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Promoting Sustainable Production and Consumption:

Five Policy Studies

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Abstract

Policy development for promoting sustainable production and consumption has focused in recent years on economic instruments, such as environmental taxes and emission trading systems, often integrated into regulatory regimes. Regulations can ensure that policy objectives are met, while economic incentives can reduce the costs of meeting objectives, generate revenues to facilitate cleaner production and social development, and build political support for the policies. The policy studies include:

- Acid rain reduction (United States);
- Leaded gasoline phase-out (Slovakia, United States);
- Palm oil effluent reduction (Malaysia);
- Tradable carbon offset instruments (Costa Rica);
- Tradable water rights (Chile).

Introduction

This paper presents an analytical review of five policies that have been designed and implemented by a number of Governments to protect the environment while promoting long-term sustainable development. The case studies included are:

1. Emissions trading of SO_2 (acid rain) in the United States;
2. Leaded gasoline phase out in Slovakia and the United States;
3. Palm oil effluent reduction in Malaysia;
4. Tradable carbon offset instruments in Costa Rica;
5. Tradable water rights in Chile.

These policies are examples of the new approach for promoting sustainable development, combining economic and regulatory elements in order to protect human health and the viability of essential ecosystems, while conserving resources and promoting economic and social development. All of these policies have been in effect for many years, allowing an evaluation of their effectiveness. The purpose of reviewing these case studies is to enable other countries and international organizations to learn from the experience of countries that pioneered this new approach.

The analysis examines the regulatory requirements and mechanisms and the economic incentives in each case and the contributions they appear to have made to the effectiveness of the policy. The primary focus of the analysis is whether progress was made in achieving the intended environmental or resource management objectives of the policy at acceptable cost. Where possible, other economic, social, political and administrative issues relating to the policies are also considered to assess their overall impact.

Analyses of policy instruments often divide the instruments into regulatory, economic and perhaps other types of instruments. In theory, regulatory approaches have the advantage of ensuring a desired outcome when vigorously enforced, while economic incentives can achieve progress at minimum cost. In practice, economic instruments are often part of a regulatory framework, rather than separate policies. The analyses here will focus on the integration of economic incentives into regulatory frameworks to achieve the advantages of both.

These policies, designed and implemented some years ago, are assessed in retrospect with the knowledge and experience that we have today. The assessment should therefore not be seen as a critique of policy making in the past under different circumstances, but as an attempt to identify effective new approaches for guidance in future policy making.

These case studies are intended as part of a continuing effort to build a collection of analyses of various types of policy instruments for sustainable development. The collection is intended for use by national policy makers and international organizations concerned with sustainable development. The Division for Sustainable Development welcomes comments on these case studies and information that could contribute to future work in this area.

Policy instruments for sustainable development

The case studies illustrate examples of the use of emission taxes, emission quotas, tradable emission allowances, tradable resource rights, and performance standards. Each of these instruments has characteristic effects, although the extent of those effects and the presence of other effects will vary according to the circumstances.

Emissions taxes or charges

Taxes on emissions are economic instruments that raise the costs of production. Depending on market conditions and the availability of alternative products, this may raise the price of the products and reduce demand. Taxes may also induce producers to invest in emission reduction technology if resulting reduction in taxes is greater than the cost of the technology. If the reduction in production and employment resulting from the tax is seen by the Government as undesirable, the revenues generated by the tax could be "recycled" back to the producers to compensate them for investments in emission reduction, improve profitability and growth in other production lines, or otherwise maintain profitability and employment while reducing emissions. Alternatively, the tax revenues could be used to reduce general production taxes, such as payroll taxes, encouraging increased employment in other areas to offset losses in emission-intensive production. Another possibility is for the State to use tax revenues to fund environmental clean-up, generating business and employment in that sector. In theory, environmental taxes can promote emissions reductions at minimum total cost to society, with the distribution of costs depending on the use of the tax revenues.

Emission quotas

Emission quotas are regulatory instruments that set limits on specified emissions from production facilities. If the limits are below actual emission levels, producers must either reduce production or install cleaner production systems, thus increasing production costs. Emission quotas differ from emissions taxes in that they require specified reductions but provide no incentives for further reductions, and they generally do not generate tax revenues and thus do not allow revenue recycling. Quotas tend to be effective at achieving specific environmental targets, although the overall costs to producers and consumers may be higher than with taxes. On the other hand, quotas, by requiring reductions, are probably more effective at promoting the development and use of cleaner technologies. Quotas often involve fines for exceeding the quotas, which may generate some revenues.

Most commonly, quotas are allocated without cost on the basis of existing emission patterns in order to minimize their effect on production and employment. However, they can also be auctioned or sold in order to generate revenue and provide incentives for reducing emissions further than would be required by quota allocation. The incentive effects of auctioned quotas are similar to those of emission taxes, but government revenues increase.

