ENVIRONMENTAL CRISIS IN INDIA
Management Stratagies*

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INTRODUCTION

"My own judgement, based on the evidence now at hand is that the present course of environmental degradation, at least in industrialized countries, represents a challenge to essential ecological systems that is so serious that if continued, it will destroy the capability of the environment to support a reasonably civilised human society" *(Barry Commoner. 1972)*.

Commoner, a noted biologist and acknowledged as a perceptive and informed student of environmental problems, based his opposition to unlimited growth after having assessed the impact of development on ecology. The concept has since gained wide support both from some economists and ecologists alike. Studies conducted on the computerized models [with parameters of Resources, Population, Food per capita, Pollution, Industrial output per capita] indicate a violent collapse of the world system under the assumption that no major changes takes place in the present system (Jay Forrester, 1971, Donella H. Meadows et.al, 1972). The report of Club of Rome entitled, "The Limit to Growth" by Meadows et al. (op.cit), and MIT Professor Forrester (op.cit), on "World Dynamics" was strongly oppo-

*Read in the Seminar organised during the celebration of Centenary.

sed by Professor William Nordhaus of Yale University in his paper 'World Dynamics, Measurements without Data' (1973), by replacing production equation with others,' allowing for some substitution among inputs in the process of production' and making it appear strikingly different from vision of catachymis collapse, Nordhaus (op.cit) emphasised on "possible improvement of technology" vis-a-vis growth or on 'increased output per unit of input' and also on the substantial range substitutability among inputs that characterizes most production process. The researchers however are to judge about the acceptibility of either of the sets of model but have to keep in mind that long term economic forecasts have not often fared very well and dressing them up in a set of equation does not necessarily make them any more valid' (Baumol & Oates, 1979). So one can argue that continued economic growth is possible but is it desirable ?

Prof. Mishan, of London School of Economics & Political Science, mentioned as far back as in 1969, that social and cultural costs of continued economic growth will be excessively high. The problem created 'out of efficiency,' and by uncheked commercialism' in a growth obsessed governmental system invariably leads to degradation of quality of human life, Mishan had agreed.

In India, after the colonial rule lasting over centuries, the obsession for growth is obvious in post-independence era. The Planning process is aimed at the same goal and the entire pattern has been an uninhibited mechanism for achieving quick result. The effects of such developmental projects on environment have been realised rather slowly, but nevertheless more perceptably in the last decade.

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RESOURCES, STATUS, USE AND STATE OF ART

The natural resources, are usually grouped as 'living' and 'non-living'. The resources base in any case does not offer an unlimited source for untilisation/exploitation. Taking a eue from the vital sector like Water Resources, one can proceed to examine the state of art.

Surface flow of water in India is channeled through 14 major rivers, which share among themselves 83% of the total drainage basin in the country, account of 85% of surface flow and serve of the 60% of the 685 million population (1981 census). The ground water reserve has been estimated at 210 billion cubic meters. The subject of water resource management has been given adequate thoughts in view of the fact that water is vital for agriculture, industry, hydel-power, and above all domestic life, of these irrigation and power takes up nearly 80% and 14%, of the available water/year, the remaining being shared almost equally by domestic and industrial sector.

The alarming and rather disheartening situation out of the sectors named above, can be seen in urban and rural water supply scenario. Classically, cities, and towns are classified by the population size and while 95% of the population in class I cities/towns (with 100,000+ population) is previlaged by water supply schemes, only 40% of the class VI towns (500 or less pop.) is covered by such a system. Seventy six percent of India's population live in 5,75,936 villages and the water supply to this vast habitat-centers remain abysmally poor.

While one can witness such lack of basic facility for the vast multitude of citizens of India, at the same time attempt can be made to assess the quality of water available to the previlaged ones. The user sectors consume about 80% of the water drawn and return to the the surface system, the rest. It is only after enactment of Water Act in 1974, the assessment work was started and Central Pollution Control Board initiated reporting on waste water collection, treatment and disposal in class I and class II cities/towns. It was revealed that 41% and 84% of waste water needs to be treated (CUPS/4/1978-79 & CUPS/6/179-80). Only 5.6 % of cities and 1.6% of towns have full sewerage and full treatment facilities and 50.7% and 77.36% have neither sewerage nor treatment facilities. During the preparation of project document, it was revealed that major source of pollution (between 84% to 92%) originate in domestic sector. The water born diseases continue to be the single most important group of diseases in India. (Table 1).

