ENVIRONMENT LAW AND POLLUTION MANAGEMENT

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Preface

Environmental law encompasses regulations and policies aimed at protecting the environment and managing pollution. These laws are designed to prevent or minimize the adverse impacts of human activities on natural ecosystems, air, water, and land. The foundational principles of environmental law include the prevention of harm to human health and the environment, the promotion of sustainable development, and the preservation of natural resources for future generations.

One aspect of environmental law is pollution management, which involves regulating the release of harmful substances into the environment and mitigating their impact. This includes laws governing air quality, water quality, waste management, and hazardous substances. Pollution management measures aim to reduce emissions of pollutants from industrial facilities, vehicles, and other sources, as well as to clean up contaminated sites and prevent further environmental degradation.

Environmental laws establish regulatory frameworks and standards for pollution control, setting limits on pollutant emissions and prescribing measures for monitoring and enforcement. Regulatory agencies are responsible for overseeing compliance with environmental laws, conducting inspections, and imposing penalties for non-compliance. Additionally, environmental laws often incorporate mechanisms for public participation, allowing stakeholders to voice concerns, provide input on regulatory decisions, and seek redress for environmental harm.

Effective pollution management requires a multi-faceted approach that integrates regulatory measures with pollution prevention, remediation, and sustainable practices. This includes promoting the use of cleaner technologies,

implementing pollution prevention programmes, and incentivizing sustainable practices through economic instruments such as taxes, subsidies, and market-based mechanisms.

Environmental laws also play a critical role in addressing transboundary pollution, which can affect air and water quality across national borders. International agreements and treaties facilitate cooperation among countries to address shared environmental challenges and harmonize regulatory standards for pollution management.

In recent years, there has been growing recognition of the need for holistic approaches to pollution management that address the interconnected nature of environmental issues and consider social, economic, and cultural factors. This has led to the emergence of integrated pollution management frameworks that emphasize collaboration among stakeholders, adaptive management approaches, and the integration of traditional knowledge with modern science and technology.

Overall, effective environmental law and pollution management are essential for safeguarding human health, protecting ecosystems, and promoting sustainable development. By establishing clear regulatory frameworks, fostering stakeholder engagement, and promoting best practices, environmental laws play a crucial role in addressing pollution and advancing environmental sustainability.

The book on Environment Law and Pollution Management provides comprehensive insights into regulatory frameworks and strategies for effectively managing pollution to protect the environment and human health.

–Author

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Preliminary Environmental Protection Legislation

SHORT TITLE

- This Act may be called the Environment (Protection) Act, 1986.
- It extends to the whole of India.
- It shall come into force on such date as the Central Government may, by notification in the Official Gazette, appoint and different dates may be appointed for different provisions of this Act and for different areas.

DEFINITIONS

In this Act, unless the context otherwise requires:

- "Environment" includes water, air and land and the inter- relationship which exists among and between water, air and land, and human beings, other living creatures, plants, micro-organism and property;
- "Environmental pollutant" means any solid, liquid or gaseous substance present in such concentration as may be, or tend to be, injurious to environment;
- "Environmental pollution" means the presence in the environment of any environmental pollutant;
- "Handling", in relation to any substance, means the manufacture, processing, treatment, package, storage, transportation, use, collection, destruction, conversion, offering for sale, transfer or the like of such substance;

- "Hazardous substance" means any substance or preparation which, by reason of its chemical or physico-chemical properties or handling, is liable to cause harm to human beings, other living creatures, plant, micro-organism, property or the environment;
- "Occupier", in relation to any factory or premises, means a person who has, control over the affairs of the factory or the premises and includes in relation to any substance, the person in possession of the substance;
- "Prescribed" means prescribed by rules made under this Act.

PREAMBLE

An Act to provide for the protection and improvement of environment and for matters connected therewith. Whereas decisions were taken at the United Nations Conference on the Human Environment held at Stockholm in June, 1972, in which India participated, to take appropriate steps for the protection and improvement of human environment; And whereas it is considered necessary further to implement the decisions aforesaid in so far as they relate to the protection and improvement of environment and the prevention of hazards to human being, other living creatures, plants and property; Be it enacted by Parliament in the Thirty-seventh Year of the Republic of India as follows.

ENVIRONMENTAL LABORATORIES

- The Central Government may, by notification in the Official Gazette,
  - Establish one or more environmental laboratories;
  - Recognise one or more laboratories or institutes as environmental laboratories to carry out the functions entrusted to an environmental laboratory under this Act.
- The Central Government may, by notification in the Official Gazette, make rules specifying
  - The functions of the environmental laboratory;
  - The procedure for the submission to the said laboratory of samples of air, water, soil or other substance for analysis or tests, the form of the laboratory report thereon the fees payable for such report;
  - Such other matters as may be necessary or expedient to enable that laboratory to carry out its functions.

GOVERNMENT ANALYSTS

The Central Government may, by notification in the Official Gazette, appoint or recognise such persons as it thinks fit and having the prescribed qualifications to be Government Analysts for the purpose of analysis of sample of air, water, soil or other substance sent for analysis to any environmental laboratory established or recognised under sub-section (1) of section 12.

REPORTS OF GOVERNMENT ANALYSTS

Any document purporting to be a report signed by a Government analyst may be used as evidence of the facts stated therein in any proceeding under this Act.

Penalty for contravention of the provisions of the act and the rules, orders and direction: Whoever fails to comply with or contravenes any of the provisions of this Act, or the rules made or orders or directions issued there under, shall, in respect of each such failure or contravention, be punishable with imprisonment for a term which may extend to five years or with fine which may extend to one lakh rupees, or with both, and in case the failure or contravention continues, with additional fine which may extend to five thousand rupees for every day during which such failure or contravention continues after the conviction for the first such failure or contravention.

If the failure or contravention referred to in sub-section (1) continues beyond a period of one year after the date of conviction, the offender shall be punishable with imprisonment for a term which may extend to seven years.

Offences by Companies

Where any offence under this Act has been committed by a company, every person who, at the time the offence was committed, was directly in charge of, and was responsible to, the company for the conduct of the business of the company, as well as the company, shall be deemed to be guilty of the offence and shall be liable to be proceeded against and punished accordingly:

Provided that nothing contained in this sub-section shall render any such person liable to any punishment provide in this Act, if he proves that the offence was committed without his knowledge or that he exercised all due diligence to prevent the commission of such offence.

Notwithstanding anything contained in sub-section (1), where an offence under this Act has been committed by a company and it is proved that the offence has been committed with the consent or connivance of, or is attributable to any neglect on the part of, any director, manager, secretary or other officer of the company, such director, manager, secretary or other officer shall also deemed to be guilty of that offence and shall be liable to be proceeded against and punished accordingly.

Explanation: For the purposes of this section

- "Company" means any body corporate and includes a firm or other association of individuals;
- "Director", in relation to a firm, means a partner in the firm.

Offences by Government Departments

Where an offence under this Act has been committed by the Department of Government, the Head of the Department shall be deemed to be guilty of the offence and shall be liable to be proceeded against and punished accordingly: Provided that nothing contained in this section shall render such Head of the Department liable to any punishment if he proves that the offence was committed

without his knowledge or that he exercised all due diligence to prevent the commission of such offence. Notwithstanding anything contained in sub-section (1), where an offence under this Act has been committed by a Department of Government and it is proved that the offence has been committed with the consent or connivance of, or is attributable to any neglect on the part of, any officer, other than the Head of the Department, such officer shall also be deemed to be guilty of that offence and shall be liable to be proceeded against and punished accordingly.

Protection of Action Taken in Good Faith

No suit, prosecution or other legal proceeding shall lie against the Government or any officer or other employee of the Government or any authority constituted under this Act or any member, officer or other employee of such authority in respect of anything which is done or intended to be done in good faith in pursuance of this Act or the rules made or orders or directions issued there under.

COGNIZANCE OF OFFENCES

No Court shall take cognizance of any offence under this Act except on a complaint made by:

- The Central Government or any authority or officer authorised in this behalf by that Government; or
- Any person who has given notice of not less than sixty days, in the manner prescribed, of the alleged offence and of his intention to make a complaint, to the Central Government or the authority or officer authorised as aforesaid.

Information, Reports or Returns

The Central Government may, in relation to its functions under this Act, from time to time, require any person, officer, State Government or other authority to furnish to it or any prescribed authority or officer any reports, returns, statistics, accounts and other information and such person, officer, State Government or other authority shall be bound to do so.

Members, Officers and Employees of the Authority

All the members of the authority, constituted, if any, under section 3 and all officers and other employees of such authority when acting or purporting to act in pursuance of any provisions of this Act, or the rules made, or orders or directions issued there under, shall be deemed to be public servants within the meaning of section 21 of the Indian Penal Code.

Bar of Jurisdiction

No Civil Court shall have jurisdiction to entertain any suit or proceeding in respect of anything done, action taken or order or direction issued by the Central Government or any authority or officer in pursuance of any power conferred by or in relation to its or his functions under this Act.

POWER TO DELEGATE

Without prejudice to the provisions of sub-section (3) of section 3, the Central Government may, by notification in the Official Gazette, delegate, subject to such conditions and limitations as may be specified in the notification, such of its powers and functions under this Act, [except the power to constitute an authority under sub-section (3) of section 3 and to make rules under section 25] as it may deem necessary or expedient, to any officer, State Government or other authority.

Effect of Other Laws

Subject to the provisions of sub-section (2), the provisions of this Act and the rules or orders made therein shall have effect notwithstanding anything inconsistent therewith contained in any enactment other than this Act.

Where any act or omission constitutes an offence punishable under this Act and also under any other Act then the offender found guilty of such offence shall be liable to be punished under the other Act and not under this Act.

Power to Make Rules

The Central Government may, by notification in the Official Gazette, make rules for carrying out the purposes of this Act.

In particular, and without prejudice to the generality of the foregoing power, such rules may provide for all or any of the following matters, namely:

- The standards in excess of which environmental pollutants shall not be discharged or emitted under section 7;
- The procedure in accordance with and the safeguards in compliance with which hazardous substances shall be handled or caused to be handled under section 8;
- The authorities or agencies to which intimation of the fact of occurrence or apprehension of occurrence of the discharge of any environmental pollutant in excess of the prescribed standards shall be given and to whom all assistance shall be bound to be rendered under sub-section (1) of section 9;
- The manner in which samples of air, water, soil or other substance for the purpose of analysis shall be taken under sub-section (1) of section 11;
- The form in which notice of intention to have a sample analysed shall be served under clause (a) of sub-section (3) of section 11;
- The functions of the environmental laboratories, the procedure for the submission to such laboratories of samples of air, water, soil and other substances for analysis or test; the form of laboratory report; the fees payable for such report and other matters to enable such laboratories to carry out their functions under sub-section (2) of section 12;
- The qualifications of Government Analyst, appointed or recognised for the purpose of analysis of samples of air, water, soil or other substances under section 13;

- The manner in which notice of the offence and of the intention to make a complaint to the Central Government shall be given under clause (b) of section 19;
  - The authority or officer to whom any reports, returns, statistics, accounts and other information shall be furnished under section 20;
- Any other matter which is required to be, or may be, prescribed.

Act to be Laid Before Parliament

Every rule made under this Act shall be laid, as soon as may be after it is made, before each House of Parliament, while it is in session, for a total period of thirty days which may be comprised in one session or in two or more successive sessions, and if, before the expiry of the session immediately following the session or the successive sessions aforesaid, both Houses agree in making any modification in the rule or both House agree that the rule should not be made, the rule shall thereafter have effect only in such modified form or be of no effect, as the case may be; so, however, that any such modification or annulment shall be without prejudice to the validity of anything previously done under that rule.

MEASURES TO PROTECT AND IMPROVE ENVIRONMENT

Subject to the provisions of this Act, the Central Government shall have the power to take all such measures as it deems necessary or expedient for the purpose of protecting and improving the quality of the environment and preventing, controlling and abating environmental pollution.

In particular, and without prejudice to the generality of the provisions of sub-section (1), such measures may include measures with respect to all or any of the following matters, namely:

- Co-ordination of actions by the State Governments, officers and other authorities
  - Under this Act, or the rules made there under;
  - Under any other law for the time being in force which is relatable to the objects of this Act;
- Planning and execution of a nation-wide programme for the prevention, control and abatement of environmental pollution;
- Laying down standards for the quality of environment in its various aspects;
- Laying down standards for emission or discharge of environmental pollutants from various sources whatsoever: Provided that different standards for emission or discharge may be laid down under this clause from different sources having regard to the quality or composition of the emission or discharge of environmental pollutants from such sources;

- Restriction of areas in which any industries, operations or processes, or class of industries, operations or processes shall not be carried out or shall be carried out subject to certain safeguards;
- Laying down procedures and safeguards for the prevention of accidents which may cause environmental pollution and remedial measures for such accidents;
- Laying down procedures and safeguards for the handling of hazardous substances;
- Examination of such manufacturing processes, materials and substances as are likely to cause environmental pollution;
- Carrying out and sponsoring investigations and research relating to problems of environmental pollution;
- Inspection of any premises, plant, equipment, machinery, manufacturing or other processes, materials or substances and giving, by order, of such directions to such authorities, officers or persons as it may consider necessary to take steps for the prevention, control and abatement of environmental pollution;
- Establishment or recognition of environmental laboratories and institutes to carry out the functions entrusted to such environmental laboratories and institutes under this Act;
- Collection and dissemination of information in respect of matters relating to environmental pollution;
- Preparation of manuals, codes or guides relating to the prevention, control and abatement of environmental pollution;
- Such other matters as the Central Government deems necessary or expedient for the purpose of securing the effective implementation of the provisions of this Act.

The Central Government may, if it considers it necessary or expedient so to do for the purposes of this Act, by order, published in the Official Gazette, constitute an authority or authorities by such name or names as may be specified in the order for the purpose of exercising and performing such of the powers and functions (including the power to issue directions under section 5) of the Central Government under this Act and for taking measures with respect to such of the matters referred to in sub-section (2) as may be mentioned in the order and subject to the supervision and control of the Central Government and the provisions of such order, such authority or authorities may exercise the powers or perform the functions or take the measures so mentioned in the order as if such authority or authorities had been empowered by this Act to exercise those powers or perform those functions or take such measures.

APPOINTMENT OF OFFICERS

(1) Without prejudice to the provisions of sub-section (3) of section 3, the Central Government may appoint officers with such designations as it thinks fit for the purposes of this Act and may entrust to them such of the powers and

functions under this Act as it may deem fit. (2) The officers appointed under sub-section (1) shall be subject to the general control and direction of the Central Government or, if so directed by that Government, also of the authority or authorities, if any, constituted under sub-section (3) of section 3 or of any other authority or officer.

POWER TO GIVE DIRECTIONS

Notwithstanding anything contained in any other law but subject to the provisions of this Act, the Central Government may, in the exercise of its powers and performance of its functions under this Act, issue directions in writing to any person, officer or any authority and such person, officer or authority shall be bound to comply with such directions. *Explanation:* For the avoidance of doubts, it is hereby declared that the power to issue directions under this section includes the power to direct

- The closure, prohibition or regulation of any industry, operation or process; or
- Stoppage or regulation of the supply of electricity or water or any other service.

REGULATE ENVIRONMENTAL POLLUTION

- The Central Government may, by notification in the Official Gazette, make rules in respect of all or any of the matters referred to in section 3.
- In particular, and without prejudice to the generality of the foregoing power, such rules may provide for all or any of the following matters, namely:
  - The standards of quality of air, water or soil for various areas and purposes;
  - The maximum allowable limits of concentration of various environmental pollutants (including noise) for different areas;
  - The procedures and safeguards for the handling of hazardous substances;
  - The prohibition and restrictions on the handling of hazardous substances in different areas;
  - The prohibition and restrictions on the location of industries and the carrying on of processes and operations in different areas;
  - The procedures and safeguards for the prevention of accidents which may cause environmental pollution and for providing for remedial measures for such accidents.

Persons carrying on industry, operation, *etc.* Not to allow emission or discharge of environmental pollutants in excess of the standards.

No person carrying on any industry, operation or process shall discharge or emit or permit to be discharged or emitted any environmental pollutant in excess of such standards as may be prescribed.

Persons handling hazardous substances to comply with procedural safeguards. No person shall handle or cause to be handled any hazardous substance except in accordance with such procedure and after complying with such safeguards as may be prescribed

Furnishing of Information to Authorities

Where the discharge of any environmental pollutant in excess of the prescribed standards occurs or is apprehended to occur due to any accident or other unforeseen act or event, the person responsible for such discharge and the person in charge of the place at which such discharge occurs, or is apprehended to occur shall be bound to prevent or mitigate the environmental pollution caused as a result of such discharge and shall also forthwith.

- Intimate the fact of such occurrence or apprehension of such occurrence; and
- Be bound, if called upon, to render all assistance, to such authorities or agencies as may be prescribed.

On receipt of information with respect to the fact or apprehension of any occurrence of the nature referred to in sub-section (1), whether through intimation under that sub-section or otherwise, the authorities or agencies referred to in sub-section (1) shall, as early as practicable, cause such remedial measures to be taken as are necessary to prevent or mitigate the environmental pollution.

The expenses, if any, incurred by any authority or agency with respect to the remedial measures referred to in sub-section (2), together with interest (at such reasonable rate as the Government may, by order, fix) from the date when a demand for the expenses is made until it is paid may be recovered by such authority or agency from the person concerned as arrears of land revenue or of public demand.

POWER OF ENTRY AND INSPECTION

Subject to the provisions of this section, any person empowered by the Central Government in this behalf shall have a right to enter, at all reasonable times with such assistance as he considers necessary, any place.

- For the purpose of performing any of the functions of the Central Government entrusted to him;
- For the purpose of determining whether and if so in what manner any such functions are to be performed or whether any provisions of this Act or the rules made there under or any notice, order, direction or authorisation served, made, given or granted under this Act is being or has been complied with;
- For the purpose of examining and testing any equipment, industrial plant, record, register, document or any other material object or for conducting a search of any building in which he has reason to believe that an offence under this Act or the rules made there under has been or is being or is about to be committed and for seizing any such equipment, industrial plant, record, register, document or other material object if he has reasons to

believe that it may furnish evidence of the commission of an offence punishable under this Act or the rules made there under or that such seizure is necessary to prevent or mitigate environmental pollution.

Every person carrying on any industry, operation or process or handling any hazardous substance shall be bound to render all assistance to the person empowered by the Central Government under sub-section (1) for carrying out the functions under that sub-section and if he fails to do so without any reasonable cause or excuse, he shall be guilty of an offence under this Act. If any person willfully delays or obstructs any person empowered by the Central Government under sub-section (1) in the performance of his functions, he shall be guilty of an offence under this Act.

The provisions of the Code of Criminal Procedure, 1973 in relation to the State of Jammu and Kashmir, or any area in which that Code is not in force, the provisions of any corresponding law in force in that State or area shall, so far as may be, apply to any search or seizure under this section as they apply to any search or seizure made under the authority of a warrant issued under section 94 of the said Code or, as the case may be, under the corresponding provisions of the said law.

SAMPLE AND PROCEDURE

The Central Government or any officer empowered by it in this behalf, shall have power to take, for the purpose of analysis, samples of air, water, soil or other substance from any factory, premises or other place in such manner as may be prescribed.

The result of any analysis of a sample taken under sub-section (1) shall not be admissible in evidence in any legal proceeding unless the provisions of sub-sections (3) and (4) are complied with.

Subject to the provisions of sub-section (4), the person taking the sample under sub-section (1) shall

- Serve on the occupier or his agent or person in charge of the place, a notice, then and there, in such form as may be prescribed, of his intention to have it so analysed;
- In the presence of the occupier or his agent or person, collect a sample for analysis;
- Cause the sample to be placed in a container or containers which shall be marked and sealed and shall also be signed both by the person taking the sample and the occupier or his agent or person;
- Send without delay, the container or the containers to the laboratory established or recognised by the Central Government under section 12.

When a sample is taken for analysis under sub-section (1) and the person taking the sample serves on the occupier or his agent or person, a notice under clause (a) of sub-section

Then,

- In a case where the occupier, his agent or person willfully absents himself, the person taking the sample shall collect the sample for

analysis to be placed in a container or containers which shall be marked and sealed and shall also be signed by the person taking the sample, and

- In a case where the occupier or his agent or person present at the time of taking the sample refuses to sign the marked and sealed container or containers of the sample as required under clause
- Of sub-section (3), the marked and sealed container or containers shall be signed by the person taking the samples, and the container or containers shall be sent without delay by the person taking the sample for analysis to the laboratory established or recognised under section 12 and such person shall inform the Government Analyst appointed or recognised under section 13 in writing, about the willful absence of the occupier or his agent or person, or, as the case may be, his refusal to sign the container or containers.

THE FEDERAL APPROACH TO ENVIRONMENTAL REGULATION

Federal environmental statutes and programmes provide much of the framework used to develop, interpret, and enforce state environmental protection laws. For this reason, it is important to acquire a general understanding of federal environmental protection laws as they relate to state law. With the exception of National Environmental Policy and Endangered Species Act, California law preceded and was the basis for the development of federal environmental laws.

