ENVIRONMENTAL EXTERNALITIES

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INTRODUCTION

The aim of this dissemination paper is to provide a non-technical introduction to the concept of environmental externalities, its implications for resource allocation and policy options for internalization with a view to improve social welfare. Section 2 introduces the concept of externalities and explains how externalities cause divergence between social costs (benefits) and private costs (benefits). This is followed by illustrations of different types of negative externalities and how they arise. Section 3 reviews briefly important theoretical contributions in the theory of negative externalities and policy options for dealing with them. Section 4 deals with global environmental externalities. Section 5 considers policy options for internalizing environmental externalities in the Indian context.

MEANING, SOURCES AND TYPES

Externalities

Externalities arise when certain actions of producers or consumers have unintended external (indirect) effects on other producers or/and consumers. Externalities may be positive or negative. Positive externality arises when an action by an individual or a group confers benefits to others. A technological spillover is a positive externality and it occurs when a firm's invention not only benefits the firm but also enters into the society's pool of technological knowledge and benefits the society as a whole. Negative externalities arise when an action by an individual or group produces harmful effects on others. Pollution is a negative externality. When a factory discharges its untreated effluents in a river, the river is polluted and consumers of the river water bear costs in the form of health costs or/and water purification costs. In an activity generating positive externality, social benefit is higher than private benefit and in an activity generating negative externality, social cost is higher than private cost. Thus, in the presence of externalities, social benefits (costs) and private benefits (costs) differ.

The divergence between private benefits (costs) and social benefits (costs) results in inefficiency in resource allocation[1]. Producers of externalities do not have any incentive to take into account the effects of their actions on others. In a competitive market economy, private optimum output is determined at the point where marginal private cost equals price[2]. When a positive externality occurs, the marginal social benefit will be higher than the marginal private benefit (price) and hence the private optimal output will be lower than the social optimal output[3]. When a negative externality occurs the marginal social cost will be higher than the marginal private cost (price) and hence the private optimal level of output will be higher than the social optimal output[4]. Government intervention is needed to internalize externalities in production and consumption decisions of individuals so that social optimal levels of outputs and private optimal levels of outputs will be the same.

Environmental Externalities

The Environment (Protection) Act, 1986 defines environment to include 'water, air and land and the interrelationship which exists among and between water, air and land, and human beings, other living creatures, plants, microorganisms and property'.

Due to population growth and rapid industrialization, environmental resources such as groundwater and water in lakes and rivers and clean air in many places have become scarce resources. Industrial discharge of untreated effluents into water bodies and emissions into air have deteriorated the quality of water and air respectively. Negative intertemporal externalities occur when exhaustible resources are depleted and when renewable resources are harvested at rates greater than the regeneration rates.

Market Failures and Policy Failures

Environmental problems such as pollution and depletion and degradation of natural resources arise because of market failures and government failures. Market failures occur because markets for environmental goods and services do not exist or when the markets do exist, the market prices underestimate their social scarcity values.

Markets can exist and function efficiently only when property rights on goods and services exchanged are well defined and transaction costs of exchange are small[5].

For environmental resources such as clean air, water in river and springs, oceans and atmosphere, property rights are not well-defined. In most countries these resources are in public domain. Users of these resources consider them as "free" goods or "unpaid" factor of production. Therefore they impute zero prices for using these resources in their private decisions even when their social scarcity values are positive. Two important reasons for non-existence of the markets are (a) difficulty in defining, distributing and enforcing property rights and (b) high costs of creation and operation of markets.

Common property regimes do exist in fisheries and forestry. This regime permits exclusion of others from access to the resources. But collective ownership without binding agreements on rates of extraction on sharing of costs and benefits will result in overuse of the resources because each user does not take into account the consequences of his or her actions on other users. This is the well known problem of "tradegy of the commons"[6].

Forestry provides both marketed (e.g. timber) and non-marketed (e.g. carbon sink) outputs and services. Forest owners/users will normally take into consideration in their private investment and production decisions only their revenues and costs and not the benefits which accrue to society as a whole e.g. biodiversity conservation, carbon sink and other ecosystem benefits. Here the markets are incomplete in the sense that there are no exchange institutions where the persons pay for the external benefits. As a result levels of activities such as habitat preservation, forest cover, biodiversity conservation will be below their social optimal levels.