Tradable Emissions Quotas

An emissions quota system (a regulatory instrument) can be supplemented by a trading system (an economic instrument) that allows producers to buy and sell emissions allowances from each other. This can reduce the costs of compliance with the overall quota, and the impact on production and employment, by allowing facilities which can reduce emissions at lower cost to sell part of their quotas to facilities for which emission reduction is more expensive. A producer with a new facility, for example, may find it advantageous to make a long-term investment in a modification to reduce emissions, while a producer with an older facility may find it more attractive to pay for an increased quota for a few years before the facility reaches the end of its productive life. The new facility can sell emissions allowances and cover part of the cost of the investment, while the older facility can avoid an early shut-down. Countries where there is a strong political resistance to new or increased taxes may find that emissions trading is more politically acceptable.

Performance and technology standards

Performance standards are regulatory instruments that require firms to meet specified technical criteria in their production. The simplest form is a ban on the use or emission of particular materials, such as lead in gasoline or ozone-depleting chlorofluorocarbons (CFCs). Other examples are maximum emission levels for cars, energy efficiency standards for appliances, and insulation requirements for new buildings. Performance standards generally specify, directly or indirectly, emissions per unit of production or use rather than total emissions as in the case of quotas. They provide no incentives for over-compliance and may involve high fines for non-compliance.

In some cases, regulatory agencies may impose performance standards by specifying technologies that must be used. When production does not involve relatively standard products or processes, it may be difficult to define performance standards, but easier to identify relatively clean technologies. The agencies may require operating permits for certain types of facilities or facilities emitting certain pollutants, and grant permits only if clean technologies are used. Such technology standards give regulatory agencies flexibility in regulating emissions in accordance with local conditions and specific production processes, but give little flexibility to the producers.

CASE STUDIES

Acid rain and SO_2 policies in the United States

Introduction

Acid rain is one of the major environmental problems in the United States, causing damage to humans, nature and buildings. Acid rain contributes to the elimination of certain fish species from acidic lakes and streams, forest degradation, lung disorders and related diseases in humans, and corrosion of metals and deterioration of buildings and monuments. A large number of lakes in the United States suffer from chronic acidity, primarily due to acid rain.

Emission sources in the United States also contribute to acidic deposition in Canada, with an estimated 14,000 lakes in Canada suffering from acid rain contamination. It was in part due to Canadian objections to transboundary pollution, as well as protests from environmental pressure groups and northeastern states, that acid rain became a serious political issue, resulting in the Clean Air Act Amendments of 1977. Through the 1980s acid rain remained an issue, and in November 1990 further Clean Air Act Amendments were passed.[2,3,7]

Sulfur dioxide (SO_2), released when fossil fuels containing sulfur are burned, is the main cause of acid rain. Electric utility power generating plants in the United States emit about 20 million tons of SO_2 each year, accounting for about 70 per cent of such emissions. Those plants are therefore the primary targets of the Clean Air Act Amendments.[3]

Title IV of the Clean Air Act Amendments of 1990 established the Acid Rain Program. The Program calls for SO_2 emissions to be reduced to about half of 1980 emission levels, a reduction of about 10 million tons. That action should substantially reduce the environmental damage caused by acid rain.

The 1990 Clean Air Act Amendments introduced emission quotas for fossil-fuel power generating plants, together with a market-based emissions trading system. This is the largest emissions trading system yet established and has served as a model for proposed trading systems in the United States and other countries for nitrogen oxides (NO_2) and greenhouse gases.

Each power plant is allotted each year a certain amount of allowances based primarily on its past fuel usage, with each allowance entitling a plant to emit one ton of SO_2. The system allows the plants to trade emission allowances with each other or with third parties. Each plant is required to install a SO_2 emissions monitoring device to measure and record emissions. At the end of each year, each plant must have enough allowances to cover its emissions. If a plant's emissions exceed its allowances, it pays a penalty of $2,000 per ton of excess emissions, and each excess ton must be offset by allowances the following year.

The United States Environmental Protection Agency (EPA) operates an allowance tracking system to monitor the allowance accounts of each plant and to track trading. Allowances that are not used can be “banked” for future use.

The programme has two phases. Phase I took effect in 1995 and requires the 263 “dirtiest” power-generating units in the United States to reduce total SO_2 emissions to about 5.7 million tons per year over the period 1995-1999, a reduction of 5 million tons below 1980 emission levels. Phase II of the programme, beginning in 2000, will require further reductions for those plants and will extend coverage to all large fossil-fuel generating plants and all new plants. The total amount of allowances for all plants will be 9 million tons annually, less than half of the 1980 emission levels.[1,3,7,8]

In order to ensure the development of a market, the EPA, since 1993, has auctioned 2.8 per cent of the total allowances each year, with the revenue recycled back to the utilities in proportion to their alloted allowances. Private parties are also permitted to sell allowances through the EPA auctions.

Analysis

The United States Government Accounting Office has estimated that the SO_2 allowance trading system has reduced the cost of reducing SO_2 by 40 per cent compared with regulations alone.[1]

Before the 1990 Clean Air Act Amendments were passed, abatement costs for SO_2 were estimated at about $1,500 per ton. In 1990, the EPA estimated the cost to be around $750 per ton. The first allowances were traded in 1992, but substantial numbers were not traded until 1995, when allowance prices in bilateral trades fell to $170 per ton, and further to $100 per ton by the end of the year.

