maximum) economic consequences of noncompliance,
(d) actual or expected damages are covered by actual payments (at least in principle), and
(e) in certain applications they may stimulate people other than those directly involved to reduce the effects on the environment (such as scavengers, school groups, scouts etc. in the case of refunds on littered items).

Politically these schemes may also be appealing in that they can be self-funding, and in that they should not affect the distribution of income, and hence prove politically to be very acceptable.

Examples of possible (and actual applications) are for **consumers** of products which may create environmental effects when disposed of, such as, mercury, cadmium, batteries, beverage containers, tires, junked cars, used "white goods", lubrication oil, freons in air conditioners and refrigerators, etc.

Similarly, deposit-refund systems may be designed for **producers** to check hazardous emissions of chemicals into the air and waterways or dumping toxic wastes, in particular when proper treatment of such releases or wastes is expensive and improper disposal is easy to conceal. If the potential emissions or wastes are related to certain inputs in a straightforward fashion (such as potential sulphur emissions to the input high-sulphur fuel oil, or coal), a tax/deposit could be levied on these inputs and a subsidy/refund paid for the quantity of chemicals (e.g. sulphur) or toxic material transferred to a specified type of processing firms (Bohm and Russell, 1985).

Huppes (1988) in a paper in which he discusses the application of a deposit-refund scheme to cadmium in The Netherlands, gives the following characteristics that should hold for this instrument to work:

1. the material in question must be stable in the production and consumption process;
2. the material should not escape too easily. This is a less stringent criterion because many techniques exist to capture gaseous emissions;
3. the diffusion of the material (residuals) must present and economic problem;and
4. it must be possible to be able to quantitatively account for the material both in production and from imports.

Examples.
An example of applying a deposit-refund scheme to a consumer good is the **Oregon's "Bottle Bill."** The bill aimed at inducing the re-use of beer and softdrink containers. Standardized containers had a lower deposit so as to encourage their use by beverage manufacturers to reduce the costs of sorting and returning them. As Baumol and Oates (1979) report, the effect of these price incentives has been quite impressive. Many other States and countries have followed the examples.

There is however a catch to the success of the deposit-refund scheme on beverage containers, and that is the increased use of plastic-one-way bottles. This has created a new environmental problem. Hopefully in the near future this problem will diminish with the new plastic containers now becoming degradable.

An interesting follow up is provided by the container deposit scheme introduced in Denmark.

In 1981 **Denmark** introduced a law requiring that beer and soft drinks be sold only in returnable bottles, with a compulsory deposit. (Denmark is not unique in doing this, other countries and States in the USA have done this also).
In the case of Denmark, however, this lead to a new problem, or as in the phrase coined by The Economist "The freedom to be cleaner than the rest". The problem is how do countries at different stages of economic development, and with different shades of green, pursue national environmental policies that do not get in the way of free trade?
The Danish law was severely criticised, and brewers from other countries grumbled that the costs of recycling bottles wiped out the profit to be made in Denmark's small market. The case was taken to court by the European Commission which argued that the Danes were imposing a disproportionate level of environmental protection.
In September 1988, however, the court backed Denmark. Its judgement, invoking the environmental provisions of the Single European Act, was the first to allow what is indeed a trade barrier on such grounds. It was a big victory for the Commission's environment directorate over the the internal-market directorate, which had insisted on taking Denmark to court. The West German government has now decided to go ahead with a proposal for mandatory deposits on plastic bottles. (The Economist, 1989a).

In **Sweden**, new cars have a deposit on them of 250 SEK. When the car is delivered at a wrecking yard, the deposit is refunded with interest (250 SEK plus 50 SEK). The scheme has not been very successful since the deposit has been too low (eroded by inflation), and it has been too easy to get the refund without having to deliver the wreck (Vos and Opschoor, 1988).

Some countries are considering using deposit-refund systems for **containerised hazardous wastes.**

The instrument of deposit-refund hold an attraction in that it places the responsibility for the prevention of environmental pollution on the user. Implicitly, the instrument places a price on the environment which the user of the potential residual is free to pay or not.

In practice however, not many countries have made use of the technique. This may have something to do with the substantial information that would be required to implement such a system (for say heavy metals) in the production process. Further, and this refers especially to things like returnable items like bottle, oil, batteries etc., there must be an extensive collection system present where the refunds can be paid. In less densely populated countries, the cost of collection has often been too great, and many systems that have been started have folded. For other applications it turned out that the administrative cost was too high. Future use of this type of instrument depends upon a compromise between fine tuning the incentive structures and keeping administrative and enforcement costs as low as possible (Tietenberg, 1988).

3.5 PRICING POLICY AS AN INSTRUMENT FOR ENCOURAGING ENVIRONMENTALLY BENIGN PRODUCTION

The discussion in the previous three sections has already covered most of this topic. The discussion on charges highlighted how in theory and in practice, financial incentives can be used to change behaviour and encourage environmentally less degrading production processes. Similarly, it was shown that deposit-refund policies can also achieve desirable behavioural changes in consumers as well as producers. Another area of great concern is pricing policy by Governments that leads to environmentally destructive practices. In Meister (1990) several examples were quoted, dealing with subsidised fuel prices leading to deforestation, water prices leading to over-use of water with associated problems of salinity, product prices and other subsidies leading to the development of marginal lands and soil erosion problems, etc. In The Economist article quoted earlier (The Economist, 1989a), there is a discussion of how vast increases in money to the peripheral EEC countries (to help development) will in many cases be simply "money for destruction". Immense pressure to start spending the cash quickly means that proposals for roads, bridges, and dams are being rushed through. The money is approved before local greens have been told what is mooted and have has a chance to comment. The Environment Departments in these countries have only a handful of people looking at proposals as they pour in. Many other examples exist, of situations where Government policy (funding and pricing) have been the direct consequence of environmental degradation. In this section not much more will be said about this topic. However it is important to make one more point regarding pricing, policy and control. The point that needs to be made is that is that pollution control does not always have to begin at "the end of the pipe-line". Several factors influence the magnitude of pollution causing activities, and prevention of them may be much more cost effective then end of pipe control. Government has a big role to play through its policies and its regulations to encourage industry, farmers, and others to prevent pollution before it starts.

