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## Environmental Concerns: An Economic Perspective

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**Abstract:**

*Although environmental economics is a new area of research emerging very fast, there is vast literature available in this field. In this paper we are trying to provide a comprehensive view of the development of environmental economics, ranging from the greats of Malthus to modern economists. Of course, we are confining to important research works of this discipline in general and the application of the concepts of environmental economics for abating water pollution in particular.*

**Keywords:** Externality; Tragedy of Commons; Economic Perspective; Economic Instruments; Command-and-Control Instruments

### 1. Introduction

The various economists starting from Malthus to Dasgupta have addressed economic perspectives on the environment and have pointed out factors responsible for its damage. Human beings have been concerned about the environment because of dependence on it. Initially the main concern about environment was to treat it as an extractive resource for fuel, food, water and salt. During the nineteenth century in the era of industrialization, the environmental concern was mainly for raw materials for industry using both renewable and non-renewable resources. Though originally environment may have been viewed as a source of extractive resources, but economist like J.S. Mill (1965) also emphasized the quality of environment to enjoy solitude and natural beauty. Accordingly, we can classify the environmental problem in two distinct foci, (a) resource depletion problem (b) pollution problem. The first refers to problems with use of renewable resource such as forests, fisheries or biodiversity, as well to problems associated with the non-renewable resource such as coal, mines and oil etc. The second refers to injection of wastes into the atmosphere from production and consumption activities. While the natural scientist base their perception of pollution, mainly on the physical effect on the environment, we in economics rely on perceived utility losses to define the pollution. In welfare economics, environmental pollution is regarded as an 'externality'. Externality arises when consumption and production decisions of an individual enter into the utility or production function of other individuals without providing any compensation. An externality may be positive such as a rose garden in your neighborhood or may be negative a polluting factory in your surroundings. In economics, pollution is defined not only on the basis of physical effects on environment, but also on the basis of human response to the physical effects.

### 2. Economic Concerns

In economics, concern about the deterioration of the quality of the environment dates back to the classic works of Malthus (1798). It was an alarming work in the sense that it made clear that the natural resources are finite and must be used cautiously. Malthus was of the opinion that there are limited possibilities regarding the use of natural resource. Natural resources can support only a limited population because of difference in their growth rates. However, Malthus approach is static because he assumed that the technology would only have a slight or modest influence on the level of production.

According to Hardin (1968) 'tragedy of commons' reappears in a reverse way in pollution problems. In this situation, each individual is contributing something's in the commons-sewage or chemical, radioactive and heat-wastes into the water body. While doing so, each individual thinks that his share of the cost is less than the cost of purifying his wastes before releasing them and it is true for everyone independently. To prevent this tragedy of commons (as water, fencing may not be possible), Hardin recommends coercive law or a taxing device, which make it less expensive for the polluter to treat his pollutants, rather than to discharge them untreated.

Mishan's (1967) most significant contribution to the discussion of environmental problems can perhaps be found in the fact that he, being a well-known economist, attacked traditional economics, in which environmental issues were ignored. He strongly criticized the concept of economic growth because of overlooking and neglecting the other economic issues specifically the environment. Mishan's ideas about 'solutions' to the environmental problem are two folds; one instrument could be the implementation of amenity rights. The amenity rights can be a kind of property rights with right to environmental goods. As soon as these rights are established, people who experience a loss of amenity may go to the court to force the economic actor to stop frustrating the amenity rights, or the victim may negotiate with the polluters aimed at reaching a certain acceptable level of pollution with or without compensation. This amenity rights framework can only work if there are limited numbers of polluters.

A second way of 'solving' the environmental problems mentioned by Mishan is the idea of separate facilities: certain parts of the country can be used for polluting activities while others are excluded. In this case, people can choose the location of their houses according to their evaluation of environmental pollution. Here again the assumption is that it is possible to restrict pollution to a certain geographical area. In this model national and trans-boundary pollution causing problems in all location, is a non-issue.

Commoner (1971) viewed pollution as the result of free-market economy in which, the goal of firm is to grow. As a part of this competitive process, firms try to find new combinations resulting in new and improved products. He gave the examples of artificial fertilizers, plastics and heavy metals, etc, using fossil resources, which are exhaustible. Pollution reduction can be done by using 'old fashioned' raw materials and materials of an organic nature which, are more compatible with the ecosystem itself. Unlike Hardin, Commoner did not blame pollution; rather it is the inevitable result of this counter-ecological pattern of growth.