The allowances sold in EPA auctions in 1995 ranged between $122 and $140 per ton. In 1998, allowances have traded for as low as $60 at the EPA auctions.[1,5,6]

The major factors in reducing the costs of SO_2 abatement have been the fall in the prices of SO_2 flue-gas scrubbers and low-sulfur coal, the two main ways to reduce SO_2 emissions. The price of low-sulfur coal fell from $40 per ton in the 1980s to $25 in 1995, and scrubber prices had a similar decline.[1] The decline in coal prices to utilities was also due to a fall in rail transportation costs, which normally constitute about 50 per cent of the cost of low-sulfur coal to utilities. At the end of the 1980s, the prices for rail transportation fell more than 75 per cent, extending the number of power plants that could afford to purchase low-sulfur coal. Population shifts to the western United States also promoted the use of low-sulfur coal. About 55 per cent of the overall SO_2 reduction was due to fuel switching from high to low-sulfur coals.[1,7]

Another reason for the surplus of allowances is the fact that 182 "cleaner" power plants volunteered to join the programme in phase I. These units were given allowances based on their previous emissions, but through a shift to low-sulfur coal, they were able to reduce emissions 20 to 30 per cent at low cost.[7]

Finally, reductions with respect to 1980 levels were also stimulated by the Clean Air Act Amendments of 1977, which imposed an SO_2 reduction standard of 90 per cent on high-sulfur coal and 70 per cent on low-sulfur coal. Thus, even before the Clean Air Act Amendments of 1990 took effect, there were regulations that required the plants to reduce SO_2 emissions below 1980 levels. Those reductions were achieved primarily through the use of scrubbers.[1,7]

Most power generating plants in the United States have had little difficulty in meeting their quotas. In 1996, many units reduced emissions well below their allowance allocations, allowing them to transfer their allowances to other plants of the same company, sell them or bank them. In 1995 and 1996, total emissions were 39 per cent and 33 per cent respectively below the total allowances issued or auctioned those years, and 6.2 million allowances were banked for future use.[7] That high volume of banking presumably reflects an expectation that allowances will become more valuable when quotas are further reduced in 2000. The banking provision thus make emissions reduction a profitable financial investment.

The EPA auctions that were set up to ensure at least a small market have become unimportant. Up to March 1993, 150,000 allowances were sold at auction, with a similar amount traded on the private market. Auctioned amounts increased to 300,000 allowances in 1996, while trading increased to over 5 million allowances. By March 1997, a total of almost 13 million allowances had been traded since the passing of the 1990 Amendments, out of a total of about 40 million allowances issues between 1990 and 1997.[6]

Only a small number of plants had to buy allowances to cover emissions not covered by their quotas. The trading system thus provided relief for the few plants for which both low-sulfur coal and investments in scrubbers were uneconomic, thereby preserving economic activity and employment in plants which might have shut down under a simple quota or performance standard system.

The provision for banking allowances has stimulated early compliance with SO_2 reduction targets. The banked allowances will presumably be used to allow late compliance with future, more demanding and more costly, reductions. The effect therefore is to transform a gradual reduction in SO_2 emission targets and quotas into a steeper initial reduction, followed by a slower subsequent reduction. The result will be SO_2 emissions above the target level for a period in the future when the banked allowances are used. Since SO_2 has a short atmospheric lifetime before precipitating as acid rain, the same effects hold for the incidence of acid rain. If the health and environmental effects of acid rain increase disproportionately with the acid rain intensity, which seems likely due to some acid buffering capacity of natural systems, then early reduction followed by slower additional reductions should have a net beneficial effect.

Analyses of the programme including a political perspective suggest that the allowance trading and banking system played an important role in promoting industry acceptance of ambitious targets for SO_2 reductions. In providing a mechanism by which early compliers could cover some, or perhaps all, of their emission abatement costs by selling allowances, while building a reputation as environmentally responsible enterprises, the programme acquired supporters within the target sector. This political support for the programme from industry may have been the greatest environmental benefit of the market component of the programme. It would appear that the political acceptability of market trading systems and the political opposition to taxes, in some countries at least, is due more to political and cultural attitudes than to economic impacts.

It should be noted that the success of the programme was due in part to events independent of the programme. The decline in cost of low-sulfur coal and rail transportation, due to rail deregulation, was independent of the SO_2 reduction programme but contributed substantially to the early achievement of the target. The reduction in the cost of scrubbers may have been due in part to the increased demand resulting from SO_2 reduction requirements, but was also in part due to technological developments.

The success of the programme is in part due to the lack of restrictions on trading. Any plant in the country could trade with any other plant regardless of local conditions and without regulatory approval, thus facilitating development of a substantial market in allowances. This could have resulted in concentrations of SO_2 emissions, air pollution and acid rain in some critical areas due to under-compliance through purchase of allowances, together with very clean air through over-compliance in other areas. Fortunately, this did not happen. An unrestricted national system of emissions trading might not be effective, however, in dealing with emissions that have more local impacts and where trading might lead to concentrations of emissions.

In substantial part due to the success of the United States SO_2 programme, tradable emissions systems have become quite popular and are seen as a key to successful reductions in greenhouse gas emissions to meet commitments under the Kyoto Protocol. Article 17 of the Protocol provides for an international emissions trading system, with details to be elaborated in subsequent meetings of the Conference of Parties. A number of developed countries are currently developing national greenhouse gas emissions trading systems as a central component of strategies for meeting their Kyoto commitments. Because the impacts of greenhouse gases are global rather than local, international emissions trading is quite suitable.