THE FEDERAL ENVIRONMENTAL PROTECTION AGENCY (U.S., EPA)

There are numerous agencies of the federal government such as the Department of Transportation, Department of Agriculture, Food and Drug Administration, and the Occupational Safety and Health Administration that have tangential authority over the environment. But primary responsibility for the nation's environment rests with the Environmental Protection Agency (U.S., EPA). The U.S., EPA is the only major federal regulatory agency that was created not by an act of Congress, but rather by a Presidential Executive Order. As such, the U.S., EPA is not an independent regulatory agency, but is purely a creature of the Executive Branch.

The U.S., EPA is among the most highly decentralized agencies in the federal government, operating through 10 regional offices. The regional office for the western states is in San Francisco. Generally, U.S., EPA headquarters in Washington, D.C. sets policy and promulgates rules, while the regional offices implement U.S., EPA's programmes.

The regional offices pass on to the states the policies and requirements that are issued in Washington, D.C. The regional offices enter formal agreements with each state that include criteria for enforcement and for other conditions of

financial assistance. Each regional office has a great deal of autonomy, especially in enforcement and permitting decisions. Where state programmes do not meet federal standards or where the states have chosen not to assume responsibility, U.S., EPA regional offices may assume enforcement authority. Where states have implemented their own programmes (as in California), U.S., EPA enforcement activity (at least as to administrative and civil enforcement) is fairly limited. US EPA has peace officer investigators in the Criminal Investigation Division.EPA CID one of only three of the 63 federal agencies with peace officers who have jurisdiction beyond their regulatory programme and therefore can investigate and arrest for any federal crime.

THE FEDERAL-STATE RELATIONSHIP

While federal statutes have established national standards for the transportation, emission, discharge, and the disposal of harmful substances, implementation and enforcement of many of the large programmes has been delegated by the U.S., EPA to the states. In turn, the states apply national standards to sources within their borders through permit programmes that control the release of pollutants into the environment. Thus, while most implementation and enforcement occurs at the state or local level, the U.S., EPA maintains an overarching role with respect to the states by establishing federal standards and approving state programmes.

In a few exceptions, states can set stricter standards than those required by federal law. Some of the programmes that have been delegated (this term is used in a general sense, some of the programmes use other terms) by the U.S., EPA to the states are the emissions standards for hazardous air pollutants (HAPs), Prevention of Significant Deterioration (PSD) Permits under the CAA, the Water Quality Standards and the National Pollution Discharge Elimination System (NPDES) Programmes under the CWA, the Hazardous Waste Programme under RCRA, and the Drinking Water and Underground Injection Control (UIC) Programmes under the SDWA.

CALIFORNIA ENVIRONMENTAL LAWS

The summary that follows in the remainder of this chapter briefly describes many of California's environmental laws, including those that are analogous to the federal statutes and those that are unique to California.

The California Environmental Quality Act (CEQA)

The California Environmental Quality Act (CEQA) (Public Resources Code sections 21000 et seq.) is the California analog to NEPA. CEQA requires government projects and government-approved projects to be planned to avoid significant adverse environmental effects.

CEQA requires that prior to approval by a state or local agency of a project, an Environmental Impact Report (EIR) must be prepared to identify the significant effects of a project on the environment, the alternatives to the project,

and to indicate the manner in which those significant effects can be mitigated or avoided. (Pub. Res. Code § 21002.1.) If no significant environmental effects are foreseen, a "negative declaration" (Neg Dec) briefly describing the proposed project and the reasons why an EIR should not be required may be submitted.

Designation of a Lead Agency

If two or more agencies are involved in implementing or approving a proposed project, one will be designated the "lead" agency. The lead agency will normally be the one with general governmental powers, such as a city or county, rather than an agency with a single limited purpose, such as an air-pollution-control district.

The lead agency has the primary responsibility for approving or carrying out a project, decides whether an EIR or Negative Declaration will be necessary, and prepares the document. Other involved agencies are designated either "responsible" or "trustee" agencies. These agencies consult with and provide input for the decisions of the lead agency.

Public Notice

The CEQA statute and its implementing regulations, title 22 of the California Administrative Code sections 15000 et seq., provide detailed procedures for the environmental review. The procedures include notice to the public and an opportunity for public comment. The agency is required to respond to all public comments and to implement all feasible mitigation measures. But the agency retains discretion to approve a project despite adverse environmental impacts that cannot be mitigated or avoided if the agency finds that there are overriding considerations justifying the project.

Enforcement

CEQA is enforced by private litigation and by the Attorney General's Office. There is no specific statutory authority for enforcement by district attorneys. Legal challenges to projects alleging violations of CEQA must show that either the agency failed to follow the required procedures in its environmental review or that the project approval constituted an abuse of discretion. In general, the courts require strict adherence to CEQA's procedures but defer to the agency's balancing of the benefits of a project against any adverse environmental impacts disclosed by the EIR.

AIR POLLUTION

The California Air Resources Act, Health and Safety Code sections 39000 et seq., contains provisions required by the federal Clean Air Act as well as additional provisions to improve and protect the state's air quality. The Act provides for the establishment and enforcement of air quality standards and emission limitations. directs the State Air Resources Board (ARB) to divide the state into air basins of similar meteorological and geographical characteristics

and to adopt ambient air-quality standards for each basin considering human health, aesthetic value, interference with visibility, and economic effects. Investigation and regulation of sources and types of pollution occur at both the state and local levels.

Responsibility at the State Level

The State Air Resources Board (ARB) is responsible for developing the state implementation plan required by the federal CAA. It also has general oversight powers to ensure pollution control by establishing state ambient air quality standards and by setting emission standards for mobile sources (vehicles). While primary responsibility for the regulation of stationary sources rests with the local air pollution control districts, the state ARB monitors air quality, adopts test procedures, conducts research, and regulates sandblasting material, various types of engines, motor vehicle emissions (including fuels), and emissions of various consumer products such as paint and hairspray. The ARB also enforces air related asbestos regulations in certain counties that do not have their programmes.

Responsibility at the Local Level

Local Air Pollution Control Districts (APCDs) usually encompass a single county. But several county districts have merged into regional districts. These consolidated districts now cover the San Francisco Bay Area, the South Coast Air Basin, and the San Joaquin Valley. The APCDs have primary responsibility for the implementation of basin-wide plans by regulating stationary sources within their boundaries, such as industrial facilities and fixed equipment. Each APCD has a permit system for new and existing stationary sources to insure that emissions sources do not prevent the attainment or maintenance of air quality standards.

Enforcement

Air-Pollution Law for these particular enforcement provisions.

WATER POLLUTION

The Porter-Cologne Water Quality Control Act, California Water Code sections 13300-13999 and Title 23 of the California Administrative Code, is analogous to the federal Clean Water Act (CWA) in that it regulates discharges that may affect the quality of the state's waters. The California Act is broader in scope than the federal CWA, however, in that it includes groundwater, while the CWA regulates only surface waters.

The Porter-Cologne Act is implemented by the State Water Resources Control Board and nine Regional Water Quality Control Boards (RWQCBs) that are responsible for planning, permitting, and enforcement. The State Board formulates state policies for water-quality control and implements the permit system required by the CWA.

The State and Regional Water Boards have broad authority to take a variety of enforcement actions under the Porter-Cologne Water Quality Control Act; the Toxic Pits Cleanup Act of 1984; Chapters 6.67, 6.7, and 6.75 of Division 20 of the Health and Safety Code regarding underground and aboveground tanks; Health and Safety Code section 25356.1; and Chapter 6 of Division 3 of the Harbours and Navigation Code.

Examples of enforcement actions include:

- Violation of an effluent limit, receiving water limit, or discharge prohibition contained in an order or Water Quality Control Plan (Basin Plan) adopted by the State Water Board or a Regional Water Board;
- An unauthorized spill, leak, fill, or other discharge;
- Failure to perform an action required by the State Water Board or a Regional Water Board, such as submittal of a self-monitoring or technical report or completion of a cleanup task by a specified deadline.

State Water Resources Control Board

The State Water Resources Control Board (SWRCB) is responsible for developing and implementing a statewide water-quality policy. (Water Code §§ 13140-13142.) The SWRCB also oversees the activities of the Regional Water Quality Control Boards. The SWRCB also licenses operators of local wastewater treatment plants, has an Underground Storage Tank Enforcement Unit, and has an Office of Statewide Enforcement.

Regional Water Quality Control Boards

Under the Porter-Cologne Act, the Regional Water Quality Control Boards have primary responsibility for the day-to-day administration of the laws and regulations protecting California's surface and groundwater. Each Regional Board must develop a regional water-quality plan that establishes water-quality objectives for the region and provides a framework for all administrative actions taken by the board. Each Regional Board has a person assigned as the Enforcement Manager who coordinates enforcement issues for that Regional Board.

The Permit System

National Pollution Discharge Elimination System (NPDES) permits are issued by the State or Regional Boards and are required for all point source pollution discharges into California's surface waters. Point source discharges are defined as planned non-agricultural waste discharges from man made conveyance systems.

The permit system in California is essentially the same as the federal permit system under the NPDES. Before proceeding with any waste discharge that could affect the quality of the groundwater or surface waters of the state, the potential discharger must first report to and receive a permit from the local Regional Water Quality Control Board. As of 2000, California has approximately

2,250 active NPDES permits protecting the state's water resources from industrial and municipal waste discharges. For discharges onto land that may affect water quality, Waste Discharge Requirements (WDRs) are issued by the State and Regional Boards to regulate waste-disposal impoundments and land disposal for liquid and solid wastes. The permitting system addresses many types of waste discharges, including municipal, industrial, and commercial sources. As of 2000, California has approximately 3,670 active WDRs protecting its groundwater resources.

Storm Water Programme

Discharges of storm water associated with industrial activities require compliance with the General Industrial Activities Storm Water Permit (part of the NPDES system). Requirements include submission of a Notice of Intent for coverage under the general permit, a Storm Water Pollution Prevention Plan (SWPPP), implementation of the SWPPP, and annual reports.

Hazardous-Waste Facilities

In addition to administering the state's discharge permit system, the Regional Boards participate in the administration of the hazardous-waste-facility permit system. The Regional Boards are responsible for classifying all current and proposed hazardous-waste facilities within their regions in accordance with the classification system adopted by the State Board.

Administrative Enforcement

Regional Water Quality Control Boards have authority to inspect any facility discharging or proposing to discharge pollutants into the state waters and to require the owners of those facilities to prepare technical or monitoring programme reports. If the Regional Board discovers any discharge or proposed discharge in violation of the water-quality laws and regulations, it may, after notice and a hearing, issue an administrative cease-and-desist order directing the offending party to comply with the applicable titles and regulations. Where appropriate, the Board may also issue a cleanup and abatement order. The Regional Board may itself undertake cleanup, abatement, and remedial work if it deems such work necessary to prevent substantial pollution, nuisance, or injury to the waters of the state.

The Board is authorized to seek reimbursement of any costs incurred in such work from the responsible parties through suit in state court. (Id.) If the Regional Board establishes that a party has failed to file a discharge report before discharging a pollutant, or has failed to abide by any requirements or orders issued by the Board, or has caused a discharge creating a condition of pollution or nuisance, the Board is authorized to administratively impose civil fines up to specified maximums. Alternatively, the Regional Boards may request the attorney general to seek injunctive relief in state court. District attorneys are limited to bringing criminal actions or civil actions for unfair competition.

Criminal Enforcement

Water Code Section 13387 Cases

- *Constitutional Challenges*: *People v. Appel* (1996) 51 Cal.App.4th 495, 503-505: No ex post facto defence allowed where defendant's actions took place prior to EPA's formal determination of jurisdiction over the waters on defendant's property because the statute regarding jurisdiction existed prior to defendant's actions. Challenge based on vagueness refuted as defendant refused to cooperate with the federal and state agencies' investigations, so he may not later complain that he did not know that he was in violation.
- *Intent*: *People v. Ramsey* (2000) 79 Cal.App.4th 621, 632-633: Knowledge that a material discharged into navigable waters is a "pollutant" is not an element of the offence set forth in section 13387. Mistake or lack of knowledge that the material was a pollutant is not a defence as discharging a pollutant into navigable waters is not a specific-intent crime.
- *Defence of Necessity*: *People v. Buena Vista Mines, Inc*. (1998) 60 Cal.App.4th 1198, 1202-1203: Requirements of necessity defence not present because the holding pond was inadequately sized to hold the contaminated water, and defendant did not exhaust all reasonable alternatives prior to pumping the contaminated water into the creek.
- *Felony*: *People v. Buena Vista Mines, Inc*. (1996) 48 Cal.App.4th 1030, 1033-1034: Violation of section 13387(c) is a felony (statute wording was unclear). Note the statute was amended in 2002 to clarify that imprisonment is "in the state prison."
- *Pre-emption*: *Appel*, 51 Cal.App.4th at 505: The Federal Water Pollution Control Act does not pre-empt state criminal conviction under this section for violations of the Federal Act.
- *Relationship to Federal Law*: *Buena Vista Mines, Inc.,* 48 Cal.App.4th at 1034: As the Porter-Cologne Water Quality Act refers to the Federal Water Pollution Control Act, federal authority is used to interpret the Act.

Penalties

Criminal — Misdemeanors

The following violations are misdemeanors, *i.e.*, fine of up to $1,000 for each day of violation and up to six months in jail unless otherwise stated.

CAVEAT: Water Code Section 13271(d) provides use immunity for notification in all other criminal prosecutions. The State Board may grant use immunity to anyone who is subpoenaed to testify at its hearings. (See Water Code Sections 1105-1106.)

- *Water Code Section 13265(a)*: Discharge without report or requirements (prior notice is required).
- *Water Code Section 13265(b)*: Discharge of hazardous waste without report or requirements. Note: This may also be chargeable under Health and Safety Code section 25189.5.
- *Water Code Section 13525.5*: Recycling without requirements in violation of Water Code section 13524.
- *Water Code Section 13526*: Recycling without required permit.

The following reporting violations are misdemeanors, *i.e.*, fine of up to $500 and up to six months in jail, except as otherwise stated.

- *Water Code Section 13261(a)*: Failure to file report of waste discharge after demand.
- *Water Code Section 13261(b)*: Failure to file or falsification of report of discharge of hazardous waste (up to $1,000 fine per day).
- *Water Code Section 13268(a)*: Failure to furnish or falsification of technical or monitoring reports (up to $1,000 fine per day).
- *Water Code Section 13268(b)*: Failure to furnish or falsification of technical or monitoring reports of hazardous waste (up to $1,000 fine per day).
- *Water Code Section 13271(c)*: Failure to report discharge of hazardous substances in greater than reportable quantities (fine up to $20,000 and up to one year in jail).
- *Water Code Section 13272(c)*: Failure to report discharges of oil ($500-5,000 fine per violation and up to one year in jail).
- *Water Code Section 13387(b)*: Falsification of reports of discharge to waters of U.S., or violation of any other discharge, dredge, or fill material permit requirements.
- *Water Code Section 13522.6*: Failure to file recycling report.

Criminal — Felonies

- *Water Code Section 13387*: Violation of Clean Water Act programme requirements ($5,000 to $25,000 fine for each day of violation and up to one year in jail; $5,000 to $50,000 fine for each day of intentional violation and up to three years in jail).
- *Health and Safety Code Section 25284.4 (i)*: Perjury provision for fraud by underground tank testers.

Civil

Up to $6,000 fine per day (unless otherwise stated). No district attorney authority, but a district attorney can charge violation as an unfair business practice pursuant to Business and Professions Code Section 17200 and other provisions such as the Fish and Game Code.

- *Water Code Section 13265(b)*: Discharge of hazardous waste without report or requirements (up to $5,000 fine per day).

- *Water Code Section 13385*: Violation of Clean Water Act requirements (up to $25,000 fine [in lieu of Water Code section 13350]).
- *Water Code Section 13350(a)(3)*: Unpermitted discharge of oil (up to $15,000 fine for each day of violation).
- *Water Code Section 13350(b)*: Unpermitted discharge of hazardous waste that causes or threatens to cause pollution or nuisance—strict liability (up to $15,000 fine for each day of violation).
- *Water Code Section 13261(b)*: Failure to file or falsification of a report of hazardous-waste discharge (up to $25,000 fine per day).
- *Water Code Section 13268(b)*: Failure to furnish or falsification of report of technical or monitoring programmes relating to hazardous waste (up to $25,000 fine per day).
- *Water Code Section 13350(a)(1)*: Violation of cease-and-desist order (up to $15,000 fine per day).
- *Water Code Section 13350(a)(2)*: Discharges in violation of waste discharge requirements, orders, or prohibitions that create condition of pollution or nuisance (up to $15,000 fine per day).
- *Water Code Section 13385*: Violation of orders implementing Clean Water Act (up to $15,000 fine per day, up to $25,000 fine per day [in lieu of Water Code section 13350]).

Injunctions

No district attorney authority (but remember Business and Professions Code section 17200):

- *Water Code Section 13262*: Enjoin discharge pending compliance with Water Code sections 13260 and 13264(a).
- *Water Code Section 13386*: Compel compliance with Clean Water Act requirements.
- *Water Code Section 13525*: Enjoin recycling in violation of Water Code section 13524.
- *Water Code Section 13262*: To compel report of waste discharge.
- *Water Code Section 13522.7*: To compel recycling report.
- *Water Code Section 13304*: Enjoin violations of cleanup and abatement order.
- *Water Code Section 13331*: Enjoin violation of cease-and-desist order.
- *Water Code Section 13340*: Compel abatement of pollution or nuisance in emergency.

Reimbursement

Water Code section 13304(c)—Reimbursement of costs under cleanup and abatement authority. Also, section 13305(f) provides for reimbursement of costs under cleanup and abatement authority for non-operating business or industrial facilities.

Proposition 65

This initiative is codified at Health and Safety Code sections 25249.5 et seq. There are two separate parts to the act: one deals with requirements for warning labels to the public, the other with discharges to drinking water. The act prohibits businesses from knowingly discharging into water listed carcinogens or mutagens (substances that cause genetic alteration) without first giving a warning. The specific carcinogens and mutagens are listed in the California Code of Regulations Title 22, section 12000. Provision is made for civil penalties of up to $2,500 per day for each violation. There is a significant amount of case law regarding Proposition 65. It is suggested that prosecutors contact the Attorney General's Office or the state Office of Environmental Health Hazard Assessment for more information. There is a provision for a private cause of action, but notice is required to be given to the local district attorney and the Attorney General. This is why your office may receive "Notices of Intent to Sue" under the provisions of Proposition 65 from private counsel.

Local Agencies—The Unified Programme

The Unified Hazardous Waste and Hazardous Materials Management Regulatory Programme (Unified Programme) provides for local implementation of the following six regulatory programmes:

- The Spill Prevention Control and Countermeasure Plan of the Aboveground Storage Tank programme (SPCC)
- The Hazardous Materials Release Response Plan and Inventory programme (HMRRP) (Business Plan)
- The California Accidental Release Prevention programme (CalARP)
- The Uniform Fire Code Hazardous Materials Management Plan and Inventory Statement (HMMP/HMIS)
- The Underground Storage Tank programme (UST)
- The Hazardous Waste Generator and Onsite Hazardous Waste Treatment programme

The local implementing agencies are known as CUPAs (certified unified programme agencies) or PAs (participating agencies).

Aboveground Storage Tanks

According to current laws, The Aboveground Storage Tank (AST) programme, is to be implemented by the SWRCB and the RWQCBs. The program's requirements are found in Chapter 6.67 of Division 20 of the Health and Safety Code. "In general, the [AST programme] requires owners or operators of aboveground petroleum storage tanks to file a storage statement, pay a fee... and implement measures to prevent spills." The owner or operator of an aboveground storage tank facility that has a petroleum storage capacity of more than 660 gallons in a single tank, or a total storage capacity of more than 1,320 gallons in more than one tank, is generally required by Health and Safety Code Section 25270.5

to prepare a Spill Prevention Control and Countermeasure Plan (SPCC) plan. The specific requirements for a SPCC are laid out in the Code of Federal Regulations Title 40, Section 112.7. However, funding and positions for this programme were cut in 2002. There may be legislation to transfer this programme to the CUPAs but as of this writing (2007) that has not yet occurred.

The Attorney General's Office may bring civil actions against violators of Chapter 6.67 (including violators of SPCC requirements). It may seek to enjoin violators and may seek civil penalties of up to $5,000 per day for a first offence, up to $10,000 per day for repeat violations.

Hazardous Materials Inventory and Reporting Requirements

Experience has shown that prevention mechanisms are the most cost effective methods of reducing hazardous material incidents. Implementation of state and federal hazardous material planning laws and regulations can be effective in minimizing releases of hazardous materials. Proper enforcement is critical to the implementation of the hazardous material regulatory programme and to ensure appropriate protection of public health and safety and the environment. Chapter 6.95 of the Health and Safety Code contains significant planning requirements for control of hazardous materials.