Meadows (1972) sought to establish the relationships among all relevant variables like accelerating industrialization, rapid population growth, widespread malnutrition, the depletion of non-renewable resources and deteriorating environment in a single model first time by taking changes in decades or centuries instead of months and years. Despite of its severe criticism, this phenomenal work has helped to improve our macro global mental models.

The declaration of the United Nation Conference on Human Environment (1972) held in Stockholm has considered the need for a common outlook and for common principles to inspire and guide the peoples of world in the preservation and enhancement of human environment. This conference proved to be one of the most significant events in the history of environmentalism, which led to the development of a number of national and international policy programmes aimed at reducing environmental problems. Additionally, the relevance of the Stockholm conference can be demonstrated by the fact that the significant international problem of acid rain (or air pollution as it was called then) was put on the international agenda. Thereafter, the first conference on a European policy for protecting clean air was convened in Geneva in 1979, in which agreement was reached on general principles such as the dissemination of information and technology, the relevance of public health and necessity of reducing emission.

Boulding (1973) held that the aims of a traditional economic raw materials. However, this process causes the environmental problems. Such a production process causes the environmental problems. Such a production process is based on a cowboy economy in which people are inclined to look for other resources, which will create new possibilities for mankind. This typical approach has to be replaced by a spaceship economy in which people are aware that we have only a limited supply of energy, raw materials and other resources including natural resources.

Tinbergen (1977) focused on the question of how to distribute wealth and income in a world with limited resources. He argued that in a world with limited resources and limited possibilities of growth, underdeveloped countries should be allowed to take a more than proportional share in comparison to Western developed countries, which have already reached a certain level of wealth and income. According to Tinbergen, what we need, is a New International Order based on the rights of all human beings to live a safe life, unhampered by fundamental shortage of essential resources.

United Nation's World Commission on Environment and Development (1987) in its publication *Our Common Future* established a systematic relationship between environmental and developmental issues for the very first time. It made explicit that the environment is not an isolated issue but is closely related with food, fuel, fodder, poverty, safety, development, employment and existence of life on earth.

Shiva (1988) has examined the position of women in relation to nature (the forests, the food chain, and water supplies) and links the violation of nature to the violation and marginalization of women, especially in the Third World. She has concluded that it is only the ecological path of harmony, sustainability and diversity to survival and liberation for nature, women and men.

*The Dutch Environmental Research Institute*, National Institute of Public Health and Environmental Protection (1989) presented an analysis of ecological cycles for flows of material and energy at five levels –local, regional, fluvial, continental and global. The general idea of the report is that a far-reaching adjustment of our management of the environment must not be delayed, even if we are still faced with numerous uncertainties.

P.Harrison (1992) pleads for a multi-disciplinary approach to development and an action programmed to resolve the growing environmental crisis with broadest analyses and strategy. Most of theories in the field stress single cause like population or over-consumption or technology or inequality and/or denial of importance to others. According to Harrison, three factors are having a direct impact on the environment: population, consumption and technology, which dictate how much space and resources, are used and how much waste is generated to meet consumption needs.

Dasgupta (1995) has provided an excellent synthesis of the issues associated with population, poverty and environment. Part of the debate however, centers on whether population growth cause poverty or whether poverty cause population growth. It is not population growth, per se, that results in environmental degradation; rather it is population growth coupled with poverty that places tremendous strains on the environment. Hence, the environmental policy should be sensitive to the economic circumstances of the population.

The World Commission on Environment and Development (WCED), also known as the Brundtland Commission, Report (1987) defines “sustainable development as meeting the needs of the present generation without compromising the needs of future generation. Despite the popularity of concept of sustainable development, there are considerable disagreements to the conceptual as well as operational content of the term. Whereas, the neo-classical growth models of Solow (1974) and Hartwick (1977) has incorporated natural resources constraints in economic activity modeled sustainable development as non-decreasing consumption over time. The main emphasis here is on inter-generational efficiency. However, this approach is criticized on various grounds because it may not be feasible to substitute man-made capital for natural resources.

As Pearce and Turner (1990) argue that some components of natural capital cannot be replaced by man-made capital. There are various examples, such as processes responsible for regulation of atmospheric composition, spiritual and cultural values provided by certain natural resources and nutrition cycle etc; where it is not possible to substitute natural capital by man-made capital.

