About the Paper

Herath Gunatilake and Franklin D. De Guzman argue that the supply of ecosystem services cannot be entirely left to the public sector. Quoting some examples, they assert that market-based incentives can be aligned with the private sector's self interests that could lead to development of markets for environmental goods and services; and that market-based approaches can reduce dependency on unsustainable financing for environment management.

About the Asian Development Bank

ADB's vision is an Asia and Pacific region free of poverty. Its mission is to help its developing member countries substantially reduce poverty and improve the quality of life of their people. Despite the region's many successes, i t remains home to two thirds of the world's poor. Six hundred million people in the region live on $1 a day or less. ADB is committed to reducing poverty through inclusive economic growth, environmentally sustainable growth, and regional integration.

Based in Manila, ADB is owned by 67 members, including 48 from the region. Its main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance. In 2007, it approved $10.1 billion of loans, $673 million of grant projects, and technical assistance amounting to $243 million.

Asian Development Bank
6 ADB Avenue, Mandaluyong City
1550 Metro Manila, Philippines
www.adb.org/economics
ISSN: 1655-5252
Publication Stock No.: 091108

Printed in the Philippines

ADB

ADB Economics
Working Paper Series

Market-Based Approaches for Managing the Asian Environment: A Review

Herath Gunatilake and Franklin D. De Guzman

No. 124 | October 2008

Asian Development Bank

ADB Economics Working Paper Series No. 124

Market-Based Approaches for Managing the Asian Environment: A Review

Herath Gunatilake and Franklin D. De Guzman
October 2008

Herath Gunatilake and Franklin D. De Guzman are Senior Economist, Economic Analysis and Operations Support Division, Economics and Research Department; and Evaluation Officer, Operations and Evaluation Department, Asian Development Bank. The authors thank Juzhong Zhuang for his helpful suggestions in finalizing this paper.

Asian Development Bank

Asian Development Bank
6 ADB Avenue, Mandaluyong City
1550 Metro Manila, Philippines
www.adb.org/economics

October 2008
ISSN 1655-5252
Publication Stock No.: 091108

The ADB Economics Working Paper Series is a forum for stimulating discussion and eliciting feedback on ongoing and recently completed research and policy studies undertaken by the Asian Development Bank (ADB) staff, consultants, or resource persons. The series deals with key economic and development problems, particularly those facing the Asia and Pacific region; as well as conceptual, analytical, or methodological issues relating to project/program economic analysis, and statistical data and measurement. The series aims to enhance the knowledge on Asia's development and policy challenges; strengthen analytical rigor and quality of ADB's country partnership strategies, and its subregional and country operations; and improve the quality and availability of statistical data and development indicators for monitoring development effectiveness.

The ADB Economics Working Paper Series is a quick-disseminating, informal publication whose titles could subsequently be revised for publication as articles in professional journals or chapters in books. The series is maintained by the Economics and Research Department.

Contents

Abstract

This paper identifies inadequate effort to use market-based approaches, among others, as a reason for limited progress in arresting continuing environmental degradation in the Asia and Pacific region. Quoting examples, the paper asserts that markets can be created for ecosystem protection and provision of ecosystem services under innovative regulatory mechanisms; and that use of market-based approaches can reduce the dependency on unsustainable financing for environmental management. The paper also briefly discusses the role of governments, donors, and other stakeholders in creating the enabling policy and institutional framework for introducing market-based approaches.

I. Introduction

Rapid economic growth in the Asia and Pacific region in recent years has been accompanied by concomitant changes such as increased demographic pressure, greater intensification of agricultural production, industrialization, and urbanization. These changes have brought about further stress on the region's natural resource base that underpins development (ADB 2001 and 2005). Despite the considerable efforts of the international donor community, governments, nongovernment organizations (NGOs), civil society, and other stakeholders, environmental degradation in the region has continued, except for some scattered improvements in a few sectors. At risk are people's health and livelihoods; survival of species; and ecosystem services that are the bases for long-term economic development. Sustaining economic growth and development would be increasingly constrained if the current trends on environmental degradation remain unchecked (ADB 2001 and 2005).

Environmental degradation is not only confined in the Asia and Pacific region. It has become a global phenomenon affecting both developed and developing countries. Global warming, brought about by increases in greenhouse gas (GHG) emissions, is an alarming case, for example. The Stern Report (2006) warns that failure to invest 1% of global gross domestic product (GDP) now to reduce global warming could risk a future reduction of up to 20% in world GDP. Asia, being the host of two giant growing economies and being the most dynamic region in the world in terms of economic expansion, has a vital responsibility in solving both global and regional environmental problems.

There have been no shortages of initiatives to address environmental issues at the global, regional, national, sector, and project levels. Recent landmarks of the global community's efforts toward better environmental managements include the Millennium Declaration[1] in September 2000 and the publications of the Asia Pacific Environment Outlook 2 by the United Nations Environment Program (UNEP 2001), and the State of the Environment in the Asia Pacific 2000 by the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP 2000).[2] Aside from these global and regional initiatives, the international development agencies have supported investments in environmental programs and projects. These development agencies have provided technical assistance to mainstream environmental objectives in national development planning and policy

[1] The Millennium Declaration committed countries across the globe to meet eight Millennium Development Goals. Goal 7 aims to ensure "environmental sustainability".

[2] Other initiatives include the Ministerial Conference on Environment and Development in the Asia and the Pacific and consequent Regional Action Program for Environmentally Sound Sustainable Development; and Kitakyushu Initiative for Clean Development; and Regional Platform for Sustainable Development in the Asia Pacific in Phnom Penh.

processes; introduce good practices; and develop safeguard policies and procedures to assist developing countries. Regulatory systems have also been strengthened, including linkages with environmental institutes. However, these initiatives and efforts have shown only limited success.

There are a host of reasons and contributing factors that explain the continuing environmental degradation in the region. Weak national and local institutions, huge investment requirements for environmental programs/projects, and more pressing needs to allocate government resources for employment generation and poverty reduction at the expense of the environment, coupled with weak environmental awareness, among other things, have contributed to environmental degradation. This paper emphasizes that the lack of concerted efforts to use market-based approaches for environmental management in the region is one of the major shortcomings of previous efforts to address environmental degradation. The role of markets and associated incentives in environmental management cannot be overemphasized. The far-reaching trends in globalization and economic integration; the increasing roles of the private sector and civil society; and rapid technological advances, which are largely taking place in private/corporate sectors, have been reshaping the contemporary world. Such trends cause developmental and environmental challenges to be even more intertwined and complicated. Given these trends, environmental degradation cannot be meaningfully addressed by excluding the role of the private sector.

This paper argues that public sector alone cannot supply ecosystem services efficiently and effectively. Also, environmental management should not depend on unsustainable donation-driven financing. Citing some examples mainly from developed countries, this paper demonstrates that market-based incentives can be aligned with self interests of the private sector that could lead to development of markets for environmental goods and services. Once such markets with appropriate incentives for the private sector are developed, these could be self-sustaining and could provide correct market signals for environmental protection. The paper discusses the potentials of using market-based approaches that show a lot of promise in the Asian region. It also highlights the need to create conducive policy and institutional setup to facilitate adoption of market-based approaches to environmental management.

The rest of this paper is organized as follows: Section II discusses the role of governments and the sustainability of financing. Section III introduces the role of economic incentives in environmental protection. Section IV presents selected evidence on the cost of environmental degradation and profitability of conservation. Section V outlines selected market mechanisms and innovations. Section VI briefly discusses the role of regulatory frameworks, institutions, and donor agencies. The last section provides the concluding remarks.

II. Role of Governments in Environment Management

There is a need to revisit the long-held belief that environmental protection is solely the responsibility of the government. The world has been moving toward deregulation, private sector initiatives, and global and regional market integration in the last few decades. However, despite this trend of placing more trust on the markets to allocate resources and improve society's welfare, the government has remained as the custodian of the environment and the main supplier of ecosystem services. There are valid reasons for this deviation. Although markets are efficient in allocating resources and determining prices and quantities of consumer goods, it is widely accepted that market allocation of resources generally fails to protect the environment. When market mechanism is unable to protect the environment, this is recognized as a "market failure".[3] In many sectors of the economy, the incentives associated with private decisions can be shown to be compatible with social objectives. However, private decisions can sometimes promote environmental degradation.

Often, public goods, externalities, and the absence of well-defined property rights are market failures that lead to environmental degradation. In mainstream economic thought, most of ecosystem services are considered as public goods where benefits from environmental protection (for example, biodiversity protection or provision of clean air) can be enjoyed by all. There is no mechanism for allowing the benefits to be solely consumed by those who bear the cost of protection or provision. This nonexcludability and nonrivalry in consumption undermine the formation of markets and promote free-riding.

An externality is a consequence of a decision that falls on someone other than the decision maker. As a result, the decision maker will either tend to undervalue that consequence or ignore it completely. These can result in private decisions being biased against socially desirable outcomes. For example, exhaust from automobiles causes pollution. However, since the costs of pollution mainly fall on other people, this has not been adequately considered when purchasing types of vehicles. Other factors inadequately considered include how often the vehicle is used, as against using public transit or a carpooling system, and the number of miles in which the vehicle will be driven per year. As a result of this externality, the stock of vehicles has become too large; the average vehicle in that stock gets too few miles per gallon of gasoline; and the fleet is driven an excessive number of miles per year. All these decisions result in more pollution than would otherwise result in the absence of externalities.

The absence of well-defined property rights is another important cause of environmental degradation. For example, suppose the access to some stock of resources is unrestricted, i.e., resource-use is based on a first-come, first-served basis. As the aggregate level of use of these open access resources grows, the tendency for overuse will also increase. The so-called "tragedy of the commons" is perhaps the most familiar example of this

[3] Market failure refers to all the situations where private decisions result in outcomes that fail to maximize the value that society could get from its resources.

phenomenon. This type of outcome can be seen in some fisheries and even in the use of the atmosphere as a repository for pollution.

The market failures briefly described above provide necessary justification for a government to intervene in environmental management. However, market failures are not sufficient for government interventions because the government or public sector also fails in efficiently and effectively providing environmental goods and services. These failures are generally known as policy failures or nonmarket failures. Most of the government interventions for environmental management in the Asia and Pacific region are of "command and control" in nature. In a command and control regime, the governments set the rules, regulations, and standards and force the business and other economic agents to follow these regulations. A study concluded that environmental degradation in the Asia and Pacific region was above all a failure of policy and of institutions (ADB 1997). Population growth, poverty and affluence, the pace and path of technological advancements, and other driving forces that influence environmental change evolve within the context of international, national, and regional institutions and policies. Institutional and policy failures include lack of political will and commitment to environmental protection; limited financing for environmental improvement; continued dominance of sectoral approaches to policy making; poor compliance; and weak enforcement (ADB 2001).