Every "person" who "handles" (defined terms) more than a specified quantity of hazardous materials must prepare a business plan, which includes a chemical inventory (including a site map), an emergency response plan and procedures, and information on the business's hazardous materials training plan for employees. The requirements for business plans are found in Health and Safety Code Sections 25500 et seq. These regulations are found in Chapter 4 of Division 2 of Title 19 of the California Code of Regulations.

The several unique elements that include:

- The most comprehensive statutory definition of "hazardous materials":
  - "Hazardous material" means any material that, because of its quantity, concentration, or physical or chemical characteristics, poses a significant present or potential hazard to human health and safety if released into the workplace or environment.
  - "Hazardous materials" include, but are not limited to, hazardous substances, hazardous waste, and any material which a handler or the administering agency has a reasonable basis for believing would be injurious to the health and safety of persons or harmful if released into the workplace or the environment.
- A definition of "business" that includes "an employer" and government.
- A definition of "handler" to assist in defining the businesses covered.
- A comprehensive definition of "release."
- Definition of "threatened release"—important for emergency-notification prosecution.
- Requirements to immediately report significant releases or potential releases of hazardous materials to the State Office of Emergency Services and to the local CUPA.

Required Planning Elements

Each business that handles any one hazardous material in an amount that is equal to or greater than 500 pounds, 55 gallons, or 200 cubic feet of gas must develop a business plan and submit it to the local unified programme agency. This plan must include an inventory of hazardous materials and cover emergency response, pre-empt planning, training, and evacuation.

Note: This plan may be the same document used to satisfy the contingency plan requirement of the hazardous waste law. The Uniform Fire Code also requires a "plan." The business plans and inventories of hazardous materials are held by the administering agencies and are available for review by the general public.

Handlers of acutely hazardous materials (using U.S., EPA's definition of extremely hazardous substances found in 42 U.S.C. section 11002(a)(2)) may be required to develop Risk Management and Prevention Programmes (RMPPs) upon request from local CUPAs. These risk prevention programmes may be required following an evaluation of the potential hazard presented by a specific facility to public health and safety or the environment. The quantities of extremely hazardous materials, the methods and processes involved, and the results of a hazard analysis will be used to determine the necessity for an RMPP.

Trade secrets have minimal protection from emergency responders needing the data for emergency response or medical personnel needing specific chemical data for specific medical treatment of patients.

Acutely Hazardous Materials

An owner or operator of a new or modified facility that will be used for the handling of acutely hazardous materials must prepare an RMPP.

Reporting Requirements

Anyone required to file a plan is also required to report releases or threatened releases of hazardous materials to the administering agency.

Enforcement

Civil Liability

Businesses violating aspects of business plan development, review, or submission, or failing to yield inspection authority, or failing to provide adequate and updated chemical inventory data are civilly liable to the administering city or county for up to $2,000 per day of violation. Costs of any necessary emergency response and the cost of cleanup and disposal may also be recovered. Following reasonable notice, a defendant that knowingly violates the elements in Chapter 6.95 may be civilly liable for up to $5,000 per day of violation. Civil actions may be brought by the district attorney, city attorney, or attorney general. Injunctions, restraining orders, and other appropriate orders shall be issued without proof of irreparable damage or that the remedy at law is inadequate.

Criminal Liability

Failure to notify of a significant release of hazardous materials is a misdemeanor punishable by a $25,000 fine for each day and one year in jail. Second offences are wobblers. Full costs of the emergency response, cleanup, and disposal shall also be recovered.

Knowing failure to file a business plan is a misdemeanor punishable by a $1,000 fine and one year in jail. Interference with authorized representatives of an administering agency carries misdemeanor liability. Health and Safety Code section 25515.2 deals with apportionment of criminal and civil penalties. Prosecutors receive 50 per cent of the penalties; $200 of every civil or criminal penalty must be sent to a state training fund.

Rewards—Persons Providing Information

Health and Safety Code section 25517 allows for the payment of up to $5,000 for information that materially contributes to the imposition of civil penalties or the conviction of a person or business.

California Accidental Release Prevention (CalARP)

CalARP is California's programme to implement the federal Accidental Release Prevention programme (ARP) with certain additional provisions specific to California. CalARP requires businesses that handle more than a threshold quantity of any of a list of extremely hazardous substances to prepare a Risk Management Plan (RMP) in order to analyze "potential accident factors that are present and the mitigation measures that can be implemented to reduce this accident potential."

The requirements for CalARP are found in Article 2 of Chapter 6.95 of Division 20 of the Health and Safety Code. The state Office of Emergency Services has responsibility for developing regulations that establish statewide standards for CalARP. These regulations are found in Chapter 4.5 of Division 2 of Title 19 of the California Code of Regulations.

Violators of CalARP's requirements are subject to a variety of civil penalties. If these penalties are recovered from the violator, a statute prohibits criminal prosecution of the violator for the same offence, and any civil action pending against a violator must be dismissed upon filing of a criminal complaint. A first-time violator may be held liable for up to $10,000 per day of violation and any costs incurred for emergency response or cleanup resulting from the violation. A person who commits a violation after reasonable notice is liable for up to $25,000 per day.

Criminal misdemeanor penalties apply to anyone convicted of knowingly falsifying, destroying, altering, or concealing documents used for compliance with CalARP, including fines of up to $25,000 per day of violation and/or imprisonment up to one year in county jail in addition to any costs incurred for emergency response or cleanup resulting from the violation. Second or subsequent convictions may be charged as misdemeanors or felonies.

UNIFORM FIRE CODE—HAZARDOUS MATERIALS MANAGEMENT PLAN, HAZARDOUS MATERIALS INVENTORY STATEMENT

The Uniform Fire Code (UFC) is published by the Western Fire Chiefs Association. The UFC "prescribes regulations consistent with nationally recognized good practice for the safeguarding... of life and property from the hazards of fire and explosion arising from the storage, handling and use of hazardous substances, materials and devices, and from conditions hazardous to life or property in the use or occupancy of buildings or premises." The State Fire Marshal, part of the Department of Forestry and Fire Protection since 1996, has adopted the Uniform Fire Code, with amendments, as the California Fire Code. Local fire departments are required to adopt local fire codes that are no less stringent than the California Fire Code.

Section 8001.3 of Article 80 of the California Fire Code pertains to hazardous materials permits. Pursuant to section 8001.3.1, a permit is required "to store, dispense, use or handle hazardous material in excess of" specified quantities. The actual issuance of these permits and compliance with their requirements are outside the scope of the Unified Programme. Permit applicants may be required by a fire chief to prepare a Hazardous

Materials Management Plan (HMMP) and Hazardous Materials Inventory Statement (HMIS); these two documents are included in the Unified Programme. The requirements of the HMMP and HMIS are now essentially the same as those of the business plan. The only enforcement mechanisms for Fire Code violations are those provided in local ordinance—usually infractions or misdemeanors. But see enforcement options under the discussion of business plans, above.

Underground Storage Tanks

The problem of hazardous substances leaking from underground tanks is not confined to California. Leakage from underground storage tanks containing hazardous material has contaminated groundwater and drinking water supplies throughout the nation. One gallon of gasoline can contaminate one million gallons of drinking water to an unsafe level of one part per million. High groundwater and sandy alluvial soil accelerate the corrosion of steel underground tanks and piping. As a result, leaks may occur in some tanks that are less than 10 years old.

More than half the reported leaks occur in the pressurized piping associated with the tanks rather than in the tanks themselves. Gasoline leaking from a hole in a pressure line will do so at a much faster rate than gasoline dripping from a hole in a tank's bottom. Moreover, because gasoline is so temperature sensitive and volatile, a 10,000-gallon tank can easily leak 100 gallons per month without being detected.

The requirements for the UST programme are found in Article 2, Chapter 6.7, Division 20 of the Health and Safety Code. The SWRCB has responsibility

for developing regulations that establish statewide standards for the UST programme, which are found in Chapter 16 of Division 3 of Title 23, in the California Code of Regulations. The programme is implemented on the local level by CUPAs. The owner or operator of a UST must obtain a permit from the CUPA prior to commencing operation of a tank. The permit includes conditions regarding design, construction, and installation of new USTs, monitoring, repairs, upgrades, release response, closure, and notification or reporting.

The Role of the State Water Resources Control Board

The State Water Resources Control Board promulgates regulations to implement the standards for underground storage tanks outlined in Health and Safety Code section 25299.3. These regulations govern implementation of safety technologies, monitoring requirements, and reporting. The State Board is also required to develop standardized underground storage tank permit applications to be used by local authorities in monitoring the permit system and to keep records of all permit applications filed with local authorities. The State Board has an underground tank enforcement unit that investigates violations related to USTs.

Tank Owners Requirements

Health and Safety Code sections 25280 et seq. lists the requirements for owners of tanks:

- Obtain a Permit to Operate and pay a fee to the local agency, *i.e.*, install a leak-detection system on all existing tanks.
- On new tank installations, obtain a Permit to Install and provide secondary containment of the tank and piping.
- Upon abandoning a tank, obtain a Permit to Abandon, clean out the tank, remove it from the ground, and check the ground beneath for evidence of contamination and past leakage.
- No permit is required for pits, ponds, lagoons.

Permits

The local CUPA issues permits and oversees activities pertaining to underground hazardous material storage tanks. Agriculture is exempt from local agency permit requirements.

The three kinds of permits and their requirements are as follows:

- Permit to Operate
  - Installation of a leak-detection system.
  - Compliance schedule for installation of leak-detection system.
  - Inspection of the leak-detection system installation and proper use, monitoring, and maintenance of the system.
- Permit to Install
  - Review of plans for secondary containment of tanks and piping.
  - Inspection of installation to ensure proper construction of the secondary containment system.

- *Permit to Close*: This permit requires the tank to be completely emptied and removed from the ground and the soil around and beneath the tank sampled for contamination.

Leak-Detection Programme

Applicants must file a plan and install a leak-detection system at their facilities. The plan must incorporate one of the monitoring alternatives contained in the regulations.

Requirements include:

- Description of proposed leak-detection system.
- Identification of monitoring alternatives.
- List of proposed equipment.
- Inventory schedule and procedures.
- Tank testing schedule.
- Monitoring of person responsible for leak-detection reporting procedures to be used if leak is detected.
- Name of the person responsible for leak detection reporting procedures to be used if leak is detected.
- Identification of duties to be performed by the owner of the tank and the operator of the facility.

ENFORCEMENT

Civil

Health and Safety Code section 25299 states that an owner or operator of an underground storage tank facility shall be liable for a civil penalty of from $500 to $5,000 per day for any of the following violations:

- Operating the facility's tanks without a Permit to Operate.
- Failing to monitor the tanks as required by the permit.
- Failing to maintain inventory and other records.
- Failing to report leaks.
- Improperly closing/abandoning a tank.
- Improperly repairing a leaking tank.

Criminal

Misdemeanors

Anyone falsifying any monitoring records or knowingly fails to report a leak may be fined from $5,000 to $10,000 per day and/or imprisoned in county jail for not more than one year. Anyone intentionally tampering with leak detection systems leak may be fined from $5,000 to $10,000 per day and/or imprisoned in county jail for not more than one year.

Felonies

Health and Safety Code Section 25284.4 (i): Perjury provision for fraud by underground tank testers

Alternative Penalties

In certain cases, an owner of a tank may be held liable for illegal disposal of hazardous waste under the Hazardous Waste Control Board Law with civil and criminal penalties similar to those described above.

HAZARDOUS WASTE

California's Hazardous Waste Control Act of 1972 was the first comprehensive hazardous waste control law in the United States. It has served as a model for other states as well as for the federal government. The Hazardous Waste Control Law, Health and Safety Code sections 25100 et seq., establishes standards for regulating the generation, handling, processing, storage, transportation, and disposal of hazardous wastes—a "cradle to grave" scheme.

The purpose of the regulations is the management of hazardous waste from the moment it is generated by an individual or a business until it is recycled or discarded. The hazardous waste control programme is administered by the state Department of Toxic Substances Control (DTSC) and by local CUPAs.

Hazardous Material vs. Hazardous Waste

The distinction between hazardous material and hazardous waste is important. Different regulatory schemes have different lists of what constitutes a hazardous material. For example, Health and Safety Code section 25501 provides its own particular definition of hazardous material. Hazardous materials become hazardous waste when the material has been used for its original purpose and is about to be discarded or recycled. California law subjects recyclable materials to many of the same restrictions as hazardous waste.

Hazardous waste is defined as a waste, or combination of wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may either:

- Cause or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness.
- Pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or
- Otherwise managed.

Criteria for specific types of hazardous waste are found in the California Code of Regulations at Title 22, sections 66261.10-66261.24. These regulations describe specific testing methods for toxicity, flammability, reactivity, and corrosiveness..

The Manifest System

DTSC is responsible for maintaining and regulating the manifest system mandated by the Hazardous Waste Control Law. The focus of the system is the requirement of a "manifest," a document that tracks the movement and disposal

of hazardous waste. Manifest regulations are set forth at California Code of Regulations Title 22, sections 66262.20-66262.23 and 66262.40. The generator prepares the manifest that identifies the generator, the type and amount of waste to be shipped, the designated hauler, and the designated disposal site.

The generator prepares six copies of the manifest. When waste is offered for transportation, the transporter acknowledges receipt of the waste by signing the manifest. The generator retains one signed copy and sends another copy to DTSC within 30 days of shipping the waste. The hauler carries the remaining four copies with him or her at all times during the transportation of the waste. Upon delivery to the disposal site, the owner or operator of the disposal facility inspects the waste to assure that it is accurately described in the manifest and then acknowledges receipt of the waste by signing the manifest.

TREATMENT, STORAGE, AND DISPOSAL FACILITIES (TSDFS)

Facility Permits

The state issues permits only to facilities engaged in the treatment, storage, disposal, or transportation of hazardous wastes. Generators are not required to obtain a permit, but are required to have a U.S., EPA generator ID number and must report to the federal Environmental Protection Agency if they produce more than 1,000 kilograms (2,200 pounds) of hazardous waste within a calendar month.

Exceptions are made for hazardous wastes generated onsite and stored for less than 90 days or where the total hazardous waste generated is less than 5,000 gallons or 45,000 pounds. Transfer facilities holding hazardous waste for more than 144 hours and all other off-site facilities holding hazardous waste for any period of time must also hold a valid TSDF permit.

Fees

Disposal fees are assessed on a per-ton basis. Fees are collected by the Board of Equalization, not the Department of Toxic Substances Control.

Generator Responsibilities

A generator is a person or business whose act or process produces a hazardous waste or whose act first causes a hazardous waste to become subject to regulation.

Responsibilities include:

- Filing a hazardous waste notification statement with DTSC prior to generating, treating, storing, or disposing of hazardous waste.
- The generator determines if its waste falls within the definition of "hazardous" and treats it accordingly. The generator must obtain a U.S., EPA Identification Number. Variance procedures are available if the generator believes the waste need not be handled as hazardous waste.
- A generator of extremely hazardous waste must notify DTSC of its intent to dispose it.

- A generator may store hazardous waste at an outside facility for up to 90 days or at an offsite transfer facility for 144 hours without obtaining a facility permit. Extensions of the 90-day rule are available on application to DTSC if unforeseen circumstances cause delay.
- Small generators, defined as generators of less than 100 kilograms (220 pounds) of hazardous waste or less than one kilogram (2.2 pounds) of extremely hazardous waste per month, may store up to 100 kilograms of hazardous waste or one kilogram of extremely hazardous waste indefinitely without a permit.
- Generators must dispose of all hazardous waste at a licensed facility using a registered hazardous-waste hauler for all transportation.
- Generators must use a manifest for all transportation of hazardous waste and:
  - Complete the generator portion (including a description of the waste) and sign the certification.
  - Insure that the transporter signs and dates the manifest upon receipt of the waste.
  - Keep two copies of the manifest (special rules apply regarding transport by ship, rail, *etc.*).
  - Contact the transporter and disposal facility if the copy signed by the disposer is not received within 35 days of shipment.
  - Submit an Exception Report to DTSC if a signed copy from the disposal facility is not received within 45 days of shipment. Maintain records.
- Generators must maintain copies of all manifests for three years, submit biennial reports, keep a copy of all biennial reports and exception reports for three years, and maintain copies of all chemical test reports for three years.
- Generators must insure that hazardous waste is properly packaged and labeled for transport.
- Generators must insure that storage conditions comply with regulations during storage prior to disposal.

Comply with storage and container regulations for Interim Status and Permitted Facilities, including providing for adequate security, containment of spills, alarm systems, *etc.* The date on which accumulation of waste began must be marked and visible on each container to assure compliance with the 90-day rule.

Containers must be marked as containing hazardous waste:

- Generators must comply with regulations regarding preparedness and prevention for fires, spills, accidents, *etc.*, and also with regulations regarding contingency plans for accidents, evacuations, emergency response, *etc.* This may be the same document as the Hazardous Materials Management Plan prepared pursuant to Health and Safety Code Chapter 6.95.

- Generators must comply with training requirements for personnel who handle hazardous waste.
- Generators must recycle all hazardous wastes for which DTSC determines recycling is economically and technologically feasible. A list of such wastes appears at California Code of Regulations Title 22, section 66266.2.
- Generators who produce more than five tons of hazardous waste per year must pay generator fees.

HAZARDOUS-WASTE TRANSPORTERS

Registration

DTSC has the responsibility for the registration of all transporters of hazardous waste in California. All transporters must hold a valid registration permit from DTSC before carrying any hazardous waste. DTSC reviews applications for registration to ensure that:

- All equipment to be used by the transporter for transporting hazardous wastes has passed inspection by the California Highway Patrol (CHP).
- All persons who will operate any hazardous waste transportation equipment have received adequate safety training.
- The transporter has established his or her financial responsibility.
- The hauler has agreed to allow authorized agents of DTSC or the CHP to inspect his or her vehicle, transportation equipment, and records.

Enforcement of Transportation Laws

DTSC shares responsibility for enforcing California's hazardous waste transportation laws and regulations with CHP. DTSC is authorized to inspect company records and, when accompanied by a uniformed police officer, to stop and inspect any vehicle reasonably suspected of transporting hazardous wastes. DTSC may suspend the transporter's registration absent proof of ability to respond to damage. When DTSC determines that a violation has occurred or is about to occur, it may request the city attorney, district attorney, or the attorney general to seek injunctive relief or civil penalties in the California courts.

- *California Highway Patrol*: Under Vehicle Code section 34501(b), CHP has broad authority to promulgate regulations to ensure safety in the transportation of hazardous substances. Pursuant to that authority, CHP has issued extensive regulations regarding:
  - Packaging and labeling of hazardous substances offered for transportation, the placarding of vehicles, the preparation of shipping papers, safety-equipment requirements, and routing restrictions.
  - CHP packaging and labeling requirements extensively reference federal Department of Transportation regulations.
  - *Licensing*: The CHP is responsible for licensing hazardous-waste haulers. No person may transport hazardous waste without first

acquiring a license from CHP. The license is non-transferable and may be denied, suspended, or revoked if the hauler is found to be guilty of multiple violations of the hazardous waste transportation laws.

– *Suspensions*: CHP is also authorized to suspend or revoke any license for the transportation of hazardous materials if it finds that the hauler has been found guilty of multiple violations of the Vehicle Code and that such suspension or revocation is in the public interest. The CHP commissioner is authorized to temporarily suspend any hauler's license when he or she deems such suspension necessary to prevent an imminent and substantial danger to the public health.

- Responsibilities of Transporters
  - Must be registered with DTSC and obtain CHP inspection/ approval for all trucks and containers used in transport. There is an exception for small quantities (under five gallons/50 pounds).
  - Must comply with all regulations regarding manifests.
  - Must ensure that the generator signs, dates, and describes the waste.
  - Must complete, sign, and date the transporter section and give a copy to the generator prior to the removal of the waste.
  - Must have a copy of the manifest in his or her possession during transportation and must provide a copy to the facility to which the waste is delivered.
  - Must obtain the signature and date of transfer of the waste to the licensed facility where it is disposed or to another registered waste hauler upon surrender of the waste.
  - Must keep a copy of the manifest for three years.
  - Must take immediate and appropriate action regarding spills during transport.

Cleanup Superfund

Pursuant to the Carpenter-Presley-Tanner Hazardous Substance Account Act (the State Superfund), DTSC is responsible for formulating criteria for the selection and priority ranking of hazardous-waste sites for remedial action. For this purpose, DTSC has adopted a modified version of U.S., EPA's hazard ranking system. DTSC has prepared a priority list of sites for cleanup that it updates monthly. In addition to this priority list, DTSC prepares site-specific plans of expenditures for removal and remedial actions to be paid for from the State Superfund.

Whenever DTSC determines that a release of a hazardous waste has occurred or is about to occur, it is authorized to investigate the nature of the release or potential release, to plan and direct appropriate remedial action, and, if no other party has undertaken the appropriate remedial action, to undertake that action itself. It is also authorized to require the property owner to secure the site.