Ciricacy-Wantrup (1952), in the safe minimum standards approach notes that reduction in the natural capital stock be prevented unless the opportunity costs of doing so are very large. But in practice it is very difficult to calculate the costs and benefits of the critical assets, because of the preference of living individuals and subjectively involved. However, one feasible option to society is the preservation of these natural assets.

### 3. Pollution Control Instruments-A Critical Issue

Various policy instruments to control pollution have been suggested and devised by number of researchers starting from the classic work of Pigou to the modern economists. Pigou (1920) recognized the shortcomings of a market economy dealing with the issues of environmental degradation. The concept of negative external effects made it possible to analyse environmental problems from an economic point of view. In the Pigouvian approach negative external effects have to be defined by authorities, which, allows them to monetize these effects. Pigouvian approach recommends an economic tax to shift the burden of these social costs to the polluting industries, restoring optimal allocation of production factors. This approach had some practical difficulties, as the impact of polluting activities on nature and the environment are uncertain.

Pigou (1932) provided the first systematic economic analysis of pollution as an externality phenomenon. According to his view externality arises when there is divergence between marginal social net product and marginal private net product. Under the condition of competition, he observed that, ‘self interest will tend to bring about equality in the values of marginal net products of resources invested in different ways.... but when there is a divergence between these two sorts of marginal net products, self-interest will not, therefore, tend to make the national dividend a maximum; and consequently certain specific aspects of interference with normal economic processes may be expected, not to diminish but to increase the dividend’. To internalize the negative external effects as in the case of pollution, he recommended a pollution tax. If marginal external effects costs are negative, and accordingly, the externality is positive, the Pigou tax consequently is negative i.e. a subsidy. Hence, Pigouvian approaches make the polluters liable for the negative externality and recommend pollution taxes to correct it. Apart from Pigou-taxes, Pigou-subsides is also suitable for guaranteeing the marginal condition for a Pareto Optimum in a decentralized market system, even in the case of a negative externality. Coase (1960) however, described that the first order condition for an optimum car under certain circumstances also be met without the introduction of taxes or subsidies in competitive equilibrium even if competitive markets for external effects do not exist. This requires that the parties involved in an externality enter into voluntary negotiations in order to be able to realize gains from trade. However, precondition for this is that, there is limited number of polluters and of those affected by the externality. Here Coase assigns a role for the state in defining and enforcing property rights for environmental resources but rules out government intervention in the form of specifying the standards or imposing a tax to correct the externality.

Coase theorem postulates that the transaction costs combined with negotiation must not be high (actually zero) and those affected by pollution need to know the polluters as well as the extent of the damage. If a negotiation solution can be reached in such a scenario, the introduction of Pigou taxes may even disturb the Pareto optimality. But it is very difficult to define the property rights for natural resources such as water and air etc. therefore negotiation between polluters and pollutes can be very costly especially when numbers involved are very large. Coase (1981) recognized this problem of transaction costs as he writes: ‘In order to carry out a market transaction it is necessary to discover who it is that one wishes to deal with, to inform people that one wishes to deal and on what terms, to conduct negotiations leading upto a bargain, to draw up the contract, to undertake the inspection needed to make sure that the terms of the contract are being observed, and so on. The operations are often extremely costly, sufficiently costly at any rate of prevent any transaction that would be carried out in a world in which pricing system worked without cost’.

Helm and Pearce (1990) note that the basic difference between Pigouvian and Coasean solution lie in the mechanism recommended for resolving the externality problems. In Pigouvian approach, state is involved to identify the polluters and estimate the marginal abatement cost, as well as gathers information about the damage and estimate the marginal benefits. Thus tax is set at that point where marginal abatement cost and marginal benefit are equal to each other. However, Coasean approach relies heavily on the role of polluters and the pollutes and their bargaining power in a free market. If both the parties are unable to reach a solution, the case goes to the court.

Dales (1968) established that if costs-benefits of pollution/pollution abatement are known to the pollution control board/authority – then the pollution rights market (developed by auctioning emission rights among competing bidders) could lead to the same efficient level of pollution as in the case of an emission tax.

Kneese and Bower (1968) are the first economists after Pigou to treat externalities analytically and at the same time express a serious concern for water pollution. The major contribution of their study are-(1) an explicit use of the Pigouvian externality framework,

which economist can further develop and apply to this problem and (2) recognition of other management alternatives. They have recommended internal process change, recovery and recycling of residuals, public investment in centralized treatment and flow augmentation with end of pipe treatment of wastes.