Public sector interventions in environment protection and the provision of ecosystem services have not worked well in Asia and the Pacific region. Responsible agencies for the environment in the region usually do not have the political power. These are also chronically understaffed and underfunded. Enforcing environmental regulations has proven to be difficult, especially where rent-seeking practices is less expensive than compliance. This leaves us with no option other than weighing two types of failures and choosing a path that tends to fail less in provision of environmental services. Aside from these policy failure arguments, trends in financing for environmental protection show disturbing signs that need to be considered in future environmental management strategies. Although the data on overall expenditure for environmental protection is not available, expenditures on forest conservation show some generalized trends (Table 1). Based on the data, official development assistance for both sustainable forest management and protected areas management were reduced by almost 50% during the last decade. Philanthropic contributions for sustainable forest management have increased but such contributions provide only a fraction of the total requirements. An encouraging trend is that the overall community contributions, which include self-financing and in-kind contributions, have increased over time.

Table 1: Estimated Financial Flows for Forest Conservation (million US dollars)

Sources of Finance	Sustainable Forest Management (early 1990s)	Sustainable Forest Management (early 2000)	Protected Areas System (early 1990s)	Protected Areas System (early 2000)
Official development assistance	2,000–2,200	1,000–1,200	700–770	350–420
Public expenditure	na	1,600	na	598
Philanthropy	85.60	150	na	na
Communities	365–730	1,300–2,600	na	na
Private companies	na	na	na	na

na = not available.
Source: Jenkins et al. (2004).

The trends show that conservation and proper management of natural resource cannot continue to rely only on grants and donations. In the Asia and Pacific region, expenditure on environmental programs rarely exceeded 1–2% of GDP compared to defense budgets, which range from about 0.8–6% of GDP. To meet the environmental program needs of the region, expenditures of at least 7% of GDP will be required (ADB 2001). However, there is little evidence that such increases in environmental expenditures are being considered by policy makers in the region (UNDP 1999, ADB 2001).

There is a growing recognition that “command and control”-based regulatory approaches to conservation and management of natural resources is not adequate. Moreover, the question of financing has to be resolved in order to achieve measurable results. Difficulties in sustaining the financial support for conservation and management of natural resources force us to think of alternatives. Among the possible alternatives, involvement of the corporate sector, which holds a vast amount of financial resources, deserves due attention.

Open and competitive markets, both within and between nations, foster innovation and efficiency and provide opportunities for improving living conditions. But such markets should give right signals—the price of goods and services must increasingly recognize and reflect the environmental costs of their production, use, recycling, and disposal. When the polluting/degrading agent does not bear the cost, there is no incentive for such agent to correct the problem. The economic instruments are innovative mechanisms for motivating environmental protection because they allow for internalizing external costs. Businesses and individuals are then forced to treat such costs like any other expenditure. This is fundamental and could best be achieved by a menu of economic instruments that are designed to correct distortions while at the same time encouraging innovations and continuous improvements. The next section briefly discusses various types of market-based instruments that are designed to provide economic incentives for environmental protection.

III. Economic Incentives for Environmental Protection

A. Market-Based Instruments

The policy instruments for achieving environmental objectives can be divided into two broad categories: (i) "command-and-control" approaches or those that provide businesses with relatively little flexibility in achieving goals; and (ii) market-based or incentive-based mechanisms or those that provide businesses with greater flexibility to consider more effective ways of making sustained environmental progress.

Command-and-control regulations include both technology and performance standards, collectively termed environmental standards. These standards are imposed on the producers/consumers in the form of maximum allowable discharges of known pollutants into the atmosphere or waterways. This is usually done by imposing a common emission limit on all plants in a given industry; imposing firm-specific or industry sector-specific limits; or imposing on all producers a standard technology that meets the limits. Exceeding the imposed limits would be punishable by closure and steep fines (Habito 2007). However, it is argued that holding all businesses to the same uniform standard is not only prohibitive but can also be counterproductive. This is attributed to the fact that the costs of controlling emissions can vary greatly among businesses, thus rendering technology-specific regulations inappropriate and even inefficient in some situations.

The problem with this traditional command-and-control approach is that it limits the freedom of affected producers to choose their method of compliance with the standards. This tends to make compliance more expensive than it needs to be. As a punitive approach, it is not only costlier to enforce but also costlier to comply with. Furthermore, there is no incentive on the part of the producer to reduce pollution below the emission target. And where governance is weak, enforcement is likely to be selective and may result in rent-seeking activities. The traditional regulatory system, which is dependent on reporting, inspections, and fines for noncompliance, can be very expensive and burdensome to manage when applied to thousands or even millions of pollution sources.

There is also a growing recognition that in mitigating environmentally damaging human activities, management by prices is superior to management by control. In recent years, traditional command-and-control approaches have been giving way to more efficient and effective market-based approaches or economic incentives as the favored method for curtailing environmentally degrading economic activities.

Economic incentives are based on the idea that it is possible to provide businesses with the same types of incentives that they face in markets for labor, capital, and raw materials, i.e., the same motivation that forces businesses to be as efficient as possible in order to be competitive can be harnessed to protect the environment. These market-based approaches would allow the market to better reflect environmental costs and

benefits while at the same time promote environmental protection. In effect, economic incentives minimize costs by maximizing the flexibility of producers' responses.

Economic incentives encourage a given business to employ the most efficient means possible in achieving a goal instead of requiring it to use a specific technology for a particular problem. By granting businesses more flexibility, economic incentives provide impetus in searching for the appropriate technological advances that could make compliance even cheaper (Hahn and Stavins 1991). Aside from flexibility, the main advantages associated with economic incentives are encouragement of technological innovation, improved relationships between the private and public sector, substantial cost savings, and better management of nonpoint emission sources.

The use of economic incentives results not only in improved environmental performance but in substantial cost savings as well. A 1999 study for the Environmental Protection Agency (EPA) entitled "United States Experience With Economic Incentives" estimated that the potential savings from widespread use of economic incentives at the federal, state, and local levels could be almost $50 billion, or one-quarter of the approximately $200 billion per year currently being spent on environmental pollution management in the United States (Hahn and Stavins 1991). In addition to cost savings, innovative environmental strategies also stand to make firms more competitive. Another advantage to economic incentives is that they may be more effective in dealing with smaller, and often diffuse, (nonpoint) emissions sources that collectively contribute large amounts of pollution. These sources tend to be largely ignored in favor of controlling pollution from major sources. Broadly, market-based approaches include environmental taxation; quantity rationing and marketable/tradable permits; performance bonds; deposit-refund schemes; and liability rules, disclosure and certification strategies, subsidies and other incentives, voluntary and recognition programs, and permit and regulatory incentives. Appendix 1 provides a brief description of these market-based instruments.

B. Use of Some Market-Based Instruments in the Asian Context

The lack of use of economic instruments in the Asia and Pacific region is mainly due to institutional deficiencies and only rarely by technical constraints. Many agencies have been reluctant to propose more sophisticated market-based instruments such as tradable permits in the belief that these are too complex to administer. Less complex instruments such as emission charges are often structured only to achieve regulatory levels, thus failing to provide incentives for the continuous improvement that is at the core of cleaner production. Incentives such as tax and tariff waivers for implementation of cleaner production are opposed by financial agencies, which are loath to forego any source of revenue. Government policy should tackle these constraints in a systematic manner, progressing from simple to more complex policy instruments as the agencies gain greater experience (ADB 2001).

Many countries are beginning to make more use of economic instruments although often still in combination with "command-and-control" regulations. The People's Republic of China (PRC) is a typical example. Economic instruments such as pollution charges, pricing policy, favorable terms of investment for environmental technology, market creation, as well as ecological compensation fees are being introduced. In the near future, the PRC aims to incorporate natural resource and environment values into the accounting system for its national economy, and to establish a pricing system that reflects environmental cost. Mongolia, in trying to move from a top-down, "command-and-control" approach to a regime with increased public participation, is relying on traditional patterns of resource use enhanced by economic incentives and user-pay principles. Thailand has subsidized capital investment in the treatment of hazardous waste and toxic chemicals; implemented a service charge on community wastewater treatment; introduced a price differentiation between leaded and unleaded gasoline; and is considering granting community rights to conserve forests (UNEP 2000).

Also, many developing and recently industrializing economies in Asia such as Hong Kong, China; Republic of Korea (henceforth Korea); Malaysia; Singapore; Taipei,China; and Thailand have adopted regulations for new vehicles and for fuels that are not far behind those adopted in Europe and the United States (Sterner 2003). Singapore introduced road/area pricing in the early 1970s to reduce road congestion. Highly effective area licensing schemes were adopted which, by charging drivers to use the roads in the city center during peak hours, reduced congestion significantly during these times. This scheme is considered the best example of a modern area pricing system. In 1990, to control the growth of private vehicles even further, Singapore introduced a vehicle quota system in which anybody wishing to own a car had to bid for a Certificate of Entitlement (Sterner 2003, UNEP 2000). Table 2 presents a few examples of use of policy instruments.

Table 2: Use of Policy Instruments for Environmental Protection in Some Asian Countries

Type of Policy Instruments	Explanation
Air (intraboundary) fees	Air pollution fees (PRC and Taipei, China) and emissions charges above a threshold (Korea)
Water charges	Charges for discharge above specified levels (Malaysia and PRC)
User charges	Water effluent treatment charges (Thailand) and solid waste disposal (Hong Kong, China; PRC; and parts of Thailand)
Input taxes	Taxes on the sulfur content of coal (PRC)
Emission trading permits	Auctionable permits for the import and use of ozone-depleting substances (Singapore)
Performance (guarantee) bonds and noncompliance fees	Fees for cleanup of mining wastes (Australia and Malaysia) and littering along tourist trails (Nepal)
Resource pricing	Energy pricing (PRC) and auctioning of certificate of vehicle entitlement (Singapore)

Source: ADB (2001).

IV. Environmental Degradation Cost and Profitability of Conservation

There is emerging and credible evidence that environmental degradation is costly. The Stern Report estimates that climate costs in East Asia and Pacific could range from $181 billion (5% GDP) to about $723 billion (20% of GDP) per year in current prices. Using these estimates, the cost of climate in East Asia and Pacific could range from $181 billion to about $723 billion of GDP in current prices. In South Asia, the damage could be about $57 billion to $229 billion in current GDP.[4] In contrast, the costs of action—reducing GHG emissions to avoid the worst impacts of climate change—can be limited to around 1% of global GDP each year. Impacts of climate change are very likely to impose net annual costs that will increase over time as global temperatures increase. Peer-reviewed estimates of the social cost of carbon in 2005 average $12 per ton of carbon dioxide, but the range from 100 estimates is large ($–3 to $95 per ton of carbon dioxide). This is due in large part to differences in assumptions regarding climate sensitivity, response lags, treatment of risk and equity, economic and noneconomic impacts, inclusion of potentially catastrophic losses, and discount rates. Aggregate estimates of costs mask significant differences in impacts across sectors, regions, and populations and very likely underestimate costs of damages because they cannot include many nonquantifiable impacts.