Therefore in the section below some comments will be made with reference to (a) preventive versus cleaning strategies and (b) nonpoint pollution, both in relation to pricing policy.

3.5.1 Pollution control versus pollution prevention

The ultimate objective in pollution control must be the prevention of the causes rather than the prevention of the effects. Prevention of the effects is environmental policy of the 'curative' type. It's goal is to eliminate ex post a number of hazardous elements out of the existing streams of waste and emissions and to render them as harmless as possible. This approach has created a growth in rather specialised environmental technology embodied in equipment for pollution control at the 'end-of-the-pipe'. This technology could be called 'add-on technology'.

In recent years, there is a growing interest in innovations that will deal earlier with the causes of pollution and hence prevent the need for environmental control of the effects. The term prevention is not very clear. No one will question the fact that to prevent is better, and in most cases less expensive, than to cure. But to transform this principle into concrete policy measures is, perhaps, less difficult in health care than it is in environmental management. The use of add-on technology will undoubtedly prevent much pollution. Nevertheless, a strategy aimed at reducing the production of hazardous waste and emissions, and/or a policy aimed at reducing the possibilities of potential pollutants entering the environment should fundamentally be based more on preventive than add-on technology.

Example: "Pollution Prevention: The Chevron Story" (Karras,1989)

In the early 1980s, the Chevron USA petroleum refinery, California, was creating serious toxicity threats in San Francisco Bay (chromium, nickel and other chemicals). Weak federal standards failed to require the best available technology for wastewater treatment and would have allowed the refinery's chromium discharge to grow from 1800 to 7000 pounds per year. Public appeal caused the San Francisco Bay Regional Water Quality Authority Control Board to require Chevron to analyse in-plant measures to reduce or eliminate pollutant discharges.

Chevron chose not to pursue the conventional approach of appending treatments like additional biological digestion, filtration, or carbon adsorption to convert toxic pollutants from aqueous to solid wastes. Although treatment at the end of a combined sewer can transform biodegradable pollutants into recyclable materials, it only reroutes persistent toxic pollutants to other environmental media and may reduce recycling options for the sewage sludge contaminated with these pollutants.
Chevron instead performed an environmental audit on its waste generating activities. The auditor chose two toxic-use reduction measures:

1. substituting raw materials that introduce fewer hazardous substances or smaller quantities of such substances into the production process;
2. redesigning or reformulating end products.

And three toxic-waste reduction measures:

3. improving process technology and equipment to alter the primary source of waste generation;
4. improving plant operations such as housekeeping, materials handling, equipment maintenance, waste tracking, and mass balance; and
5. recycling a waste or part of it at the site of its generation (closed-loop recycling).

The end result was that pollution prevention and source treatment has reduced Chevron's toxic metals discharges to San Francisco Bay by 70 to 90 percent. In doing so Chevron also showed that the BAT standards for some of the toxic metals as set by the State of California and EPA were far too lax.

Chevron's resistance to pollution control turned to cooperation the moment the in-plant audit information, particularly the mass balance result, was made public. Government policy should require a pollution prevention audit and citizens should be able to see these audits. Often is is ignorance on part of firms to consider prevention measures. However there are now many examples around to show that prevention may be the most cost-effective way to control pollution, see for example a book of case studies titled "Proven Profits from Pollution Prevention." (Morris and Seldman, 1986).

Preventive control has two main goals: the development of cleaner technologies (by innovation), and the development of a structure of production and consumption that entails less pollution (by reallocation). Both have important effects, as can be illustrated by Japan, where the emissions of SO_2 were reduced by 25 per cent within a few years (1975-1980). This was not so much the result of the use of pollution control techniques as of energy-saving measures. The use of better fuels and the effect of a changing industrial structure played a significant role as well (van Driel and Krozer, 1988).

Experience in many countries has shown that environmental policies using quantitative standards (command-and-control) have not in many cases encouraged prevention practices. Sometimes when combined with other pressures, such as competition, it has (see the example below) but in the main "end-of-pipe control has been the most popular response.

Example of pollution prevention **(product design).**
In response to regulatory trends and competition from the paper industry, the chemical industry in the United States and Europe has begun to develop biodegradable plastics; this reaction is similar to the industry's response 25 years ago when long-lasting detergents were polluting water supplies.
However, degradable plastics carry with them their own risks which need to be carefully considered.
Other areas of product design where changes are taking place are e.g. automobiles, aerosol sprays, paints and solvents (Friedlander, 1989).

The discussion in the preceding sections has shown that financial (or market) instruments could be of help, also in encouraging pollution prevention.

Pollution taxes would provide the incentives for firms to seek out and use the least-cost methods for controlling their emissions, and hopefully also to look into the development of new technologies (Oates, 1988). This was also the conclusion reached in a study of environmental control of the metal-plating industry in The Netherlands (Mensink et al., 1988). However, in the view of van Driel and Krozer (1988) the dominance of add-on technology cannot be broken by way of indirect regulation alone. A more direct approach has to be developed by tackling the most important barriers, such as the traditions in environmental policies or the quote them:

"Environmental policies influence supply and demand of environmental technology. Until now such policies did not generate strong stimuli to reduce pollution to a high degree. Most expenditures are directed towards compensation, repairing and controlling past and present pollution. The low rate of penetration of cleaner techniques can also partly be explained by institutional factors and traditions (such as the way in which waste disposal is regulated, the monopoly of power plants). The environmental laws, instruments, etc. hardly generated incentives for innovation and prevention. Subsidies are given, but firms have to prove that their extra investment is aimed at the reduction of pollution; this can easily be demonstrated by buying add-on equipment. Only small amounts of money are available to stimulate the development and implementation of cleaner techniques."

van Driel and Krozer finally conclude that besides market instruments to 'internalise' environmental management, also some form of regulation will be necessary to accomplish the greater levels of preventive measures in environmental control.

In the search for more effective, more efficient, and more desirable (from a long term perspective) environmental control it is important to take into consideration not only the incentive effect of taxes and other market instruments on end-of-pipe control but also of preventive measures to reduce the cause of the emissions and wastes.