Buchanan (1969) has shown that imposition of a Pigouvian tax in a non-competitive market can considerably reduce social welfare rather than raise it. A monopolist restricts output below socially optimal level, and with the imposition of tax on waste emission, he can further reduce the production. The net effect is not clear. The welfare gains from less pollution must be offset against the losses from less production by the monopolist. So the regulatory authority should introduce twin policy measures- a tax on waste emission plus a subsidy to the output equal to the difference between MR and MC at the socially optimal level of pollution.

Dorfman (1972) has proved that a uniform standard would, generate a higher pollution level as compared to a uniform effluent charge or pollution tax. Baumol and Oates (1972) have shown that due to an externality, a non-convexity may develop in the production possibility set which may affect the effectiveness of Pigouvian taxes to drive the economy to a point of global efficiency. They have shown that the bribe (subsidy) does reduce emissions per firm; it would tend to increase them at industry level due to possibility of new entrants. Baumol and Oates pointed that efficient taxes will vary not only with meteorological conditions over space but also with any variations over time. They have also shown that the Zoning or spatial separation of polluter and pollute can limit the non-convexity but cannot prevent it. V.K. Smith (1975) argued that a tax could generate a technical change, which can also reduce the non-convexity.

Baumol and Oates (1988) obtained shadow prices (opportunity and marginal costs) by minimizing cost function of polluting firms subject to given production function and environmental standards as constraints.

Ferrari and Whinston (1972) and Tietenberg (1978) have derived that in a pollution rights market the environmental quality will be maintained without any further action (like changes in taxes), though prices of emission quotas may fluctuate like other markets.

Weitzman (1974) has shown that per firm welfare effects of price and quantity-based instruments are no longer the same if there is uncertainty about the marginal cost of abatement at the time that policy parameters are set. In particular, he showed that, with uncertainty about the position of the MCA (Marginal Cost of Abatement) curve, a quantity instrument would be preferred if the MCA curve is flat relative to MBA (Marginal Benefits of Abatement) curve, while a price instrument would be preferred if the MCA is relatively steep. The choice among instruments in a democratic society can be influenced by the geographical distribution of the impacts of alternative instruments, particularly when the improvement in environmental quality take the form of a public good where the benefits are widely dispersed. However, the costs of reducing the pollutants are often concentrated in identifiable geographic regions. Since, representatives of these regions bearing a large sum of the cost are likely to oppose strongly any legislation to be implemented for these improvements. However, the strength of the opposition from adversely affected regions is likely to be stronger, as the benefits are widely dispersed, though the costs are concentrated.

Jorgenson and Wilcoxon (1990) have identified that environmental regulation may have certain effects on the firms production technology like- (a) the firm may substitute less-polluting inputs for more polluting ones (b) the firm may invest in pollution abatement devices (c) the firm may change the production process to reduce emission. All these effects may also take place simultaneously.

Tietenberg (1991) has concluded that the command-and-control policy has been not efficient in part because it has been based on a legal fiction, a threshold below which no health damages are inflicted on any member of the population. In fact, damage occurs at levels lower than the ambient standards to especially sensitive members of the population, such as those which respiratory system in case of air pollution. This attempt to formulate standards without reference to control costs has been thwarted by the absence for a scientifically defensible health based threshold.

Jai Kishan (2002) concluded that CAC regime so far has not been able to do any good for environmental degradation in India. He advocates an alternative strategy in form of economic instrument to tackle this problem. Such an approach can benefit not only the pollution-affected public (less pollution) and the government (in terms of extra revenue) but also, the polluting industries as well.

However, Hahn and Stavins (1992) have stressed that the cost-effectiveness is by no means the only possible criterion for judging regulation policies. They have pointed out that why considerations such as overall effectiveness, ease of implementation, equity, information's requirement and enforcement capability political feasibility and involvement and clarity to general public should also be important.

Fare and others (1993) have analyzed the cost effectiveness of the regulatory system. Applying the distance function approach, which is originally outlined by Shephard (1970), the authors model the production outlined by Shephard (1970), the authors model the production technology using a translog output distance function and apply linear programming to compute the shadow prices. The purpose of their study is to construct shadow prices for pollution and examine the cost-effectiveness of the regulatory system and its impact on firm efficiency.