Moreover the World Bank estimates show that the economic cost of environmental degradation in developing countries is about 4–8% of GDP in these countries. For example, the economic cost of air and water pollution alone in the PRC is estimated to be 3–8% of its GDP (World Bank 1997). Many researches have shown that the cost of preventive measures are much less than the cost of environmental damages, and therefore, it is economically efficient to prevent environmental degradation. The challenge is to convert the avoided costs (or the benefits from environmental protection) to monetary terms (i.e., revenues) by allowing the self-interests of the private sector to capture the potential profits in a competitive setting. In the case of air pollution, for example, the necessary improvements in air quality can be successfully implemented with policy reforms, harnessing markets and investments on alternative energy sources, boosting availability of natural gas, and improving public transport. These activities would provide ample business opportunities to the private sector. Such measures would prevent an estimated 289,000 deaths a year in the PRC if air pollution were reduced to comply with the PRC government's standards.

If the proper incentives for the private investments and necessary regulatory measures are put in place, pollution reduction, by itself, could generate $67.43[5] billions worth of economic benefits in the PRC. A very high proportion of this value can be captured by

[4] Regional GDP figures were derived from the World Bank's World Development Indicators database.

[5] This figure was calculated using 2002 GDP figures and taking average percentage of GDP (5.5%) as the costs of air and water pollution.

the private sector by engaging the private sector in the above-mentioned air quality improvements. More importantly, once the necessary regulatory framework is put in place, there would be adequate profits to be made. Then, the corporate sector will mobilize its own resources to provide environmental services. Thus, the intricate issue of financing through donations, grants, and subsidies would not arise.

The total economic value of 17 ecosystem services across 16 biomes has been estimated and the values have been extrapolated to the global scale. Findings of this work show that the aggregated annual value of nature's services (at year 2000 values) lies in the range of $18–61 trillion.[6] These figures are of similar size to global gross national product (Costanza et. al. 1997). The problem is that these values are not exchanged in the market. Every year, we lose a part of this natural capital through environmental degradation. A few centuries ago, these services were abundant such that scarcity, a fundamental requirement for market development, was not met. Today, these are scarce, and they provide utility. Yet, private ownership, the third condition for a market commodity, has still to be met. If the innovative mechanisms are developed to ensure the ownership for the ecosystem services, these values can be exchanged in the market. If markets for ecosystem services are successfully developed, provisions of environmental goods and services do not need to depend on the unsustainable donation-driven financing mechanisms.

A group of researchers from the United States (US) and the United Kingdom (UK) asserts that conservation is highly profitable. Their estimates show that humanity losses $250 billion through loss of habitats annually. They further show that conservation benefits are much higher than the benefits of conversion of many habitats for development purposes. Their analysis shows that conservation of certain habitats would provide benefit–cost ratio of over 100.[7] These researches have estimated that the goods and ecosystem services in the nature reserves of the globe are worth $4,400 billion more than the profits to be made after conversion (ENS 2002).

The question is, Why then is the wilderness and related ecosystem gradually disappearing? The answer lies in the conceptual nature of the above estimated benefits. These numbers are not like the actual prices we observe in the market. The market prices, which represent value, are derived through the interaction between demand and supply or the market exchange process. These are real and can be converted to incomes and then to actual human welfare. This paper asserts that similar revenue streams can be generated through developing markets for ecosystems services. The next section provides some examples where innovative approaches have been used to develop markets for environmental goods and services.

---

[6] This research work has been subjected to some criticisms. Despite the shortcoming in the methodology, the figures are roughly indicative of the services provided by nature.

[7] These numbers should be read with caution because the estimations were done with a large number of assumptions. Although the absolute values may change if they are further refined, the general policy directions suggested by these numbers will not change.

V. Selected Market Mechanisms and Innovations

The basic challenge in using markets for exchanging environmental services lies in converting conceptual values to real values like actual market prices. A large number of innovative methods for achieving this have been developed. This section of the paper describes some of these selected innovations.

A. Biodiversity Conservation and Watershed Management

In the case of biodiversity, for example, the compensation for foregone development opportunities due to allocation of lands for conservation can be made in terms of purchase of high-value habitats, payments for access to species or habitat, payments for biodiversity conservation management, tradable rights under cap-and-trade regulations, and support for biodiversity business (Table 3). A team from McKinsey & Company, World Resources Institute, and Nature Conservancy estimated the annual international finance for conservation market (protecting land from development) to be $2 billion. Buyers are predominantly development banks and foundations from US and Europe (Jenkins et al. 2004).

Currently, most of these methods remain predominately at a pilot scale and the challenge is to upscale them and apply them in DMCs. Such an upscaling requires structuring the emerging markets to support community-driven conservation, mobilizing and organizing buyers for ecosystem services, connecting global and national actions for conservation, and creating the enabling policy framework and institutions required for functioning ecosystem service payment systems.

Tapping profitability in the provision of ecosystem services is not a matter of conjecture in the minds of theoreticians anymore. There are many real world examples on the profitable use of ecosystem services. This paper quotes a few well-known examples. The first shows how the New York City (NYC) planners saved billions of dollars by preserving the watersheds, which provide clean water to NYC. The city's water supply does not depend on the expensive filtration systems but on the quality of the 2,000 square miles of watersheds. In the early 1980s, water quality started deteriorating due to developmental activities in the watersheds. The NYC administration had two options in its efforts to meet the water quality requirements of the US government. The first was to install a filtration system that would initially cost about $4–6 billion and another $250 million annually for maintenance. The second option was to invest in preserving the Castkill watershed that provides high-quality urban water. The NYC spent $1.5 billion (1/8th of the cost of water purification plant) on the watershed management program and was able to save $4.5 billions by paying for the ecosystem services. Land owners in the watershed received the payments for the services they provided. This watershed program provided additional environmental benefits. Furthermore, the water conservation program of NYC, which reduced the per capita water consumption by about 80% at the cost of $500 million, saved around $3–5 billion of the potential cost of construction of new water supply works (Appleton 2002).

Table 3: Types of Payments for Biodiversity Protection

Type	Mechanism
Purchase of High-value Habitat	
Private land acquisition	Purchase by private buyers or NGOs to be used explicitly for biodiversity conservation
Public land acquisition	Purchase by a government agency to be used explicitly for biodiversity conservation
Payment for Access to Species or Habitat	
Bio-prospecting rights	Rights to collect, test, and use genetic materials from a designated area
Research permits	Right to collect specimens, take measurements in area, etc.
Hunting, fishing, or gathering permits for wild species	Right to hunt, fish, and gather
Ecotourism use	Rights to enter area, observe wildlife, camp, or hike
Payment for Biodiversity-conserving Management	
Conservation easements	Owner paid to use and manage defined piece of land only for conservation purposes; restrictions are usually in perpetuity and transferable upon sale of the land
Conservation land lease	Owner paid to use and manage defined piece of land only for conservation purposes for defined period of time
Conservation concession	Public forest agency is paid to maintain a defined area under conservation uses only; comparable to a forest logging concession
Community concession in public protected areas	Individuals or communities are allocated use rights to a defined area of forest or grassland in return for commitment to protect the area from practices that harm biodiversity
Management contracts for habitat or species conservation on private farms, forests, or grazing lands	Contract that details biodiversity management activities and payments linked to the achievement of specified objectives
Tradable Rights under Cap-and-trade Regulations	
Tradable wetland mitigation credits	Credits from wetland conservation or restoration that can be used to offset obligations of developers to maintain a minimum area of natural wetlands in a defined region
Tradable development rights	Rights allocated to develop only a limited total area of natural habitat within a defined region
Tradable biodiversity credits	Credits representing areas of biodiversity protection or enhancement that can be purchased by developers to ensure they meet a minimum standard of biodiversity protection
Support Biodiversity-conserving Businesses	
Biodiversity-friendly businesses	Business shares in enterprises that manage biodiversity conservation
Biodiversity-friendly products	Eco-labeling

Source: Scherr et al. (2003).

A similar example in Costa Rica shows that the government pays the landowners who maintain forests in their lands for the ecosystem services. The payments are based on the environmental services rendered, including carbon sequestration, water purification, and scenic beauty. Government finances this program using the funds from international agencies, tax on fuel, and support from a beer company. Under this program, the government has already distributed about $100 million among farmers who have become forest stewards (Jenkins et al. 2004). The above two examples are public payments for private landowners to enhance ecosystem services. There are several other types such as open trading under a regulatory ceiling, self-organized private deals, and eco-labeling. Among these, the self-organized private deals are the closest to conventional market operations.

Another example of market exchange of ecosystem services is the wetland banking system in the US. Under this scheme, private companies purchase degraded wetlands and improve them to meet regulatory requirements. When construction companies meet compensatory wetland improvement requirements, they purchase those certified wetlands in the “wetland banks”. One wetland banking company in California called Wildlands Inc., for example, purchased a degraded wetland and invested about $2 million to improve it. The company has already earned about $9 million by crediting wetlands to construction companies.

One common feature of all the examples cited in the paper is that environmental regulations play a key role in opening up business opportunities for the corporate sector and promote conservation of ecosystems like wetlands, watersheds, forests, etc. The UK Department for International Development funded a four-year study that focused on “payments for watershed services”—a way of compensating for the sound use of land and water upstream that bring benefits to water users downstream. The researchers found that while there is growing enthusiasm for using payments to encourage sound watershed management and to improve rural livelihoods, there is only patchy evidence for social and environmental benefits to date. Despite this preliminary finding, the researchers indicate that new payment schemes could make a difference if these are designed with specific watersheds and social contexts in mind and are led (and partially funded) by water users, particularly those in the private sector. Most rewarding upstream land practices such as organic farming, sustainable forestry, or soil conservation are likely to improve the quality and quantity of water available for downstream users. These vary in scale from one in Nicaragua that rewards just five families, to a program in the PRC that aims to reach 15 million farmers by 2010. While the early payment schemes included small-scale farmers more by accident rather than design, a new generation of schemes is specifically engaging poor upland communities as providers of watershed services, but it is too early to judge their success.

B. Debt-to-Nature Swap

Debt-to-nature swap is an agreement under which a proportion of a country's debts are written off in exchange for a commitment by the debtor country to undertake projects for environmental protection. Debt-for-environment swaps were set up by environment groups in the 1980s in an attempt to reduce the debt problem of poor countries, while simultaneously promoting conservation. A debt swap involves purchasing foreign debt at a discount, converting the debt into local currency, and using the proceeds to finance local conservation activities.