Leaded gasoline phase-out in Slovakia and the United States

Introduction

Since the 1920s, lead has been used in gasoline as an octane enhancer and engine lubricant. Lead is, however, a highly toxic heavy metal that has a negative effect on human and animal health. It affects many organ systems in the body including the nervous system, the blood forming system, the kidneys and the reproductive system. Lead exposure can cause reduced mental development, reading and learning difficulties, hyperactivity, and adverse effects on kidney functions. Lead exposure is therefore regarded as a serious health problem for the general population and especially for children.[3,5]

Lead and lead compounds are absorbed by the human body either through inhalation into the lungs or through ingestion of lead-contaminated soil and dust. The largest source of human exposure to lead is airborne lead from the exhaust of motor vehicles using leaded gasoline, accounting for up to 90 per cent of airborne lead pollution. Research has shown a direct correlation between lead in gasoline and lead in the blood. Other sources of airborne lead are industrial processes such as metal smelting or battery manufacturing and combustion sources such as coal-powered generating plants.

Since the 1970s, substitutes for lead in gasoline have been available. The octane level of gasoline can be raised through refining processes, and engines now generally do not need lead for lubrication. While unleaded gasoline was more expensive to refine than leaded gasoline through the 1980s, it can now be refined at about the same cost as leaded gasoline of equivalent performance. Now, the most important obstacle to unleaded gasoline is the cost of modifying the refining process in existing refineries. Cost-benefit analyses show that the health costs resulting from the use of leaded gasoline are much greater than the costs of shifting to unleaded gasoline. Some studies have concluded that elimination of lead from gasoline can result in reductions in health care spending up to six times the cost of the transition. Furthermore, catalytic converters to reduce other pollutants from motor vehicles require unleaded gasoline, as lead destroys the effectiveness of the catalysts.

A transition from leaded to unleaded gasoline requires adaptation of the refineries, which can be costly if the technology standard of the refinery is low. Gasoline pumps and tanks that have been used for leaded gasoline need to be thoroughly cleaned for use with unleaded gasoline. Furthermore, the public should be informed of the benefits of switching as resistance to the shift by drivers due to concerns about the effect of unleaded gasoline on the performance of the car may slow the transition. Drivers in some countries, for example, have resisted a switch in the belief that a car must have a catalytic converter in order to use unleaded gasoline.[1,3,5]

Slovakia

Slovakia faced these problems in the beginning of the 1990s, stimulated in part by the need to harmonize regulations with the European Union as part of its application for membership.[5] Slovakia's single refinery was not geared for refining unleaded gasoline, which meant that unleaded fuel had to be imported, and attachment to the familiar leaded fuel on the part of the public was an additional hindrance to the transition.[3]

The government began to address the lead problem in 1990 by reducing taxes on unleaded gasoline, but only sufficiently to offset the higher costs of refining unleaded fuel, thus equalizing the prices of leaded and unleaded gasoline. In 1993, the government required all imported cars to have catalytic converters, which required the use of unleaded gasoline, and further reduced taxes on unleaded gasoline, making it cheaper than leaded gasoline. Furthermore the road tax was reduced on cars with converters. However, the turnover of cars was so low, that by 1995, only 4 per cent of cars had catalytic converters, and drivers of cars without catalytic converters were reluctant to shift to a new type of fuel.

In 1995, the government banned all sale of leaded gasoline. This required a reconstruction of Slovakia's single refinery to produce only unleaded gasoline. Since the refinery, which is now privately owned, is a modern facility, it could be adapted relatively easily, particularly since conversion for production of unleaded gasoline had started in 1993. Gasoline stations, which are mostly privately owned, adapted quickly to the change without problems, as did drivers.[3,5]

The elimination of unleaded gasoline resulted in a large decline in airborne lead, and eventually resulted in a general improvement in the health of the public, especially of young children and urban residents.

Slovakia's modest attempts to address the problem of leaded gasoline through fuel pricing and requirements and incentives for cars with catalytic converters were not enough to change the consumption patterns of Slovakian motorists, particularly in light of the lack of public understanding of the implications of switching. A simple ban on leaded gasoline solved the problem within a year at very modest cost and with substantial health benefits. As Slovakia has only one refinery, implementation of the ban was simple, and the cost of reconstruction did not pose problems with respect to competitiveness.

United States

In the United States, the Environmental Protection Agency (EPA) established a schedule phasing out leaded gasoline over a five year period from 1983 to 1987. Refineries that could convert to production of unleaded gasoline quickly could sell lead credits to other refineries, allowing them to produce leaded gasoline above the target level. This resulted in economic benefits for those who could adapt their refining process quickly and relatively inexpensively, while easing requirements on refineries that did not have the resources or capability to meet the standards immediately.[2,4]

The technology for producing unleaded gasoline was generally adopted first by the larger refineries, which then sold lead credits, while the smaller refineries bought lead-credits and adapted more gradually. In the transition period, there was active trading of credits, indicating that many refineries had difficulties adapting quickly to the phase-out. Had the policies been based merely on performance regulations, a number of companies would probably have been shut down with negative socio-economic consequences for the regions in which they were based. The EPA managed to accomplish its goals while still providing flexibility to the refineries within the five-year phase-out.