Public ownership and management of common properties or regulation also pose problems because of lack of knowledge as well as information asymmetry both at the stage of design of rules and at the enforcement stage. Consideration of equity as well as political myopia act as barriers to social cost pricing of environmental resources and services.

Environmental Externalities: Types

Environmental externalities can be classified depending on how they affect individuals and regions. Environmental pollution or degradation may be local in

nature as in water pollution in lakes, land degradation and air pollutant like particulate matter. Local pollution becomes a local public bad when it has two characteristics namely non-rivalry and non-exclusion[7]. Pollution of large rivers and degradation of mountain ecosystems may affect many states/regions. Greenhouse gas emission is a global public bad in the sense that regardless of where the pollutants are emitted, the aggregate emissions affect all persons in the earth and the ecosystem as a whole.

The type of externality has a bearing on determining the appropriate unit for environmental governance. Here, the Subsidiarity Principle is relevant. This principle states that environmental decisions and enforcement be assigned to the lowest of government capable of handling it without significant residual externalities. For local public bads the appropriate authority is the concerned local body, that is, panchayat in village and municipality or corporation in an urban area. For pollution and natural degradation problems having regional effects the appropriate unit of governance may be state government. However, it should be noted that administrative boundaries and ecosystem boundaries may not match. For water resource development, an ecologically appropriate unit namely a watershed, may be within a state or it may be spread over more than one state. Environmental problems of transboundary nature e.g. acid rain, river pollution affecting more than one country and coastal zone degradation affect neighbouring countries. For global environmental problems such as climate change, ozone depletion and biodiversity loss, collective action level is needed at the global level.

POLICY OPTIONS FOR DEALING WITH ENVIRONMENTAL EXTERNALITIES

Theory

The theory of negative externality is the foundation of environmental economics. We review briefly three seminal contributions to the theory by Pigou (1920), Coase (1960) and Baumol and Oates (1988).

Pigou deals with the problem of smoke emission by a factory damaging nearby business/residents. His solution for correcting the negative externality is to impose a per unit tax on output of the firm generating the negative externality. The per unit tax should be equal to the difference between the social marginal cost and the

private marginal cost corresponding to the social optimal output, the output satisfying the condition the price equals the social marginal cost. Imposition of such a tax will raise the output price and reduce the demand and thereby helps in internalizing the environmental costs to some extent in the decisions of producers and consumers of the product. Pigou recognizes that 'sometimes, when the interrelations of the various private persons affected are highly complex, the government may find it necessary to exercise some means of authoritative control' (p.194).

Coase considers the pollution problem of reciprocal nature. He says it is necessary to know whether the damaging business is liable or not for the damage caused since without the establishment of this initial delimitation of rights there can be no market transactions to transfer and recombine them. But the ultimate result (which maximizes the value of production) is independent of the legal position if the pricing system is assumed to work without cost. This proposition is known as the Coase theorem. He argues that the problem which we face in dealing with actions which have harmful effects is not simply one of restraining those responsible for them. What has to be decided is whether the gain from preventing the harm is greater than the loss which would be suffered elsewhere as a result of stopping the action which produces the harm. He rules out government intervention in the form of specifying standards or levying a tax to correct the externality, but advocates a role for government in defining and enforcing property rights for environmental resources and mitigating transaction costs.

Baumol and Oates highlight the information problems (knowledge of marginal damage and marginal social cost functions, determination of social optimal output and its uniqueness) in implementing the Pigouvian tax. To solve this problem he suggests a two-stage approach: First, decide the ambient standards based on available scientific knowledge or/and social preferences, and second, pursue one of the following two options, namely, standards and charges approach or standards and permits approach. Given the standards, the charges can be decided based on knowledge of the marginal abatement cost functions. Alternatively, given the standards and information about the baseline pollution levels, tradable permits/quotas can be distributed and prices of the permits be determined by the market forces.