Debt-for-nature swaps are designed to free up resources in debtor countries for much needed conservation activities. There are a few types of debt to nature swaps. In a Bilateral Debt-for-Nature Swap, the creditor government cancels the debt owed by a debtor government. In exchange, the debtor agrees to set aside a predetermined amount of local currency counterpart funds. While NGOs like WWF may play a role in establishing the counterpart fund and determining its use, the primary agreement is made between the two governments. On the other hand, under a Commercial Debt for Nature Swaps model, a NGO such as the WWF solicits debt donations or purchases debt at a discount from face value from a creditor. The NGO then negotiates separately with the debtor government by offering to cancel the debt in exchange for conservation project funding.

Most debt-for-environment swaps have concentrated on setting aside areas of land, especially tropical rainforest, for protection and have involved private conservation foundations. The first swap took place in 1987, when a US conservation group bought $650,000 of Bolivia's national debt from a bank for US$100,000, and persuaded the Bolivian government to set aside a large area of rainforest as a nature reserve in exchange for never having to pay back the money owed. The World Wildlife Fund (WWF) was one of the pioneers of the debt-for-nature swap and successfully executed its first swap in Ecuador in 1987. Since then, WWF has played a vital role in the implementation of debt-for-nature swaps around the world. From its introduction until 2001, over 50 countries had taken part in some sort of debt-for-environment schemes.

Debt-for-nature swaps have made important contributions to conservation. They have done this directly, for example in the Philippines and Ecuador, where they have generated substantial funding for conservation and have helped catalyze new institutions; and indirectly by providing lessons for conservation funds and other institutional reforms that can foster participation from diverse sets of stakeholders ranging from national monetary officials to grassroots community organizations. Debt-for-nature swaps have ushered in a new way of thinking about conservation and also initiated opportunities to involve institutions not previously engaged in conservation efforts. Proponents have successfully found new opportunities and tailored the mechanism to the particular national circumstances. Now, there are emerging examples of harnessing similar creativity and strategic partnerships in order to tackle the greater challenge of attracting more private

investment on terms that balance economic returns with conservation objectives over the long term (Resor 1997). One drawback of the scheme is that the debtor country is expected to ensure that the area of land remains adequately protected, which in practice does not always happen.

C. Green Industries

Certain aspects of the environment management needs have already been developed as industries. Some industries that produce environmental goods and services are well established in the developed countries. Environmental goods and services are used to measure, prevent, limit, or correct environmental damage to water, air, and soil as well as problems related to waste, noise, and ecosystems. These also include eco-efficient technologies that reduce material inputs, energy consumption, emissions, waste disposal, and improve resource recovery.

The world market for environmental goods and services are valued at $515 billion in 2004 and the forecasts show that it will grow up to $688 billion in 2010. Environmental industry in the United kingdom employs about 400,000 people in 17,000 companies with an annual turnover of Sterling Pounds 55 billion. A similar market (with a slightly different definition—Healthy Product-Healthy Planet Market) in the US generates economic activity worth $40 billion per annum, which is about 4.2% of the US economy. In 2003, this market grew at 6.3%, twice the growth rate of GDP in the US. The environmental market in industrializing Asia was $19 billion in 1996 and is estimated to be over $50 billion in 2005. In 1999, the value of the organic foods market was $14.2 billion and its value is predicted to grow at 20–30% a year in the industrialized countries. Global trade in certified organic agriculture was worth $21 billion in 2000. These numbers show how the green industries have expanded over time.

Cleaner production is an important subset of green industries. This involves continuous application of an integrated preventive environmental strategy that is applied to processes, products, and services to increase overall efficiency and reduce risks to humans and the environment. Production processes should ensure conserving raw materials and energy, eliminating toxic raw materials, and reducing the quantity and toxicity of all emissions and wastes. Cleaner products should reduce negative impacts along the life cycle of a product, from raw materials extraction to its ultimate disposal. The Organisation for Economic Co-operation and Development (OECD) cleaner production sector (both software and hardware) alone produces $184 billion[8] worth of goods and services.

[8] The cleaner production and environmental goods and services can be overlapping and the market size of these two should be read with caution.

While markets for green industries are largely confined to the developed countries, rapidly growing incomes provide ample business opportunities to introduce them in the Asian region. The corporate sector should be proactive to explore such possibilities in Asia and the Pacific region.

D. Clean Energy Investments

The clean energy investment market is a fast growing $100 billion a year global industry. The concerns on climate change present opportunities for business and private capital such as investments in clean energy and low carbon alternatives. Given regional growth trajectories and projected energy demand, Asia represents the largest growth opportunity for clean energy investment globally. Businesses need to adapt to the changing investment landscape that climate change brings.

Clean energy investment can be classified into three broad and distinct investment categories: (i) investments in technology or “CleanTech”, those ideas and intellectual property that may, with time testing, commercialization, and deployment, be adapted and incorporated in the energy supply infrastructure of the future; (ii) investments in clean energy infrastructure, or those in “bricks, mortar, and steel” that generates/produces energy and delivers energy to the consumer; and (iii) energy efficiency, or those in products, applications, and technologies that reduce the energy required in a given process or operation.

There are multiple subcategories within each investment category. Each may have very different business profiles and drivers and therefore, may appeal to various investor classes. “CleanTech” tends to fall within the realm of the venture capitalists, while utility, independent power producers, and infrastructure companies have been developed traditionally by energy supply infrastructure and energy efficiency initiatives. CleanTech, clean energy infrastructure, and energy efficiency investment will clearly require significant capital allocations to address the climate change challenge and achieve the long-term stabilization levels for GHG. Table 4 illustrates how maturing CleanTech investment may lead to project opportunities for clean-energy infrastructure and energy efficiency.

Table 4: Examples Illustrating the Difference between CleanTech and Infrastructure Project Investment[a]

(I) CleanTech Investment	(II) Infrastructure and (III) Energy Efficiency Projects[b]
Biofuel technology	
GTL technology	Biofuel plant – ethanol, biodiesel, SVO
CTL technology	Biogas
Second generation BTL technology	Electricity generation project – wind,
Energy intelligence technology	solar, biomass, mini hydro (municipal)
Distributed energy	waste-to-energy, and geothermal
(wind, solar) technologies	GTL plant
Batteries	CTL plant
Fuel cells	BTL plant
Hybrid vehicles	Energy-efficiency project
Wave/tidal technologies	Carbon reduction, caption and storage
Geothermal technology	or elimination project
Carbon storage, reduction, or elimination technologies	Carbon sequestration project

BTL = biomass (cellulose)-to-liquids, CTL= coal-to-liquids, GTL= gas-to-liquids, IP= intellectual property,
SVO = straight vegetable oil.

[a] Table 4 provides examples of CleanTech investment areas and clean energy infrastructure projects to illustrate the distinction between these different business models and investment opportunities. The table is not intended to be an exhaustive list of the investment opportunities in the clean energy sector.

[b] "Infrastructure project" for the purposes hereof is intended to have a broader meaning than the meaning typically assigned to the term in that it is intended to include all investment made to commercialize/commission a clean-energy development but excludes investment in technology development.

Source: Aequero (2007) in Carmody and Ritchie (2007).

E. Climate Change Mitigation's Flexibility Mechanisms

Flexibility mechanisms refer to emission trading, joint implementation (JI), and the clean development mechanism (CDM) that are intended to lower the overall costs of achieving emissions targets as defined under the Kyoto Protocol. These mechanisms enable "Parties" to the Kyoto Protocol to achieve emission reductions or to remove carbon from the atmosphere in a cost-effective manner. While the cost of limiting emissions varies considerably from region to region, the benefit for the atmosphere is, in principle, the same wherever the action is taken. These instruments are grounded on the concept of tradable permits discussed in Appendix 1.

1. Emissions Trading

Emissions trading (or cap and trade) is an approach that is being used to control pollution through provisions of economic incentives geared toward reducing emissions of pollutants. A government or international body sets a limit or cap on the amount of a

pollutant that can be emitted. Companies or other groups are issued emission permits and are required to hold an equivalent number of allowances (or credits) that represent the right to emit a specific amount. The total amount of allowances and credits cannot exceed the cap, thus limiting total emissions to that level.

Emissions trading is emerging as a key instrument in the drive to reduce GHG emissions. The rationale is to ensure that the emission reductions take place where the cost of the reduction is lowest, thus lowering the overall costs of combating climate change. This allows a government to regulate the amount of emissions produced in aggregate by setting the overall cap for the scheme but gives companies the flexibility of determining how and where the emissions reductions will be achieved. Under this scheme, participating companies are allocated allowances. Each allowance represents a ton of the relevant emission, in this case carbon dioxide equivalent. Emissions trading allows companies to emit in excess of their own allocation by purchasing allowances from the market. Similarly, a company that emits less than its allocation of allowances can sell its surplus allowances.

In contrast to regulation, which imposes emission limit values on particular facilities, emissions trading gives companies the flexibility to meet emission reduction targets according to their own strategy; for example, by reducing emissions on site or by buying allowances from other companies who have excess allowances. By allowing participants the flexibility to trade allowances, the overall emissions reductions are achieved in the most cost-effective way possible. The environmental outcome is not affected because the amount of allowances allocated is fixed.

The European Union (EU) established a “cap-and-trade” emissions trading scheme (EU ETS) in January 2005, to impose limits on GHG emissions from large industrial plants and allow them to buy and sell allowances to release excess CO_2 into the atmosphere. Emission reduction credits from CDM projects in developing countries can also be used by companies for compliance purposes. The overall EU emission reduction target under the Kyoto Protocol has been translated into emission reduction or limitation targets for each member state under a burden-sharing agreement. These national targets have, in turn, been translated into emission reduction targets for selected industrial and economic sectors.

The first phase of the EU ETS covers only CO_2 emissions from large emitters in the power and heat generation industry and in selected energy-intensive industrial sectors (e.g., combustion plants, oil refineries, coke ovens, iron and steel plants, and factories making cement, glass, lime, bricks, ceramics, and pulp and paper). Installations covered must surrender a number of EU emission allowances (EUA) or other equivalent carbon credits to offset CO_2 emissions in that year. Installations that do not have enough EUAs

or offset credits have to pay a fine for each excess ton emitted, which rises from €40 per ton of carbon dioxide equivalent (tCO_2) between 2005 and 2007 to €100 per tCO_2 between 2008 and 2012. To help reduce the cost of compliance for companies, the European Commission has allowed certified emission reduction (CER) unit from CDM projects to be used for compliance purposes. As a result, European buyers have been a key driver of demand in the global CER market.

2. Joint Implementation

Joint implementation (JI) is an arrangement allowing industrialized countries with a GHG reduction commitment (i.e., Annex 1 countries) to invest in emission-reducing projects in another industrialized country as an alternative to emission reductions in their own countries. Countries with relatively high costs for emission reductions can reduce costs of complying with their Kyoto Protocol targets by using credits from JI projects, as costs of emission reductions are significantly lower in some countries.