3.5.2 Pricing policies and nonpoint pollution

Much of the discussion above has been in terms of point-source pollution. It should not be forgotten however, that non-point sources also have a great (sometimes greater than point sources) effect on ambient environmental quality. Especially in developing countries this may be the most important source of pollution and the hardest one to manage.

Control in the non-point pollution area is very difficult simply because of the problem of identification of the polluter. Most agricultural pollution is very diffuse, so for example taxing nitrate discharge from farmland is not practicable, whereas a tax on nitrate fertiliser clearly is (direct control also here is the most used instrument). Effluent charges here can be (and are) used indirectly as input charges on the amount of potentially polluting material used as an input. Other examples may be charges on energy, or other inputs such as fertilizers or pesticides (Harrington et al., 1985).

In theory, product and input charges do no lead to cost-effective pollution control, because they offer no incentive to improve effluent control technology. But if in practice pollution is very expensive to monitor because it is very diffuse or appears in several environmental media, then product or input charges may be the only practicable market mechanism available (Pezzey, 1988). In a theoretical, but relevant, paper, Shortle and Dunn (1986) examine the relative expected efficiency (net benefits) of four general strategies that have been suggested for achieving agricultural nonpoint pollution abatement. Referring to the flow of pollutants from a farm as runoff, the four strategies considered are (a) economic incentives applied to estimated runoff (e.g. a tax on estimated runoff); (b) estimated runoff standards (e.g. estimated soil loss standards); (c) economic incentives applied to farm management practices (e.g. taxes on nutrient applications); and (d) farm management practice standards (e.g. required use of no-til). They conclude that, setting aside policy transaction costs, an appropriately specified management practice incentive should generally outperform the other three strategies. They go on to say that this result is of particular interest under present political conditions. It is often the case that policy approaches which fare well on economic grounds are politically unacceptable. Yet, in the case of pollution control for agricultural sources, prevailing political preferences appear to favour management practice incentive schemes. Consequently, it would seem that a well-specified management practice incentives approach may be politically acceptable as well as economically advantageous.

Example. Non-point Pollution: Pesticides.
The pesticide problem would, at first glance at least, appear to be best handled by regulation - by the prohibition of the use of dangerous chemicals. This certainly is the approach that has generally been employed, and there are currently no examples where fiscal incentives have been used in this area. A study of how pesticides are typically being controlled in most countries is given in **Pesticides in Mexican Agriculture (Pearson,1987).**

In Mexico, it is argued by some, that pesticides are overused in agriculture and in public health programmes. It is suggested that this results in unnecessary poisoning and environmental contamination. It is maintained that pesticide use is ultimately self-defeating since its use generates pest populations that are pesticide-resistant and that pesticide imports waste foreign exchange critical for Mexico's development ($30 million in 1983). Finally it is claimed that production could be significantly increased through the use of integrated pest management (IPM) techniques that rely more on naturally occurring pest controls.

On the other hand advocates argue that pesticides are needed to increase agricultural productivity and to control disease vectors. Industry sources claim that pesticide use prevented more than $1 billion worth of crop loss in 1983, that it hastens agricultural modernization, and that it has a net positive effect both on gross domestic product and on the Mexican balance of payments.

Arguments on both sides are far from fully substantiated. However, there can be little doubt that pesticide use is growing in Mexico, that substances banned elsewhere are used there, that substantial pesticide pollution is already occurring, and that Mexico sorely needs to find ways to make its agriculture more productive. This situation is not at all peculiar to Mexico, it would be similar in most developing countries.

In Mexico there is an excellent set of legislation to deal with pesticides. There is strong legislative control dealing with pesticide production and importation and a framework for the implementation of a nationwide monitoring system. There is a large bureaucratic apparatus, but, however little effective control.

The problem is widely reported, but poorly documented, inattention to safety measures at all stages of pest production, storage, mixing, application and residue monitoring. Parallel to this is a lack of political consensus and resources for implementing the legislation. Further there are illegal border crossings and legal importation of products suspended, cancelled, or heavily restricted in the U.S.

To make progress, growers need to find ways to improve worker safety; storage and transportation of pesticides must be closely monitored; producers must enforce safety standards; the government must find ways to streamline its fragmented set of regulating agencies and to enforce its generally excellent legislation; and care must be taken that pesticides are not overused, either in agriculture or in disease eradication. A tall order for a country with a chronic food shortage.

What the case study shows is that it doesn't matter how excellent your legislation is, without monitoring, enforcement and the political will, it counts for nothing. Direct control as legislated here would be able to achieve much if it was actually exercised. If this approach is the most efficient way of going about pesticide control, is a different question, but one that is pretty theoretical if the essentials of control (monitoring, enforcement, political will) are not there.

There are a number of studies of agricultural production functions that indicate a wide range of substitutes for dangerous pesticides, whose use would be encouraged substantially by fiscal incentives. Fiscal incentives can also have an impact on the total use of pesticides, an increase in price can substantial affect marginal use.

Among the alternatives are also new strategies of "pest management" involving a variety of techniques to reduce damage to crops instead of a blind reliance on eradication of pests by use of hazardous pesticides. When there is evidence that a particular pesticide or chemical may constitute a serious threat to health, an outright ban on its use may, of course, be appropriate, but for less threatening products, fiscal inducements may permit more desirable adjustments in agricultural practices.

In a similar vein, a recently released report in New Zealand on **"Pesticides: Issues and Options for New Zealand."** highlight many similarities with the Mexican case (perhaps only a difference in magnitude, although this is currently widely disputed in N.Z.). The report in its conclusion opts for a policy of using selective fees (charges) to simultaneously collect the funds needed to support Government interventions and to directly encourage responsible user behaviour. (MacIntyre et al., 1989)

CHAPTER IV

4.0 CREATING MARKET: TRANSFERABLE POLLUTION PERMITS

In stead of overcoming market failure by forcing polluters to internalise the cost of the externality they cause, or the cost of achieving societal desirable standards, an alternative approach is to create markets for assimilative capacity. One way of doing this is to establish a pre-ordained environmental standard and then issue 'permits' for polluters.

Giving people a permit to pollute may seem immoral, but in reality it is no different from what is done in command-and-control regulation. There also, permits are given to polluters to pollute up to a certain level and then no more.