If DTSC determines that a site or release presents an imminent and substantial danger to the public health or the environment, it may immediately order remedial action by the responsible parties, request the attorney general to seek judicial relief, and/or take or contract for necessary remedial actions. The attorney general has jurisdiction to recover all costs expended by the DTSC.

If the local district attorney has brought an action under the HWCL pursuant to Chapter 6.5 against any person for violating the provisions of that chapter or any rule, regulation, or order and the Department has spent money from the state account for immediate corrective action in response to a release or threatened release, the state account may be made a party to that action for the purpose of recovering such costs.

Enforcement

If DTSC finds any violation of the HWCL or its rules or regulations, or if it finds that the owner or operator of the facility has misrepresented or omitted any significant fact in its permit application or in any other information submitted to the Department, it may suspend or revoke the facility's permit.

Alternatively, if DTSC or the CUPA director finds a violation of HWCL or its regulations, he or she may issue an administrative order against the owner or operator of the facility specifying a schedule for compliance. If corrective action is not taken or if it is determined that immediate action is necessary to prevent an imminent and substantial danger to the public health or environment, DTSC is authorized to take action itself.

If the director finds any violation of HWCL or its regulations, DTSC may request the local city attorney, district attorney, or the attorney general to file suit for injunctive relief or civil penalties. To the extent that criminal violations are involved, the inherent prosecutorial authority of the district attorney allows for independent criminal prosecution of any violations without regard to the above-listed requests from the DTSC. Legislation passed in 1990 creates dual criminal jurisdiction in both the district attorney and the city attorney. Coordination between district attorneys and city attorneys is critical to avoid double-jeopardy problems.

Violations

Criminal Violations: Health and Safety Code Section 25190: Any violation of Chapter 6.5 of the Health and Safety Code or any regulation adopted under Chapter 6.5 (including all registration, certification, and manifesting requirements identified above) is a misdemeanor. A second conviction is punishable by up to 24 months in state prison and a fine of $5,000 to $25,000.

Health and Safety Code Section 25191: Covers transporter registration, vehicle certification, and manifesting requirements. Any owner or lessee of a vehicle in which waste is transported, or any person authorizing transportation who knowingly violates specified provisions, shall be fined $2,000 to $50,000 for each day of violation and/or serve up to 24 months in prison.

Health and Safety Code Section 25191(c): Covers transporting or authorizing transportation in an uncertified vehicle and carrying or authorizing the carrying of hazardous waste without a manifest. Any person who knowingly violates specified provisions shall be fined up to $500 for each day of violation and/or serve six months to one year in prison.

Health and Safety Code Section 25191(d): Treatment or storage without a permit or at an unauthorized point. Any person who knowingly violates specified provisions shall be fined $2,000 to $50,000 and/or serve up to 24 months in prison. Second convictions shall be fined $5,000 to $50,000 and/or serve up to 24 months in prison—GBI enhancements.

Health and Safety Code Section 25189.5 (Felony): Where one knows or should have known of unlawful treatment, storage, transportation, or disposal, punishment is imprisonment for up to 36 months and a fine of between $5,000 and $100,000 for each day of violation—GBI enhancements. (*People v. Martin* (1989) 211 Cal.App.3d 699; *People v. Taylor* (1992) 7 Cal.App.4th 677 [lack of funds is not a defence to disposal].)

Note: Each day after an unreported illegal disposal is considered a separate offence until notice is given to DTSC. For a case upholding a similar statute against a Penal Code section 654 challenge, see *People v. Djekich* (1991) 229 Cal.App.3d 1213.

Health and Safety Code Section 25189.6 (Felony): Any person who knowingly or with reckless disregard of the risk treats, handles, transports, disposes, or stores hazardous waste in a manner that causes unreasonable risk of fire, explosion, *etc.*, may be punished by a fine of not less than $5,000 up to $250,000 per day and 16, 24, or 36 months in prison. There is an enhancement for knowingly placing another in imminent danger that is punishable by three, six, or nine years in prison. This section may be used in illegal drug laboratory situations.

This is one of the few areas where there is a lot of California law on criminal cases. See *People. v. Sangani* (1994) 22 Cal.App.4th 1120; *People v. Hale* (1994) 29 Cal.App.4th 730; *People v. Todd Shipyards Corp*. (1987) 192 Cal.App.3d Supp. 20; and *People v. Matthews* (1992) 7 Cal.App.4th 1052.

Health and Safety Code Section 25189.7 (Felony): This section provides that anyone who knew or should have known that he or she burned or caused the incineration of hazardous waste at an environmental facility may be fined up to $100,000 and imprisoned for one, two, or three years—GBI enhancement.

Civil Violations—Civil violations may be brought by the district attorney when referred by the DTSC.

Health and Safety Code Section 25189(a): Intentional or negligent false statements on an application, manifest, *etc.*, may be fined up to $25,000 for each day of each separate violation.

Health and Safety Code Section 25189(b): Intentional or negligent violation of any provision of Chapter 6.5 of the Health and Safety Code or any regulation adopted pursuant to it relating to registration, certification, and manifesting as described above may be fined up to $25,000 for each day of violation.

Health and Safety Code Section 25189(c): Intentional disposal or causing the disposal at an unauthorized point according to Chapter 6.5 of the Health and Safety Code may be fined from $1,000 to $25,000. Each day the waste remains deposited with the violator's knowledge constitutes a separate violation.

Health and Safety Code Section 25189.2(a)—Strict Liability: Any false statement on an application or manifest may be fined up to $25,000.

Health and Safety Code Section 25189.2(b)—Strict Liability: Any violation of Chapter 6.5 of the Health and Safety Code or any regulation promulgated under it may be fined up to $25,000.

Health and Safety Code Section 25189.2(c)—Strict Liability: Disposal or causing the disposal of hazardous waste at an unauthorized point may be fined up to $25,000.

2

Environmental Hazards and Pollution

DEFINITION AND MEANING

Presence of dangerous unnatural ingredients causing imbalance in the ecosystem and health hazards to human beings and animals can be called as pollution.

That is, pollution is a phenomena where natural ingredients are replaced or damaged by presence of dangerous unnatural ingredients-which have potentiality to cause imbalance to the system and to create number of health hazards to animals and human beings. Such unnatural ingredients may be gases (causing air pollution), solids/liquids (causing water, food and land pollution) or sound (causing sound pollution). All of them cause imbalance in ecosystem directly or indirectly and have potentiality to cause health hazards to human beings and animals.

MEANING

Pollution can be anything-which damages the ecosystem and destroys the delicate balance in the ecosystem. Thereby, it creates health hazards to human beings and animals besides damaging the ecosystem. For *e.g.*, industries polluting air has set imbalance in composition of air and made it unworthy to breathe-thereby causing innumerable health problems to human and animal life. Extensive use of pesticides on crops has set imbalance in ecosystems of lands besides causing drinking water pollution.

ABANDON SHIP TAKES ON NEW MEANING: ENVIRONMENTAL HAZARD

Officials in coastal states are worried that the high upkeep of boats in the depressed economy has mariners literally abandoning their ships in droves—a practice that could threaten the environment.

There's no official tally of cast-off boats, but an unusually high number are reportedly being dumped in waters off the coasts of Florida, South Carolina and Washington State; California is mulling a measure that would let owners surrender their vessels to the state, according to the *New York Times*. Other media reported last summer that more than 200 boats had been left in New York's Jamaica Bay. "Our waters have become dumping grounds," Major Paul Ouellette of the Florida Fish and Wildlife Conservation Commission told the *Times*. "It's got to the point where something has to be done."

The environmental hazards come from leaking oil and fuel, as well as degrading biocides, such as copper paints, that prevent barnacles and algae from attaching to the bottom of a vessel, said Miriam Gordon, California state director of the environmental group Clean Water Action. Oil and fuel contain Polycyclic Aromatic Hydrocarbons (PAHs) that can kill fish and other marine species if they spill, and copper can sink into sediment, also killing marine life.

Other problems come when a boat sinks, creating giant holes and patches in sea grass – a kind of nursery for marine life seeking food and shelter, she says. Healthy sea grass is also necessary for species that feed on fish eggs there, such as birds and ducks.

Margaret Podlich, vice president of government affairs for Boat US, an association of vessel owners based in Alexandria, Va., tells *ScientificAmerican.com* that abandoned boats are nothing new, but may be more pronounced now. "This is an old problem being exaggerated because of the economy," Podlich says. Have a boat you want to get rid of but can't sell? Give it away, Podlich says, or pay to have it properly disposed of in a landfill.

BIOLOGICAL HAZARDS, AND THEIR ADVERSE HEALTH EFFECTS

These generally fall into two broad categories: those which produce adverse health effects through infection and those which produce adverse effects in non-infective (allergic) ways.

As regards microbiological hazards in water, substantial improvements in the health of the population have resulted historically from the supply of drinking water free from disease causing organisms such as cholera. Similar improvements can be expected in the health of the inhabitants of developing countries if microbiologically safe water is provided by avoidance of contamination, and appropriate purification including disinfection (usually by chlorination). Occasional outbreaks of waterborne infection still arise from contamination of drinking water by soiled water (usually coliforms).

There can be other opportunities for further bacteriological contamination. Thus Legionella can grow in sumps or dead legs in the plumbing system and may then be dispersed as aerosols from showers.

Recreational water which is heavily contaminated with pathogens, notably coliform bacteria has been shown to be associated with an increased risk of gastrointestinal and other infectious illness, usually self-limiting.

So-called "clinical" waste is not merely an occupational hazard of health care workers but is becoming an increasingly more important risk, for example for children finding blood stained needles.

Many allergens such as grass pollen grains, or faecal material from house dust mites may cause attacks of asthma or "hay fever" (allergic rhinitis). There is evidence that high exposure to these allergens early in life, increases the risk of suffering from asthma later on. An increasing number of studies suggest that airborne chemical pollution can act synergistically with naturally occurring allergens and result in effects on lung function at concentrations lower than those at which either the allergen or the chemical irritant on its own would have produced an adverse effect.

CONCLUSION

The above account demonstrates the wide range of effects that the environment may have on human health, but it is very far from exhaustive and for the sake of conciseness many hazards or their effects have not been mentioned. Moreover, the simplicity of the above has meant that very important concepts have not been discussed. These include the distinction between mere association, and causation, or the quantitative implications of understanding the difference between hazard and risk.

Finally, to keep things in perspective, we must not forgot, that as a species we are the way are because of the influence of the environment on our evolution. Problems to health arise at two levels: At the level of the individual, the environmental influences which slowly 'shape' the species may in some respect or another cause harm to some members of the species-that is how a species evolves. At the level of the species, we must remember that the process of evolution is relatively slow when compared to the rate at which man can bring about environmental change. This means that unless efforts are made to care for the environment, the human species may suffer to an extent that other species already have suffered.

- Es, and Exposure Agents: Environmental Pollution (Hazards or Agents)

ENVIRONMENTAL POLLUTION

Pollution: Environmental pollution is any discharge of material or energy into water, land, or air that causes or may cause acute (short-term) or chronic (long-term) detriment to the Earth's ecological balance or that lowers the quality of life. Pollutants may cause primary damage, with direct identifiable impact on the environment, or secondary damage in the form of minor perturbations in

the delicate balance of the biological food web that are detectable only over long time periods. Until relatively recently in humanity's history, where pollution has existed, it has been primarily a local problem. The industrialization of society, the introduction of motorized vehicles, and the explosion of the human population, however, have caused an exponential growth in the production of goods and services.

Coupled with this growth has been a tremendous increase in waste by-products. The indiscriminate discharge of untreated industrial and domestic wastes into waterways, the spewing of thousands of tons of particulates and airborne gases into the atmosphere, the "throwaway" attitude towards solid wastes, and the use of newly developed chemicals without considering potential consequences have resulted in major environmental disasters, including the formation of smog in the Los Angeles area since the late 1940s and the pollution of large areas of the Mediterranean Sea.

Technology has begun to solve some pollution problems (see pollution control), and public awareness of the extent of pollution will eventually force governments to undertake more effective environmental planning and adopt more effective antipollution measures.

TYPES OF ENVIRONMENTAL HAZARDS AND DISASTER

ENVIRONMENTAL DISASTERS BY CATEGORY

Agricultural:

- Salinity in Australia
- Salinization of the Fertile Crescent
- The Dust Bowl in Canada and the United States (1934-1939)
- The Great sparrow campaign; sparrows were eliminated from Chinese farms, which caused locusts to swarm the farms and resulted in a famine which killed 38 million people.
- Africanized bees, known colloquially as "killer bees"
- Central Plains Water scheme in New Zealand
- The Osborne Reef and other similar artificial reefs made of tires
- Aral Sea mismanagement
- Dirty dairying in New Zealand
- Hedgerow removal

Biodiversity:

- Extinction of American megafauna
- Extinction of Australian megafauna
- Deforestation of Easter Island
- Destruction of the old growth forests
- Rabbits in Australia
- Red imported fire ants
- Reduction in the number of the American Bison

- Introduction of the Nile perch into Lake Victoria in Africa, decimating indigenous fish species
- The Saemangeum Seawall
- Environmental threats to the Great Barrier Reef
- 2006 Zakouma elephant slaughter
- Invasive species in New Zealand
- Ghost nets
- Grounding of SS Makambo on Lord Howe Island

Coal:

- Martin County sludge spill
- Tennessee coal sludge spill

Human health:

- Introduction of infectious diseases by Europeans causing the death of indigenous people during European colonization of the Americas
- Health effects arising from the September 11 attacks
- Goiania accident, human deaths resulting from dismantling a scrapped medical machine containing a source of radioactivity

Industrial:

- Minamata disease-mercury poisoning in Japan (1950s & 1960s)
- Ontario Minamata disease in Canada
- Itai-itai disease, due to cadmium poisoning in Japan
- Love Canal toxic waste site
- Seveso disaster (1976), chemical plant explosion, caused highest known exposure to 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) in residential populations
- Bhopal disaster
- Sandoz chemical spill into the Rhine river (1986)
- United States Environmental Protection Agency Superfund sites in the United States
- AZF Explosion at a Toulouse chemical factory (2001)
- 2005 Jilin chemical plant explosions
- The Sydney Tar Ponds and Coke Ovens sites in the city of Sydney, Nova Scotia, Canada, known as the largest toxic waste site in North America.
- Release of lead dust into Esperance Harbour.
- Release of cyanide, heavy metals and acid into the Alamosa River, Colorado from the Summitville mine, causing the death of all marine life within a 17 mile radius.
- Release of 20,000 gallons of lethal chemicals (metam sodium, tradename Vapam) into the Upper Sacramento River near Dunsmuir, causing the death of all marine life within a 38 mile radius.
- Release of CFC's resulting in ozone depletion
- Release of sulfer dioxide after a fire at the Al-Mishraq plant in Iraq
- The Phillips Disasters
- Villa Parisi (Brazil)

- Health issues on the Aamjiwnaang First Nation due to chemical factories
- Environmental issues with the Three Gorges Dam
- Kingston Fossil Plant coal fly ash slurry spill

Mining:

- The Ok Tedi environmental disaster in Papua New Guinea
- Collapse of a colliery waste tip in Aberfan, Wales
- Mining at Cerro de San Pedro in Mexico by Minera San Xavier
- Lead dust from the Magellan Metals mine in Australia
- Failure of a toxic waste dam at the Aznalcollar mine in Spain
- Uranium mining controversy in Kakadu National Park
- The proposed Cypress Mine in New Zealand
- The tailings dam from the now abandoned Tui mine

Oil industry:

- Environmental issues in the Niger Delta relating to the oil industry
- Lago Agrio oil field issues
- Arctic Refuge drilling controversy

Nuclear:

- Atomic bombings of Hiroshima and Nagasaki
- Chernobyl disaster
- Three Mile Island accident
- Nuclear testing at Moruroa and Fangataufa
- Windscale fire
- Fallout from the Castle Bravo nuclear test
- The health of Downwinders

Pollution:

- Proliferation of plastic shopping bags

Air:

- The Donora Smog of 1948 in Donora, Pennsylvania in the United States
- The Great Smog of 1952, which killed 4,000 Londoners
- The 1983 Melbourne dust storm
- The 1997 Southeast Asian haze
- The 2005 Malaysian haze
- The 2006 Southeast Asian haze
- Yokkaichi asthma in Japan
- Health problems due to the Jinkanpo Atsugi Incinerator in Japan
- Kuwaiti oil fires

Land:

- The Dust Bowl of Canada and the United States
- Contaminated soils in Mapua, New Zealand due to the operation of an agricultural chemicals factory
- Basin F, a disposal site in the United States for contaminated liquid wastes from the chemical manufacturing operations of the Army and its lessee Shell Chemical Company
- 2006 Cote d'Ivoire toxic waste spill
- Atari video game burial

Water:

- Selenium poisoning of wildlife due to farm runoff used to create Kesterson National Wildlife Refuge, an the artificial wetland
- The Jiyeh Power Station oil spill in the Mediterranean region
- Effects of polluted water in the Berkeley Pit in the United States
- Cheakamus River derailment which polluted a river with caustic soda
- Draining and development of the Everglades

Marine:

- The artificial Osborne Reef
- Dumping of conventional and chemical munitions in Beaufort's Dyke
- Marine debris
- Environmental threats to the Great Barrier Reef
- Nurdles
- Friendly Floatees
- The Great Pacific Garbage Patch

TYPES OF POLLUTION—LAND POLLUTION

Land Pollution is the degradation of earth's land surfaces often caused by human activities and their misuse of land resources. It occurs when waste is not disposed properly. Haphazard disposal of urban and industrial wastes, exploitation of minerals, and improper use of soil by inadequate agricultural practices are a few factors. Urbanization and industrialisation are major causes of land pollution.

The Industrial Revolution set a series of events into motion which destroyed natural habitats and polluted the environment, causing diseases in both humans and animals.

INCREASED MECHANIZATION

The increase in the concentration of population in cities, along with the internal combustion engine, led to the increased number of roads and all the infra structure that goes with them. Roads cause visual, noise, light, air and water pollution, in addition to land pollution. The visual and noise areas are obvious, however light pollution is becoming more widely recognised as a problem. From outer space, large cities can be picked out at night by the glow of their lighting, so city dwellers seldom experience total darkness.

The contribution of vehicular traffic to air pollution is dealt with in another article, but, suffice to say that sulfur dioxide, nitrogen oxide and carbon monoxide are the main culprits. Water pollution is caused by the run off from roads of oil, salt and rubber residue, which enter the water courses and may make conditions unsuitable for certain organisms to live.

As the demand for food has grown very high, there is an increase in field size and mechanization. The increase in field size makes it economically viable for the farmer but results in loss of habitat and shelter for wildlife, as hedgerows and copses disappear. When crops are harvested, the naked soil is left open to

wind after the heavy machinery has compacted it. Another consequence of more intensive agriculture is the move to monoculture. This is unnatural, it depletes the soil of nutrients, allows diseases and pests to spread and, in short, brings into play the use of chemical substances foreign to the environment.

PESTICIDES

Herbicides: Herbicides are used to kill weeds, especially on pavements and railways. They are similar to auxins and most are biodegradable by soil bacteria. However one group derived from trinitrophenol (2:4 D and 2:4:5 T) have the impurity dioxin, which is very toxic and causes fatality even in low concentrations. It also causes spontaneous abortions, haemorrhaging and cancer. Agent Orange (50% 2:4:5 T) was used as a defoliant in Vietnam. Eleven million gallons were used and children born since then to American soldiers who served in this conflict, have shown increased physical and mental disabilities compared to the rest of the population. It affects the head of the sperm and the chromosomes inside it.

Another herbicide, much loved by murder story writers, is Paraquat. It is highly toxic but it rapidly degrades in soil due to the action of bacteria and does not kill soil fauna.

INSECTICIDES

Insecticides are used to rid farms of pests which damage crops. The insects damage not only standing crops but also stored ones and in the tropics it is reckoned that one third of the total production is lost during food storage. As with fungicides, the first insecticides used in the nineteenth century were inorganic *e.g.*, Paris Green and other compounds of arsenic. Nicotine has also been used since the late eighteenth century. There are now two main groups of synthetic insecticides-

ORGANOCHLORINES

Organochlorines include DDT, Aldrin, Dieldrin and BHC. They are cheap to produce, potent and persistent. DDT was used on a massive scale from the 1930s, with a peak of 72,000 tonnes used 1970. Then usage fell as the harmful environmental effects were realized. It was found worldwide in fish and birds and was even discovered in the snow in the Antarctic. It is only slightly soluble in water but is very soluble in the bloodstream. It affects the nervous and endocrine systems and causes the eggshells of birds to lack calcium causing them to be easily breakable. It is thought to be responsible for the decline of the numbers of birds of prey like ospreys and peregrine falcons in the 1950s-they are now recovering.

As well as increased concentration via the food chain, it is known to enter via permeable membranes, so fish get it through their gills. As it has low water solubility, it tends to stay at the water surface, so organisms that live there are most affected. DDT found in fish that formed part of the human food chain

caused concern, but the levels found in the liver, kidney and brain tissues was less than 1ppm and in fat was 10 ppm which was below the level likely to cause harm.