Palm oil effluent reduction in Malaysia

Introduction

Production of crude palm oil is one of Malaysia's main industries, accounting for half of world production in

1980. The industry started in 1960, tripled its output between 1975 and 1985, and has been a major force in the rapid growth of the Malaysian economy.

Palm oil production requires a large amount of water; hence most palm oil mills are located close to water sources. Production of one ton of palm oil generates 2.5 tons of palm oil mill effluent (POME), a mixture of organic wastes from the separation, clarification and sterilization processes. Most of the effluent was discharged untreated into Malaysian rivers, and in 1975, the biological oxygen demand (BOD) from the effluent reached levels equivalent to a population of 10 million people. The effluent contaminated drinking water, depleted dissolved oxygen in the rivers, suffocating fish and prawns, and polluted mangroves that serve as vital spawning and feeding grounds for marine species.[2,5].

The reduction in food supply had a devastating effect on the health and livelihoods of fishermen and villagers in the affected areas, resulting in increased malnutrition and poverty. The water in the rivers became too contaminated for human consumption, and the villagers had to either dig wells or, in some cases, resettle in new locations. The pollution severely reduced the income of many rural poor in Malaysia.

Since 1969, the Malaysian government had been pursuing the New Economic Policy aimed at reducing poverty and income disparities. Increased poverty due to palm oil effluent pollution was a threat to this programme. Foreseeing the environmental and social problems, the Malaysian government addressed the problem through the 1974 Environmental Quality Act.[1,2,5]

A Department of the Environment (DOE) was established within the Ministry of Science, Technology and the Environment, with regulation and licensing of palm oil mills as a main responsibility. A license fee for palm oil mills was established with two parts, a basic operating fee which every mill had to pay, and a second fee which varied according to class of mill, location, quantity of waste generated and pollutants discharged, and ambient levels of pollution. The variable license fee was effectively a tax on pollution; the more the mills discharged, the more they paid, thus providing an incentive for reducing pollution. The first treatment system was developed in 1977. DOE formed an expert committee assigned to investigate treatment technologies that were economically and technically feasible.

In 1978, the license fees were supplemented with performance standards for eight parameters of palm oil effluent. The regulations required palm oil mills to apply for an operating license every year, and report on the discharge of effluent every three months. The DOE could reject a mill’s license application if it disapproved of the proposed discharge treatment system. The DOE made the standards increasingly stringent each year over a period of four years, with stricter standards planned for the future. As a consequence, the palm oil industry actively began to explore alternative disposal treatment systems.[1,4,5]

Realizing that some of the mills would have difficulties in meeting the standards and would need time to construct treatment facilities, and not wanting to shut down the mills, the DOE also introduced in 1978 an excess license fee that the mills could pay if they could not meet the standards. Furthermore, production plants that invested in research and development in effluent disposal treatment were given a waiver of effluent-related license fees. Both waiver and effluent related fees created an economic incentive for research in effluent disposal technology.

After a year, the DOE did not find the results entirely satisfactory. The daily BOD discharges from the average mill were reduced from 220 to 125 tons, but there were 46 mills out of 130 that chose to pay excess fees of more than $4,600. The DOE then made the standards mandatory, with stiff fines or license cancellation for non-compliance.[5]

After the elimination of the excess fees, the average daily discharge fell to 60 tons of BOD the following year. Research showed that 90 per cent of the mills complied with the fourth generation standards (1982), through innovation in disposal treatment systems. The positive result led the DOE to make the regulations more stringent through fifth and sixth generation standards.

The increasingly stringent standards, however, did not have the desired effect. By 1991, only three-quarters of the mills were meeting the current standards, even after the DOE relaxed the regulations by eliminating two of the eight effluent standards. Nonetheless, the pollution was far below its level at the inception of the regulations.

Analysis

Due to the competitive world market for palm oil, the palm oil producers could not increase the price of palm oil. They were, thus, forced to shift most of the costs to the oil palm growers. As a result, the growers, of whom 45 per cent were low-income smallholders, indirectly paid 84 per cent of the license fees and pollution abatement costs, leading to increased poverty.[2]

The increasing stringency of the fifth and sixth generation standards in the late 1980s require waste treatment systems that were beyond the means of an increasing number of mills. A study by a Japanese consulting firm concluded that a reduction of effluent pollution through waste treatment plants beyond the fourth generation standard would require a technology that was too costly for many production plants to implement.[5]

Furthermore, the license fees remained constant in nominal terms, and as a result of inflation declined by 40 per cent in real terms between 1977 and 1992, thus gradually weakening the economic incentive for pollution abatement.[3,5] The revenues from the fees were treated as general government revenues, rather than being recycled, for example to promote effluent treatment technologies, assist the small plants in meeting the new standards, or address the social problems caused by the pollution.