India has a total of 329 million ha. of land. While. India supports 15% of the world population, the land area constitutes only 2.4%. As such per capita availability

Table 1

APPENDIX-2

Water related Diseases with their Water Associations and Pathogenic Agents

Water related disease	Pathogenic agent	Category
Amoebic Dysentery	Protozoa	Faecal-oral-high infectivity

Water related disease	Pathogenic agent	Category
Ascariasis	Helminth	- do -
Bacilliary dysentery	Bacteria	- do -
Cholera	Bacteria	Faecal-oral-low infectivity
Tropical diarrhoea	Miscellaneous	Faecal-oral-high infectivity
Entrobiasis	Helminth	
Enteroviruses	Virus	
Gastro enteritis	Miscellaneous	
Giardiasis	Protozoa	
Hepatitis (infectious)	Virus	,,
Leptospirosis	Spirochaete	Faecal-oral-low infectivity
Paratyphoid	Bacteria	Faecal-oral-high infectivity
Trichuriasis	Helminth	
Tularaemia	Bacteria	
Typhoid	Bacteria	
Conjunctivitis	Miscellaneous	Waterwashed eye and skin infection
Leprosy	Bacteria	
Relapsing fever (louse borne)	Spirochaete	Waterwashed infection (skin)
Scabies	Miscellaneous	Waterwashed skin infection
Tinea	Fungus	
Trachoma	Virus	Waterwashed eye and skin infection
Typhus (flea, louse mite borne)	Rickettsae	Skin

Water related disease	Pathogenic agent	Category
Yaws	Spirochaete	Waterwashed skin infection
Clonnorchiasis	Helminth	Water based-ingested
Fasciolopsiasis	Helminth	
Guinea worm	Helminth	
Schistosomiasis	Helminth	Water based pente-trating skin
Arboviral infections	Viruses	Water related insect vector breeding in water
Dengue	Virus	
Filariasis	Helminth	
Malaria	Protozoa	
Onchocerciasis	Helminth	
Yellow fever	Virus	
Trypanosomiasis	Protozoa	Water related insect vecter biting near water

(From : Feachem. 1977)

of land in India is 0.48 ha, as against 4.14 ha, in USA, 8.43 ha, in USSR, 1.91 ha., in Burma and 0.98 ha., in China and Pakistan. When one considers the concentration of population in well-watered plains and the man-land ratio is taken in relation to arable land, it comes to only 0.27 ha. While this is considered to be very low, the quantum of degraded land, now called wasteland, is also astounding ; Out of 329 million ha, of land in the country, 175 M ha, is considered degraded.

The pressure on land becomes faster with the receeding forest (67 M ha) and increasing livestock. India supports, with just fourteith of world's land, half of its buffaloes and over a seventh of its cattle and goats. This leads to overgrazing and degradation. Likewise the opencast mining and underground mining activities and developmental projects demanding massive change in land use pattern cause serious depletion of nutrient level, loss of biomass and productivity. Loss of top-soil in areas of high population pressure and intensive monoculture is now well known. While Soviet Union has 620 millon acres of cropland and USA 421 million areas, India has only 346 million acres, but excessive loss of soil in terms of million tons has been estimated to the 2500 in USSR, 1700 in USA as against 4700 In India (Brown & Wolf, 1984) Such a heavy soil run off, as also indicated by the sediment load of single largest river system, the Ganga (1455 million metric tons), can be disastrous. In other-words, the land-pollution/degradation has become as great a concern, if not more, in dimension as that of water pollution.

The major parameters of living natural resources originate from biological diversity. The plant resources of India is rich and diverse with 45,000 species. Of the 15,000 vascular plants at least 60% are endemic. The endemism is noted both in the Himalayas as also in the Peninsular India. It is also the homeland of large number of vegetable germplasm (e.g. egg plant, wax gourd, loofah, cucumber, watermelon, melon, bitter goourd, pigeon pea, mung bean. okra, etc.) According to International Bureau of Plant Genetics, Rome, Indian subcontinent is considered to be the major centre of diversity of as many as 16