A JI project might involve, for example, replacing a coal-fired power plant with a more efficient combined heat and power plant. Most JI projects are expected to take place in the economies in transition in Eastern Europe and in the former Soviet Union (see Appendix I), where the costs of reducing emissions are considered lower. Unlike in the case of the CDM, the JI has caused less concern over possible questionable emission reductions since it takes place in countries that have an emission reduction requirement. Emission reductions achieved with JI projects are awarded credits called emission reduction units, where one emission reduction unit signifies an emission reduction of one ton of CO_2 equivalent. In 2006, JI projects from economies in transition saw increasing interest from buyers, with 16.3 million tons transacted—up 45% over 2005 levels. Bulgaria, Russia, and Ukraine provided more than 60% of transacted volumes so far—for a value of $141 million (World Bank 2007).

3. Clean Development Mechanism

The CDM is a financing instrument that allows industrialized countries with a GHG reduction commitment to invest in projects that reduce emissions in developing countries, and is considered as an alternative to more expensive emission reductions in their own countries, thereby generating tradable emission credits.

The objective of the CDM is to assist countries not included in Annex 1[9] in achieving sustainable development, and countries included in Annex 1 in achieving compliance with their quantified emission limitation and reduction commitments. A legal entity (presumably, but not necessarily, from an Annex 1 country) invests in a project that results in emissions reduction in a non-Annex 1 country. The investment decision would include an agreement between the countries on the dispensation of the emissions reduction resulting from the

[9] Annex 1 Parties include the industrialized countries that were members of the OECD in 1992, plus countries with economies in transition (the EIT Parties), including the Russian Federation, the Baltic States, and several Central and Eastern European States.

project. These emissions reductions have to be certified by an appropriate authority, and once this is done, the CER can be used to meet the Annex I commitments under the Kyoto Protocol (ADB 2003). The CDM allows net global GHG emissions to be reduced at a much lower global cost by financing emissions reduction projects in developing countries where costs are lower than in industrialized countries.

In recent years, domestic and international tradable emission permit systems have received recognition as a means of lowering the costs of meeting climate-change targets. Creating carbon markets can help economies identify and realize economic ways to reduce GHG emissions and other energy-related pollutants, or to improve efficiency of energy use. The cost of achieving the Kyoto Protocol targets in OECD regions could fall from 0.2% of GDP without trading to 0.1% as a result of introducing emission trading in an international regime. Emission trading, such as the European and CDM schemes, is designed to result in immediate GHG reductions, but CDM also has long-term aspects, since the projects must assist developing countries in achieving sustainable development.

The EU ETS continued to dominate the market with transactions nearing $2.5 billion. Project-based transactions, primarily through the CDM, doubled in value over 2005, to about $5 billion. Developing countries supplied nearly 450 million tons of carbon dioxide equivalent of CDM credits in 2006, with the PRC still leading at 61% of transacted volumes. About 920 million tons of emission reduction credits were transacted under the CDM between 2002 and 2006, corresponding to a cumulative value of $7.8 billion, leveraging an estimated $21.6 billion in investment (74% for clean energy-related projects) (World Bank 2007).

There are also numerous public and private carbon procurement programs in the market. However, most of these existing schemes provide payment only upon project completion and when the carbon credits are delivered. As a result, many clean energy projects, especially in developing countries, face a critical upfront financing gap that prevents them from being undertaken in the first place.

The World Bank has been a pioneer in the carbon market,[10] mainly through the establishment of carbon procurement funds to secure carbon credits on behalf of investors. These funds typically enter into pay-on-delivery contracts and contribute to the positive cash flow of projects after the start of operations and the delivery of emission reductions. Recently, some funds have secured limited insurance against nondelivery of CERs and are able to offer partial upfront payments. The funds in the World Bank portfolio are not solely intended to procure carbon credits, but also to help create demand and spur the global carbon market.

[10]The World Bank currently manages nine carbon funds and facilities, which are marketed to government and private company investors that are vital in the expansion of the emerging carbon market, namely, Prototype Carbon Fund; Netherlands JI and Netherlands CDM Facilities; Community Development Carbon Fund; BioCarbon Fund; Italian Carbon Fund; Spanish Carbon Fund; Danish Carbon Fund; and Umbrella Carbon Facility.

Through ADB's Carbon Market Initiative, its DMCs receive technical assistance and financing during the project development stage. Afterward, they deliver carbon credits once the projects are operational. In addition to the existing $150 million Asia Pacific Carbon Fund, ADB is proposing a Future Carbon Fund, which will pay upfront for post-2012 carbon credits to be generated by ADB-assisted projects. ADB is also striving to make several critical sectors benefit from carbon trading schemes, for example public transportation projects (e.g., bus rapid transit) and small energy efficiency projects (e.g., compact fluorescent lights).

ADB has been assisting its DMCs in capacity building to prepare for the opportunities offered by the Kyoto Protocol, in developing prefeasibility studies for CDM and GHG abatement projects, and in promoting market-based instruments (Annex 2). ADB is also considering additional market incentives other than GHG reductions. For example, some of the incentives in the US that will lead to improving local air quality are now considered in the PRC to reduce urban pollution, as well as CO_2 emissions. ADB is also looking at the benefits of public transport and high-efficiency vehicles that contribute to regional and global energy security, and considering ways to turn those into market incentives. It is scaling up its Sustainable Transport Initiative to support such activities, and will also ensure that private sector investment—supported by the proper incentives—will be one of the main pillars for addressing the financing challenges (Preuss 2008).

Despite these efforts, much remains to be done. When the CDM was introduced 10 years ago, there was expectation from the developing countries that this would provide the needed upfront financial and technical support for sustainable development projects that would reduce GHG emissions. However, due to the lack of buyers who are willing to share project development and operational risk, it is now mostly functioning to provide additional cash flow to projects that are already able to move forward with its own financing. The United Nations Framework Convention on Climate Change estimates private sector investments will constitute over 85% of financial flows into investments and infrastructure to address climate change. The challenge still remains on how to attract private capital at the required scale to meaningfully address climate change.

VI. Roles of Regulatory Framework/Institutions and Donor Agencies

Reliance on the unsustainable and inadequate public financing for environmental management so far has provide only limited results. As the incomes in the Asian region rapidly grow, the demand for environmental services will also grow. Moreover, there is a large amount of private sector resources accumulating within the region. Mobilization of these private sector resources to manage the environment in the region is the way

forward. This paper highlights some of the innovative market-based approaches for environmental management that engage the private sector. Many of these approaches are still in the pilot stages and largely applied in the developed countries. Introducing these approaches and up-scaling them as the main means to achieve environmental management objectives require proactive approaches from the private sector and complementary efforts of the governments and donors. A caveat for any up-scaling scheme is that Asian countries are in their various stages of economic development; the quality of governance, levels of income, and institutions differ from one country to another. Hence, the idea of "one-size-fits-all" up-scaling efforts has limited relevance. What may be done is to apply market-based incentives selectively; based on how strong the institutions and capacity are in each respective country.

A. Regulatory Framework and Institutions

This paper states that the traditional role of government as a custodian of the environment, together with its command and control approach, should be changed if measurable results in environment management are to be achieved using markets forces. That assertion, however, does not mean that government has no role to play in the new generation of environment management policies. In fact, it will have a bigger, newly defined, and revitalized role to play.

The regulatory framework in terms of environmental laws and environmental institutions has been in place, to some extent in the region, but they are largely inadequate to introduce innovative, market-based approaches discussed in this paper. The mature institutes with adequate capacities are preconditions for the introduction of innovative mechanisms that would utilize the strengths of the markets for environmental management. The donor community and national governments have a vital role to play to achieve this goal.

There are number of roles. Since many of the environmental goods and services are public goods or externalities, government interventions are required to create the market for them. Creating the market may be achieved by directly paying for the services, as in the examples of Costa Rica and NYC. Governments should establish property rights or put in place the regulations that will set the caps and govern the trading regimes. The markets for environmental goods are characterized by high transaction costs between buyers and sellers. These markets also lack specialized market institutions. Creating such institutions and necessary actions to reduce transaction costs is another important role of the government.

The existing environmental regulatory framework in the Asian region, to a greater extent, represents command and control approach. Regulatory innovativeness is necessary to instigate and harness business in the area of environment. Harmonization of existing regulations is another important step since strict environmental regulation in one country

in a particular region may put its business at a competitive disadvantage vis-à-vis its neighbors. An example is the greening process of tourism in Thailand, which requires hotels and other tourist establishments to meet over a hundred criteria. If the transaction and compliance costs are significantly high, such regulation may drive up the prices of hotel rooms in Thailand and consequently lead to diversion of tourists to neighboring countries. This will not only shift business from one country to another, it will also shift pollution associated with that expanding business to the country that does not adopt similar strict regulations. Therefore, harmonization of existing and new environmental regulations is important.

The current state of environmental performance drivers varies widely within the region. A few countries, such as Japan and Singapore, have an environmental regulatory infrastructure at par with that of OECD economies. But other countries lack even the rudiments of an operational national environmental regulatory framework, while many are in the middle of this continuum. Basic environmental laws are unevenly enforced, and the main policy tools available are too blunt to accommodate the range of economic and environmental circumstances they need to address. In general, weak and under-resourced institutions generate inefficient policies that make achieving environmental goals costly. Whatever the level of a country's environmental performance goals, when environmental policy is unevenly and inconsistently applied, unclear and uncertain messages concerning performance expectations result, causing higher levels of malfeasance and erosion of benefits for leading firms. An important first step to influencing basic economic decision making, therefore, is a national environmental regulatory system that provides clear performance expectations that are consistently enforced (ADB 2001).

Having innovative regulations and harmonizing them across the region are the only necessary conditions for better environmental management through market involvement. Effective enforcement of regulations is the sufficient condition. Also, there is a need to focus more attention on enforcement issues, because enforcements remain weak due to legal, institutional, and capacity limitations. Challenges in this area include, in particular, reducing overlapping authorities, decentralizing environmental functions, training core staff, raising awareness of the regulated communities, attracting and allocating necessary funds, and more importantly, reducing opportunities for corruption.