Romstad (2000) in his paper 'Theoretical considerations Regarding the Effectiveness of Policy Instrument' has made a strong case for incentive-based (IB) regulation over command and control regulations assuming that firms are sufficiently heterogeneous in their marginal cost schedule and the geographical location of emission is not so restrictive. The paper has highlighted that CAC regulations, on the contrary it is argued that regulations that have strong incentives for reducing marginal abatement costs over time, result in lower aggregate emissions.

Kahyarara (2000) in his paper 'Economic Instruments for Environmental Management in Tanzania- The case of Environmental Taxes' has shown that although environmental regulatory system of Tanzania is dominated by CAC approach, still production taxes, property taxes, miscellaneous taxes and local taxes are also used as tool of environmental protection. Specifically environmental taxes have

been imposed on sectorial activities, depending on the nature and intensity of environmental problems. The Dar-es- Salaam Sanitary and Sewage Department, for example, operates a tariff structure for sewerage with the assumption that 80 percent of the water consumed is disposed, industrial and commercial are shown as \$12, \$48 and \$13 respectively.

The benefits estimates from conventional water pollution control do exist but are subject to lot of uncertainty. Freeman (1993) has summarized such studies, focusing on 1985 as a target year. His survey of the field suggests that the benefits (in dollar on 1984 prices) from conventional water pollution control policy could be as low as \$5.7 billion or as high as \$27.7 billion with a most likely point estimate of \$14.0 billion. This compares to estimated 1985-annual costs (in dollars on 1978 prices) ranging from a low of \$25 billion to a high of 30 billion. So Freeman estimates suggest that the net benefit from conventional control is probably negative.

However, in a study Carson and Mitchell (1993), using a different methodology, concludes that current net benefits are positive but are likely to become negative as costs escalate in the future. Using contingent valuation to estimate the benefits, they have found that aggregate benefits in 1990 exceed aggregate costs by \$6.4 billion. However, they have also found that projected aggregate costs would exceed aggregate benefits because of the high marginal cost and the low marginal benefits associated with bringing the remaining bodies of water upto swimmable quality.

Luken (1990) examined the effects of regulation on a sizable sample of paper mills in the United States. The most striking aspect of his result is the marked variation across the sample in the measured level of damages resulting from the operations of the plants. Differences in the size and assimilative capacities of the receiving water and in the extent of neighboring populations imply that on economic grounds the extent of treatment of wastes should vary dramatically from one plant to the next. From this perspective, some move toward increased local discretion in the determination of regulatory parameters could achieve significant welfare gains in environmental management.

Hetemaki (1990), applying the transformed output distance function has calculated the shadow price for BOD and wastewater for paper and pulp industry in Finland. Using the annual data set from forty-six plants over the period 1972-1970, author has estimated the overall mean values of the shadow prices for BOD and wastewater flow as 109.8 FIM/ton and 366.4 FIM/1000 M<sup>3</sup> respectively.

Mehta, Mundle and Sankar (1993) computed marginal cost of abatement from estimating the total cost of abatement as a Cobb-Douglas type function of volume of influent, concentration of BOD in influent and concentration of BOD in effluent. They found that there are significant economies of scale with respect to volume of waste water treatment and estimated MAC per 100 gm of BOD reduction to achieve the BOD standard of 50 mg/litter varies between Rs. 0.24 and Rs. 1.36 at 1991-92 prices.

James and Murty (1996) have estimated abatement cost function for wastewater treatment for seventeen categories of highly polluting industries in India. Using a number of specification forms of Cobb-Douglas type cost functions, they have estimated pollutant-specific marginal cost of abatement and tax rates thereof. They have also estimated total tax liabilities of around Rs. 68 Million at 93-94 prices for the seventeen categories of highly polluting industries in India. The basic finding of their study is that a market-based hybrid instrument like a taxes- standards approach can have important role for control of industrial water pollution in India.

Xu (2001) has analyzed growth and environmental policy of China's paper industry. Objective of this paper is to examine the pollution control policies applied for the paper industry. The paper industry is the source of 10 percent of China's industrial wastewater effluents and one fourth of its chemical oxygen demand (COD) and is a major source of rural environmental pollution. The environmental authority in China favors the adoption of the end-of-pipe facility in pollution control and because financial requirements are high enough, government of China in 1996 simply closed 1000 small paper mills. The government's current rule is to close all the paper mills with annual capacity under 5000 tons. It has no other effective means to control effluents from these heaviest polluters. But the large firms are putting more energy in the efficient use of materials and/or making internal adjustment to reduce waste emission. This may reduce conventional output due to productive inputs being transferred to the abatement process.