Objectives of Environmental Policy

The United Nations Conference on Environment and Development (UNCED) held at Rio de Janerio in 1992 specifies the following objectives of environmental policy:

1. To incorporate environmental costs in the decisions of producers and consumers, to reverse the tendency to treat environment as a "free good" and to pass these costs on to other parts of society, other countries or to future generations.
2. To move more fully towards the integration of social and environmental costs into economic activities, so that prices will appropriately reflect the relative scarcity and total value of resources and contribute towards the prevention of environment degradation.
3. To include, wherever appropriate, the use of market principles in the framing of economic instruments and policies to pursue sustainable development (UNCED: *Agenda 21*, Chapter 8, p.85)

It may be noted that Agenda 21 adopted at the Conference represents a global consensus and political commitment at the highest level on socio-economic development and environmental cooperation. The Rio Declaration advocates the principles of intergenerational equity, the polluter pays principle and the precautionary approach in framing environmental policies.

Policy Options for Internalising Negative Externalities

We indicate below policy options available for internalizing environmental externalities.

a. Pollution from stationary or point sources

i. Regulatory mechanism: standards and regulation
ii. Pollution charges based on volume of effluents/emissions and concentrations of pollutants (above the prescribed limits) in effluents/emissions
iii. Assignment of tradable pollution permits and creation of markets to determine their prices
iv. Liability insurance, environmental bonds, bank guarantees
v. Taxes on outputs/inputs of polluting units

vi. Fiscal incentives for pollution abatement and introduction of clean technologies

vii. Use of market signals for environmental compliance: ecolabelling, green rating, public disclosures.

b. Pollution from non-stationary or non-point sources

i. Deposit refund system

ii. Technology standards e.g. vehicle standards, pesticide content in food

iii. Taxes on observable, measurable items which serve as proxies for pollution tax base e.g weight of car, type of fuel.

Choice among instruments of pollution control depends on factors such as information intensity, political feasibility, institutional capacity, cost effectiveness and environmental effectiveness. For a discussion on the design problems, preconditions for application and their evaluation and references to the literature, see Sankar (2001).

c. Natural resources

Natural and environmental resources are vital for sustainable development. As inputs into production, they are private goods but problems of depletion and degradation do arise. As waste disposal services, quantities of disposals should be related to the environment's assimilative capacity. Common property/common pool resource problems and use of nature as a sink, a free good, arise. As life support and asthetic services, they provide non-marketed/non-use values. Hence government intervention is needed to correct market failures.

i. For private goods like coal, petroleum and other exhaustible resources prices to reflect marginal social costs including depletion costs

ii. For renewable natural resources, prices/user charges should be fixed in such a manner the harvesting rates do not exceed the regeneration rates. Subsidies which encourage unsustainable use should be phased out

iii. For resources having use and non-use values an incentive package consisting of prices based on long-run marginal costs for goods/services having use values, and subsidies for production of non-use values yielding ecosystem benefits

iv. Where there are threats of serious or irreversible danger to a natural habitat, the precautionary approach be applied by designating such an area a protected area.

GLOBAL ENVIRONMENTAL EXTERNALITIES

Global environmental issues can be classified under three heads: (a) trade-related, (b) pollution, and (c) biodiversity. Greenhouse gas emissions, ozone depletion and biodiversity are global public bads. Here, collective action and binding agreements are needed to avoid free-rider problems. On trade and environment, there is a consensus on the need for regulation of movement of hazardous chemicals, trade in endangered species, and exports of goods causing environmental problems in importing countries. On issues such as whether developed countries can prescribe their own environmental standards on imports from developing countries, whether processes and production methods requirements are legitimate under GATT rules and whether use of mandatory or voluntary environmental requirements amount to non-tariff barriers remain contentious. In all these cases the relative roles and responsibilities of developed and developing countries assume significance because they are in different stages of development and their tradeoffs between environment and development differ. In this context it is worth remembering the Rio principles.

The Rio Declaration contains the following principles for international cooperation on environmental issues:

Principle 2: States have…… the sovereign *right to exploit their own resources pursuant to their own environmental and development policies,* and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other states.

Principle 6: The *special situation and needs of developing countries*, particularly, the least developed and those most environmentally vulnerable, shall be given special priority.