While many plants addressed the problem through a conventional effluent treatment approach, some plants were able to convert the effluent profitably into marketable material. In 1977, a Danish company, aware of the new regulations, entered the Malaysian market with a technology that could convert palm oil effluent into animal feed or fertilizer. Some mills with tank digesters were producing methane from effluent.[4] This new income generating technology may have provided the main economic incentive for some palm oil mills to reduce effluent pollution. By 1984, four mills had eliminated effluent discharge and found profitable use for all their effluent.[5] It appears, however, that the Department of the Environment, in its efforts to assist the mills in pollution reduction, focused on conventional effluent treatment technologies to reduce BOD of the discharge, rather than identifying and promoting productive uses of the waste. Most plants invested in conventional treatment systems.

Conclusion

A range of factors ultimately contributed to the reduction of palm oil related pollution in Malaysia. The license fees, as economic incentives, reduced pollution to some extent, until it became more economical for the palm oil producers to pay the excess fees. Increasingly stringent mandatory standards then required the mills to further reduce pollution over a period of nearly ten years, but an increasing number of mills failed to comply with the more stringent standards and the government was reluctant to shut down the plants, which provided livelihoods to smallholder farmers. The potential for converting waste into marketable material has not yet been fully exploited, perhaps due to lack of investment capital, particularly for the small plants.

Internationally tradable carbon offset instruments in Costa Rica

Introduction

The international community has become concerned in recent years about the risks of global warming and climate change due to the accumulation of carbon dioxide (CO_2) and other greenhouse gases in the atmosphere. In 1997, with the adoption of the Kyoto Protocol to the United Nations Framework Convention on Climate Change (FCCC), the developed countries ("annex 1 countries") committed themselves to reducing their total greenhouse gas emissions to about 5 per cent below 1990 levels by the period 2008-2010. Reductions in net CO_2 emissions can be achieved through either reduction in fossil fuel consumption or increases in CO_2 absorption and storage by forests and other vegetation. The Kyoto Protocol provides that the developed countries can meet their commitments not only by domestic action, but also by promoting action in other countries, including developing countries through the Clean Development Mechanism. It is expected to be substantially more economical to reduce CO_2 emissions or increase CO_2 storage in developing countries than in developed countries.

The Kyoto "flexible mechanisms" for international cooperation in meeting greenhouse gas reduction targets are an elaboration of provisions for "joint implementation" in UNFCCC and of decision 5/CP.1 of the first Conference of the Parties (COP-1) in 1995. Further elaboration of the flexible mechanisms by the Conference of the Parties is still needed before any exchanges can occur.

Following the 1995 COP-1, Costa Rica created a carbon trading system based on carbon emission certificates.[7] In 1996 the Costa Rican Office for Joint Implementation (OCIC) was established. The OCIC designed a financial instrument (CTO) for selling greenhouse gas offsets on the international market and arranged their certification and sale through the Chicago Board of Trade. A CTO represents a specific quantity of greenhouse gas emissions equivalent to the carbon emissions reduced or sequestered. The revenues from CTO sales are used in Costa Rica for reforestation, hydropower improvements, forest conservation and related carbon reduction activities.[3,4]

In July 1996, Costa Rica sold its first CTOs to the Government of Norway at $10 per ton, for a total of $2 million. $1.7 million was financed through a Norwegian carbon tax and $300,000 from a Norwegian company. In early 1997, Costa Rica sold more CTOs to the Environmental Financial Products company, which intends to sell them to third parties.[2,3,4]

Analysis

It is not yet clear whether there is a real demand for carbon offsets of the type created by Costa Rica or whether they could be used in fulfillment of obligations under the Kyoto Protocol. The first purchase was intended by the Government of Norway to initiate the market in such instruments, but there has been little development of the market since.

The initial price of CTOs was set at $10 per ton of carbon. The United States Center for Clean Air Policy has estimated that reduction efforts in the United States might cost about $34 per ton in 2010. CTOs at the current price could therefore be a cost-effective means for the United States to meet its greenhouse gas reduction commitment.[3] In some European countries, notably the Scandinavian countries, a high level of energy efficiency has already been achieved, making it more expensive to reduce emissions further and making CTOs more economically attractive.[1]

An important aspect of tradable carbon offset instruments will be simplicity in the transaction. Investment in emission reduction projects will generally be time consuming, costly and perhaps risky for the investing companies. The CTOs are designed to provide inexpensive, fast and practically risk free transactions. Under the CTO arrangement, Costa Rica determines the amount of emissions credits to be sold and chooses the areas of the country and the economy where these emission reductions are to be achieved. The Government guarantees the buyer that the specified CO_2 reduction has taken place and will be maintained.

CTOs from a developing country, such as Costa Rica, cannot be used as part of the emissions trading system defined in article 17 of the Kyoto Protocol, which only allows trades between the developed countries with emissions quotas. They may be usable under the Clean Development Mechanism (article 12), which allows developed countries to meet commitments through greenhouse gas emission-reduction projects in developing countries.[7]

If instruments like CTOs from developing countries are recognized as certified emission reductions under the Clean Development Mechanism, they could be a low cost means for developed countries to meet greenhouse gas reduction commitments, while providing finance for sustainable development in developing countries. A large trade in such instruments could thus develop.