Over the years, environmental regulations in the Asia and Pacific region have become strict. Conventionally, the corporate sector perceives these ever increasing and stricter regulations as barriers to flourishing of their businesses. These emerging and unavoidable trends of more strict regulations can be turned to opportunities in favor of the private sector, because environmental regulation is a precondition to successful exchanges of environmental values in the market. Conventionally perceived threats of such regulations can be converted to opportunities by innovative business. For example, the corporate sector can differentiate through products and processes that result in

smaller environmental costs or greater environmental benefits than their competitors. Corporations also can improve profits and environmental performances by focusing on eco-efficiency and recycling, continuous improvement processes, and energy efficiency. They also can capitalize on expanding demands for new infrastructure such as water supply and waste water treatment systems, industrial pollution control technology, renewable energy, environmental services, environmentally responsible procurement, and environmentally sound primary production. The corporate sector should thus adopt a proactive approach to initiate businesses. The green industries and organic markets, which can flourish under the existing regulatory framework, can be a very good starting point. Governments and donors should work with the private sector to eliminate the information and coordination failures so that private interests on environmental management can thrive.

B. Donor Agencies

Much needs to be done to fully utilize the opportunities provided by market-based mechanisms for managing the Asian environment. All stakeholders—including governments, private sector, and donors—have vital roles to play in advancing the application of market-based approaches for environmental management. In particular, donor agencies can consider the following:

1. Promotion of Knowledge and Information Sharing

The Asia and Pacific region constitutes wide and diverse ecosystems that are home to much of the world's biological diversity. However, attempts at environmental management in the region, especially the use of economic incentives, appear to be disparate. While there are a few scattered examples on the use of policy instruments, a systematic assessment has yet to be undertaken, especially one that would examine the potential for application of market-based approaches for environmental management.

Donor agencies could help inform the design of these market-based incentives through promotion of learning and knowledge sharing. This can be done by undertaking appropriate special studies and providing technical assistance and other grants that would explore the potentials of these incentive-based approaches as an alternative to "command-and-control" approach. Assistance can be best geared toward tailoring these market-based approaches to suit the local needs and conditions of specific recipient countries. Technical assistance resources can be mobilized to generate and share knowledge such as scoping and reviewing current practices and technologies, risk mapping, promoting awareness, institution-building and feasibility studies, among others.

Donors can also act as a platform for knowledge and encourage better practices through seminars, symposia, and other fora. Future initiatives that could deepen understanding on these approaches could focus on (i) examining the linkage between market-based mechanisms and environmental protection; (ii) assessing the state of environmental

protection and the involvement of the private sector especially in green businesses; (iii) addressing pricing and affordability issues and information gaps; (iv) exploring government–private sector and community partnerships; and (v) political economy considerations in designing market-based mechanisms. The possible impact of these approaches in reducing a government's fiscal burden could also be the subject of future inquiries.

Once sufficient experiences and knowledge are accumulated, donor agencies might be in a position to incorporate these programs on some regional initiatives. Networking with relevant institutes would also have to be undertaken. It would be helpful for the dissemination to link and harmonize initiatives with the existing international organizations and programs doing relevant activities.

2. Assistance in Institution Building

Donor agencies can strengthen the existing institutional framework in DMCs to effectively use market-based approaches to manage the environment. Institutional capacities to address environmental protection generally remain weak. Another aspect in which donors' expertise may be needed in the future is assisting DMCs in setting up legislative frameworks and policies for the development of green businesses and environmental protection. The imperative for strengthening institutions cannot be overemphasized as the developing world confronts environmental challenges.

Institutions play important roles in addressing climate change. For instance, the slow progress in arriving at a collective solution on GHG mitigation or what would constitute equitable international commitments can be attributed to climate-related global institutions in their nascent state. There is also a need to coordinate the actions of a large number of stakeholders globally, which places strain on institutional capacity. On the other hand, the success of adaptive responses to climate change requires strong national and local institutions. Institutions increase adaptive capacity and affect the form, adoption, and delivery of adaptation actions, especially to vulnerable groups.

This underscores the importance of capacity building and undertaking reforms within institutions to improve the incentive structure, and to guide economic agents who would be affected by environmental degradation so that they get the right market signals.

3. Pilot Testing for Possible Scaling-Up or Replication

Donor agencies could provide support in small-scale projects that would pilot test the innovative market-based approaches in order to assess their feasibility and adaptability to the specific situation. Insights from this pilot testing would facilitate scaling up or replication elsewhere, including possible link ups with green industries. Donors could also perform advisory roles by facilitating coordination of governments and green businesses.

VII. Concluding Remarks

Development indices show a promising future for the Asia and Pacific region if the current trends continue for a reasonably long period. Environmental management, unfortunately, shows only limited success despite considerable efforts of various stakeholders. The paper recognizes the lack of concerted efforts to use market forces for environmental management by various global and regional initiatives and processes as one fundamental reason for limited success in this area. It argues, quoting examples, that markets can be created for ecosystem protection and provision of ecosystem services under innovative regulatory frameworks. Aligning ecosystem service provision with the interests of individuals who comprise the market will reduce the dependency on unsustainable donation-driven financing mechanisms.

Changing the existing command-and-control-oriented regulations to more flexible market-creating innovative regulations, enhancing institutions and capacities, and strengthening enforcement mechanisms are preconditions for market-driven environmental management systems. Some of the innovative mechanisms are nascent and still limited in scope even in most advanced countries. Although they have a greater potential, lots of ground work needs to be done before introducing them. However, the time is ripe for developing a future vision and action plans that take into account the role of markets and the corporate sector in environmental management. While donor community and governments work toward this end, the corporate sector should adopt a proactive approach to capitalize on existing green market opportunities utilizing the existing regulatory framework.

This paper argues for the market's role in protection and provision of ecosystem services. Planners, however, should adopt a cautious approach in introducing them. As learned from past experiences, being overoptimistic and setting overambitious targets should be avoided. Weaknesses in existing regulations, poor capacity, inadequate enforcements, and lack of adequate funding should be given due consideration, in introducing market-based instruments.

Piloting and scaling up market-based approaches would be complex and challenging. There is limited relevance in proposing a menu of these instruments given the need to examine the maturity and capacity of existing institutions. As such, this paper highlights some good examples, both in the developed world and the Asia and Pacific region, which would serve as springboards for further and more detailed research.

Appendix 1: Market-Based Instruments

Environmental Taxation

Environmental taxation is also known as the price approach, which puts a price tag on emissions (e.g., carbon tax). Thus, producers would have to adjust the quantity or levels of emissions accordingly. Environmental taxation raises the cost of the process/product, reduces demand for it, and thereby naturally reduces emissions. But it also encourages polluters to seek ways to reduce emissions that cost less than the tax being imposed.

Charges, fees, or taxes are prices paid for discharges of pollutants to the environment, based on the quantity and/or quality of the pollutant(s). To be most effective, the charge is levied directly on the quantity of pollution in the form of an emissions tax. Product charges can occur at different usage points: manufacturing, consumption, or disposal. Charges include: (i) effluent charges that are based on the content and quantity of a firm's discharges into the air, water, or sewerage system; (ii) user charges that are charged for using a resource such as timber or for being provided with a service such as garbage collection; (iii) product charges such as those for packaging that are used to discourage disposal or encourage recycling; and (iv) sales and excise taxes that give environmentally friendly products a price advantage over polluting products. Current examples of environmental taxation that are designed to discourage environmentally degrading behavior include emission charges, fuel taxes, and congestion charges. In the case of emission charges, if the emitter can demonstrate that its emissions were lower than the presumed amount, it can qualify for a rebate on the difference between presumed and actual emissions. In effect, this shifts the monitoring responsibility from the government to the firm.

An example of unit-based pricing is the pay-as-you-throw (PAYT) initiative, which is gaining popularity in the United States as an innovative method of managing solid waste. This type of program is at work in 3,000 communities nationwide. Rather than paying one flat fee for solid waste disposal, residents and businesses in PAYT communities pay per pound or gallon of garbage disposed. This offers residents an incentive to recycle and reduce waste, and helps communities cover solid waste costs by accurately charging residents for solid waste services. It also gives waste generators more control over their garbage bill and lets them pay only for the amount of waste generated. PAYT may affect household purchasing decisions by favoring products that come with less and/or recyclable packaging.

In Malaysia, massive diversification into oil palm plantations resulted in effluent wastes being pumped into the nearest water bodies. The government used a combination of policies to tackle this issue which were: (i) a progressive system of standards that applied to the effluents; (ii) a varied license fee that corresponded closely to a two-tier effluent charge; and (iii) subsidies for abatement technology and research into such technology. The success of the policy package has been attributed to the combination of these instruments (Sterner 2003).

Designed to curb their rampant consumption of 1.2 billion plastic grocery bags a year, the Republic of Ireland levied the innovative plastic bag tax or "plastax" in 2002. The plastax resulted in a 90% drop in consumption and approximately 1 billion fewer bags consumed annually. Moreover, approximately $9.6 million was raised from the tax in the first year and was earmarked for a "green fund" established to benefit the environment. The "plastax" is being closely watched by other countries. Bangladesh has banned polythene bags altogether, while Taipei,China and Singapore are taking steps to discourage their use (BBC 2002).

Quantity Rationing and Marketable/Tradable Permits

Quantity rationing refers to a mechanism in which the government sets a maximum allowable quantity of pollution (e.g., CO_2 emissions). The price of the "permit to pollute" is then allowed to adjust according to supply and demand. This has the same effect as mandating a standard, with the difference that the allocated quantity target can be bought and sold. Polluters are free to seek the best way to comply with the target. Polluters can trade these permits with other "permitees", treating them like any other commodity in the marketplace. Those who can clean up effectively and cheaply can then make money by selling spare permission to pollute to those for whom cleaning up would be more expensive. The key point is that tradable permits allow governments to set the precise amount of pollution that they are prepared to handle. This is something they could do with regulation, but could not do with a tax. The price of the permit has the same effect of leading the polluter to seek cheaper ways to cut emissions, thereby lowering costs for all.

On the other hand, marketable or tradable permits are referred to as a "cap-and-trade" system. The rationale is based on setting an absolute quantity of pollution to be allowed, and then giving or selling polluters rights or "permits" to pollute up to that given cap. Marketable permits specify a predetermined total level of emissions or emission concentrations within a specified region. Permits equal to the permissible total emissions are distributed among producers in the region. The permits can be traded among plants of a single producer as well as among producers. Since users are free to trade their allocated amounts among themselves as long as the cap is not violated, this approach tends either to allow the environmental goal, as expressed via the cap, to be reached at a lower cost than more traditional "command and control" regulatory policies, or to allow a higher goal to be reached with same expenditure.

Well-designed marketable permits provide an incentive for firms to equate abatement costs at the margin, thus achieving a given level of environmental quality at least cost. For example, a market-based approach to the acid rain problem would limit pollution from sulfur dioxide by defining a suitable number of emission rights, distributing these rights, and then allowing firms to trade them freely. A firm would not be legally allowed to emit unless it owned emission rights that equaled or exceeded its emissions. This approach can yield cost savings due to the trading of the emission rights among sources. It can also provide incentives for firms to cut back their emissions even further by adopting cleaner and less costly production technologies. Indeed, in the case of reducing acid rain in the US, simulations indicate that approximately $1 billion may be saved annually by substituting a market-based approach for a "command-and-control" approach (Hahn and Stavins 1991). In theory, a similar result could be achieved through the introduction of an emission charge or tax.