However, DDT was banned in Britain and America to stop the further build up of it in the food chain. The USA exploited this ban and sold DDT to developing countries, who could not afford the expensive replacement chemicals and who did not have such stringent regulations governing the use of pesticides.

Some insects have developed a resistance to insecticides-*e.g.*, the which carries malaria.

ORGANOPHOSPHATES

Organophosphates, *e.g.*, parathion, methyl parathion and about 40 other insecticides are available nationally. Parathion is highly toxic, methyl-parathion is less so and Malathion is generally considered safe as it has low toxicity and is rapidly broken down in the mammalian liver. This group works by preventing normal nerve transmission as cholinesterase is prevented from breaking down the transmitter substance acetylcholine, resulting in uncontrolled muscle movements.

Entry of a variety of pesticides into our water supplies causes concern to environmental groups, as in many cases the long term effects of these specific chemicals is not known.

Restrictions came into force in July 1985 and were so frequently broken that in 1987, formal proceedings were taken against the British government. Britain is still the only European state to use Aldrin and organochlorines, although it was supposed to stop in 1993.

East Anglia has the worst record for pesticide contamination of drinking water. Of the 350 pesticides used in Britain, only 50 can be analyzed, which is worrying for the global community.

BURIAL

Burial is the technique used by Jews, Muslims, Christians and other religions with Abrahamic influence, to dispose off the corpse of dead humans and animals. This process leads to regular soil erosion due to loosening of soil. Also, the decomposing fluids act as poisonous herbicides, pesticides and may even lead to epidemics in surrounding areas. It leads to soil pollution, soil erosion and even water pollution.

INCREASED WASTE DISPOSAL

In Scotland in 1993, 14 million tons of waste was produced. 100,000 tons was special waste and 260,000 tons was controlled waste from other parts of Britain and abroad. 45% of the special waste was in liquid form and 18% was asbestos-radioactive waste was not included.

Of the controlled waste, 48% came from the demolition of buildings, 22% from industry, 17% from households and 13% from business-only 3% were

recycled. 90% of controlled waste was buried in landfill sites and produced 2 million tons of methane gas. 1.5% was burned in incinerators and 1.5% were exported to be disposed of or recycled. There are 748 disposal sites in Scotland. Landfills produce leachate, which has to be recycled to keep favourable conditions for microbial activity, methane gas and some carbon dioxide.

There are very few vacant or derelict land sites in the north east of Scotland, as there are few traditional heavy industries or coal/mineral extraction sites. However some areas are contaminated by aromatic hydrocarbons (500 cubic meters).

The Urban Waste Water Treatment Directive allows sewage sludge to be sprayed onto land and the volume is expected to double to 185,000 tons of dry solids in 2005. <!-information should be updated-> This has good agricultural properties due to the high nitrogen and phosphate content. In 1990/1991, 13% wet weight was sprayed onto 0.13% of the land, however this is expected to rise 15 fold by 2005. There is a need to control this so that pathogenic microorganisms do not get into water courses and to ensure that there is no accumulation of heavy metals in the top soil.

AIR POLLUTION

Air pollution is the introduction of chemicals, particulate matter, or biological materials that cause harm or discomfort to humans or other living organisms, or damages the natural environment, into the atmosphere.

The atmosphere is a complex, dynamic natural gaseous system that is essential to support life on planet Earth. Stratospheric ozone depletion due to air pollution has long been recognized as a threat to human health as well as to the Earth's ecosystems.

POLLUTANTS

An air pollutant is known as a substance in the air that can cause harm to humans and the environment. Pollutants can be in the form of solid particles, liquid droplets, or gases. In addition, they may be natural or man-made.

Pollutants can be classified as either primary or secondary. Usually, primary pollutants are substances directly emitted from a process, such as ash from a volcanic eruption, the carbon monoxide gas from a motor vehicle exhaust or sulfur dioxide released from factories.

Secondary pollutants are not emitted directly. Rather, they form in the air when primary pollutants react or interact. An important example of a secondary pollutant is ground level ozone-one of the many secondary pollutants that make up photochemical smog.

Note that some pollutants may be both primary and secondary: that is, they are both emitted directly and formed from other primary pollutants.

About 4 percent of deaths in the United States can be attributed to air pollution, according to the Environmental Science Engineering Programme at the Harvard School of Public Health.

Major primary pollutants produced by human activity include:

- Sulfur oxides (SO_x)-especially sulfur dioxide, a chemical compound with the formula SO_2. SO_2 is produced by volcanoes and in various industrial processes. Since coal and petroleum often contain sulfur compounds, their combustion generates sulfur dioxide. Further oxidation of SO_2, usually in the presence of a catalyst such as NO_2, forms H_2SO_4, and thus acid rain. This is one of the causes for concern over the environmental impact of the use of these fuels as power sources.
- Nitrogen oxides (NO_x)-especially nitrogen dioxide are emitted from high temperature combustion. Can be seen as the brown haze dome above or plume downwind of cities. Nitrogen dioxide is the chemical compound with the formula NO_2. It is one of the several nitrogen oxides. This reddish-brown toxic gas has a characteristic sharp, biting odor. NO_2 is one of the most prominent air pollutants.
- Carbon monoxide-is a colourless, odourless, non-irritating but very poisonous gas. It is a product by incomplete combustion of fuel such as natural gas, coal or wood. Vehicular exhaust is a major source of carbon monoxide.
- Carbon dioxide (CO_2)-a greenhouse gas emitted from combustion but is also a gas vital to living organisms. It is a natural gas in the atmosphere.
- Volatile organic compounds-VOCs are an important outdoor air pollutant. In this field they are often divided into the separate categories of methane (CH_4) and non-methane (NMVOCs). Methane is an extremely efficient greenhouse gas which contributes to enhanced global warming. Other hydrocarbon VOCs are also significant greenhouse gases via their role in creating ozone and in prolonging the life of methane in the atmosphere, although the effect varies depending on local air quality. Within the NMVOCs, the aromatic compounds benzene, toluene and xylene are suspected carcinogens and may lead to leukemia through prolonged exposure. 1,3-butadiene is another dangerous compound which is often associated with industrial uses.
- Particulate matter-Particulates, alternatively referred to as particulate matter (PM) or fine particles, are tiny particles of solid or liquid suspended in a gas. In contrast, aerosol refers to particles and the gas together. Sources of particulate matter can be man made or natural. Some particulates occur naturally, originating from volcanoes, dust storms, forest and grassland fires, living vegetation, and sea spray. Human activities, such as the burning of fossil fuels in vehicles, power plants and various industrial processes also generate significant amounts of aerosols. Averaged over the globe, anthropogenic aerosols—those made by human activities—currently account for about 10 percent of the total amount of aerosols in our atmosphere. Increased levels of fine particles in the air are linked to health hazards such as heart disease, altered lung function and lung cancer.

- Toxic metals, such as lead, cadmium and copper.
- Chlorofluorocarbons (CFCs)-harmful to the ozone layer emitted from products currently banned from use.
- Ammonia (NH_3)-emitted from agricultural processes. Ammonia is a compound with the formula NH_3. It is normally encountered as a gas with a characteristic pungent odor. Ammonia contributes significantly to the nutritional needs of terrestrial organisms by serving as a precursor to foodstuffs and fertilizers. Ammonia, either directly or indirectly, is also a building block for the synthesis of many pharmaceuticals. Although in wide use, ammonia is both caustic and hazardous.
- Odors-such as from garbage, sewage, and industrial processes
- Radioactive pollutants-produced by nuclear explosions, war explosives, and natural processes such as the radioactive decay of radon.

Secondary pollutants include:

- Particulate matter formed from gaseous primary pollutants and compounds in photochemical smog. Smog is a kind of air pollution; the word "smog" is a portmanteau of smoke and fog. Classic smog results from large amounts of coal burning in an area caused by a mixture of smoke and sulfur dioxide. Modern smog does not usually come from coal but from vehicular and industrial emissions that are acted on in the atmosphere by sunlight to form secondary pollutants that also combine with the primary emissions to form photochemical smog.
- Ground level ozone (O_3) formed from NO_x and VOCs. Ozone (O_3) is a key constituent of the troposphere (it is also an important constituent of certain regions of the stratosphere commonly known as the Ozone layer). Photochemical and chemical reactions involving it drive many of the chemical processes that occur in the atmosphere by day and by night. At abnormally high concentrations brought about by human activities (largely the combustion of fossil fuel), it is a pollutant, and a constituent of smog.
- Peroxyacetyl nitrate (PAN)-similarly formed from NO_x and VOCs.

Minor air pollutants include:

- A large number of minor hazardous air pollutants. Some of these are regulated in USA under the Clean Air Act and in Europe under the Air Framework Directive.
- A variety of persistent organic pollutants, which can attach to particulate matter.

Persistent organic pollutants (POPs) are organic compounds that are resistant to environmental degradation through chemical, biological, and photolytic processes. Because of this, they have been observed to persist in the environment, to be capable of long-range transport, bioaccumulate in human and animal tissue, biomagnify in food chains, and to have potential significant impacts on human health and the environment.

SOURCES

Sources of air pollution refer to the various locations, activities or factors which are responsible for the releasing of pollutants in the atmosphere. These sources can be classified into two major categories which are:

Anthropogenic sources (human activity) mostly related to burning different kinds of fuel

- "Stationary Sources" include smoke stacks of power plants, manufacturing facilities (factories) and waste incinerators, as well as furnaces and other types of fuel-burning heating devices
- "Mobile Sources" include motor vehicles, marine vessels, aircraft and the effect of sound, *etc.*
- Chemicals, dust and controlled burn practices in agriculture and forestry management. Controlled or prescribed burning is a technique sometimes used in forest management, farming, prairie restoration or greenhouse gas abatement. Fire is a natural part of both forest and grassland ecology and controlled fire can be a tool for foresters. Controlled burning stimulates the germination of some desirable forest trees, thus renewing the forest.
- Fumes from paint, hair spray, varnish, aerosol sprays and other solvents
- Waste deposition in landfills, which generate methane. Methane is not toxic; however, it is highly flammable and may form explosive mixtures with air. Methane is also an asphyxiant and may displace oxygen in an enclosed space. Asphyxia or suffocation may result if the oxygen concentration is reduced to below 19.5% by displacement
- Military, such as nuclear weapons, toxic gases, germ warfare and rocketry

Natural sources:

- Dust from natural sources, usually large areas of land with little or no vegetation.
- Methane, emitted by the digestion of food by animals, for example cattle.
- Radon gas from radioactive decay within the Earth's crust. Radon is a colourless, odorless, naturally occurring, radioactive noble gas that is formed from the decay of radium. It is considered to be a health hazard. Radon gas from natural sources can accumulate in buildings, especially in confined areas such as the basement and it is the second most frequent cause of lung cancer, after cigarette smoking.
- Smoke and carbon monoxide from wildfires.
- Volcanic activity, which produce sulfur, chlorine, and ash particulates.

EMISSION FACTORS

Air pollutant emission factors are representative values that attempt to relate the quantity of a pollutant released to the ambient air with an activity associated with the release of that pollutant. These factors are usually expressed as the weight of pollutant divided by a unit weight, volume, distance, or duration of

the activity emitting the pollutant (*e.g.*, kilograms of particulate emitted per megagram of coal burned). Such factors facilitate estimation of emissions from various sources of air pollution. In most cases, these factors are simply averages of all available data of acceptable quality, and are generally assumed to be representative of long-term averages.

The United States Environmental Protection Agency has published a compilation of air pollutant emission factors for a multitude of industrial sources. The United Kingdom, Australia, Canada and other countries have published similar compilations, as has the European Environment Agency.

INDOOR AIR QUALITY (IAQ)

A lack of ventilation indoors concentrates air pollution where people often spend the majority of their time. Radon (Rn) gas, a carcinogen, is exuded from the Earth in certain locations and trapped inside houses. Building materials including carpeting and plywood emit formaldehyde (H_2CO) gas. Paint and solvents give off volatile organic compounds (VOCs) as they dry. Lead paint can degenerate into dust and be inhaled. Intentional air pollution is introduced with the use of air fresheners, incense, and other scented items. Controlled wood fires in stoves and fireplaces can add significant amounts of smoke particulates into the air, inside and out. Indoor pollution fatalities may be caused by using pesticides and other chemical sprays indoors without proper ventilation.

Carbon monoxide (CO) poisoning and fatalities are often caused by faulty vents and chimneys, or by the burning of charcoal indoors. Chronic carbon monoxide poisoning can result even from poorly adjusted pilot lights. Traps are built into all domestic plumbing to keep sewer gas, hydrogen sulfide, out of interiors. Clothing emits tetrachloroethylene, or other dry cleaning fluids, for days after dry cleaning.

Though its use has now been banned in many countries, the extensive use of asbestos in industrial and domestic environments in the past has left a potentially very dangerous material in many localities. Asbestosis is a chronic inflammatory medical condition affecting the tissue of the lungs. It occurs after long-term, heavy exposure to asbestos from asbestos-containing materials in structures. Sufferers have severe dyspnea (shortness of breath) and are at an increased risk regarding several different types of lung cancer. As clear explanations are not always stressed in non-technical literature, care should be taken to distinguish between several forms of relevant diseases. According to the World Health Organisation (WHO), these may defined as; asbestosis, lung cancer*, and* mesothelioma *(generally a very rare form of cancer, when more widespread it is almost always associated with prolonged exposure to asbestos).*

Biological sources of air pollution are also found indoors, as gases and airborne particulates. Pets produce dander, people produce dust from minute skin flakes and decomposed hair, dust mites in bedding, carpeting and furniture produce enzymes and micrometre-sized fecal droppings, inhabitants emit methane, mold forms in walls and generates mycotoxins and spores, air

conditioning systems can incubate Legionnaires' disease and mold, and houseplants, soil and surrounding gardens can produce pollen, dust, and mold. Indoors, the lack of air circulation allows these airborne pollutants to accumulate more than they would otherwise occur in nature.

WATER POLLUTION

Water pollution is the contamination of water bodies such as lakes, rivers, oceans, and groundwater caused by human activities, which can be harmful to organisms and plants that live in these water bodies. It occurs when pollutants are discharged directly into water bodies without treating it first.

INTRODUCTION

Water pollution is a major problem in the global context. It has been suggested that it is the leading worldwide cause of deaths and diseases, and that it accounts for the deaths of more than 14,000 people daily. In addition to the acute problems of water pollution in developing countries, industrialized countries continue to struggle with pollution problems as well. In the most recent national report on water quality in the United States, 45 percent of assessed stream miles, 47 percent of assessed lake acres, and 32 percent of assessed bay and estuarine square miles were classified as polluted.

Water is typically referred to as polluted when it is impaired by anthropogenic contaminants and either does not support a human use, like serving as drinking water, and/or undergoes a marked shift in its ability to support its constituent biotic communities, such as fish. Natural phenomena such as volcanoes, algae blooms, storms, and earthquakes also cause major changes in water quality and the ecological status of water. Water pollution has many causes and characteristics.

WATER POLLUTION CATEGORIES

Surface water and groundwater have often been studied and managed as separate resources, although they are interrelated. Sources of surface water pollution are generally grouped into two categories based on their origin.

POINT SOURCE POLLUTION

Point source pollution refers to contaminants that enter a waterway through a discrete conveyance, such as a pipe or ditch. Examples of sources in this category include discharges from a sewage treatment plant, a factory, or a city storm drain. The U.S., Clean Water Act (CWA) defines point source for regulatory enforcement purposes.

NON-POINT SOURCE POLLUTION

Non-point source (NPS) pollution refers to diffuse contamination that does not originate from a single discrete source. NPS pollution is often a cumulative

effect of small amounts of contaminants gathered from a large area. Nutrient runoff in stormwater from "sheet flow" over an agricultural field or a forest are sometimes cited as examples of NPS pollution.

Contaminated stormwater washed off of parking lots, roads and highways, called urban runoff, is sometimes included under the category of NPS pollution. However, this runoff is typically channeled into storm drain systems and discharged through pipes to local surface waters, and is a point source. The CWA definition of point source was amended in 1987 to include municipal storm sewer systems, as well as industrial stormwater, such as from construction sites.

GROUNDWATER POLLUTION

Interactions between groundwater and surface water are complex. Consequently, groundwater pollution, sometimes referred to as groundwater contamination, is not as easily classified as surface water pollution. By its very nature, groundwater aquifers are susceptible to contamination from sources that may not directly affect surface water bodies, and the distinction of point vs. nonpoint source may be irrelevant. A spill of a chemical contaminant on soil, located away from a surface water body, may not necessarily create point source or non-point source pollution, but nonetheless may contaminate the aquifer below. Analysis of groundwater contamination may focus on soil characteristics and hydrology, as well as the nature of the contaminant itself.

CAUSES OF WATER POLLUTION

The specific contaminants leading to pollution in water include a wide spectrum of chemicals, pathogens, and physical or sensory changes such as elevated temperature and discoloration. While many of the chemicals and substances that are regulated may be naturally occurring (calcium, sodium, iron, manganese, *etc.*) the concentration is often the key in determining what is a natural component of water, and what is a contaminant.

Oxygen-depleting substances may be natural materials, such as plant matter (*e.g.*, leaves and grass) as well as man-made chemicals. Other natural and anthropogenic substances may cause turbidity (cloudiness) which blocks light and disrupts plant growth, and clogs the gills of some fish species.

Many of the chemical substances are toxic. Pathogens can produce waterborne diseases in either human or animal hosts. Alteration of water's physical chemistry include acidity (change in pH), electrical conductivity, temperature, and eutrophication. Eutrophication is the fertilization of surface water by nutrients that were previously scarce.

PATHOGENS

Coliform bacteria are a commonly-used bacterial indicator of water pollution, although not an actual cause of disease. Other microorganisms sometimes found in surface waters which have caused human health problems include:

- *Cryptosporidium parvum*
- *Giardia lamblia*
- *Salmonella*
- *Novovirus* and other viruses
- Parasitic worms (helminths).

High levels of pathogens may result from inadequately treated sewage discharges. This can be caused by a sewage plant designed with less than secondary treatment (more typical in less-developed countries). In developed countries, older cities with aging infrastructure may have leaky sewage collection systems (pipes, pumps, valves), which can cause sanitary sewer overflows. Some cities also have combined sewers, which may discharge untreated sewage during rain storms. Pathogen discharges may also be caused by poorly-managed livestock operations.

CHEMICAL AND OTHER CONTAMINANTS

Contaminants may include organic and inorganic substances.

Organic water pollutants include:

- Detergents
- Disinfection by-products found in chemically disinfected drinking water, such as chloroform
- Food processing waste, which can include oxygen-demanding substances, fats and grease
- Insecticides and herbicides, a huge range of organohalides and other chemical compounds
- Petroleum hydrocarbons, including fuels (gasoline, diesel fuel, jet fuels, and fuel oil) and lubricants (motor oil), and fuel combustion byproducts, from stormwater runoff
- Tree and brush debris from logging operations
- Volatile organic compounds (VOCs), such as industrial solvents, from improper storage. Chlorinated solvents, which are dense non-aqueous phase liquids (DNAPLs), may fall to the bottom of reservoirs, since they don't mix well with water and are denser.
- Various chemical compounds found in personal hygiene and cosmetic products

Inorganic water pollutants include:

- Acidity caused by industrial discharges (especially sulfur dioxide from power plants)
- Ammonia from food processing waste
- Chemical waste as industrial by-products
- Fertilizers containing nutrients—nitrates and phosphates—which are found in stormwater runoff from agriculture, as well as commercial and residential use
- Heavy metals from motor vehicles (via urban stormwater runoff) and acid mine drainage
- Silt (sediment) in runoff from construction sites, logging, slash and burn practices or land clearing sites

Macroscopic pollution—large visible items polluting the water—may be termed "floatables" in an urban stormwater context, or marine debris when found on the open seas, and can include such items as:

- Trash (*e.g.*, paper, plastic, or food waste) discarded by people on the ground, and that are washed by rainfall into storm drains and eventually discharged into surface waters
- Nurdles, small ubiquitous waterborne plastic pellets
- Shipwrecks, large derelict ships

THERMAL POLLUTION

Thermal pollution is the rise or fall in the temperature of a natural body of water caused by human influence. A common cause of thermal pollution is the use of water as a coolant by power plants and industrial manufacturers. Elevated water temperatures decreases oxygen levels (which can kill fish) and affects ecosystem composition, such as invasion by new thermophilic species. Urban runoff may also elevate temperature in surface waters. Thermal pollution can also be caused by the release of very cold water from the base of reservoirs into cooler rivers.

NOISE POLLUTION

Noise pollution (or environmental noise) is displeasing human-, animal-or machine-created sound that disrupts the activity or balance of human or animal life. A common form of noise pollution is from transportation, principally motor vehicles. The word noise comes from the Latin word nausea meaning seasickness.