Rusell (1981) has attempted to assess the importance of facilitating role of government in simulating the effects on the allocation of pollution control responsibility in response to regional economic growth, changing technology and changing product mix. Focusing on the steel, paper, and petroleum refining industries in the 11 country Delaware Estuary Region, his study estimated the change in permit use for three pollutants (BOD, SS and ammonia) that would have resulted, if a marketable permit system were in place over the 1940-1978 period.

Marsiliani and Renstorm (2000) have suggested tax earmarking that is 'dedicating specific revenues to the financing of specific public services' as a solution to time inconsistency problem in tax policy. They have shown the earmarking ruled that allocate a larger fraction of environmental tax receipts, than labor tax receipts, to abatement provide a double-edged incentive to the government for taxing energy less first, since the rules induce a scarcity of funds for public goods and are abundance of funds for abatement, the government raises the taxes that are largely earmarked to the scarce expenditure, and lower those taxes that are, largely earmarked to the expenditure that is abundant. Second, since abatement is abundant the government has an incentive to use less pollution tax.

Murty, Kumar and Paul (2001) have estimated shadow prices of bad outputs for sugar industry in India using output distance function to estimate the marginal cost of pollution abatement function. Using the taxed-standard approach, they have designed the pollution taxes using the estimates of MAC and pollution standard. They have estimated taxes necessary for making firms in the Indian sugar industry comply with the standards as Rs. 23518, Rs. 45,567 and Rs. 7,605 respectively per ton of BOD, COD and SS.

Hailu and Veeman (2000) have used the input-based method to estimate technical efficiency, technical change and shadow prices for the Canadian paper and pulp industry.

Snower (1982) suggests that the environmental target should be set so as to elicit the optimal relation between the production and treatment activities. He has shown that resources are transformed into consumption goods, treatment services and residual flows. In this context, paper has shown that different technological improvements, such as improved labor productivity or improved pollution

abatement technology, require dynamic target response. Moreover, every technological improvement calls for an 'inter-temporal target reversal'.

Daughjaerg (2000) has attempted to explain some of the reasons why green taxes have been introduced in some countries but not in others. He has concluded that the environmental policy-making is heavily influenced by historical perspective. Environmentalists have to maneuver within political system with well-developed structures, which, in most cases, are established long before the issue of pollution control appeared on the political agenda. This study has focused on two such structures, namely policy networks and the parliamentary support of the groups subject to green taxes. It has been argued that less cohesive the established policy network in the sector subject to green taxes, the more favorable is the condition for the introduction of them.

Bovenberg and Mooij (1994) maintained the hypothesis that environmental taxes may yield benefit over and above a cleaner environment. In particular government can use the revenues from pollution taxes to decrease other, distortionary taxes. In this way, environmental taxes may yield a 'double dividend' i.e. not only a cleaner environment, but also a less distortionary tax system. Indeed, they demonstrated that in the presence of pre-existing distortionary taxes the optimal pollution tax typically lies below the Pigouvian tax, which internalizes the marginal social damage from pollution. They have found that environmental taxes typically render the tax structure, a less efficient instrument for raising revenue and, therefore, increase the welfare cost of financing public spending. The additional cost of environmental taxes due to less efficient revenue raising are likely to be especially high if the marginal efficiency cost of the existing tax system are substantial. They examined an ecological tax reform in a simple model with a clean and polluting consumption good, with proceeds from pollution tax used to reduce a distorting tax on labor. The spillover effect in the model consists of the fact that not only the wage tax but also the environmental tax on the dirty good affects labor supply via a change in real income.

Buchanan and Tullock (1975), and Stratmann (1992) have demonstrated that, while his 'strength of preference' cannot be reflected directly in a one-person/one-vote process, it can be reflected through processes such as 'logrolling' or 'vote trading'.

Arnold (1979), Ackerman and Hassler (1981) and Hahn (1990) noted that when environmental policy decisions are made in federal system, the distribution of jurisdiction creates co-ordination problem as it is spread across levels of governments (Federal vs. State vs. Local). In addition, it can be spread across branches within the Federal or State Government (Executive vs. Legislative vs. Judicial).

Braden and Segerson (1993), Kolstad et al (1999) have suggested that in some cases the use of multiple instruments result in complementarity that serve to improve the effectiveness of individual policy instrument. But, it is a challenge to design a package that exploits the complementarity while at same time minimizing conflicting impacts of the individual prices of the package.