Once a standard has been set and permits issued, then a market can be established in which these permits can be traded (i.e. bought and sold). The rationale for this is the same as that underlying the pollution charges approach; polluters with high abatement costs will prefer to buy the permits, while low abatement cost polluters will sell permits in favour of abating pollution. Once again, the overall standard is not threatened but is achieved. The standard can be changed by the Authority through buying in permits or selling more.

The theoretical attractiveness of marketable permits lies in their promise of greater economic efficiency than the currently prevailing "command-and-control" approach to environmental policy. With rights to discharge pollution being bought and sold like other property, plants for which pollution abatement is difficult and expensive could purchase such rights from plants that have lower costs. The result is that pollution would be controlled by those firms that have the lowest abatement costs. Specifically, any source reducing its emissions further at any discharge point than that which is required by law, may apply to have this excess reduction certified as an emission reduction credit.

Example 1, the Atlantic Richfield Oil Co. (ARCO) invested $8 million dollars into the building of two pyramidal traps, to capture oil and gas escaping from fissures on the ocean floor by Santa Barbara County, California. Doing this, helps getting rid of thick gooey carpet of tar that washes up daily on the beaches, as well as eliminating the putrid smell of hydrogen sulphide which often hangs over the area like vapour from a truck load of rotten eggs. The project is expected to yield 50bbl. of oil and 600,000 cu.ft of gas a day, which will not be enough to offset the investment made by ARCO and partners. Under a deal struck with state and local government, the oil companies will get an air pollution credit; for every two tons of hydrocarbons they eliminate, they will be allowed one ton of sulphur- and nitrogen oxide emissions from future drilling in the Santa Barbara Channel. This offset will now allow the company to develop a nearby well that could produce as many as 4,100 bbl. of oil a day. Without this trade-off or offset, this would not have been possible.

Example 2. Tradable permits for Water Pollution Control (Stavins, 1989, page 6).

The experience of Dillon Reservoir, the major source of waer for the city of Denver, Colorado, provides an excellent example of a trading approach that works effectively on nonpoint-source water pollution. In past years, nitrogen and phosphorus loading was causing the reservoir to become eutrophic, even though point sources from surrounding communities were controlled to "best available technology" standards. To preserve and protect water quality in the face of rapid population growth, EPA and the state of Colorado jointly developed a "point/nonpoint-source control optimisation" programme to cut the phosphorus flows that mainly came from nonpoint urban and agricultural sources.

The point/nonpoint-source trading plan was developed with the active participation of environmental groups, industry, and local and state governments, and was approved in 1984 by the Colorado legislature and EPA. The programme allows for publicly owned sewage treatment works (POTWs) to finance the control of nonpoint sources in lieu of upgrading their own treated effluent to drinking-water standards. The programme is effective because the cost per pound of phosphorus removed via trading is $67; the cheapest advanced treatment alternative developed for the POTWs would cost $824 per pound. EPA has estimated that the plan has made aggregate savings of more than $1 million per year, compared with the conventional workings of four fairly small POTWs. Furthermore, to provide a margin of safety, a 2-to-1 ratio on trades is used, requiring control over a minimum of two pounds of non point phosphorus for one pound of credit for a point source. As a result, the plan not only saves money but increases the likelihood of achieving environmental improvements. The same type of programme is currently being developed for nutrients and other pollutants at other sites in Colorado and elsewhere.

To receive certification, the emission reduction must be: 1. surplus, 2. enforceable, 3. permanent, 4. quantifiable. The conditions under which these credits can be created, stored, transferred, and used are defined by the particular programme, e.g. bubble, offset, banking and netting.

4.1 THE BUBBLE POLICY

The bubble concept is designed to take account of the different incremental costs of controlling pollution, both across processes within a particular plant and across plants and firms. A figurative "bubble" is placed over an entire plant or area, treating it as a single source of emissions rather than as a series of independent sources. The bubble programme allows regulators to set emissions limits for a plant as a whole, while managers are free to allocate pollution abatement among the various sources so long as the overall emissions target is attained. Consequently, the bubble provides an important incentive for keeping down the cost of abatement. Firms are encouraged to reduce overall outlays by increasing pollution control at sources where incremental abatement costs are low (hence earning emissions reduction credits) and decreasing control where costs are high (using up the emissions reduction credits). Under certain conditions, the bubble programme can be expanded to include more than one plant or firm.

Experience with bubbles has shown cost savings. In Tampa, Florida, for instance, an electric utility used the bubble to reduce the costs of controlling sulphur dioxide. The utility reported savings of $20 million. In Middletown, Ohio, Aramco substituted dust-reducing actions on its plant site for pollution controls in its steelmaking process. The company was able to save $20 million in capital costs and $2.5 million a year in operating costs (Crone and DeFina, 1984)

Regulators (in the USA) are currently involved with many bubbles, and by September 1983 already 33 bubbles had been approved and many were under review. Tietenberg (1985) summarises the cost savings achieved from eight bubble trades approved by EPA during 1981. Most of the transactions were primarily within firms in nonattainment areas. The savings were all very significant both in capital cost (because switches to different technologies) operating cost (often fuel saving). A final step in this programme toward the economist's approach would be to make these "licenses to pollute" fully marketable so that firms best able to reduce emissions could sell their excess abatement to firms for which pollution abatement is too expensive (like the banking discussed below).

Example of emission trading. Quoted from,"Hard Heads, Soft Hearts." (Blinder, 1987)

The state of Wisconsin found itself unable to achieve EPA-mandated levels of water quality along the polluted Fox and Wisconsin Rivers, even when it employed the prescribed technology. A team of engineers and economists then devised a sophisticated system of transferable discharge permits. Firms were issued an initial allocation of pollution permits (at no charge), based on historical levels of discharges. In total, these permits allow no more pollution than is consistent with EPA standards for water quality. But firms are allowed to trade pollution permits freely in the open market (by 1982 the first trades had taken place). Thus, in stark contrast to the standard regulatory approach, the Wisconsin system lets the firms along the river - not the regulators - decide how to reduce discharges. Little emissions trading has taken place to date because the entire scheme has been tied up in litigation. But one study estimated that pollution-control costs might eventually fall by as much as 80 percent compared to the alternative or ordering all firms along the river to reduce their discharges by a uniform percentage. The potential saving realised from a permit approach were estimated at $6.7 million.