Substantial demand for CTOs is likely to develop only if they are accepted for meeting commitments under the Kyoto Protocol. Discussions at a Technical Workshop on Mechanisms Under Articles 6, 12 and 17 of the Kyoto Protocol, held in Bonn, Germany, 9-15 April 1999, indicate that questions relating to CTO-type instruments are under consideration but are not yet resolved.[8] Further discussion and negotiation will take place in future meetings of the Conference of the Parties and related meetings, addressing issues including criteria for project eligibility, systems for independent auditing and verification of project activities, and procedures for certification.

Tradable Water Rights in Chile

Introduction

Water is a scarce resource in large parts of Chile. The Central Valley, which is the most densely populated region, has a shortage of water in the dry summer season, making irrigation necessary for agriculture. The allocation of water resources is therefore an important issue.

In Chile, there is a long tradition of water sharing and trading, and water rights have been recognized since the 1920s, although not formalized until recently. The first Chilean Water Code, passed in 1951, allowed the state to give concessions of public water to private parties. These concessions could not be traded and had to be returned to the state if not used. With the Agrarian Reform of 1969, all waters became state property, and the state could both grant and withdraw concessions, again without trading between private parties.[1,2,5,6]

In 1981, a new Water Code was adopted with the following provisions:

- Water rights are no longer tied to land rights.
- Water rights are governed by the Civil Code law of private property and can be freely transferred, sold and bought. Conflicts are resolved through the legal system.
- The state allocates water rights without charge. If there is more than one applicant for particular water rights, the right may be sold to the highest bidder.
- Water rights are defined according to categories of water use. Holders of consumptive water rights, mostly farmers and urban water utilities, use water without any obligation to return used water to the river. Holders of non-consumptive water rights, mostly power generating dams, must return the water to the river without degradation, allowing use by other users downstream. Water rights cannot be traded between consumptive and non-consumptive users.
- Water rights may be permanent, i.e. valid under all conditions; or contingent, i.e. valid only when river flow is more than sufficient to meet all permanent rights.
- Finally, there is a distinction between continuous rights, which allow uninterrupted use of the water 24 hours a day, and discontinuous rights, which allow use of water only during specified periods.

The Chilean Government is currently preparing a reform of the 1981 Water Code. The analysis of this case study relates only to the 1981 Code.

Depending on the infrastructure for water management in each river basin and the total flow available in a particular year, water rights may be defined in volumetric terms (m^3/yr), flow terms (m^3/sec) or share of local stream flow. When river flow is insufficient to meet all permanent rights, volumetric and flow rights are reduced to share rights. For each river basin, a cap is set annually on the total consumption of water, depending on the expected flow during the dry season, providing a basic for determining share rights.

A number of institutions were created by the Water Code to implement the new regulations. The General Directorate of Water is a government agency that has the overall responsibility for water use planning. The local Water User Associations manage and monitor water distribution and collect fees for construction, maintenance and administration of distribution channels. A user must be a member of a Water User Association in order to have registered water rights. The National Irrigation Commission is in charge of evaluating and improving irrigation infrastructure, and finally the Directorate of Irrigation conducts technical and economic studies of irrigation projects.[1,5]

It is estimated that there are 300,000 holders of water rights and 4,000 Water User Associations in Chile. Most are consumptive users accounting for approximately 68 per cent of the water rights, with agriculture accounting for 89 per cent of consumptive use. Industrial, mining and urban water utility users share the rest.

To be traded, traditional water rights need to be registered. However, only about 35 to 50 per cent of traditional rights have been registered. The unregistered rights are held primarily by farmers and villagers. Those rights are generally being respected, although their legal status and security is uncertain. There is no cost for registering a water right, but one must be part of a Water User Association and pay the fees of the association, which may deter some small farmers from registering their traditional rights.

Analysis

Trading of water rights has been rather modest. Most trades have been sales by farmers who have not been using their traditional water rights to either urban water utilities for meeting increasing domestic consumption, or to farms producing high value grapes for export. Thus trades have generally occurred only when there is a major increase in the value of the water through the trade. This suggests that transaction costs are deterring many trades that could create more economic benefits.

The registration of traditional water rights, combined with the trading system, appears to have created a greater sense of security of water rights and a greater appreciation of the economic value of water. Since 1981, there has been an increase in investment in irrigation systems, including upgrading of systems to improve water efficiency. Urban water utilities have taken measures to reduce losses due to leakage from their distribution systems. As urban water utilities and wealthy users now buy rights from willing sellers, there is reduced risk of small farmers being deprived of their rights without their consent and with uncertain compensation.

Trading has depended to a large extent on water management infrastructure in each river basin. In most areas, water is distributed through fixed flow dividers in distribution channels, and redistribution of water requires the reconstruction of many flow dividers along the distribution channel concerned, with engineering supervision. While the nominal transaction costs of registering a water trade are low, the practical transaction costs can be quite high, deterring trades with low value added. For this reason, most trades have taken place in the more arid regions north of Santiago where water is scarcer and more valuable. Trades have been particularly common in the Limari river basin, where many distribution channels already had adjustable dividers and flow-meters, facilitating management of water rights by the user associations and river basin management groups.