Principle 7: States shall cooperate in a spirit of global partnership to conserve, protect and restore the health and integrity of the Earth's ecosystem. In view of the different

contributions to global environmental degradation, *states have common but differentiated responsibilities*. The developed countries acknowledge the responsibility that they bear in the international pursuit of sustainable development in view of the pressures their societies place on the global environment and of the technologies and financial resources they command.

Principle 9: States should cooperate to strengthen endogenous capacity-building for sustainable development by improving scientific understanding through exchanges of scientific and technological knowledge and by enhancing the development, adaptation, diffusion and transfer to technologies, including new and innovative technologies.

Principle 12: States should cooperate to promote a supportive and open international economic system that would lead to economic growth and sustainable development in all countries, to better address the problems of environmental degradation. *Trade policy measures for environmental purposes should not constitute a means of arbitrary or unjustifiable discrimination or a disguided restriction on international trade*.

The common but differentiated responsibilities principle is recognized in multilateral agreements relating to trade (Uruguay Round), ozone depletion (Montreal Protocol), climate change (Framework Convention on Climate Change) and biodiversity (Convention on Biodiversity). There are also special programmes for capacity building and financial support in environmental management for developing countries through agencies such as United Nations Development Programme, United Nations Environment Programme and Global Environment Fund,. But there is a limited success in the transfer of environmentally sustaining technologies to developing countries on concessional concerns. Many developing countries are also concerned about uses of environmental standards by certain developed countries as non-tariff barriers. Such attempts would erode the comparative advantage of developing countries in exports of labour-intensive manufactured products such as processed food, leather and leather products and textiles.

POLICIES FOR INTERNALISING ENVIRONMENTAL EXTERNALITIES IN INDIA

India has been playing a proactive role on international environmental cooperation since 1972. Constitutional sanction was given to environmental concerns through the 42nd Amendment, which incorporated them into the Directive Principles of State Policy and Fundamental Rights and Duties. Beginning with Water (Prevention and Control of Pollution) Act 1974, a series of environmental Acts have been enacted, including the umbrella legislation, the Environment (Protection) Act 1986[8]. Also, India has a legal framework for dealing with environmental issues relating to forests and biodiversity. The Ministry of Environment and Forests is the apex regulatory and administrative agency for all matters relating to environment. India has also developed the institutional capacity for documentation of flora and fauna, forest cover, biospheres, land degradation, and traditional knowledge. The Ministry's publication *Agenda 21 An Assessment* (2002) documents India's experience in implementing Agenda 21.

India's efforts in implementing Agenda 21 in terms of creation of legal and legislative framework, capacity building in science and technology and institutional setup are noteworthy. However, India needs environmental policy reforms both in pollution prevention and control and natural resource management in order to internalize environmental externalities.

Reforms in Pollution Control Policy

India's pollution control policy regime may be characterized as command and control regime. The emphasis is on criminal jurisprudence rather than encouraging sustainable development. Enforcement of the laws is generally weak because of information problems relating to prosecution and conviction of non-complying units, especially small scale units. From an economic angle, the enforcement problem arises because the penalties are unrelated to the extent of violations. Our law considers only compliance or non-compliance and not the extent of compliance. As the cost of compliance increases with the level of pollution abatement, we need a penalty structure where the penalty must be linked to the extent of violations.

The Judiciary has been playing a proactive role in recent years in the enforcement of environmental regulations. In cases dealing with pollution from

tanneries, it directed the tanners to install treatment plants or face closure or relocation, and bear the remedial cost as well as compensation to the victims of pollution. In cases dealing with pollution in Delhi, the Court directed the government to facilitate a switch from diesel to compressed natural gas for buses, cars and autorickshaws in Delhi within a specified period. The Court also gave directions to central and state government to ensure compliance with the laws, to create new authorities for implemntating Court decisions and offered advice on environmental protection.

Full internalization of environmental externalities in a market economy can be achieved voluntarily by polluters only if they realize that compliance with regulations is a better option than non-compliance. The advantage of an economic instrument is that a pollution charge or a penalty is linked to the extent of violation. The Ministry of Environment and Forests issued a Policy Statement for Abatement of Pollution in 1992. It recommends the adoption of polluter pays principle and new approaches for considering market choices 'to give industries and consumers clear signals about the cost of using environmental and natural resources'.