The source of most noise worldwide is transportation systems, motor vehicle noise, but also including aircraft noise and rail noise. Poor urban planning may give rise to noise pollution, since side-by-side industrial and residential buildings can result in noise pollution in the residential area.

Other sources are car alarms, office equipment, factory machinery, construction work, groundskeeping equipment, barking dogs, appliances, power tools, lighting hum, audio entertainment systems, loudspeakers and noisy people.

HUMAN HEALTH EFFECTS

Noise health effects are both health and behavioural in nature. The unwanted sound is called noise. This unwanted sound can damage physiological and psychological health.

Noise pollution can cause annoyance and aggression, hypertension, high stress levels, tinnitus, hearing loss, sleep disturbances, and other harmful effects. Furthermore, stress and hypertension are the leading causes to health problems, whereas tinnitus can lead to forgetfulness, severe depression and at times panic attacks.

Chronic exposure to noise may cause noise-induced hearing loss. Older males exposed to significant occupational noise demonstrate significantly reduced hearing sensitivity than their non-exposed peers, though differences in hearing

sensitivity decrease with time and the two groups are indistinguishable by age 79. A comparison of Maaban tribesmen, who were insignificantly exposed to transportation or industrial noise, to a typical U.S., population showed that chronic exposure to moderately high levels of environmental noise contributes to hearing loss.

High noise levels can contribute to cardiovascular effects and exposure to moderately high levels during a single eight hour period causes a statistical rise in blood pressure of five to ten points and an increase in stress and vasoconstriction leading to the increased blood pressure noted above as well as to increased incidence of coronary artery disease.

Noise pollution is also a cause of annoyance. A 2005 study by Spanish researchers found that in urban areas households are willing to pay approximately four Euros per decibel per year for noise reduction.

ENVIRONMENTAL EFFECTS

Noise can have a detrimental effect on animals by causing stress, increasing risk of mortality by changing the delicate balance in predator/prey detection and avoidance, and by interfering with their use of sounds in communication especially in relation to reproduction and in navigation. Acoustic overexposure can lead to temporary or permanent loss of hearing.

An impact of noise on animal life is the reduction of usable habitat that noisy areas may cause, which in the case of endangered species may be part of the path to extinction. One of the best known cases of damage caused by noise pollution is the death of certain species of beached whales, brought on by the loud sound of military sonar.

Noise also makes species communicate louder, which is called Lombard vocal response. Scientists and researchers have conducted experiments that show whales' song length is longer when submarine-detectors are on. If creatures don't "speak" loud enough, their voice will be masked by anthropogenic sounds. These unheard voices might be warnings, finding of prey, or preparations of net-bubbling.

When one species begins speaking louder, it will mask other species' voice, causing the whole ecosystem to eventually speak louder.

European Robins living in urban environments are more likely to sing at night in places with high levels of noise pollution during the day, suggesting that they sing at night because it is quieter, and their message can propagate through the environment more clearly. Interestingly, the same study showed that daytime noise was a stronger predictor of nocturnal singing than night-time Light pollution, to which the phenomenon is often attributed.

Zebra finches become less faithful to their partners when exposed to traffic noise. This could alter a population's evolutionary trajectory by selecting traits, sapping resources normally devoted to other activities and thus lead to profound genetic and evolutionary consequences.

MITIGATION AND CONTROL OF NOISE

Technology to mitigate or remove noise can be applied as follows:

> *There are a variety of strategies for mitigating roadway noise including: use of noise barriers, limitation of vehicle speeds, alteration of roadway surface texture, limitation of heavy vehicles, use of traffic controls that smooth vehicle flow to reduce braking and acceleration, and tire design. An important factor in applying these strategies is a computer model for roadway noise, that is capable of addressing local topography, meteorology, traffic operations and hypothetical mitigation. Costs of building-in mitigation can be modest, provided these solutions are sought in the planning stage of a roadway project.*

Aircraft noise can be reduced to some extent by design of quieter jet engines, which was pursued vigorously in the 1970s and 1980s. This strategy has brought limited but noticeable reduction of urban sound levels. Reconsideration of operations, such as altering flight paths and time of day runway use, have demonstrated benefits for residential populations near airports. FAA sponsored residential retrofit (insulation) programmes initiated in the 1970s has also enjoyed success in reducing interior residential noise in thousands of residences across the United States.

Exposure of workers to Industrial noise has been addressed since the 1930s. Changes include redesign of industrial equipment, shock mounting assemblies and physical barriers in the workplace.

Noise Free America, a national anti-noise pollution organization, regularly lobbies for the enforcement of noise ordinances at all levels of government.

LEGAL STATUS

Governments up until the 1970s viewed noise as a "nuisance" rather than an environmental problem. In the United States there are federal standards for highway and aircraft noise; states and local governments typically have very specific statutes on building codes, urban planning and roadway development. In Canada and the EU there are few national, provincial, or state laws that protect against noise.

Noise laws and ordinances vary widely among municipalities and indeed do not even exist in some cities. An ordinance may contain a general prohibition against making noise that is a nuisance, or it may set out specific guidelines for the level of noise allowable at certain times of the day and for certain activities.

Dr. Paul Herman wrote the first comprehensive noise codes in 1975 for Portland, Oregon with funding from the EPA (Environmental Protection Agency) and HUD (Housing and Urban Development). The Portland Noise Code became the basis for most other ordinances for major US and Canadian metropolitan regions.

Most city ordinances prohibit sound above a threshold intensity from trespassing over property line at night, typically between 10 p.m. and 6 a.m., and during the day restricts it to a higher sound level; however, enforcement is

uneven. Many municipalities do not follow up on complaints. Even where a municipality has an enforcement office, it may only be willing to issue warnings, since taking offenders to court is expensive.

The notable exception to this rule is the City of Portland Oregon which has instituted an aggressive protection for its citizens with fines reaching as high at $5000 per infraction, with the ability to cite a responsible noise violator multiple times in a single day.

Many conflicts over noise pollution are handled by negotiation between the emitter and the receiver. Escalation procedures vary by country, and may include action in conjunction with local authorities, in particular the police. Noise pollution often persists because only five to ten percent of people affected by noise will lodge a formal complaint. Many people are not aware of their legal right to quiet and do not know how to register a complaint.

3

Dimensions of Environment Management

A fruitful approach to studying environmental management is the analysis of industry-government relationships. Policy is defined and translated into action in this context. We find that industrial managers legitimize government regulation of industrial water use. However, the pattern of responses suggests that some of the support may be based on economic self-interest and industry's ability to control agency action. Managers legitimize a policy-setting role for federal agencies and an enforcement role for local and state government. Across the Asian region, natural resource exploitation is accelerating dramatically as countries, cities and small communities are ever more incorporated into the global economy.

Economic reform programmes that favour domestic and global market expansion rather than a social welfare agenda, policy responses to climate change, pressures associated with population growth and intensified geographical mobility, and urbanization and commoditization, are reconfiguring patterns of natural resource use and governance at both a national and local level and are having complex effects on peoples' lives. These processes are themselves not innocent of gendered power relations: they are inflected with gender discourses that set in motion differentiated and unjust life opportunities and exclusions.

At the same time, sustainable development policy initiatives that seek to ameliorate environmental degradation and its negative livelihood effects not only bring gendered impacts and responses, they also work through and produce particular framings of gender and gendered power relations. The impact of this is

apparent in the unintended consequences associated with sustainable development initiatives that target women as a homogeneous and undifferentiated social category, at times exacerbating social and gender injustices. Related to this process of globalized marketization, natural resource management is embedded in the increasing diversification of livelihoods: a process buoyed by policies that support entrepreneurialism and appear to be producing individualized portfolio livelihood strategies across Asia.

ENVIRONMENTAL PLANNING MANAGEMENT

Environmental planning and management are strategic challenges confronting businesses in the 21st century. As customers and stakeholders demand that global companies lead by showing corporate citizenship, the health, safety and security of both the people and the natural environment have become a litmus test for good citizenry. Successful companies today are not only measured by how much profitable their products are but also how well they respond to the call to protect the natural environment. Global companies are increasingly recognizing that green products do not necessarily cost more but provide market niche that could help the company thrive. For example, the success stories of Kodak single-use camera and Xerox re-manufacturing programmes have made businesses rethink their strategies and pay attention to environmental management.

The issues concerning the environment are not purely scientific butrely also on planning and management. They are part of corporate vision, mission, and strategy which need to be effectively planned to remain competitive. Corporate leaders are recognizing the increasing role of stakeholders and are accepting that their corporate strategies must focus not only on their customers but also on their stakeholders. Stakeholders are those whose actions or reactions have the potential to affect the firm's business operation and survival. Environmental burden is an issue that affects world citizens and they have the right to demand that corporate responsibility be properly defined to take into consideration these concerns. Today, companies are adapting their strategies in response to these concerns. World communities have reacted by adopting international and national laws to ensure compliance to environmental standards.

It is also clear that green products may in fact, provide competitive advantage. Recently, there has been significant growth in the development of such products since the 1990s. Paint companies are now producing zero-VOC (Volatile Organic Compounds) products. Glidden introduced zero-VOC paint in the US in the mid 1990s and was followed by other major paint manufacturers such as Benjamin Moore and Sherman-Williams. Homeowners have responded very well to this development. Today, all major paint manufacturers market zero-VOC paint and offer lower-VOC coatings fora variety of substrates. Some manufacturers such as Rodda Paint of Portland, OR; have gained Green Seal on their paint products and that has given it a competitive edge.

It joins the likes of big players like Benjamin Moore. The energy industry has also reacted to green power which has been defined by the National

Association of Attorney Generals [NAAG] as the use of replenishable or sustainable fuel sources in the generation and transmission of electricity and the disposal of spent fuels. These release sin to the environment would not create harmful substances and would pose no significant concern to the ecosystem and to land use. The focus is on renewable energy supply. Studies have shown that homeowners are willing to pay more to use green power. This programme is similar to the waste recycling programme in many communities that are paid for by consumers. The trend towards green is on the rise in every sector of the economy. According to a study by Yanklovich Clancy Schulman, 78% of peopleare "influenced greatly" to buy products that make environmental claims. The Organic Trading Association notes that products with the word "organic" have 34% sell-through rate compared to conventional products. Furthermore, the rate of growth of natural or organic food has been steady at 18-25% while conventional foods remain flat at 3-4%. The demand for organic products has also affected the clothing industry where the current trend calls for the use of organic cotton.

The growth of "conspicuous conservation" is also on the rise as the demand for hybrid vehicles skyrocket. Companies like Toyota and Honda that were among the first to manufacture hybrid cars that combinegas engines with battery-powered electric motors have witnessed surge in demand. These products are not only environmentally friendly but are also economical. Aside from the fact that these hybrid cars cut emissions, owners in the US can write off a one-time deduction of $2,000 of the purchase price for these vehicles since the Internal Revenue Services (IRS) has recognized them as eligible for the clean-burning fuel tax deduction. This law also applies to other vehicles that operate on natural gas, liquefied natural gas, liquefied petroleum gas, hydrogen, or any other fuel that is at least 85% alcohol. Owners of completely electric vehicles would even get tax credit of up to $4,000. Customers who patronize these products want to be seen as saving energy and believe that their consumption behaviour reflect who they are.

The trend towards environmental conservation is further reflected in the emergence of energy saving products such as energy star appliances, compact fluorescent lights, photovoltaic solar cells, "high performance" homes and others. The green trend is on the rise and green products offer a new market niche to global companies. According to The LOHAS journal, about 63 million consumers or about 30% of US adults purchase goods and services that are classified as healthy, environmentally friendly, socially conscious and sustainable. The LOHAS index constitutes of five major areas that comprise sustainable economy, healthy living, alternative health care, personal development and ecological life style. While there are more to this index, however, environmental issues are prominent.

The discussions above highlight the growing importance of environmental management systems and the need to effectively plan and manage in order to harness the values that would accrue to companies that adopt environmental

strategies. We shall next look at how to assess the cost of environmental quality. It is very important that manager sunderst and the cost side of environmental quality. Knowledge of the costs would obviously, hit home the need to be proactive and prevent environmental errors from occurring. Environmental Management Systems (EMS) The focus of this book is on Environmental Management and Planning. Naturally, Environmental Management System (EMS) forms the core of any environmental management and planning programme. EMS has become increasingly popular in the past few years mainly due to ISO 14000 series which is labelled EMS. EMS is a well structured and documented approach to respond to environmental challenges by focusing on environmental regulations and standards, and customer requirements. It is based on the need to respond proactively to the management of natural environment by conducting lifecycle assessment to lessen environmental burden and optimize the use of limited natural resources.

Firms that adopt the EMS approach focus on effective ways to use such limited resources to produce environmentally conscious products and services. One of the popular approaches to achieve this is to adopt a plan-do-check (study) - act (PDCA) which was popularized by the father of Total Quality Management (TQM) Dr. Edward Deming. Using PDCA requires that the firm focuses on how to develop environmental policies by recognizing corporate, industry, local, national and international environmental policies and standards. The consideration of these policies and standards constitutes a major factor in designing a product or service for the environment. Planning is important to any successful EMS programme.

Planning offers a way to optimization of resources and stops the firm from "fighting fires." Planning leads to preventive measures and anticipation of future environmental changes. It positions the firm to take competitive advantage rather than responding only to challenges as they occur. Effective planning also smoothens out implementation and minimizes environmental burden since many of the sources of environmental burden would be anticipated and addressed. It also helps address "what if " or sensitivity analysis questions. Thus, different scenarios and alternatives will be anticipated, investigated, and prototypes looked at to identify at least a satisficing solution that may not necessarily be optimal but give a very good resolution to the environmental problem. When products and services are designed for the environment, they are properly planned and fully tested before introduction into the marketplace.

However, pushing these products and services to the market does not end the responsibility of the firm. Environmental scanning is an ongoing process that would lead to continuous review of the products and services to achieve continuous improvement. Our approach in this book is to focus on management issues as key to the success of environmental planning programme. The traditional focus of environmental systems has been on the natural sciences. While natural sciences continue to play a major role in understanding the natural environment, the problem of environmental burden or optimization of natural

resources would not be achieved without a focus on how such burden or resources can be effectively managed. This book therefore focuses on the strategic context of environmental management. It focuses on corporate strategies to develop a new vision of environmental management systems. Some of the areas that are looked into are:

- *Top management commitment:* Since the era of TQM, it has become apparent that most problems organizations face can be blamed on top management. Top management wields a lot of power and authority. It provides the mission and vision of the organization. It lays down organizational strategies and it provides the resources to achieve organizational goals. If top management is not committed to a cause, it would not devote the needed resources to it. Top management must take EMS to heart for it to be successfully implemented. Employees respond to the call from their leaders. Corporate leaders have the responsibility to educate their employees and make them buy into the corporate mission. When top management views environmental management as strategic, integrate it in corporate mission and devote resources and commit time to it, others will follow. These resources would enable to provide proper training, education, and technology to address environmental burden.
- *Cross-functional team:* There is a need to develop cross-functional teams that would work concurrently to address environmental issues. The use of cross-functional teams is vogue in managing successful organization. It is important that members of the teams have a single view of the organization. Functional units within organizations are interdependent and should not be treated as independent silos. Members of the manufacturing unit should be able to work together with marketing and express and share views at the same time. The concurrency at the design stage helps to reduce the cycle time to introduce new products and makes the organization more competitive. The different backgrounds of team members also expose different world views that could be captured and used to develop an acceptable plan to all the departments.
- *Stakeholder Teams:* In conjunction with the cross-functional teams that may comprise mostly of organizational employees, it is important to also work with stakeholder teams. Stakeholders constitute those whose actions and reactions affect or are affected by organizational actions. As cited in the book, many organizations are today working with various interest groups to develop environmental strategies. The involvement of different stakeholder teams also helps win acceptance of final decisions that are reached.
- *Responsibility for the environment:* Who is responsible for environmental management in the organization? Our response to this question is that everyone is responsible. The approach adopted in this book is known as

Total Environmental Quality Management (TEQM). Environmental management is not relegated to a particular department or to particular individuals in the organization. Instead, every member of the organization takes full responsibility for his or her own action and works hard to make sure that EMS is fully implemented. Each member of the organization seeks out ways to contribute, and identifies ways to limit pollution and minimize waste in whatever function or activity he or she is involved in.

- *The bottom line:* Businesses operate to maximize stockholders wealth and must pay attention to the bottom line. If an activity is not value-adding, then there is no need to continue with such an activity. In the past, many corporate leaders complained about the high cost of environmental management to justify inaction or disinterest. Today, things have changed. Businesses are observing that the external cost for environmental quality has been underestimated and that such costs significantly affect the survival of the business. In addition, they are acknowledging that being environmentally conscious is being competitive. In this book, we illustrate several case studies of companies who regained market shares because they developed successful environmental management programmes. The recognition of the importance of environmental management as a competitive weapon could also explain the growing interest of companies to get environmental certifications such as ISO 14000 and the other environmental seals. Companies flout such recognition in advertisement campaigns because they understand that social consciousness influences purchasing decisions. Therefore, it pays to be green.

ENVIRONMENTAL EFFICIENCY

Companies often strive to minimize the costs of their operations. This is especially relevant in relation to the efficiency with which they use their material inputs. As the ability of the environment to supply raw materials and accept waste is diminished, the costs of these services to industry will increase. As a result, more efficient raw material utilization and a decrease in the amount of waste generated are key factors which will encourage industry to minimize its environmental impact. Particularly in relation to waste products, companies are experiencing increasingly stringent legislation which increases the costs of waste management. Waste should be viewed both in terms of physical waste generated and the less tangible losses experienced through an inefficient use of resources. Avoiding these losses improves both the business and environmental performance of a company. As a result, many companies have pursued a strategy of waste minimization for a number of years and have experienced short payback periods on investment in waste management. In efforts to increase the efficiency of their operations, many companies have developed integrated management systems to reduce inefficiencies and the likelihood of errors. Most commonly to date, these have centered around the promotion of quality.

THE INFLUENCE OF GOVERNMENT

The main impact of government on the environmental performance of industry has been through the development of environmental legislation. Environmental considerations have been built into the legislative framework for many years. Initially, establishing rights of ownership over natural resources led to the development of a legal system to protect those rights. Subsequently, the impact of industrial activity on the health of employees and the surrounding community *kd* to the creation of public health and safety legislation. Measures have also been introduced to control the use of products, processes and wastes which may harm the environment.

The impact of environmental legislation on the operation of industry has been profound and is set to become ever more tough. As the strain placed upon the environment mounts and knowledge of the causes and effects of environmental degradation becomes more complete, the extent and impact of environmental legislation will continue to develop. Thus, industry must satisfy an increasing number of legal obligations in relation to the effect that its activities have upon the environment. As a result, in all of its operations, industry must plan ahead to meet the demands of current and forthcoming environmental legislation.

By developing proactive responses to legislative pressure, industry will reduce its costs and exposure to risk. While in the short term, legal obligations undoubtedly increase the costs of production that fall upon the firm, it is up to each firm to comply with legislation in the most cost-effective way. The development of proactive strategic responses to the demands of legislation will reduce these costs.

In parallel with the development of environmental legislation, governments are increasingly applying market instruments to achieve environmental objectives. Actions of this nature may include the imposition of taxes on environmentally damaging goods, subsidies on environmentally friendly goods or the provision of information relating to the environmental performance of companies or products. Market instruments are intended to channel the choice of consumers or other stakeholders towards the better environmental option. Thus through a combination of legislative and market instruments, by encouraging certain activities and discouraging others, governments seek to accelerate the structural change which encourages improved environmental efficiency in the economy as a whole.

THE DEVELOPMENT OF STAKEHOLDER INFLUENCE

Individual businesses interact with a number of stakeholders, all of whom have an interest in the performance of that company. Traditionally the main focus of stakeholder interest has been upon the financial performance of the company. Increasingly, however, stakeholder pressure is concentrating on the environmental performance of the company.

Customers

The relationship between a company and its customers is obviously of paramount importance. In relation to environmental considerations, the potential importance of green consumerism cannot be overstated. The range of characteristics that underlay the purchasing decision are a fundamental consideration for all businesses. Increasingly, the environment is being accepted as one such characteristic by consumers. At present, however, the influence of green consumerism on most businesses is marginal. Of the myriad of products that each consumer buys, very few are chosen on the basis of their environmental credentials alone.

Nevertheless, it is certain that credible claims relating to environmental performance constitute one positive element among the many characteristics upon which consumers base their purchasing decision. Companies which can validate and communicate the environmental performance of their products will enhance their competitive position.

Governments are also seeking to increase the potency of green consumerism by providing the consumer with the information necessary to make an informed choice in relation to the environmental performance of each product within the product range. For this reason for example, we saw the introduction of the EC's eco-labelling scheme in 1993.

Trading Partners

Many businesses do not sell into 'end-consumer' markets and may therefore perceive themselves to be remote from any consumer pressures to improve their environmental performance. Increasingly, the pressure to improve environmental performance is emanating from trading partners rather than the ultimate consumer. In efforts to improve overall environmental performance, many companies are exercising their own rights both as purchasers and as vendors and are demanding that all of the companies within their supply chain seek to minimize their own environmental impacts. Hence, demands to improve environmental performance at all stages in the supply chain are being diffused beyond those companies that are directly exposed to the pressures of green consumerism.