Environmental organizations could also, in theory, buy up permits and thus reduce the amount of pollution allowed. Current examples of this approach to control pollution include the sulfur allowance program in the US and the EU ETS. Other examples include individual transferable quotas in fisheries; tradable energy certificates for energy production; introduction of marketable

permits to reduce the leaded content of gasoline; and limiting the production and use of chlorofluorocarbons.

Individual transferable quotas are used in fisheries to limit the magnitude of the harvest to sustainable levels. After setting a total allowable catch that is compatible with preserving the population, individual harvesting quotas are parceled out to individual fishers such that the sum of the individual quotas equals the total allowable catch. Fishers must surrender sufficient quota to cover their harvests. Sanctions are imposed when harvests are not legitimized by sufficient quota. Initial quota allocations are typically based at least in part on past fishing experience. In addition to simply using their quota to justify harvest, quota recipients also have the option of buying more or selling any excess to others. Advantages of successful transferable quota systems include the prevention of overfishing, and raising both the value of the fishery and the profits derived from it. However, not all applications of this approach have been successful. Success requires effective monitoring and enforcement and low transaction costs; and in fisheries, monitoring sometimes poses a significant challenge (Tietenberg and Niggol Seo 2006).

One of the most successful examples of tradable permits has been the Clean Air Act amendments in 1990 in the US. An ambitious tradable permit system was created under which more than 100 large coal-fired power plants were given initial emissions reductions. The goal was to reduce emissions of sulfur dioxide by 50% in the eastern half of the US. These facilities were given the ability to purchase excess emission reductions generated by other plants that found it easy to reduce their sulfur dioxide, along with the choice of meeting their emissions reductions targets. This cap-and-trade approach resulted in sulfur dioxide reductions that have been both larger and faster than required by law. Furthermore, annual savings to electricity rate payers nationally (compared to the previous traditional approach) range from 50–80%, amounting to savings of $1–6 billion annually. Similar cap-and-trade permits are being used in state and local governments nationwide to reduce other types of pollution. One such project in the Pacific Northwest is the pollutant trading system in Idaho, which uses cap-and-trade to lower pollution emissions into the Boise River.

Performance Bond, Deposit-Refund Scheme, and Liability Rules

Under the deposit refund systems that are prominent in Asia, purchasers of potentially polluting products pay a surcharge, which is refunded to them when they return the product or its container to an approved center for recycling or proper disposal. This instrument rewards good environmental behavior. Deposit-refund systems require a monetary deposit at the point of sale of a product, with the deposit given back when the item is returned at the end of its useful life. The key feature to this approach is that it provides an incentive for the consumer to return the item as opposed to simply throwing it away. It has no negative budgetary impact on the public sector. The incentive is provided by the consumers' money and not by the public treasury. Deposit-refund systems are used for such diverse items as softdrink bottles or cans, waste oil, and even old automobiles.

A number of deposit-refund schemes have been promoted to encourage recycling and reuse of products, especially packaging materials. For instance, manufacturers and importers of various goods in Korea are required to deposit funds with the government to cover the costs of waste recovery and treatment (UNEP 2000). In the US, deposit-refund schemes have been applied most commonly to help manage the disposal of lead-acid batteries. These are also being successfully applied in some states to beverage containers, pesticide containers, and tires. A deposit-refund system could also be used to divert some of the massive amounts of electronic waste that goes into the solid waste stream every year.

With a performance bond, a producer posts a bond before operations begin, forfeiting the bond if his activities cause environmental harm or if he pollutes in excess of acceptable levels. Bonds can reduce the incentive to shirk. With perfect monitoring, the value of the bond should equal or exceed the value of damages. With imperfect monitoring, the value of the bond should reflect both the damages and the probability of detecting the damage. By requiring that producers post bonds, the cost of the environmental damage will be registered and therefore, open to public debate and scrutiny (Hanley et al. 1997).

Liability rules are set in such a way that there is an incentive for a producer to follow some prescribed mandate, technological restriction, or acceptable behavior. These require an economic agent who causes an injurious outcome (such as an oil spill) to pay for the clean-up and to compensate those who were injured by the action. By forcing the party that caused the damage to bear all of the costs of that damage, liability rules remove the externality and the biased decision-making that results from it. In principle, parties engaged in an activity that poses an environmental risk are encouraged to take all cost-justified levels of precaution. Recent examples of the application of liability rules include the 1989 Exxon-Valdez oil spill in Prince William Sound, Alaska, and the 1984 industrial disaster in Bhopal, India (Tietenberg and Cleveland 2006). Liability rules can be set so that the producer pays a bond in advance and is reimbursed if there is no harm committed or pays a noncompliance fee after the harm occurred. Liability rules attempt to reduce the level of shirking on environmental pollution control by raising the costs of misbehavior.

Disclosure and Certification Strategies

Increasingly, “right-to-know” laws are forcing parties that could pose an environmental risk to reveal information to the public about the nature and danger of the possible risks. Making such information available to the public provides an economic incentive for those posing the risk to limit the adverse publicity by lowering the probability or magnitude of the activity that is considered risky. Examples include: California’s Proposition 65 that requires businesses to notify Californians about significant amounts of chemicals in the products they purchase, in their homes or workplaces, or that are released into the environment; and the Toxic Release Inventory in the United States (Tietenberg and Cleveland 2006).

Surveys reveal that many consumers are willing to pay higher prices for commodities that pose a lower environmental risk either. However, most consumers would find it difficult to distinguish low- and high-risk products. To correct this information deficiency, certification systems have been set up where third-party certifiers monitor production processes and allow those who meet rigorous standards to label their product as “green”. Examples include: organic foods, sustainable harvested wood products, and bird-friendly coffee (Tietenberg and Cleveland 2006).

Subsidies and Incentives

Subsidies are forms of financial assistance offered to a producer by regulators. These can be used as incentives to encourage pollution control or to mitigate the economic impact of regulations. This is done by helping firms meet compliance costs. Subsidies are commonly used tools in environmental management. Some examples are grants, low-interest loans, favorable tax treatment, and environmentally preferable procurement policies. Subsidies are used to promote pollution prevention, cleanup of contaminated industrial sites, farming and land preservation, sustainable/green energy, environmentally friendly fuels and vehicles, and municipal wastewater treatment. However, these subsidies are sometimes criticized because the government is helping to bear the costs that should be the responsibility of the polluter. Subsidies also could lead to higher levels of pollution by encouraging cost-inefficient firms not to exit the industry.

Incentives include preferential tax credits and accelerated depreciation allowances on pollution abatement and control equipment. For example, tax deductions stimulated the installation of industrial antipollution equipment in Korea and the Philippines; while in India, an investment allowance of 35%, compared with the general rate of 25%, was provided to the cost of new machinery and plant for pollution control or environment protection. Another success story is the Demand-side Management Program in the power sector of Thailand, partly funded by the Global Environment Facility (UNEP 2000). Under its pilot energy services company program, interest-free loans will be provided to finance industrial energy conservation investments that use the performance contracting process. Private energy services companies will enter into an agreement with customers to provide a turn-key operation of energy efficiency investment and a guarantee for energy savings performance of installed equipment. Customers will pay back the cost of the investment over a predetermined period.

Voluntary and Recognition Programs

The use of voluntary and recognition programs of economic incentives has been growing tremendously in the last 10 years. Currently, the US EPA and the state and local governments have various programs that encourage sources like private businesses, schools, hospitals, and universities to reduce specific types of pollution. According to a 2001 EPA report, more than 7,000 organizations participated in EPA's voluntary programs, and in 1998, those participants conserved 1.8 billion gallons of clean water, 7.8 million tons of solid waste, and prevented the release of air pollution in an amount equivalent to taking 13 million cars off the road. Not only were these actions a great boon for the environment, but EPA also estimated that these organizations saved roughly $3.3 billion. Hundreds of similar programs are now in operation at state and local levels.

A successful case that illustrates the benefits of a voluntary recognition program is the 33/50 Program. Introduced in 1991, it challenged industry to reduce toxic emissions by 33% by 1992 and 50% by 1995, relative to a 1988 baseline for each facility. Actual emissions reduced by participating businesses exceeded EPA's expectations and occurred a year ahead of schedule. One of the main factors driving participation in this and other recognition programs is the desire of the firm to achieve favorable publicity, aimed at reducing market shares of its competitors, which are perceived to be less environmentally friendly. Numerous polls in recent years have shown evidences that consumers are willing to pay a premium for products that are considered environmentally friendly. Another reason companies choose to participate in a voluntary recognition program is the benefits of free technical assistance from the sponsoring regulatory agency.

Permit and Regulatory Incentives

Although technically not falling under the definition of market-based incentives, permit incentives come in the form of expedited permitting, increased permit flexibility, multimedia permitting, and self-certification permit programs, among other different options. Also, experimental regulatory incentives in the form of "grace period" laws were explored in the mid-1990s. "Grace period" laws are designed to focus limited public resources more clearly on serious violations. When a "minor" violation is discovered, the relevant environmental agency must provide the violator with a "notice to comply" or a "notice of violation". The notice identifies the violation and provides a time period wherein the violator must come into compliance.

Another form of regulatory incentive is the environmental "amnesty" law. These laws are designed to encourage businesses to request technical assistance, and/or to voluntarily be engaged

in pollution prevention activities. Regulatory agencies will ignore a committed offense if the violator requests technical assistance or participates in an officially sponsored voluntary pollution prevention program. Amnesty laws are targeted toward small businesses that may not have adequate resources or expertise to conduct an environmental self-audit. By not levying fines during these "amnesty" periods, businesses generate financial benefits.

An example of a permit incentive program is Florida's Department of Environmental Protection "team permitting" approach. Applicants who need to receive permits from multiple agencies can agree to have team permits known as "ecosystem management agreements". In exchange, applicants must have exemplary compliance records and must demonstrate that this approach will result in a "net ecosystem benefit" to the affected ecosystem and a reduction in overall risks to human health and the environment. This program has resulted in increased permit flexibility, expedited permit processing, alternative monitoring and reporting requirements, cooperative inspections, and hundreds of thousands of dollars in savings for private sector participants. Annex 1 indicates the advantages and disadvantages of each incentive.

However, there are two downsides. A country that imposes economic instruments may hurt its industrial competitiveness relative to other countries that do not utilize these types of incentives. There is also the "carbon leakage" effect, where reducing CO_2 emissions in one country may only lead to increases elsewhere, as high-carbon production activities relocate where no controls are in place. But both effects would not be a problem if all countries agree to do the same thing (Habito 2007).