vegetable, (highest in the world). Likewise, a national survey estimated that although about 50,000 local rice varieties are still in cultivation, they are being rapidly lost due to changing land use and introduction of high yielding varities. But International Rice Research Institute asserts that "the seeds of these rare and endangered species of the world rice must be conserved to assure their survival". For example, *oryza nivara* a wild rice from India is the only known source of genesis for resistance to grassy stunt virus disease. Incorporation of that resistance into improved rice varieties has saved Third world farmers, millions of dollars they would have lost to disease or spent to protect crops with petrochemical based pesticides (IRRT Reporter 1-89 March 1989, Manila). It is not only Vegetable and Cereals, current national priorities are also aimed at germplasm of millets, legumes, oilseeds, fibre crop, fruit, crop, beverages, spices etc. The tree genetic resources is also threatened and as may as 20 species have been listed under this category (Indian Forester, 1980).

The animal wealth in the wild is facing increasing threat from loss of habitat. The mammals (340 species) birds (1230 species) reptiles (414 species), amphibions (198 species) and fishes (2100 species), all contribute to the national economy in the form ot utilizable protein, material for biomedical researches including behaviour and physiology and preparation of drug and pharmaceuticals. The domesticated animal species exhibit a wide variety (26 breeds of cattle and 7 of buffaloes) but remain prone to epidemics. The fish genetic resource is also undergoing a perceptable impact due to changing land use pattern and multipurpose river valley project. This is at

a time when only a few species have been cultivated and India's fish eating population continue to suffer from price-instability and hike due to the gap between demand and supply.

Forest resources of India need a special mention. The country is yet to have a rellable satistics of forest cover. The figure varies between 19-22% of the total land area as under forest, as against recommendation of National Forest Policy (1952) to put 33% upper forest. What is most alarming is the trend of deforestation at the rate of 1.5 million ha/per year, (out of a total forest land of 67.22 millon ha). The most common forest types in India are Tropical dry deciduous (38.77) and Tropical moist deciduous (30.9%) and in general, it is an accepted fact that Tropical Forest offer substantially higher biological diversity that the Temperate Forest and much of the yet to be discovered flora and fauna are expected from the tropical Forests. In one estimate, the majority of unknown living forms could only be expected from such forest patch (for example while 1, 300, 000 species of invertebrates are known from the world as many as 30 million insect species could be expected from Tropical Forest above (World Resource, 1986, p. 86).

The forest serves more than the purpose of supplying fuelwood for energy sector and industrial wood for number of users. The minor forest products account for 57.7% of the total foreign exchange in India. The removal of forests, according to several studies, causes loss of topsoil in catchment area, unstable slope condition and land slip, change in precipitation and evotranspiration, loss of habitat for biological forms (many yet to be described) and increase

in the impact of air pollution. In a recent study, at least ten hypothesis are put forward on how air pollution could cause forest decline. (World Resources, 1984, p.212). In other words, while broad-leaved forest can deceidedly act as remover of air-pollutants and agent for better environmental conditions, deteriorating condition of air-resources can, after a period of exposure to such toxic elements, cause direct damage to the forest. In India, the decline however is largely attributed to the changing land use pattern and to the onslaught of population and livestock on forest in search of fuelwood and fodder.

Since the objective of assessing extent and level of environmental degradation or pollution is directly linked with "quality of life" the changing profile of air in urban and peri-urban region of India also need to be studied. The longest survey of air-quality in India has been conducted by National Environmental Engineering Research Institute (NEERI) was based only on three parameters viz. S02, SPM and NO. The data base as such remain very weak and the enactment of AIR ACT (1982) was rather belated the air pollution level in densely populated zones of India, has reached an alarming level. What is worse is that the drifting air has also been noted to carry the heavy pollution load to health resorts [as in South Bengal, as par the result of study carried out by Calcutta based 'Centre for Study of Man and Environment' (CSME).

The effect of air pollutant like Carbon monoxide, (CO) Suspended particulate matter (SPM), Nitrogen Oxides (NO_x) Sulpher dioxide, ($S0_2$), Toxic metals, volatile organic compounds have been studied in detaiis and it can be summarised that range of effects extend from diseases

of blood to bones. The source of air pollution can be traced to use of fossile fuel, power plants, industries, automobile exhausts, metal smelters etc. As such siting of some of the stationary sources of pollution (Industry, Coal Mines, Smelters, Power Plants) call for serious planning. The case of Bhopal Gas leakage stands out supreme to illustrate the hazards of emission and wrong siting of industries.