Singh and Goel (2001) have made an assessment of the impact of environmental protection programs on the productivity and efficiency of industrial workers of some units in Haryana. They found that these programs have positive effects in the form of better life quality for workers and such improvements.

Barde (1975) has noted that environmental policies in different countries are based on a common cost-allocation principle. Taking due account of diversities between different countries and with in region, which is, in fact an important condition for efficient environmental management, because each policy must fit as much as possible into the environmental conditions, social preference and economic structures prevailing in each country. Therefore, this diversity of situation calls for a diversity of policy instruments, whether it is in form of standard and or charges.

#### **4. Environmental Valuation Techniques: A Difficult Task**

A large number of researchers have made an attempt to measure the benefits of environmental quality by deriving its demand through various techniques. The measurement of benefits of non-marketable goods as environmental quality is quite difficult because there are not markets for these goods, at least in the usual sense, as demand cannot be estimated from people's response to prices. Freeman (1993), and Braden and Kolstad have developed a number of approaches like WTP (Willingness to Pay) survey, travel cost, hedonic, averting-behavior and cost of replacement method to estimate demands and value for commodities not traded in markets.

Mitchell and Carson (1989), Bjornstad and Kahn (1996) introduced the CV (Contingent Valuation) methods and evaluated CV research. Economist employ CV to infer the values of a variety of public goods, particularly environmental amenities. Mitchell and Carson (1989) also identified problems and biases associated with the formats of CV method.

Sherwin Rosen (1974) formalized hedonic price method to value both air quality and health, for non-market valuation. Accustomed to observing behavior in markets, it is preferred for indirect methods that infer value for a non-market commodity based on observed behavior in connected markets.

However, Bartik (1987) and Kanemoto (1988) have shown that the marginal WTP from the hedonic regression gives an upper bound estimate of benefits. Musgrave and Musgrave (1976) also noted that given that most polluted and overused resources are public goods, the people are likely to attempt to free ride, and it is difficult to estimate the true willingness to pay (WTP).

Diamond and Hausman (1994) have also pointed out many problems in using contingent valuation method like the nature, extent, and timing of information about the issue, limited knowledge people have about the effects of particular events, confusion regarding effects on the environment in general rather than any particular site, hypothetical evaluation of commonalties larger differences between WTP and WTA (Willingness to Accept) estimates- which, makes them less reliable for judicial purpose.

Backer (1983) suggested the averting-behavior method, which uses the household production framework to estimate the value of environmental quality. The household-production model postulates that households behave like firms, combining environmental quality together one or more market goods to 'produce' a service such as good health or cleanliness. By looking at way household trade-off between market goods at different levels of environmental quality it allows economists to infer the value of natural resource.

Another indirect approach, which is similar to averting behavior method, is travel-cost method, firstly proposed by Harold Hotelling (1949). This method presumes that households use environmental quality, together with market goods, to produce recreation services. The intuition underlying this method is that recreators pay an implicit price through the cost of travel and time to acquire access to a site. *Ceteris paribus*, people will continue to visit a site until the marginal value of last trip is exactly equal to travel expenses and the opportunity of the time spent travelling. As recreators visit a site from many different point of origin, they face different prices, and so their demand for site services can be estimated from their travel behavior. With estimated demand, consumer surplus can be calculated.

UN system of National Accounts use net national product (NNP) as a measure of national income, which does not take into consideration degradation and cost of maintenance of environmental quality. Hartwick (1990) and Maler (1991) have developed some methods to adjust the NNP to arrive at a measure of environmentally adjusted NNP. Murty (1996) have estimated environmentally adjusted gross domestic product for India. However, measurement of environmentally adjusted national-accounts, requires knowledge of relevant shadow prices, which are not easily and readily available. The Earth Summit held in Rio-de Janeiro in 1992 has outlined the need for integration of environmental and economic accounting.

Kuran (1987) noted that there is typically a divergence between the public and private preferences of individuals, and that people are likely to falsify their preferences in the face of political or other pressure, and in the face of uncertainty.

### **5. Collective Action: As an Alternative Strategy**

Many economists found collective action as a useful and effective strategy to control environmental degradation. Wade (1987), on the basis of a study of the institutions of collective action for resource management in thirty one irrigated villages in a district of South India, argued that it is possible for an interest group organization to emerge voluntarily and be sustained, on the whole, voluntarily i.e. without selective benefits or costs if the net collective benefits are high enough. He has many such examples where villager have themselves framed rules, monitored the condition of commons and cheating and have awarded punishment. He spells out the conditions for the success of this kind of self-organization.