4.2 OFFSETS AND BANKS

The offset programme (in the USA) was developed primarily as a way to allow new plants to open and old ones to expand in nonattainement areas (areas that had not attained the ambient air quality standards set by the EPA and mandated in the Clean Air Act), while ensuring that environmental quality did not deteriorate. Prior to offsets, within a nonattainment area, construction of new emissions sources and expansions of existing ones was prohibited. The offset policy enables new sources to enter such regions provided that they meet strict emission standards and acquire sufficient offsetting reductions (or credits) from other facilities so that total regional emissions will be lower after their entry than before. This programme therefore provides a way to improve air quality by reducing emissions at existing sources, but it does so by forcing new sources to find and finance the offsetting reductions.

Since the programme began in early 1977, the EPA reports that hundreds of offsets have taken place. Most arrangements have been internal, with companies finding offsets to expand their own facilities. Of the 150 offset transactions closely scrutinized by Vivian (1981) and Vivian and Hall(1979), 55 were found to have led to emission reduction through the use of improved technology and 15 resulted in emission reduction through fuel switching. Many offsets were made available when plants closed down. These actual results reinforce the findings of many simulation studies which studied not only the potential cost savings, but also the savings associated with implementing this programme as compared to a command-and-control programme. Of course the fact that emissions credits are traded vigorously, involving a number of pollutant and a number of geographic areas, is a sign that there are costs to be saved.

The offset programme does however give existing sources in nonattainement areas a significant competitive edge over their potential new rivals by perpetuating the traditional regulatory bias against new sources (Tietenberg, 1985b).

The **emission bank programme** (in the USA) is really an extension of the offset programme, affording greater flexibility in terms of timing the trade of emissions reductions. If a firm reduces its daily emissions below mandated levels, it can "bank" those reductions, that is, hold them in reserve at a clearing house, for trade at some future date. In this way, the basic offset programme is made more efficient, since potential polluters do not have to expend substantial amounts of resources trying to locate offset partners; instead, they can simply consult the clearing house inventory. Normally, only some fraction of the reduction in emissions is eligible for sale, and this is determined by the regulators on a case-by-case basis. Thus, each transaction under the bank programme results in a net reduction in emissions.

4.3 NETTING

Netting allows a source undergoing modification or expansion to escape the burden of new source review requirements so long as any net increase (counting the emissions reduction credits) in plant-wide emissions is insignificant. By "netting out" of review, the facility may be exempted from the need to acquire preconstruction permits as well as from meeting the associated requirements, such as modeling or monitoring the impact of the new source on air quality, installing 'best available control technology' or 'lowest achievable emission they meet strict emission standards and acquire sufficient offsetting reductions (or credits) from other facilities so that total regional emissions will be lower after their entry than before. This programme therefore provides a way to improve air quality by reducing emissions at existing sources, but it does so by forcing new sources to find and finance the offsetting reductions.

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To initiate an offset or bubbles programme some major problems need to be resolved. One of the more basic ones deals with the definition of the baseline from which trades among sources are measured. Is this baseline to be defined as emissions permitted or as actual emissions? If firms are emitting much less than permitted, and if they are allowed to trade off against their permitted emissions, the net effect might be more rather than less pollution. In the second place there is the question of how emission rights are given (or sold). Does everyone start from the present position (those that have already put abatement control facilities into place and those that have not)? The question of a fair distribution needs to be answered before a politically acceptable programme can be started. Even if all the above questions are answered, a trading policy needs to be establish that will reduce transaction costs.

Finally, as Opschoor and Vos (1989) say, it needs to be remembered that the instrument of emissions trading, when used, will always be additional to the instrument of direct regulation. The two instruments have often been presented as alternatives in the literature, but this is hardly conceivable in practice. And like all programmes, ultimate effectiveness will depend on effective monitoring and enforcement.

CHAPTER V

5.0 ENVIRONMENTAL REGULATIONS, EMPLOYMENT, PRODUCTIVITY AND GROWTH

Conflicting assertions are being made about the incompatibility of environmental quality and other important goals. On the one hand, opponents of the environmental movement argue that stiff controls will be inflationary, will impede economic growth, will deprive firms of needed productive investment, will lead to plant closures, and will cause a loss of jobs. On the other hand, increasing numbers of environmentalists have argued that it is possible simultaneously to create jobs, conserve energy and nonrenewable resources, and protect the environment (Haveman and Smith, 1978)

The claims at both sides deserve serious consideration - especially with high rates of unemployment and increasing rates of inflation in many western countries. Especially in the U.S. the deterioration in macroeconomic performance during the year 1973-1982 occurred at the same time that the environmental movement began to gain strength. A plausible hypothesis, then, is that the increasing scope and volume of environmental regulations promulgated after the mid-1960s contributed to the country's poor macroeconomic performance.

Even though claims, as those made above, should be given serious consideration it should not forgotten that the kind of growth we have been enjoying has in some ways been like "fools gold", in that we enjoyed the benefits today but pushed the costs onto our children. Or:

> "Green growth will indeed be somewhat slower than a dash for the dirty variety. At present, most economic activity takes little account of the costs it imposes on its surrounding. Factories pollute rivers as if the rinsing water flowed past them for free, power stations burn coal without charging customers for the effects of carbon dioxide belched into the atmosphere, loggers destroy forests without a care for the impact on wildlife or climate. The bills are left for other to pick up - neigbours, citizens of other countries, and future generations. A truly green economy would pay such bills as it went along, not slip them to posterity. To the extent that it had to forgo consumption today, in order to bequeath more of the world's resources and rubbish-absorbing capacity to its children, a green economy would not grow as fast as a dirty one might. The sacrifice need not to be great however." (The Economist, 1989c).