An increasing number of companies are preferring to buy their resources from or sell their products to companies which meet certain standards of environmental performance. The provision of information on company environmental performance through standards such as BS7750, the British Standard on Environmental Management Systems, and the EC's eco-management and audit scheme will increasingly be written into contracts in the future. Increasing environmental concern and the improved provision of information relating to environmental performance will reward those companies which achieve and communicate high environmental standards with a competitive advantage.

The Community

Industry shares its surrounding environment with the local population. Increasingly this population is demanding a high level of environmental performance from its industrial neighbours, and seeks some degree of reassurance that they are not exposed to significant environmental risk due to a company's operations. This concern has been recognized for many years and was initially recognized in public health legislation. Trends towards freedom of access to environmental information will give greater power to local communities when they question the activities of local industrial cohabitants. In order to foster a positive working relationship, companies must improve their environmental performance and communicate their efforts to the surrounding communities. This is true both for future developments and existing operations.

Employees

The population in the community surrounding a company also includes the workforce of that company. The pressure to provide a healthy living environment is magnified within the workplace. Employees seek healthy and secure working conditions, and can draw on an established framework of health and safety legislation in this respect. However, employees' concerns relating to the environmental performance of their employers goes beyond the impact of operations on the working and living environment. Increasingly people wish to work for ethical and responsible companies. Companies that reflect the environmental concerns of the public will find it easier to attract, retain and motivate a quality workforce.

Investors and Insurers

The pressures to improve environmental performance also emanate from the investors and shareholders of a company. The rapid growth of ethical investment schemes in recent years reflects the desire of many investors only to lend their financial support to companies which behave in a responsible manner. There are also a number of very good business reasons why investors prefer to work with companies that have a proven track record of environmental integrity. The structure of legal liability for environmental damage dictates that any party that causes environmental damage may be fined and required to bear the costs of remediating that damage and to compensate the affected parties for any associated losses. It is increasingly difficult and expensive to obtain insurance to cover such issues. Consequently, companies associated with a significant environmental incident may suffer significant financial losses. These losses are then translated into reductions in the share price and the associated dividends.

Banks that lend to companies secure the loans on the basis of the physical assets of the company and often on the land upon which any investment takes place. Should the company cease to be viable, the bank assumes ownership of those assets which are then sold to cover any outstanding debts. However, should

the physical assets of the company be contaminated, then the value of the assets is significantly reduced. Indeed, the banks may inherit any environmental liabilities that the liquidated company generated. Commercial lenders are therefore reluctant to lend money to any company which may develop any environmental liabilities or to secure loans on the value of an asset which may be eroded through contamination. As a result, companies which cannot demonstrate a high level of environmental performance associated with low environmental risks will find it increasingly difficult and expensive to attract and retain investment and insurance for their operations.

Media and Pressure Groups

A combination of increased public awareness of environmental issues and freedom of access to information on the environmental performance of companies will serve to magnify media and pressure group interest in the environmental performance of industry. In order to manage media and pressure group attention, companies must be able to state that they have made efforts to reduce their environmental impact. However, while it may be tempting to allow the PR or marketing departments to lead the way in convincing all stakeholders of this commitment, any shallow or spurious claims will soon be uncovered. Claims which cannot be substantiated are likely to be seized upon and will be very detrimental to a company's public image. Companies which seek to communicate responsible environmental performance must base any claims that they make to this effect on hard facts which they are willing to communicate.

MAN AND HIS ENVIRONMENT

Man and the Environment were created to interact with each other on balance basis. Whiles the natural environment is to create a fair decent shelter and to provide food supplements including economic resources of gold, oil, and so on, man on other hand is suppose to care and protect the environment from destruction. Geographers in particular are interested in identifying and analyzing in detail the human and physical development interface. Both sides have directly or indirectly affected each other's potentials. In some instances, the original landscape is completely wiped off and replace with man-made cultural environment. Directly or indirectly, the physical environment has inevitably influenced man.

During the last 100 years, man has exceeded the powerful natural forces that have shaped the shape of the earth's surface. As a result, there are problems of global warming, sea-level change, acidification, salination, and environmental pollution, reduction in biodiversity, ecological imbalance, and endangering of human survival.

The biosphere is being destroyed through illegal activities of man. Through the activities of housing and construction, mining, agriculture, industry, fishing, and many more, man has inevitably produced thousands of pollutants discharged from factories, vehicles, incinerators, and engines. Pollutants of CO, CO2,

hydrocarbons, nitrogenoxides, sulphur oxides and particles causing respiratory disorders, and spread of cardiovascular diseases. For instance, the WHO indicated that at least 3.0 million people die every year for illness caused by air pollution. Also, pollutants of domestic waste, chemical waste, and animal droppings all cause environmental degradation. Aquatic life and the hydrolic circle are being greatly affected by human activities of urbanization, fishing, stream modification and channelization which produces biocides, cyanides, and radioactive substances.

Other the other hand, the environment either through natural processes or human recalcitrant activities has turn to affect the life of man through flooding, rainstorms, earthquakes, volcano, erratic rainfall, heavy winds, and crop failures. Environmentally related diseases such as malaria, cholera, diarrhea, and many others, are the influence of environmental pollution.

Perhaps, the proper understanding of human relationship with the environment is key to balancing this complex interaction. In any case, the pace of change in the context of any environment is accelerated by the growing populations, advanced and exploitative technology, and urbanization, and the characteristics of today are results of the continues changing conditions from the past. We must therefore, observe, study and understand the sophisticated relationship that exists between man and the environment and this might probably enable us re-design and restructure this relationship to facilitate a mutual benefit for both sides, otherwise, either side (man or environment) will be able contained the other in the near future.

GEOGRAPHY AS A SCIENCE OF RELATIONSHIP BETWEEN MAN AND ENVIRONMENT

The concept of geography as the study of man and environment relationship is quite old.

The Greek, Roman, Indian, Chinese and Arab geographers attempted to establish a relationship between man and natural environment. Kant, in the concluding part of the 18th century, advocated the impact of environment on the lifestyle and physical constitution and lifestyle the equatorial, hot deserts,

Mediterranean, coastal and mountainous regions. According to Kant, the inhabitants of torrid zone are exceptionally lazy and timid, while the people of the Mediterranean region living in the mild temperature conditions are industrious, hard working and progressive.

The environmental causation continued throughout the 19th century. Humboldt asserted that the mode of life of the inhabitants of the mountainous countries of the Andes mountains differ from that of the people of Amazon basin, coastal plains and islands like Cuba and West Indies.

Ritter attempted to establish the cause variations in the physical constitution of body, physique and health of people living in the different physical environmental conditions.

The idea of defining geography in terms of man and environment relationship developed on scientific lines in the later part of the 19th century after the publication of Origin of Species (1859) by Charles Darwin. This seminal work gave a new direction to the discipline of geography. The theory of evolution held that all living species have evolved from pre-existing forms. His geological observations and theories had one thing in common: the idea that things in nature change with time. He also believed that the face of the earth also changes with the change in environment over the period of time. In this book, Origin of Species, Darwin presented his idea that species evolve from more primitive species through the process of natural selection. In his account of natural selection occurs, known as Darwinism, he pointed out that not all individuals of a species are exactly the same but have variations and some of these variations make their bearers better adapted to particular ecological conditions.

He theorized that well-adapted individuals of a species have more chance of surviving and producing young than do the less adapted, and that over the passage of time the latter are slowly weeded out. Through his theory Darwin showed how the multitude of living things in our world could have come into being without any recourse to a divine master plan, in a plain, causal, naturalistic way. Darwin argued that a struggle for existence must take place; it followed that those who survived were better adapted to their environment than competitors. This means that relatively superior adaptations increase while relatively inferior ones are steadily eliminated.

The Darwin's theory had a far-reaching impact on the growth and development of geography. It assumed that variations in animals were random. In this way, the older teleological conception (the religious belief that God has a plan and every phenomena of the earth have been created to perform certain functions for man) of nature was profoundly challenged. Darwin's book upset many established patterns of thought, contradicted firmly held religious tenets (teleological concept) and brought in focus the concept that humans are one species among many that have evolved more primitive one. In his subsequent book, The Descent of Man and Selection in Relation to Sex (1871), Darwin provided evidence of human evolution from one primitive species and discussed the role of sexual selection in evolution.

The concept of defining geography in terms of relationship became quite popular in Germany. The work of Darwin influenced Friedrich Ratzel, who published Anthropogeography in two volumes in 1882 and 1891 respectively.

In the first volume, he organized the material to show the influence of physical environment on history, culture and the mode of life of the people, while the second volume deals with the geographical distribution of men in the world. It was because of this book in which he discussed the man and environment relationship of the different tribes of the world that he is considered as the 'founder of human geography'.

Ratzel, by applying the organic theory to political geography, developed the concept of lehensraum (literally living space or the geographical area within which an organism develops). While developing the man and environment relationship, Ratzel, in his book Political Geography (1897), equated a nation with a living organism, and argued that a country's search for territorial expansion was similar to a growing organism's search for space. Conflict between nations was thus seen as a contest for territory within which to expand, with the fittest surviving.

The concept was appropriated by the German School of Geopolitik in the 1920s and 1930s and used to justify the Nazi programme of territorial expansion. In the opinion of Dickinson and Gumplovicz, "Ratzel's work contains more and more important knowledge concerning the state, than the entire theoretical political science literature of the last 100 years".

Ratzel's book Anthropogeography had a great influence on the geographic thought of America, France, Britain, Russia and Sweden. Ratzel's most important disciple was Ellen Churchill Semple. Semple, in the introduction of her book, Influences of Geographic Environment declared "man as the product of earth's surface". The influence of physical environment on the history of people of the region in any part of the world can be found in her writings. The main cause of variations in the history, culture and lifestyle of the people of plains and mountains can be traced in the physical environment.

Subsequently, the French geographers, especially Vidal de Lablache, Brunhes, Martone, *etc.* The concept of pays (micro-region), developed by Lablache, was also based on the concept of relationship. He also coined the concept of genres de vie (lifestyle).

Lablache was convinced that genres de vie were themselves reflective of nature (physical environment), even as they transformed it. He always conceived human geography as natural, not a social science.

Ultimately, geography as the science of relationship appeared in the form of environmental determinism. Environmental determinism is the doctrine according to which the human activities are controlled by the physical environment. The environmentalists considered natural environment as the 'geographic factor' and their geography was known as 'pure geography'. In the opinion of environmental determinists, human geography is the study of influence of physical environment on man. Barrows, in his presidential address

(1922), recommended that relationships in geography should be studied "from man's adjustment to environment, rather than the reverse". Hettner (1907) also supported the concept of geography as the study of relationship. Thus, both the physical factors and the human factors (cultural environment) are to be studied in their relations to each other.

Geography is, therefore, exclusively human geography, or as Barrow stated, geography is 'human ecology'. Geography is a natural science in the same way as plant ecology is a biological science. Sauer, in his book Agricultural Origins and Dispersals (1952), focused upon the patterns of human culture in relation to the natural environment. He also tried to explain how human interactions with physical environment have resulted into various cultural patterns in the different parts of the world.

While examining the lifestyle and history of the people in the different regions of the world, it may be said that there is a close relationship between the environment and the mode of life of the people. Undoubtedly, terrain, topography, temperature, rainfall, natural vegetation and soils have a direct bearing on the culture, economy and society of the people, yet the role of man as the transforming agent of his physical surroundings cannot be ignored. In fact, works of man reveal many facts for which environmental forces alone can give no satisfactory explanation. For example, similar locations may not lead to similar mode of life.

The Eskimos of Tundra region differ markedly in their economic activities and cultural practices from the Tungus, Yakuts and Yukaghirs, *etc.* The Khasis and Nepalis, living in Meghalaya (India) in the same physical environmental conditions, have the different cultural ethos. Same is the case with the Gujjars and Bakkarwals of Kashmir Valley and the Kashmiris in the state of Jammu and Kashmir. Likewise, the Hanjis (water dwellers) of Dal Lake and Jhelum river in Srinagar have different attitude and mode of life from the inhabitants of Srinagar city. Geography, as the discipline of relationship, though was quite prominent approach, it lost its position after the Second World War. The advocates of spatial science, locational analysis, behaviouralists, radicalists and humanists criticized this approach and declared it just deterministic and unscientific.

ENVIRONMENTAL MANAGEMENT STRATEGIES IN THE SME SECTOR

Small and medium-sized enterprises (SMEs) have an important role to play in environmental management and although it might be argued that their individual contribution towards environmental degradation is small, taken together they have a very large impact. An obvious problem is that small-business managers do not have access to information concerning environmental management and, in addition, many small firms lack the capital to invest in environmentally-friendly technology. Nevertheless, there are things that they can do at very little cost, and if they can integrate environmental considerations

into their everyday activities they are likely to save money, rather than spend it, in the longer term. One key aim of the environmental challenge must be to help small and medium-sized enterprises develop and become resource efficient, competitive, technically advanced and environmentally-friendly. We have already noted that it is very difficult for the small enterprise along to achieve all these requirements. The short of technical expertise which large firms will have in-house to help with their environmental management, will probably be lacking, and few small businesses will have the money to buy in consultants to do these important tasks. A clear way forward for the SME sector revolves around cooperation and networking. This entails creating links between small firms and between firms and institutions. For example, a useful and often unexploited link might be between businesses and local universities, or between firms and economic development units of councils. Natural, geographical links often exist which can also be exploited. By networking and cooperating beyond even the boundaries of the firm, managers can learn from other people's experiences and errors. What small businesses need therefore is a framework within which to achieve such advantages. These can be created by the establishment of industry-specific or multi-sectoral forums, or simply forums within localities, but the common element which will determine the success of any of them is cooperation.

The development of environmental networks among small business, voluntary organisations and the public, will enable controlled and sustainable growth to occur. Ultimately what we do with our environment affects us all, also future generations. If the environment is important then we should recognise that the systems and processes used in businesses are also important. There is a need for small businesses to be given incentives to undertake environmental change. Some of these incentives are provided by the legislative framework and a need to survive in a more competitive and environmentally aware marketplace. In addition, larger firms will push environmental improvement along the supply chain. But there is still a need to convince small businesses that environmental improvements will reduce costs in the long-run, and this can only be achieved by demonstration of best practice. There is a clear role here for government and local authorities in supporting innovative developments and providing a forum where information can be exchanged.

REGIONAL ENVIRONMENTAL MANAGEMENT AND ECONOMIC DEVELOPMENT

The original Treaty of Rome did not give the EC explicit powers to legislate on environmental matters but this was amended by the adoption of the Single European Act, 1987, which now provides a firm legal basis for Community legislation on the environment. One of its provisions states that environmental protection requirements should be a component of all other policies based on the indisputable fact that measures in the sphere of other policies may have a significant positive or negative impact on the environment. This must the viewed

as an important provision as it establishes a requirement that environmental protection must form an essential component of all Community policies, including economic development policies. The ECs Fifth Environment Programme, which was introduced in 1993 and will run to the end of the century, has as a major theme the promotion of information and education of the Community's citizens towards the protection of the environment, and the direct involvement of the Community in achieving environmental protection through the use of voluntary agreements, codes of conduct, and economic and fiscal measures.

There will be a move away from dealing with environmental issues on an individual media basis, *i.e.*, air, water, noise, waste, *etc.*, to handling issues on a sectorial and regional basis involving local communities and local and national governments. This approach further emphasizes the need for regional conversion plans, which mean the integrated development of the economy and the environment involving the sectors of industry, the local community and local authorities.

Integrated preventive action encourages actions to be taken to protect the environment at an early stage, requiring environmental management to go beyond the question of repairing damages, to stopping pollution from occurring in the first place. 'The polluter pays' principle is an important instrument enabling the market to be adjusted to reflect the true costs of the production of goods and services, and is being adopted by both the EC and Member States' governments. Pressures for regulatory compliance will be met, in the main, through the initiation of continuous and sophisticated monitoring systems, waste minimization, more effective investments in process technology, and research and development. As these costs begin to impinge more heavily on an organisation's operating and capital costs, evidence of good practice will become a precondition for access to the wider investment community.

These trends confirm that industry will need to adopt a more strategic view of environmental problems. It needs to move away from predominantly short-term solutions to actual problem-solving and towards the development of pre-emptive control strategies striking a balance between regulation and the need to turn those regulations into competitive advantages abroad. The development of a regional environmental management system (REMS) can help significantly here. Not only does it allow for a cooperative environmental effort on the part of firms in the region, which can lead to synergy in research and development, waste management and energy efficiency, but also a significant advantage can be derived from a common marketing approach. A regional conversion plan aims at focusing the marketing instrument not only on the company but also on the region in which the company is based. The region can develop a competitive advantage by way of an integrated proactive environmental policy and by way of an integrated proactive regional environmental management system. In other words, the product will be produced to the highest environmental standards in a geographical region where the quality of the environment is maintained through

an efficient REMS. Where a region is already polluted or environmentally damaged, the common approach to tackling problems is to deal with specific point sources of pollution using regulatory controls. In addition, over time, individual impact assessments can mitigate environmental damage, but they do not necessarily alter the larger picture. The effect of this ad hoc approach on the regional environment can often be seen as 'two steps forward, one step back'.

Because of the non-integrated and non-coordinated approach, what is beneficial or, more often, 'not harmful' for one industry, may well be harmful to another. It must be recognised that the environment responds as a whole when stressed at a particular point, but the traditional piecemeal approach to environmental management does not provide any information about how the whole system reacts.

There is therefore a need to develop a more integrated REMS which is capable to exploring the synergistic effect of applying environmental management policies to all sectors or activity. This change from a piecemeal to a holistic approach can be seen as an important part of a 'sustainable development' approach. The concept of sustainable development recognises that there is a interdependence between the economy and the environment, not only because the way we manage the economy has an impact on the environment, but also because environmental quality has an impact on the performance of the economy.

Central to the development of a REMS is the cooperation and commitment of regional and local resources facilitated through partnerships between individuals, businesses, public sector institutions and other agencies. A regional strategy of regional environmental management is required which promotes and stimulates community-implemented development. It is particularly important, therefore, to involve the business sector and to make it clear that there are significants benefits to that sector in becoming involved. This process must begin through the provision of information, continue through education and training, and lead, subsequently, to the provision of support, advice, and capital for local initiatives.

Any environmental management system starts with, and depends strongly upon, the development of understanding and commitment from all people involved, and the REMS is no exception. There is also a need to have a clear policy for the region which integrates both regional objectives and industrial aspirations. Such policies are already in place where local authorities have followed Friends of the Earth advice in introducing a declaration of commitment to environmental protection and policy development in the areas of recycling, energy, transport and planning, environmental protection and enhancement, health, and the monitoring and minimization of pollution. Some authorities have also introduced regular environmental audits and invited public and industrial participation. However, the regional environmental management system policy needs to go beyond this and fully integrate the needs of the region, industry and the public into a plan which binds them together with the objective of significantly improving all aspects of the region's environmental performance.

Industry itself can benefit greatly by the additional help which will provided by firms working together cooperatively with the support of a regional team. The RMES will complement the firm's own internal environmental management system and further add to the firm's competitive advantage if the region can attract a 'green label'. To a large extent the future of the environment and of the planet requires more cooperation, and the concept of the regional environmental management system extends much of the best practice discussed in this book. A key concept of environmentalists has long been associated with local action, global impact. At the centre of this concept is the need for increased cooperation and the REMS extends what firms alone can do towards achieving this important objective.

4

Environmental Protection Laws and Policy Frameworks

ENVIRONMENTAL CONSERVATION MEASURES TAKEN IN INDIA— CONSTITUTIONAL AMENDMENTS MADE

Strictly, speaking no constitution deals with a matter such as environmental protection. Because basically any constitution contains only the rules of laws in relation to the power structure, allocation, and manner of exercise. Besides Indian Constitution is already a bulky document and brevity is the character of an ideal Constitution. Hence from the point of view of the principles of the constitutional law as well as, the length of the Constitution it was impossible to have any such provision safeguarding the healthy environment. Therefore till the subsequent amendments the constitutional text of India, was without any specific provision for the protection and promotion of the environment. However the seeds of such provision could be seen in Article 47 of the constitution which command the State to improve the standard of living and public health. To fulfill this constitutional goal, its necessary that the State should provide pollution free environment.

The United Nations Conference on Human Environment held on in June, 1972 at Stockholm placed the issue of the protection of biosphere on the official agenda of international policy and law.

The agenda of the conference consisted of the following:

(a) Planning and management of human settlements for environmental quality.
(b) Environmental aspects of natural resources management.
(c) Identifications and control of pollutants and nuisances of broad international significance.
(d) Educational, Information, Social and cultural aspects of environmental issues.
(e) Development and environment.
(f) International Organisational implications of action proposals.