There are a few arguments for using a mix of instruments to address a specific environmental problem: First, many environmental problems are of a "multi-aspect" nature, wherein in addition to the total amounts of releases of a certain pollutant, the environmental problems can, for example, also matter where emissions take place, when they occur, how a polluting product is applied, etc. Second, certain instruments can mutually underpin each other, as when a labeling scheme enhances the responsiveness of firms and households to an environmentally related tax, while the existence of the tax help draw attention to the labeling scheme. Often, a mix of instruments is required in order to address nonenvironmental "failures" in the markets in which environmental policy instruments operate, such as inadequate information, ill-defined property rights, weak market power, etc. Sometimes, such mixes can also limit compliance-cost uncertainty, enhance enforcement possibilities, and reduce administrative costs. When applying several policy instruments in a mix, there is a danger that one instrument will unnecessarily hamper the flexibility to find low-cost solutions to a problem that another instrument could have offered if it had been used on its own. In other cases, some of the instruments in a mix are simply redundant, contributing only to increase total administrative costs (OECD 2007).

Appendix Table 1: Types of Incentives

Incentive	Examples	Pros and Cons
Pollution Charges and Taxes	• Emission charges • Effluent charges • Solid waste charges • Sewage charges	Pros: stimulates new technology; useful when damage per unit of pollution varies little with the quantity of pollution Cons: potentially large distributional effects; uncertain environmental effects; generally requires monitoring data
Input or Output Taxes and Charges	• Leaded gasoline tax • Carbon tax • Fertilizer tax • Pesticide tax • Virgin material tax • Water user charges • Chlorofluorocarbon taxes	Pros: administratively simple; does not require monitoring data; raises revenue; effective when sources are numerous and damage per unit of pollution varies little with the quantity of pollution Cons: often weak link to pollution; uncertain environmental effects
Marketable Permits	• Emissions • Effluents • Fisheries access	Pros: provides limits to pollution; effective when damage per unit of pollution varies with the amount of pollution; provides stimulus to technological change Cons: potentially high transaction costs; requires variation in marginal control costs
Deposit-Refund Systems	• Lead-acid batteries • Beverage containers • Automobile bodies	Pros: deters littering; stimulates recycling Cons: potentially high transaction costs; product must be reusable or recyclable
Subsidies	• Municipal sewage plants • Land use by farmers • Industrial pollution • Equipment purchases	Pros: politically popular, targets specific activities Cons: financial impact on government budgets; may stimulate too much activity; uncertain effects
Voluntary and Recognition Programs	• Project XL • 33/50 • Energy Star • Performance Partnerships • EnviroStars • IdahoGemStars	Pros: low cost; flexible; many possible applications; way to test new approaches Cons: uncertain participation
Permit and Regulatory Incentives	• Increased permit flexibility • Multimedia permits • Grace period regulations • Amnesty regulations	Pros: may reduce permit overlap and redundancies, reduce permit process time, encourage small businesses to comply Cons: uncertain participation

Sources: National Center for Environmental Economics (2001).

Appendix 2: ADB Initiatives on Market-based Mechanisms

TA 2951 PRC: Promotion of Market-Based Instruments for Environmental Management (1997)
TA 3013 THA: Promotion of Market-Based Instruments for Environmental Management (1998)
TA 3746 LAO: Capacity Building for Environment and Social Management in Energy and Transport (2001)
TA 3840 PRC: Opportunities for the Clean Development Mechanism Fund in the Energy Sector (2002)
TA 4137 INO: Carbon Sequestration through CDM in Indonesia (2003)
TA 4254 THA: Capacity Building for Pollution Taxation and Resource Mobilization for Environment and Natural Resources Sectors (2003)
RETA 6180: Preparation of the Asian Environment Outlook 2005: Corporate Responsibility for Environment (2004)
TA 4496: Capacity Building for the Clean Development Mechanism in India (2004)
TA 4501 INO: Institutionalizing the Clean Development Mechanism (2004)
TA 4667 THA: Capacity Building for Pollution Taxation and Resource Mobilization for Environment and Natural Resources Sectors—Phase II (2005)
TA 4812 PRC: Support for Establishing a Clean Development Mechanism Fund (2006)
RETA 6363: Clean Energy Projects Eligible for the Clean Development Mechanism (2006)
TA 4967 PRC: Policy Study on Market-Based Instrument for Water Pollution Control (2007)

References

ADB. 1997. *Emerging Asia: Changes and Challenges*. Asian Development Bank, Manila.
———. 2000. *Implementation of the Kyoto Protocol: Opportunities and Pitfalls for Developing Countries*. Asian Development Bank, Manila.
———. 2001. *Asian Environment Outlook 2001*. Asian Development Bank, Manila.
———. 2002. *Environment Policy of the Asian Development Bank*. Asian Development Bank, Manila.
———. 2003. *Clean Development Mechanism Facility*. Asian Development Bank, Manila.
———. 2005a. *Making Profits, Protecting Our Planet: Corporate Responsibility for Environmental Performance in Asia and the Pacific*. Asian Development Bank, Manila.
———. 2005b. Technical Assistance for the Regional Environmental Compliance and Enforcement Network (Financed by the Governance Cooperation Fund). Asian Development Bank, Manila.
Appleton, A. 2002. "How New York City Used an Ecosystems Services Strategy Carried Out Through an Urban-Rural Partnership to Preserve the Pristine Quality of its Drinking Water and Save Billions of Dollars". Forest Trends, Tokyo. Available: forest-trends.org/documents/meetings/tokyo_2002/NYC_H2O_Ecosystem_Services.pdf
BBC News. 2002. "Irish Bag Tax Hailed Success." 20 August. Available: news.bbc.co.uk.
———. 2005. "Nature 'Pays Biggest Dividends'." 21 March. Available: news.bbc.co.uk.
Carmody, J., and D. Ritchie. 2007. *Investing in Clean Energy and Low Carbon Alternatives in Asia*. Asian Development Bank. Manila.
Costanza, R., R. d'Arge, R. de Groot, S. Farber, M. Grasso, B. Hannon, S. Naeem, K. Limburg, J. Paruelo, R.V. O'Neill, R. Raskin, P. Sutton, and M. van den Belt. 1997. "The Value of the World's Ecosystem Services and Natural Capital." *Nature* 387:253–60.

Department for Business Enterprise and Regulatory Reform. 2005. *Environmental Goods and Services*. London.

Ellision, K., and G. Daily. 2003. "Making Conservation Profitable." *Conservation in Practice* 4(2):13– 19.

Environment News Service. 2002. "Humanity Loses $250 Billion a Year in Wild Habitat." 9 August. Available: ens-newswire.com/ens/aug2002/2002-08-09-07.asp.

NSW Department of Primary Industries. 2005. Environmental Services of Forests: A New Role for Forests in the Green Economy. Available: forest.nsw.gov.au.

Estevadeordal, A., B. Frantz, and T. R. Nguyen. 2002. *Regional Public Goods: From Theory to Practice*. Washington, DC: IDB Publications.

Habito, C. 2007. "Pricing Pollution." *Philippine Daily Inquirer*. 10 December.

Hahn R., and R. Stavins. 1991. Economic Incentives for Environmental Protection: Integrating Theory and Practice. CSIA Discussion Paper 91-15, Kennedy School of Government,Harvard University, Massachusetts.

Hawken, P., A. B. Lovins, and L. H. Lovins. 1999. *Natural Capitalism: The Next Industrial Revolution*. London: Earthscan Publications Ltd.

Jansson, A. M., M. Hammer, C. Folke, and R. Costanza. 1994. *Investing in Natural Capital: The Ecological Economics Approach to Sustainability*. Washington, DC: Island Press.

Jenkins, M., S. J. Scherr, and M. Inbar. 2004. "Markets for Biodiversity Services: Potential Roles and Challenges." *Environment* 46(6, July/August):32–42.

National Center for Environmental Economics. 2001. *The United States Experience with Economic Incentives in Environmental Pollution Control Policy*. US Environmental Protection Agency, Washington, DC.

OECD. 2003. *Harnessing Markets for Biodiversity: Towards Conservation and Sustainable Use.* Organisation for Economic Co-operation and Development, Paris.

———. 2007. *Instrument Mixes for Environmental Policy.* Organisation for Economic Co-operation and Development, Paris.

Schäfer-Preuss, U. 2008. "Mobilizing Finance to Address Climate Change." Paper delivered at the 4th Ministerial Meeting of the Gleneagles Dialogue on Climate Change, Clean Energy and Sustainable Development, 15 March, Chiba.

Resor, J. P. 1997. "Debt-for-Nature Swaps: A Decade of Experience and New Directions for the Future." *Unasylva* 48(188):15–22.

Schmidheiny, S. 1992. *Changing Course.* Massachusetts Institute of Technology, Cambridge, Massachusetts.

Scherr, S. J., A. White, and A. Kahre. 2003. *Current Status and Future Potential of Markets for Ecosystem Services in Tropical Forests: An Overview.* Forest Trends, Washington, DC.

Stern, N. 2006. *The Economics of Climate Change: The Stern Review.* Cambridge: Cambridge University Press.

Sterner, T. 2003. *Policy Instruments for Environmental and Natural Resource Management.* Resources for the Future, Washington, DC.

Tietenberg, T. (Lead Author), and C. Cleveland (Topic Editor). 2006. "Environmental Economics." In C. J. Cleveland, ed., *Encyclopedia of Earth.Environmental Information Coalition.* National Council for Science and the Environment, Washington, DC. Available: eoearth.org/article/Environmental_economics.

Tietenberg, T. (Lead Author), and S. Niggol Seo (Topic Editor). 2006. "Individual Transferable Quotas." In C. J. Cleveland, ed., *Encyclopedia of Earth*. Environmental Information Coalition, National Council for Science and the Environment, Washington, DC. Available: eoearth.org/article/Individual_transferable_quotas.

United Nations Environment Programme. 2000. *Global Environment Outlook.* Malta: Interprint Ltd.

———. 2004. *GEO Year Book 2003.* Malta: Interprint Ltd.

World Bank. 1997. *China 2020.* Oxford: Oxford University Press.
———. 1998. *Financing Environment Services: The Costa Rican Experience and its Implications.* Costa Rica.
———. 2004. *World Development Report 2005: A Better Investment Climate for Everyone.* Washington, DC.
World Bank. 2005a. *Environment as Integral Part of the Development Challenge.* Available: lnweb18.worldbank.org.
———. 2005b. *Environmental Themes.* Available: lnweb18.worldbank.org.
World Bank. 2007. *Carbon Finance for Sustainable Development—Carbon Finance at the World Bank*. Available: http://carbonfinance.org/Router.cfm?Page=DocLib&CatalogID=37205.
Worldwatch. 2005. *Vital Signs 2003.* Available: worldwatch.org.