[3]

MANAGEMENT AND CONTROL

After having an overview and State of Art on Major parameters, one can now look at the policy instruments for management of resources and control of environmental degradation and pollution.

The control measures are largely aimed to be taken at source points. In order to do so, a meticulous data gathering process on the source and their roles in polluting the natural system become imperative. The main agency for such data collection and presentation in the form of reports in India is Central Pollution Control Board. The Control Board, over the last decade has collected and published documents related to basin, sub-basin studies with reference to the location of major polluting industries like Breweries, Chlor-Alkali, Man made fibre, Steel Plants etc., and also set up criteria for minimum Indian National Standard (MINAS) for each of the major 24 industrial sector (Table 2) thereby specifying the permissible limit of discharge. The studies on River basin included Ganga, Jamuna, Godavari, Mahi, Mahanadi, Sabarmati, Krishna, Kaveri. Besides setting up a chain of 170 monitoring

station to assess water quality based on 19 parameters (e.g. TDS, BOD, DO, metals, nitrates) the Board has also identified 173 monitoring stations all along Indian Coast. These stations are currently sampling waters of selected (i) Estuarine (ii) Coastal (iii) Offshore (5 km from Coast) and (iv) High Seas (15 km from Coast) areas.

TABLE 2

Industries for which Standards are Notified

—Caustic Soda
—Man-made fibres
—Oil refinery
—Sugar
—Thermal Power Plants
—Cotton textiles
—Composite woollen mills
—Dye and Dye intermediates
—Electroplating
—Cement Plants
—Stone crushing
—Coke ovens
—Synthetic rubber
—Small pulp & paper
—Fermentation
—Leather tanneries
—Fertilizers
—Aluminium
—Copper, lead and smelting
—Calcium carbide
—Carbon black
—Nitric acid
—Sulphurid acid
—Iron and Steel

Likewise a National network of ambient air quality monitoring stations established in 1984 and has been expanded now to 85 stations in 24 cities/towns and continuously monitor the air quality with respect to suspended particulate matter, sulpher dioxide and oxide of nitrogen (Annual Report, DOEN 1987-88).

At the same time, (as mentioned earlier, on the basis of the standards set up for 24 industries), legislative

measure have been taken to enable the government to take suitable legal action against the violators. The main instruments for control of pollution of water and air are the Water (Prevention and Control of Pollution) Act, 1974 and the Air (Prevention and Control of Pollution) Act, 1981 ; however, the most recent and comprehensive package of legislative measures came in the form of Environment (Protection) Act 1986. Normally, the Water and Air act are administered through the Central Board in Union Territories and States Boards for the States of India. A list of leglisative measures so far enacted in India to control Pollution is given in Table 3.

While monitoring, setting up of standards and legal measures have been provided in recent years, specially with reference to Air and Water resources, action at Government and Non Government level for regeneration and development have been initiated by such national level projects as Ganga Action Plan (1985), Wasteland Development (1985), setting up of Eco-Task Forces for restoration of degraded eco-system etc. The Wetland Conservation Programme, Mangrove Conservation Programmes along with 66 National Parks, 382 Sanctuaries and 5 biosphere however are expected to provide a chain of conservation areas for preservation of biological diversity and typical ecosystems in India. The legislative support in the form of Indian Wildlife (Protection) Act, 1972 and Forest (Conservation) Act, 1980 are aimed at providing teeth to the menagement strategies.

It may be noted that the Forest (conservation) Act has been enacted to prevent indiscriminate dereservation and diversion of forest land for non-forest purposes and

it has now become mandatory to get prior approval of the Government of India before any reserved forest is declared de-reserved or forest land is converted for other uses.

What can be considered as one of the most important measure to safeguard environmental condition came into existence with the introduction of compulsory submission of Environment Impact Assessment (E I A). All project proponents under public sector, are now required to incorporate environmental information in the form of EIA, at the earliest stage of the planning of the project and also after assessing the impact to submit a Environment Management Plan (EMP). Impact Assessment reports are to cover the aspect of Air and Water Pollution, Soil degredation, Noise impact, Rehabilitation Master Plan, Impact on Flora and Fauna and the EMP should also provide action plan to minimise such impact to the level of permissible limit. These are checked by Environmental appraisal committees of Department of Environment.