The current water rights regime does not adequately resolve some conflicts among different groups of water users. The hydroelectric dams situated in the upper parts of Chilean river basins, as non-consumptive users, must eventually return the water they use to the river for use downstream, but there are no limitations on accumulation schedule, storage time or flow regulation. Furthermore, the dam intakes and power plant outlets are sometimes respectively above and below irrigation intakes, thus making a non-consumptive use appear to some nearby downstream users as consumptive use. Conflicts between power companies and farmers can therefore arise when water storage and use for power generation results in low flows to farmers when they need irrigation water. The regime thus implicitly gives priority to power generation over agriculture in the river basins affected.

The current water rights regime does not provide for public water rights for recreation areas or ecosystems, nor does it ensure sufficient flow to maintain water quality. Thus full use by consumptive users combined with accumulation by non-consumptive users may result in insufficient flow to scenic waterfalls, swimming areas or estuary ecosystems, or for diluting pollution from farm, industrial or domestic return flows.

Conclusion

The Chilean water rights regime appears to be an effective instrument for sustainable development, promoting more productive and efficient use of water resources. It combines a regulatory system managing overall water consumption with a market-based system providing flexibility for transferring water for more productive uses on a voluntary basis. The system is based on the traditional Chilean system of water rights, adapted to promote management of water as an economic resource for development.

Experience with the system since its establishment in 1981 suggests some areas that could be further improved. On the regulatory side, there may need to be further provision for managing seasonal use to ensure minimum flows for public use and environmental protection. This could be done partly through public purchase of water rights, might be more productively done by regulating seasonal use patterns, particularly of non-consumptive users, without overall reductions in private use rights. On the market side, efforts could be made to promote registration by small users of their traditional rights and to reduce transaction costs for water rights trading, thus promoting further water rights transfers to more productive use. This may require further public and private investment in water distribution infrastructure to facilitate changes in water distribution. Furthermore, consideration might be given to a mechanism to compensate small-holders for loss of income due to reduced flows of irrigation water resulting from hydropower operations. Efforts are now underway in Chile to amend the 1981 Water Code to address some of these problems.

General conclusions

The case studies presented in this paper provide information based on practical experience with sustainable development policies in various countries. While it is difficult to generalize over a wide range of issues in different countries, particularly on the basis of a very limited number of cases, these five case studies suggest a number of conclusions.

Sustainable development policies need to be adapted to the political, economic and social context of the society concerned. The reactions of politicians, enterprises and consumers to taxes, quotas, bans, tradable permits and other regulatory and economic instruments will vary from country to country and market to market. In some countries, taxes arouse much more political opposition than regulations with the same impact on costs and prices. The history of water rights in Chile made it relatively easy to introduce water rights trading. The existence of a single oil refinery in Slovakia facilitated a simple ban on leaded gasoline.

The case studies generally illustrate the advantages of integrating market-based elements into regulatory systems. The regulatory framework can ensure that an environmental objective is achieved, while the market component allows flexibility in distributing the burden of achieving the goal and in reducing the total cost to society.

Economic incentives alone can achieve some effect, but it may be difficult to achieve ambitious objectives with moderate economic incentives alone. Many consumers and small producers will find it easier and less risky to pay modest cost increases rather than to change their production and consumption habits. Malaysia achieved some reductions of palm oil effluent through economic incentives, but then switched to a regulatory approach to achieve further reductions. Slovakia moved to a regulatory approach to eliminate leaded gasoline after modest economic incentives had little effect.

Regulations alone may cause disruptions in economic activity and impose higher than necessary costs. Old production facilities may be shut down rather than cleaned up through major investments in cleaner production technology. Flexible economic mechanisms may allow them to be gradually upgraded or phased out, while achieving the overall objectives through early upgrading of other facilities. While such flexibility could be achieved through regulatory rather than economic means, that might raise concerns about favoured treatment and lack of transparency. In the United States, a small number of electricity generating plants and gasoline refineries continued operation through the purchase of allowances for SO_2 and leaded gasoline, while facilities that complied ahead of schedule covered some of their investment costs. Flexible mechanisms to ease the impact of regulations may be valuable even when they affect only a small number of facilities. The social, political and psychological effects of flexibility may be as important in achieving broad acceptance of strong environmental regulations as in generating economic benefits.

Meeting regulatory requirements may pose a particular burden on small enterprises, as illustrated by the small palm oil mills in Malaysia. Non-compliance leaves the regulatory agency in the undesirable position of having to either ignore violations or shut down a substantial number of small enterprises providing livelihoods for poor people. New approaches for addressing such social issues, including the use of revenues from taxes or charges to assist in upgrading facilities, and promoting the development and adoption of new technologies, may be useful in such cases. Thus, regulatory and economic incentives may need to be supplemented by active programmes to support environmentally sound technologies.

Public information efforts can also support the implementation of sustainable development policies. In Slovakia, public misconceptions of the effects of unleaded gasoline on automotive performance were an obstacle to voluntary switching in response to economic incentives. In the palm oil industry in Malaysia, small farmers' lack of knowledge of processes for converting waste to profitable uses made compliance with regulations unnecessarily expensive. In Chile, outreach efforts may be necessary to ensure that small farmers and other small water users register and protect their traditional rights and share more equitably in the benefits from sustainable water management.

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