5.1. ANALYSIS OF MACROECONOMIC IMPACTS

To analyse the macroeconomic impact of environmental policies is not easy, and hence there are not very many reliable analyses. The reasons for this are not difficult to perceive. Firstly, environmental policies seek to alter behaviour of individuals, firms, and municipalities. But seeking to alter behaviour is not the same as altering it. The translation of controls and subsidies into costs of equipment and associated effects requires therefore a lot of simplifying assumptions and guesswork. Secondly, those affected by the control will in some cases be able to pass on the costs associated with pollution abatement. Such shifts in the financial burden make it difficult to discover the full economic impact of environmental policies. Finally, the relationships among regulation, technological progress, productivity growth, and inflation can be positive, negative or neutral depending on many factors (for a theoretical discussion, see Christainsen and Tietenberg, 1985)

Techniques to analyse the direct and indirect impacts of environmental policy can be classified in either "bottom-up" (microsimulation) or "top-down" (macroeconometric) approaches. The first one attempts to measure the impact of a policy change on individual households and businesses in the economy. The numerous individual responses and impacts are then added up to yield the aggregate impact of the policy. The second approach first specifies a system of aggregate relationships in the economy, then identifies how the policy change will affect one or a few of the key aggregate economic variables in the system, and then predict the performance of the economy in both the presence and the absence of the policy change in questions.

In most of the results, to be discussed in the next section, the impact on growth is measured in terms of the conventional national income accounting statistics. But as is well known, conventional statistics of economic growth are bad measures of people's happiness (The Economist, 1989c). They are particularly blind to the environment. National-income accounts take no notice of the value of natural resources; a country that cut down all its trees, sold them as wood chips and gambled the money away playing tiddly-winks would appear from its national accounts to have got richer in terms of GNP per person. Equally, they show measures to tackle pollution as bonuses, not burdens; the cost of cleaning up an oil spill will be clocked up as a help to the growth rate. It would be easier for politicians to talk rationally about the effects of sensible environmental policies on growth if governments agreed to remove some of these oddities from the way they keep their economic books (see e.g. Meister 1990, the section on Natural Resource Accounting).

5.2. RESULTS FROM SOME ANALYSES

Haveman and Smith (1979) report on a comparison of the effects of selected environmental programmes on macroeconomic variables. The economic indicators were: inflation, economic growth, unemployment, investment, specific sectors. The models compared were the Chase econometric model, Hollenbeck's microsimulation model; the Netherlands macroeconomic study; the Japanese macroeconomic study.

The findings were that there were modest impacts at the national level. In response to the environmental policies, inflation would increase, economic growth in real terms would decrease (after an initial rise), employment effect would be negative, and the effect on different regions varied between models. The authors concluded that the argument, that the capital needed for abatement in the next decade, would crowd-out productive investment and that private savings would be unable to meet the demand for funds with the consequence that the aggregate economy would suffer, is not substantiated. While the required pollution abatement investment would cause a reduction in real GNP. the impact would not be sufficient to inhibit growth. With regard to employment, the impact is likely to be positive in periods when there is substantial investment in pollution abatement equipment (even though the incidence of the impact may mean that those finding employment are not the ones thrown out of jobs because of environmental constraints). Whether positive or negative, the empirical work to date indicates that the absolute value of the effect on the nation's unemployment rate is probably less that 0.25 percentage points (see also Christainsen and Tietenberg, 1985).

Haveman and Smith (1979) conclude therefore that the contrasting views of the relationship of environmental policy to the economy are inaccurate. "The studies conducted to date suggest that environmental policies will not cause sizable reductions in real GNP or employment, nor are they the boon to the economy claimed by some of their proponents. For the time being, and given the state of our knowledge of the role of environmental resources in the economic processes, it does seem that some tradeoffs will be necessary. On the one hand, existing environmental policies are not likely to be catastrophic. On the other hand, the assertions of Environmentalists for Full Employment regarding the complementarity of environmental policy and full employment are overly optimistic," (Haveman and Smith, 1979).

Similar conclusions were reached by Portney (1981). He pointed out that the conclusions reached above were rather obvious since environmental control expenditure is relatively small when compared with GNP. Portney also sounds a note of warning. The macroeconomic models on which these results are based have many limitations which really only allow one to consider directions of change rather than absolute magnitudes. Secondly the relevance of the cost effect can only be measured against the benefits of pollution control.

Haveman and Christainsen (1981) discuss in more detail the specific impacts of environmental control on productivity growth. Their conclusion is that demographic factors, the sectoral shift in the composition of output, the slowdown in the rate of capital investment, cyclical changes, and under utilisation of capital could account for 60-90 per cent of the slowdown in productivity as observed in the 1970's. That leaves between 10-40 percent to be caused by other factors of which environmental regulations are but one. A reasonable estimate is that 8-12 percent of the slowdown in productivity is attributable to environmental regulations. This estimate accounts for both the direct and the indirect effects of environmental regulations. Clearly there is a wide range of uncertainty in this estimate. Also, the overall impact of this estimate should contrasted (as pointed out above) to the positive effects of environmental control such as, improved health, longer lives, expanded outdoor recreation opportunities, greater enjoyment of existing recreation opportunities, and reduced demands for cleaning and other "defensive" activities, before judgements are made about the overall impact on economic welfare.

The discussion above dealt in the main with macroeconomic impact today and in the near future. Ridker and Watson (1981) take this discussion even further and look at the long-run effects of environmental regulation. Part of their conclusions is as follows: "To sum up, if the costs and damages we have assumed here are accurate, it appears that substantial control of the common mass pollutants can be achieved without undue interference with the national economy (and, in fact, can add to national economic welfare) as long as fiscal and monetary policy bring about some increase in savings and as long as hard-hit regions and sectors are helped". While this sounds encouraging, they also sound a note of caution about additional environmental problems (the unknown consequence of some past and future human behaviour), the cost of which may be very large.

In OECD countries, "The benefits generated by environmental measures (including the damage costs avoided) have generally been greater than their costs" (OECD, 1987). Also here, studies have shown that although environmental policies impose a variety of costs on industry, and may inhibit expansion and investment, it is unlikely that significant job losses occur as a direct result of environmental policy. Even in traditional industries environmental legislation may influence the timing of plant closures, but it is unlikely to be the crucial factor that determines economic viability. And, against these often all too visible costs to the economy of environmental policy, there are many intangible benefits in terms of healthier environment, of purer air and water, of wildlife conservation, protected landscapes and well-preserved architectural heritage. Further, in the area of employment, services and administration specifically linked to environmental protections and in other industries 'down stream', have created many jobs (OECD, 1987).