The management and control strategies as one can expect must also encompass alternative sources of energy. The burning of fire wood, fossil fuel, petroleum products, have a direct effect on quality of air (besides on ecosystem at the mining and processing stage), which in turn can cause serious climatological changes on a long term and a series of human ailments. The bio-gas offers an important solution to this crisis area. In India, about 350 thousand bio-gas plants have already been set up which if operate effectively can save as much as 1800 thousand tonnes of wood equivalent per year. It is estimated that out of about 121 million rural households, 16-22 million can meet their cooking energy through bio-gas but a small

percentage has only been achieved so far (DNES, 1985-86), Bio-gas technology is also yet to be standardised. In the sector of electrical energy, according to the Advisory Board on Energy, Govt. of India (1985) 7 different approaches are available viz. Coal based energy (77,000 MW to 1,12,000 MW), Major hydel capacity (57450 MW), small/mini micro hydel capacity (5000MW), Cogeneration capacity (2000 MW), Lean gas (1750 MW)—to meet the demand upto 2004/05 AD. But except for small/mini/micro-hydel all other sources have significant negative impact. And the country's energy demand can never be met from such sources above. Thus, the careful examination of proposal for new or expansion of existing capacity in major power generation sectors viz, Coal based, Thermal Power, Major Hydel Power and Nuclear Power, becomes an absolutely essential element in the planning process.

The available solar energy and wind energy (in particular area) offer tremendous scope in utilising other non-conventional source but as yet no national plan for a grid of such system has emerged. Recycling of waste to generate energy is also being explored but such effort obviously depend on calorific value of solid waste generated in habitat centers, specially in the metropolitan cities *(Bhattacharya, 1987)*

The role of reforestation and afforestation has been increasingly emphasised in recent years through the programme of social forestry and wasteland development. Besides general input through these national programme, the provision of Forest (conservation) Act 1980, demanding compulsory afforestation of double the area of affected forest land due to any development project and

the provision of Mines and Mineral Act (Regulation and Development) modified, 1988, (IEM, 1989), provided statutory obligation for reclamation of degraded land area and perhaps ensure a more coherent efforts toward revegetation.

Considering the overall planning for control of pollution and strategies for prevention of degradation of environment, ensuring a sustainable development process and a better quality of life, it can be expected that in the next decade the entire process will be crystallised.

TABLE 3

List of Acts for protection of Indian environment since 1897

1897 Indian Fisheries Act

1905 Bengal Smoke Nuisance Act

1912 Bombay Smoke Nuisance Act

1917 Mysore Destruction by Insects & Pests Act

1919 The Poison Act

1919 Andhra Pradesh Agricultural, Pest & Diseases Act

1923 The Indian Boilers Act

1927 The Indian Forest Act

1946 Bihar Wastelands Act (Reclamation Cultivation & Improvement)

1947 Mines and Minerals Act (Regulation and Development)

1948 The Factories Act (Pollution and Pesticides)

1949 Andhra Pradesh Improvement Schemes Act (Land Utilization)

1951 Industries Act (Development and Regulation)

1953 Orissa River Pollution & Prevention Act

1954 Assam Agricultural Pests and Disease Act

1954 Prevention of Food Adulteration Act

1954 U.P. Agricultural Pests and Disease Act

1955 Acquisition of Land for Flood Control and Prevention of Erosion Act

1956 River Boards Act

1958 Ancient Monuments and Archeological Sites an Remains Act

1958 Kerala Agricultural Pests and Disease Act

1962 Atomic Energy Act (Radiation Protection Rules 1971)

1963 Gujarat Smoke Nuisances Act

1964 Delhi Restriction of Land Uses Act

1968 The Insecticides Act

1969 Maharashtra Prevention of Water Pollution Act

1970 Merchant Shipping (amendment) Act. (Harbour and Coastal Water Dumping of Oil etc)

1972 Wild Life Protection Act

1974 Water Act (Prevention and Control of Pollution)

1976 Urban Land Act (Ceiling and Regulation)

1977 Water Cess Act (Prevention and Control of Pollution)

1980 The Forest (Conservation) Act, 1980

1981 Air Pollution Prevention and Control Act

1986 The Environment (Protection) Act, 1986

1988 The MMRD Act (modified), 1988

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