Russel, Harrington and Vaughan (1986), taking a note from the seminal paper by Gary Becker (1968) on the economics of crime and punishment, have addressed enforcement issues as they apply to environmental regulations. Most of the literature on the economic of environmental regulation simply assumes that polluters comply with existing directives. However, they noted that violations of environmental regulations may have two sources: (a) a polluter can deliberately exceed his discharge limitation (or underreport emission under fee system) to reduce compliance cost or (b) a stochastic dimension to discharge may exist so that the polluters has only imperfect control over his levels of emissions. In such a situation, regulatory problem becomes a more complicated one. Therefore, regulatory authority not only set the usual policy parameter, but it must also decide upon an enforcement policy which involves both monitoring procedures and level of penalty for violations.

Ostrom (1990) in her study has analyzed, how a group of people who are in an interdependent situation can organize and govern themselves to get continuing common benefits when everyone have temptation to free-ride, shirk or otherwise act opportunistically. She argues that appropriation and use of the common-pool resource units are more closely related to the theory of private goods than to the theory of public goods but the process of designing, implementing, enforcing a set of rules to co-ordinate provision activities is equivalent to the provision of a local collective good. She has also discussed the principles and institutional mechanism of enduring commons. Nabli and Nugent (1991) argue that in a secure, stable and non-dictatorial environment it is possible for organizations and pressure groups to survive for long periods of time and hence attains maturity that helps them to devise incentives for collective action.

OECD (1992) Report observes that imposing environmental standards in many developing countries is difficult due to various inherent problems. In these countries regulations that stipulates penalties for non-complaints are hard to monitor, as the polluters are numerous small-scale operators. Regulations also presume some sort of devolution of power where the 'regulator' is entrusted with the task of monitoring and enforcing the standards. Although by no means unique to the developing world, bribery and corruption are important forces to reckon with. Murty (1995b) has noted that in the case of many developing countries including India, control of externalities like environmental pollution, the corrupt bureaucracy often colludes with external diseconomy-creating economic agents (mainly the industry) in augmenting the externality problem rather than correcting it. In such a situation, collective action by the affected party or political influence (Becker, 1983) exerted by the pressure group is the only option left for dealing the bureaucracy and perpetrator of externality.

Misra and Murty (1995a) suggested collective action as an alternative institution to government for environmental regulation. Collective action requires the government to play a minimal role of creating the initial property rights for the environmental resources. Collective action of affected people (who can organize themselves as clubs or as pressure groups thus reducing the Coasean transaction cost) and the bargaining between a coalition of the polluters and a grand coalition of affected parties can result in the optimal control of environmental pollution.

Murty and Prasad (1997) found that location-and community specific factors are important in facilitating informal regulation when formal regulation is ineffective. They have shown that the affluence of local communities as reflected in the higher relative development index of localities to which they belong and the level of political activity as reflected in their rate of participation in elections to parliament plays important role in determining the degree to compliance of industries with water pollution abatement standards. Murty (1999) found that voluntary collective action may be an alternative to market failure and government regulation in the management of common property resources. He noted that in the developing countries, people's capabilities to harness the

preserved commons and the fairness in the appropriation of benefits from them are the limits on the voluntary collective action. Paper also shows that there can be mutually beneficial sharing agreements between government & village communities from the management of local forest resources.

Goel, Chauhan and Jaikishan (2000) have suggested that collective action is possible if there are institutional arrangements in which all the relevant agents like polluters, affected public and the government can play an important role. Presence of incentives for all the relevant agents to co-operate in the management of an environmental externality is a pre-condition for any such arrangement. Out of these agents, affected people can take a lead by forcing the government as well as polluters to do some serious efforts to solve this problem. In addition, the govt. should involve various industrial bodies like CII, Assocham, FICCI etc. and other trade associations of specific industries while setting up regulatory mechanism to create a sense of participation.

Goel and Chauhan (2002) found that the private benefits of environmental protection programmes in India Fertilizers industry are far exceeding the costs for within-the-process innovation. But for the investment in end-of-the-pipe treatment technologies the private costs are very high and there is no incentive, for the producers to invest in these technologies.

## 6. Conclusion

The central economic problem of environmental economics has been the availability of adequate technical means an appropriate legislative and administrative framework availability of reliable data and designing of pollutants and contextual economic instruments.

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