At present, there is little prospect of introducing a pollution permit trade scheme in India. Indian law provides only usufruct rights for natural resources while implementation of a tradable permit scheme requires that the rights are exchangeable. The Supreme Court gives the right to clean environment to citizens. Further, the design and implementation of a tradable permit scheme requires a good information system about the sources of, extent of and geographical dispersion of pollution, a fairly large market so that competitive outcomes would result, and administrative capacity to design the system, certification of credits and so on.

It may not be feasible to introduce pollution charges now. Our environmental legislations, except the Water Cess Act, are not in the nature of money bill. Even in the case of the Water Cess Act, the preamble says the purpose of the cess is to finance the activities of Pollution Control Boards and not environmental protection. We need a comprehensive environmental legislation for introduction of tradable permit scheme and pollution charges, wherever they are feasible and desirable.

A few other economic instruments have been in vougue. They include fiscal incentives for erection of effluent treatment plants, eco-labelling scheme, green rating on experimental basis, environmental audit in Gujarat, bank guarantee schemes in West Bengal and a few other states for compliance with Court verdicts and fulfillment of obligations under the consent to establish and consent to operate schemes implemented by the State Pollution Boards. Even in establishment of common effluent treatment plants for small polluting units in industrial clusters, the focus is more on technology and administration and no effort has been made to introduce incentive-based cost sharing agreements.

There is no legal or administrative hurdle to levy a tax/charge on inputs/outputs of polluting activities. Madras School of Economics (2004) has submitted a proposal on such taxes to the Ministry of Environment and Forests for consideration.

Reforms in Natural Resource Management

The government has taken a few initiatives in the management of natural resources by involving the affected parties/users. The initiatives include Joint Forests Management, Tree Growers Association in Common Property Areas, and Water Users Association.

There are many government – induced policy distortions in natural resource pricing. Irrigation water and drinking water are heavily subsidized. Electricity for agricultural pumpsets is heavily subsidized; in a few states it is provided free. As a result there is an alarming extraction of ground water. Prices of coal, chemical fertilizers, kerosene, and LPG are below their social costs.

At present pricing of natural resources and some publicly supplied goods is highly politicized. There is a political resistance to raise prices due to cost escalations. The cost of inaction must be understood. Economic Survey 1998-99 documents the current status of environment, notes the causes of environmental degradation and discusses some policy options. It reports that the annual cost of environmental degradation (urban air pollution, water pollution, soil erosion, land degradation and deforestation) in 1992 at US$ 10-13.8 billion and the cost as percent of GDP in the range 4.5-6.0.

As India is contemplating a sustained annual GDP growth rate of 7-8 percent, it is time that environmental concerns are integrated in the decisions of producers and consumers so that polluters pay for pollution and users of environmental resources pay user charges/prices which reflect their social scarcity values. If full cost pricing is not feasible because of sudden increases in prices of certain essential items, the price increases can be done in a phased manner. Equity considerations can also be taken into account in case of a merit good like drinking water via differential pricing for deserving target groups.

Footnotes

1. A resource allocation is inefficient according to Pareto if it is possible, by a reallocation, to improve the welfare of atleast one individual without decreasing the welfare of others.
2. Marginal cost refers to the incremental cost of producing an additional unit. For example if the total costs of producing n and (n+1) units are C(n) and C(n+1) respectively, the marginal cost of (n+1) unit is C(n+1) – C(n). The average cost of producing (n+1) unit is C(n+1) / (n+1) which may be smaller, higher or equal to the marginal cost. The price measures the amount a consumer is willing to pay for the good, at the margin. The marginal cost reflects the real cost (in the sense of foregone alternatives) of producing an additional unit.
3. Marginal social benefit is the sum of marginal private benefit and marginal external benefit.
4. Marginal social cost is the sum of marginal private cost and marginal external cost.
5. Property rights include right to own, right to use and right to exchange. When land tenures are insecure, there is little incentive for tenants to prevent land degradation.
6. Hardin (1968) shows how the tragedy of the commons arises in over exploitation of grazing land with open access and pollution. Ostrom (1990) discusses the design principles and institutional mechanisms of enduring commons.
7. Public bad is the opposite of public good.
8. See Divan and Rosencranz (2000).

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