5.3 CONCLUSION

Although the discussion regarding macroeconomic impact of environmental regulations has been brief, the following conclusions can be drawn:

1. Models are available to analyse the impacts of environmental control on the major macroeconomic variable. However these models are complex and suffer from serious limitations.
2. All of the studies mentioned above, find a distinct relationship between environmental regulations and productivity, employment and inflation.
3. The U.S. studies have show that in relation to GNP the adverse effects of environmental regulation on the inflation rate and the growth rate of productivity have been no more than 0.3 percentage points. Adverse employment effects have also been small, and it has been shown that the policy has acted so as to increase employment.
4. Most available work suggests that total benefits have exceeded total costs.
5. Much more analysis and refinement to procedures is needed before absolute statement can be made about the exact magnitude of these impacts.
6. These studies offer us the best information available to-date and it would be a mistake not to heed their message simply because the studies fail a test of perfection (Christainsen and Tietenberg, 1985).

As a final note, these findings should not induce complacency. Much of the macroeconomic analysis has dealt with measurable and known environmental problems. The accumulation of hazardous elements in the environment as a result of both the not (yet) regulated production of waste and the residual waste left after treatment, are still major problems that need to be dealt with. The economic effects of the longer-term environmental problems that are connected with the production of waste, e.g. dying forests and erosion, the 'geen-house' effect, the destruction of the ozone layer and the exhaustion of scarce resources, can only be the subject of speculation. Lasting economic growth really seems to be at stake here (van Driel and Krozer, 1988).

CHAPTER VI

6.0 SELF-SUSTAINING ENVIRONMENTAL FINANCING

Following the considerable growth in government expenditure during the last two decades, strong pressures have emerged to stabilise or reduce Government's share of total environmental expenditure. This has led to the introduction of much tighter evaluation of measures (cost-benefit analysis and cost-effectiveness analysis) and the introduction of economic instruments. These developments are an expression of the now widely held philosophy that "the cost of preventing and eliminating nuisances must in principle be borne by the polluter" (The European Community, 1987). This is also clearly reflected in the Comprehensive Environmental Response, Compensation and Liability Act of 1980 in the USA (Yang et al., 1984)

This principle brings with it several problems when implemented in practice. In the first place a distinction is often made between existing firms (polluters) and new firms, i.e. how does one deal with the exigencies of the past? Secondly, there are transition costs, the effect of which may significantly affect the existing income distribution. Or as Baumol and Oates (1979) state, "There is real doubt about the justification of any measure that is designed to improve the quality of life, but whose burdens fall preponderantly on the poor." (Baumol and Oates, p.188) Recognition of these effects requires that explicit provisions are incorporated in environmental programmes to distribute their costs (and, if possible their benefits) fairly.

But notwithstanding the above, it is true in many market/mixed economies that, wherever polluters can be clearly identified, more and more consideration is given (or programmes actually implemented) to put in place fees, and other market instruments to place the financial burden on the polluter. Even in the area of non-point pollution, the implementation of cross compliance also places a much greater pressure on the agricultural sector to clean up their act (even though subsidies are still available and hence Government does share the burden).

Much of the discussion above has already dealt with this topic of self-financing regulation. It became evident when discussing effluent charges, that many of these scheme were intended to be self-financing. The Dutch scheme discussed in detail was in its original intend such a scheme, but has now turned into an effluent charge scheme, but still being self-financing.

When implementing pollution permits, a decision needs to be made if they are to be given away, or auctioned off. Auctioning might prove to be a powerful money raiser for the EPA and state environmental agencies. As Blinder (1988) explains, in the U.S. under the current legal system, pollution taxes would probably be levied and collected by the IRS and state tax departments. Congress and state legislatures might or might not earmark some of the funds for monitoring emissions and enforcing environmental regulations. Auctions of pollution rights, on the other hand, would probably be run by EPA and state environmental agencies, just as the Interior Department now auctions off oil leases. According to one educated guess, such auctions might bring in a minimum of $6 - $10 billion per year. If Congress let EPA keep even a fraction of this amount, the EPA's operating budget - which is now $1.3 billion - would be doubled or tripled, leading to far more rigorous monitoring and enforcement that has been experienced till now - and therefore to a cleaner environment.

In summary, it is justified to say that when environmental concerns where minor, in many countries the cost of control and other environmental expenditures where paid from general revenues. With the increasing burden of those costs in national budgets, and with the increasing concern about the provision and control of environmental goods and services, part of this payment burden has been transferred to the private sectors. Where it was obvious that the environmental goods and services had clear public good characteristics, Governments often established authorities or departments that dealt with those issues, and in this way made the payments for them clearly transparent in the national budget. But also in the provision of public goods, more and more emphasis is being placed on identifying the polluter and the beneficiaries and to implement the polluter-pays and user-pays principle through means of market and economic instruments.

> Or, as the Economist wrote "Finance ministers have generally stood aside. They have come to regard greenery mainly as another begging bowl - an excuse for more government spending. This is a mistake. Handled skilfully, the environment could be a way to cut public spending and to generate a whole new source of revenue.
>
> ....In the past, environment ministers tended to argue that such taxes [pollution taxes] would be publicly acceptable only if their revenue was earmarked to reduce pollution. Finance ministers, taking advantage of the green mood, should now be bolder. They can offer people a choice between taxing, say, children's clothes versus non-returnable drink cans, or all company profits versus hazardous waste. Put that way, the choice is obvious. It is not often that finance ministers have a chance to combine revenue-raising with improving the quality of life they should seize it." (The Economist, 1989b, also see the Economist, 1990)

CHAPTER VII

7.0 CONCLUSION

The aim of environmental control is to clean up the environment and prevent any further deterioration. In this paper a variety of instruments has been discussed that can be used for environmental planning and management. The instruments discussed can be placed in three groups: regulations; pricing policies; and tradable permits. For each of the groups of instruments, principles and applications have been discussed.

Regulations (or direct controls) are the oldest and simplest way to control environmental damages, and are the most widely used instrument. However, as was discussed, command-and-control policies treat all polluter as if they were the same, even though some firms may find it more costly than others to obey the regulations. Further regulatory measures often are technology based, and to minimise risk firms will put into place the technology specified, even though better alternatives are available. The cost of regulatory programmes has escalated and it is increasingly unlikely that the environment can be improved by simply spending more money on programmes and policies already in place.

To ensure that investments in environmental protection is cost effective more attention has recently been focused on harnessing market forces to spur both technological advance and sustainable management of natural resources. Where mechanism can be developed to make environmental goals part of economic decisions, the strong forces of the market place can work to reduce the costs of compliance and enlist the innovative capacity of entrepreneurs.

Economic-incentive systems provide various ways to achieve greater efficiency in control. These systems have been discussed in this paper, they are the various forms of pollution charges, deposit-refund systems, other pricing policies (including removal of unwarranted price and input subsidies), and tradable permits for industrial pollutants. These systems or instruments promise environmental improvement at a lower cost. It is this promise of greater efficiency, of compensation and self-funding, of encouraging pollutions prevention and of providing continuous incentives to firms to introduce non-polluting technology that has kindled the renewed interest in these instruments.

The economists' approach to environmental protection through market instruments is no panacea. It is fully recognised that there are circumstances under which market based solutions are inappropriate and quantitative standards are better. These are situations where there is danger to health (and an outright ban is required); where there are sudden health emergencies; and where there is no adequate monitoring device (soil erosion, pesticides) etc. However, at the same time, regulations have too often in the past been promulgated by government, industry or environmental groups without a thorough analysis of alternatives. Reasons for this are (Blinder, 1988):

1. bureaucratic inertia, a built in tendency to preserve the status quo;
2. a preference by industry for the apparent straitjacket of direct control (over the freedom of effluent charges), because they know how to escape the first one through their power on decision makers, and their ability to win legal cases;
3. opposition by environmental groups who see charges, and tradable permits as pollution rights. They see this as immoral because it has taken the pollution problem out of the realm of rights (in which polluters can be punished) into the realm of markets.

The tenor of this paper has been that evidence from around the world suggests that decision makers concerned about environmental control, its effectiveness and cost, should more carefully consider market instruments, not just on their own but in combination with the more conventionally regulatory processes such as standards. Examples in this paper have shown that the most effective anti-pollution programme probably is one that has both rules and charges. The money raised by the charges can be used to help pay for enforcing the rules. This latter has great appeal in times of budget constraints. It also implements the 'polluter-pays' principle rather than to pay lip service to it. The Dutch water quality programme discussed, showed how a basically non-market oriented programme can be turned into a market oriented one with all the characteristics of being regulatory, being efficient and providing incentives.

Blinder (1988) suggest that many direct control programmes could be transformed into market oriented programmes, by going through a transition phase. During this phase, tax exemptions would allow firms to emit a certain volume of pollutants free of charge. That way, firms would not be penalised financially for the efficiency gains reaped by society. Over time these tax exemptions can be adjusted to turn the programme into a fully operational effluent charge programme.

Irrespective of the policies chosen, all of them require an investment in monitoring and enforcement. Market instruments do not work very effectively in cases where the sources of pollution are not readily identifiable, such as e.g. seepage into groundwater. But also direct regulation will fail if monitoring and enforcement are not present.

Direct control and market tools are only two of many approaches for environmental planning and management. As discussed in this paper, emphasis should really shift to preventative rather than curative measures. Both set of instruments should be analysed in terms of the incentives they provide for prevention and other approaches should be considered. There is evidence that moral suasion and direct negotiation with firms can be effective, simply because firms are coming to realise that it is in their own interest to think through the effects they have on the environment and the image they create. Especially in countries like West Germany, a lot of use is made of negotiations between the government and firms to come to some kind of agreement regarding some environmental problem ('Branchenvertragen') (Vos and Opschoor, 1988).

Of particular concern also is how these instruments could be used in **developing countries,** as most of the discussion and the examples have been from the developed world. In brief, the first step should be to understand the problem at hand, just as what has been done in the developed nations. It is essential to analyse the seriousness of the problem and to determine the cost of not doing anything. Or as stated in a report on the drylands dillemma, "The economic methods and techniques, available to measure or predict the costs of dryland degradation, have been little used. As a result, dryland have been given low priority in national development plans and funding allocations by national treasuries and international agencies (Drylands, 1987). Some of these techniques are described in companion paper (Meister, 1990).

Secondly, instruments to achieve goals based on the data and information gathered should be chosen in light of the current institutions, funds, manpower and effectiveness and incidence of benefits and costs. When dealing with point-source pollutants that can be monitored (and monitoring is not too expensive) market instruments (combined with regulations) should feature highly in control. On the other hand when monitoring is not feasible as with many non-point pollution situations, market instruments may not be very useful. There may be options here for using input taxes or subsidies to influence behaviour, but this will depend on the country's development of market economies and public administrative systems. In many less developed countries the scope for this is likely to be limited. Tax collection facilities may be deficient, people may resist paying them and incomes are typically low. Direct assistance schemes, involving the provision for goods and services to land users, may take the form of fertilisers, equipment, seed and construction services.

As stated above. much of the discussion in this paper has been in light of the experience in developing countries. This is not an apology, but a fact. At the same time however much can be learned from the experience of the developed countries. Not that the tools can be copied directly. The applications are all situation specific. Therefore charge rates, permit prices, regulation guidelines, will differ from place to place. However the concepts will not. It has been the purpose of this paper to demonstrate the concepts, and to look for strengths and weaknesses.

In conclusion, the choice of instruments or combinations of instruments to use will depend very much on the objectives to be achieved, the particular problem situation, the costs associated with monitoring, and many other considerations. It is not possible to have a blanket recommendation as to what approach to take. This paper discussed the pros and cons of several of the techniques, it gave examples and hopefully in this way has shown what can or cannot be achieved in particular situations. Further the paper discussed research findings that showed that environmental control does not need to break economic growth.

Studies, mainly from America and Europe, have shown that the effect on growth has been small.

If there was one theme in that paper that needs to be emphasised, then it was that decision makers should not refuse to consider the possibility of more clean-up for less money something that market based instruments can offer in certain situations. As Blinder (1988) says, that is an offer society should not refuse.

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