The Stockholm Conference agendas, proclamations, principles and subsequent global, environment protection efforts shows the words realisation of the need to preserve and protect the natural environment. The Conference acclaimed man's fundamental right to adequate conditions of life in an environment of a quality that permitted a life off dignity and well-being. In United Nations Conference on Human Environment, at Stockholm the then Prime Minister of India Mrs. Gandhi while displaying the nations commitment to the protection of environment said:

> *"The natural resources of the earth, including the air, water, land flora and fauna and especially representative sample of the nature ecosystem must be safeguard for the benefits of present and future generations through careful planning or management, as appropriate... Nature conservation including wildlife must therefore receive importance in planning for economic development".*

To comply with the principles of the Stockholm Declarations adopted by the International Conference on Human Environment, the Government of India, by the Constitution 42nd Amendment Act, 1976 made the express provision for the protection and promotion of the environment, by the introduction of Article 48-A and 51-A(g) which form the part of Directive Principles of State Policy and the Fundamental Duties respectively. The amendment provided for the following:

ARTICLE 48 A

By the Constitution (42nd Amendment) Act, Section 10 (w.e.f. 3.1.1977). Protection and improvement of environment and safeguarding of forests and wild life:-

"The State shall endeavour to protect and improve the environment and to safeguard the forest and wildlife of the country".

FUNDAMENTAL DUTY

(I) Article 51-A(g): By Constitution (42nd Amendment) Act, 1976. Section 11 (w.e.f. 3.1.1977)

"It shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures".

Thus the Indian Constitution makes two fold provision.

(a) On the one hand, it gives directive to the State for the protection and improvement of environment.

(b) On the other hand the citizens owe a constitutional duty to protect and improve natural environment.

In protecting the natural environment Article 48-A is of immense importance today. Because with the activist approach of judiciary in India the legal value of Directive Principles jurisprudence has constantly grown up in the Indian Constitutional set-up.

Hence the above provisions are of pivotal significance.

The Government of India to accelerate the pace for environment protection. Further amended the constitutional text by making the following changes.

1. *Seventh Schedule of the Constitution:*
   (1) In the Concurrent List, 42nd Amendment Inserted.
      (a) Entry 17-A, providing for forests.
      (b) Entry 17-B, for the protection of wild animals and birds.
      (c) Entry 20-A, providing for population control and family planning.
2. Eleventh Schedule of the Constitution.
   (1) This new schedule is added by the Constitution 73rd Amendment Act, 1992. Which received the assent ol' tlic President on 20.4.1993. This schedule has 8 entries (2,3.6.7,11,12,15 and 29) providing for environmental protection and conservation
3. Twelfth Schedule of the Constitution.
   (1) The entry number 8 of this schedule added to the constitutional text by the 74th Amendment Act, 1992, which received the assessment of the President on 20.4.1993 providal for the Urban Local bodies, with the function of environment and promotion of ecological aspects to them.

Due to the above changes the division of legislative power between the Union and the States is spelt out in the following three of the 7th Schedule of the constitution.

LIST I (UNION LIST) ENTRIES

52. Industries.
53. Regulation and development of oil fields and mineral oil/resources.
54. Regulation of mines and mineral development.
56. Regulation and development of inter-State rivers and river valleys.
57. Fishing and fisheries beyond territorial waters.

LIST II (STATE LIST) ENTRIES

6. Public health and sanitation.
14. Agriculture protection against past and prevention of plant diseases.
18. Land colonisation, *etc.*

21. Fisheries.
23. Regulation of Mines and Mineral development subject to the provisions of
24. Industries subject to the provisions of

LIST III (COMMON OR CONCURRENT LIST) ENTRIES

17-A Forests.
17-B Protection and wild animals and birds.
20. Economic and social planning.
20-A Population control and family planning.

The Eleventh Schedule, added to the Constitution by the constitution 73rd Amendment Act, 1992, assign the functions of soil conservation, water management, social and form forestry, drinking water, fuel and fodder, *etc.*, to the Panchayats with a view to environmental management.

The 12th Schedule of the Constitution added by 74th Amendment Act, 1992 commands the Urban local bodies such as municipalities to perform the functions of Protection of environment and promotion of ecological aspects.

The constitutional changes effected in the 7th Schedule by the 42nd Amendment Act, 1976 is a milestone steps, in the direction of the protection of environment. Because the subject of forests originally was in the State list as entry 19, this resulted into no uniform policy by the State so as to protect the forests. By placing the item 'forest' now in the concurrent list by the entry 17-A, along with the State, Parliament has acquired a law making power.

Because of the above change, in order to have a uniform policy in the forest management the Government of India in the year 1980 set up the Ministry of Environment and Forests. By virtue of this change Parliament also enacted, the central legislation *i.e.*, Forest Conservation Act, 1980, which was amended in 1988. The government also adopted the new National Forest Policy in 1988 with a twin object. One to protect the forests and another to consider the needs of the forest dwellers.

Similarly the insertion of the entry 17-B in the concurrent list has empowered the Parliament to enact a law with a view to protection of wild animals and birds. Although we had a comprehensive legislation in the form of Wildlife Protection Act of 1972 the 42nd Amendment has considered the wildlife along with forests. India has also formulated National Action plan for the Protection of wild life. The new entry 20 A in the concurrent list embowers the Parliament to regulate the population explosion one, of the prime cause of the environmental pollution. By these changes, legally and constitutionally it has become possible to lake a uniform action in the matters of proper management of the environment.

FUNDAMENTAL RIGHTS

The judiciary's dynamic interpretation of fundamental rights have regulated into the rights to healthy environment from the following Articles:

(a) *Article 14:* "State shall not deny to any person equality before the law or the equal protection of the laws within the territory of India".

(b) *Article 19 (6):* State is empowered to make any law imposing in the interests of the general public, reasonable restrictions on the exercise of freedom to practice any profession, or to carry on any occupation, trade or business. guaranteed by (1) (g).
(c) *Article 21:* "No person shall be deprived of his life or personal liberty except according to procedure established by law".

RIGHT ENVIRONMENT

The importation of the 'due process* clause *by the activist approach of the Supreme Court in Maneka Gandhi's case (AIR 1978 SC 597) has revolutionized the ambit and scope of the expression 'right to life* embodied in Article 21 of the Constitution. The right to live in healthy environment is one more golden feather of article 21.

This right connotes that the enjoyment of life and its attainment and fulfillment guaranteed by Article 21 embraces the protection and preservation of nature's gift without which life cannot be enjoyed. The supreme Court of India, in 1980, indirectly conceived this right in a monumental judgment in the case of Ratlam Municipality V/s. Vardichand (AIR 1980 SC 1622).

In this case the Bench of Justice V. R. Krishna lyer and Justice 0. Chinnappa Reddy held the neglect of sanitation of the town of Ratlam by Municipal Council Health hazard. The Court observed:

> *"Even as human rights under Part III of the Constitution have respected by the State regardless provision. Decency and dignity race non-negotiable facts of human rights and are a first charge on local self governing bodies".*

The Court's decision was founded on it's earlier decision in Govind V. Shanti Sarup (AIR 1957 SC 1943), where Section 133 of the code of Criminal procedure was used by the Court to preserve the environment in the interest of "health safety and convenience of public a large".

In the judgment the Supreme Court has no-where referred to Article 21 of the Constitution. But it is simply clear that, the judgment is based on the right to live with decency and dignity as provided in the right to life.

The Court continued, its hidden approach of not referring to Article 21 directly, in another landmark case. Rural litigation and Entitlement Kendra V. State of Uttar Pradesh (AIR 1985 SC p52) although the Court has successfully read Article 21 in Article 48-A of the Part N of the Constitution.

In this case, the Apex Court converted a letter into written petition alleging that the operation of unauthorised and illegal, mining in the Mussorie-Dehradun belt affected the ecology of the areas and led to environment disorder. The Bench consist of Chief Justice P.N.Bhagwati (as he then was), Justice A.N. Sen and Justice Ranganath Misra ordered closing down of mining operations on the ground that lime stone quarries operation causing ecological imbalance and a hazard to healthy environment. The striking feature of this decision is that, the Court converted a letter in the writ petition under Article 32, without referring to any

article from the chapter on fundamental rights. From the jurists process, it could be submitted that Court restrained itself from invoking Article 21 directly, but regarded the right to live in healthy environment as a part of fundamental right.

In M. C. Mchta V. Shriram Food and Fertilizer Industries and Union of India (Oleum Gas Leak Case-I) (AIR 1987 SC 1965) petitioner filed the write against the oleum gas leakage and for closing down one of the units of Shriram food and Fertilizers industries belonging to Delhi Cloth Mills Ltd.

The Court allowed to restart plant subject to certain stringent conditions laid down in the order. But the notable development is that the Court held that, can enterprise, engaged in any hazardous or inherently dangerous industry which could pose a threat to public health owed an absolutely and non-delidatable duty to the community to ensure that no harm resulted to anyone. Here again Court made no reference to Article 21.

But in III Oleum Gas Leak Case, M. C. Mehta V/s. Union of India (AIR 19P7 SC 1086),Chief Justice P. N. Bhagwati (as he then was) speaking for the Court clearly treated the lights to live in a healthy environment as fundamental right under Article 21 of the Constitution.

This case came before the Apex Court's Judges Bench by a reference made by a Bench of three Judges. On 4th and 6 December, there was leakage of Oleum' Gas from one of the units of Shriram which affected the health of large number of people and death of one person. On behalf of affected people application for compensation came up for hearing. The claim of Article 21 against a private corporation engaged in an activity which has potential to effect the life and health of the people was vehemently argued by counsel for the applicants. On the other hand counsel for Shriram opposed subjecting Shriram to the discipline of Article 21.

In the judgement Chief Justice P. N. Bhagwati (as he then was) speaking for the Court observed:

> *"These applications for compensation are the enforcement of the fundamental rights to life enshrined in Article 2 lot the Constitution and while dealing with such applications, we cannot adopt a hypertechnical approach which would defeat that ends of justice... If this Court is prepared to accept a letter complaining of violation of the fundamental rights of an individual or a class of individuals who cannot approach the Court for justice, there is no reason why these applications for compensation which have been made for the enforcement of the fundamental right of persons affected by oleum gas leak under Article..21 should not be entertained. (AIR 19K7 SC 1089).*

In the judgement. Chief Justice P. N. Bhagwati stressed on the need to develop a law recognising the rule of strict and absolute liability in cases of hazardous or dangerous industries operating at the cost of environment and the human life. The learned Chief Justice observed:

> *"We in India cannot hold our hands back and 1 venture to evolve a new principle of liability which English Courts have not done. We have*

to develop our law and if we find that it is necessary to construct a new principle of liability to deal with an unusual situation which has arisen and which is likely to arise in future on account of hazardous or inherently dangerous industries which are concomitant to an industrial economy, there is no reason why we should hesitate to evolve such principle of liability merely because, it has not been so done England (AIR 1988 SC 1089)".

The significant feature of this litigation is that the Court decided the important issues of liability and quantum of compensation without making a decision on the issue of assumption of jurisdiction in a write petition for orders against Shreeram Enterprises on the ground of violation of Article 21 of the Constitution. The judgement of the Supreme Court had an impact on the various High Court Judgements (AIR 1987A.P.171).

In the case of Subhash Kumar V. State of Bihar (AIR 1991 SC 424) the petitioner by way of public interest litigation, filed a petition for ensuring enjoyment of pollution free water and air. Justice K. N. Singh and Justice N. D. Ojha held:

"Right to live is a fundamental right under Article 21 of the Constitution and it includes the right of enjoyment of life. If anything endangerous or impairs that quality of life in derogation of laws, a citizen has a right to have eerecourse to Article 32 of the Constitution for removing the pollution of water or air which may determined to the quality of life (AIR 1991 SC424).

Since 1980 there is a substantial growth in the case law in environment. In 1987, the Apex Court delivered 13 judgements on the issue. Among the judges. Justice Ranganath Mishra (as he then was). Justice P. N. Bhagawati as judge and then as a Chief Justice, and Justice G. L. Oza decided the maximum cases. Though the Apex Court favoured the balanced approached between the environmental protection and development process. Bhagawati's last judgement on the eve of his retirement in M. C. Mehta's case has opened new horizon in the development of environmental law and also administration of environmental justice (J.I.L.I. Vol.35.PartI.1993).

Any Social process of change must be backed by the social sanction. If it is not then, no Court, no law, no Constitution can enforce it. If it is therefore, although now we find some constitutional provisions protecting the ecological balance it calls for the social sanction through the observance of the constitutional morality, which we lack today, as a national morality. Hence Constitutional directives or decisions fails to produce a desired result.

It is also now being suggested that the Constitution of India must provide a new Article *i.e* Article 21-A stating that, all persons shall have the right to clean and lieveable environment, throughout the territory of India subject to any law imposing reasonable restriction in the interest of general public (C. M. Jariwala, Indian Law Institute International Conference Souvenir, 1994, P.72).

However with due respect to the above views it is humbly submitted that it would be better if such matters are left to the specific legislation or judicial

laws rather than accumulating everything in the constitutional text. After all the sanctify of the document called as the fundamental law of the land, the constitution must be upheld so as to distinguish it from any other ordinary legislation. Besides the exploration of the different dimensions of the Article 21 is on going process. The new horizons of the article 21 are coming up from case to case.

In the ultimate analysis of the problem of environmental pollution and its solution it is submitted that, no doubt, the legal, constitutional measures are necessary in the process of management of the proper and better environment. But it is not (he ever lasting solution. The ever lasting solution is that it calls for the people's inner feeling for the protection of environment, the environmental value system, the peoples movement rather than a legal movement.

Hence it calls for the mass education and awareness. This aspect has been very rightly upheld by the summit Court in the case of M.C. Mehta V. Union of India (AIR 1992 SC 382). The peoples collective conscience should wake up before the matter slips out of the hands. Each country now must seriously strive for the maintaining of ecological balance, otherwise tomorrow will be too late.

WATER

Water quality standards especially those for drinking water are set by the Indian Council of Medical Research. These bear close resemblance to WHO standards. The discharge of industrial effluents is regulated by the Indian Standard Codes and recently, water quality standards for coastal water marine outfalls have also been specified.

In addition to the general standards, certain specific standards have been developed for effluent discharges from industries such as, iron and steel, aluminium, pulp and paper, oil refineries, petrochemicals and thermal power plants. Legislation to control water pollution are listed below.

Water (Prevention and Control of Pollution) Act, 1974: This Act represented India's first attempts to comprehensively deal with environmental issues. The Act prohibits the discharge of pollutants into water bodies beyond a given standard, and lays down penalties for non-compliance. The Act was amended in 1988 to conform closely to the provisions of the EPA, 1986. It set up the CPCB (Central Pollution Control Board) which lays down standards for the prevention and control of water pollution. At the State level, the SPCBs (State Pollution Control Board) function under the direction of the CPCB and the state government.

Water (Prevention and Control of Pollution) Cess Act, 1977: This Act provides for a levy and collection of a cess on water consumed by industries and local authorities. It aims at augmenting the resources of the central and state boards for prevention and control of water pollution. Following this Act, *The Water (Prevention and Control of Pollution) Cess Rules* were formulated in 1978 for defining standards and indications for the kind of and location of meters that every consumer of water is required to install.

AIR

Air (Prevention and Control of Pollution) Act, 1981: To counter the problems associated with air pollution, ambient air quality standards were established, under the 1981 Act. The Act provides means for the control and abatement of air pollution. The Act seeks to combat air pollution by prohibiting the use of polluting fuels and substances, as well as by regulating appliances that give rise to air pollution. Under the Act establishing or operating of any industrial plant in the pollution control area requires consent from state boards. The boards are also expected to test the air in air pollution control areas, inspect pollution control equipment, and manufacturing processes.

National Ambient Air Quality Standards (NAAQS) for major pollutants were notified by the CPCB in April 1994. These are deemed to be levels of air quality necessary with an adequate margin of safety, to protect public health, vegetation and property (CPCB 1995 cited in Gupta, 1999). The NAAQS prescribe specific standards for industrial, residential, rural and other sensitive areas. Industry-specific emission standards have also been developed for iron and steel plants, cement plants, fertilizer plants, oil refineries and the aluminium industry. The ambient quality standards prescribed in India are similar to those prevailing in many developed and developing countries.

To empower the central and state pollution boards to meet grave emergencies, the *Air (Prevention and Control of Pollution) Amendment Act*, 1987, was enacted. The boards were authorized to take immediate measures to tackle such emergencies and recover the expenses incurred from the offenders. The power to cancel consent for non-fulfilment of the conditions prescribed has also been emphasized in the Air Act Amendment.

The Air (Prevention and Control of Pollution) Rules formulated in 1982, defined the procedures for conducting meetings of the boards, the powers of the presiding officers, decision-making, the quorum; manner in which the records of the meeting were to be set, *etc.* They also prescribed the manner and the purpose of seeking assistance from specialists and the fee to be paid to them.

Complementing the above Acts is the *Atomic Energy Act* of 1982, which was introduced to deal with radioactive waste. In 1988, the *Motor Vehicles Act,* was enacted to regulate vehicular traffic, besides ensuring proper packaging, labelling and transportation of the hazardous wastes. Various aspects of vehicular pollution have also been notified under the EPA of 1986. Mass emission standards were notified in 1990, which were made more stringent in 1996.

In 2000 these standards were revised yet again and for the first time separate obligations for vehicle owners, manufacturers and enforcing agencies were stipulated. In addition, fairly stringent Euro I and II emission norms were notified by the Supreme Court on April 29, 1999 for the city of Delhi. The notification made it mandatory for car manufacturers to conform to the Euro I and Euro II norms by May 1999 and April 2000, respectively, for new non-commercial vehicle sold in Delhi.

FORESTS AND WILDLIFE

The Wildlife (Protection) Act, 1972, Amendment 1991: The WPA (Wildlife Protection Act), 1972, provides for protection to listed species of flora and fauna and establishes a network of ecologically-important protected areas. The WPA empowers the central and state governments to declare any area a wildlife sanctuary, national park or closed area. There is a blanket ban on carrying out any industrial activity inside these protected areas.

It provides for authorities to administer and implement the Act; regulate the hunting of wild animals; protect specified plants, sanctuaries, national parks and closed areas; restrict trade or commerce in wild animals or animal articles; and miscellaneous matters. The Act prohibits hunting of animals except with permission of authorized officer when an animal has become dangerous to human life or property or so disabled or diseased as to be beyond recovery (WWF-India, 1999). The near-total prohibition on hunting was made more effective by the Amendment Act of 1991.

The Forest (Conservation) Act, 1980: This Act was adopted to protect and conserve forests. The Act restricts the powers of the state in respect of de-reservation of forests and use of forestland for non-forest purposes (the term 'non-forest purpose' includes clearing any forestland for cultivation of cash crops, plantation crops, horticulture or any purpose other than re-afforestation).

GENERAL

Environment (Protection) Act, 1986 (EPA): This Act is an umbrella legislation designed to provide a framework for the co-ordination of central and state authorities established under the Water (Prevention and Control) Act, 1974 and Air (Prevention and Control) Act, 1981. Under this Act, the central government is empowered to take measures necessary to protect and improve the quality of the environment by setting standards for emissions and discharges; regulating the location of industries; management of hazardous wastes, and protection of public health and welfare.

From time to time the central government issues notifications under the EPA for the protection of ecologically-sensitive areas or issues guidelines for matters under the EPA.

Some notifications issued under this Act are:

- *Doon Valley Notification* (1989), which prohibits the setting up of an industry in which the daily consumption of coal/fuel is more than 24 MT (million tonnes) per day in the Doon Valley.
- *Coastal Regulation Zone Notification* (1991), which regulates activities along coastal stretches. As per this notification, dumping ash or any other waste in the CRZ is prohibited. The thermal power plants (only foreshore facilities for transport of raw materials, facilities for intake of cooling water and outfall for discharge of treated waste water/cooling water) require clearance from the MoEF.

- *Dhanu Taluka Notification* (1991), under which the district of Dhanu Taluka has been declared an ecologically fragile region and setting up power plants in its vicinity is prohibited.
- *Revdanda Creek Notification (1989)*, which prohibits setting up industries in the belt around the Revdanda Creek as per the rules laid down in the notification.
- *The Environmental Impact Assessment of Development Projects Notification*, (1994 and as amended in 1997). As per this notification:
- All projects listed under Schedule I require environmental clearance from the MoEF.
- Projects under the delicenced category of the New Industrial Policy also require clearance from the MoEF.
- All developmental projects whether or not under the Schedule I, if located in fragile regions must obtain MoEF clearance.
- Industrial projects with investments above Rs 500 million must obtain MoEF clearance and are further required to obtain a LOI (Letter Of Intent) from the Ministry of Industry, and an NOC (No Objection Certificate) from the SPCB and the State Forest Department if the location involves forestland. Once the NOC is obtained, the LOI is converted into an industrial licence by the state authority.
- The notification also stipulated procedural requirements for the establishment and operation of new power plants. As per this notification, two-stage clearance for site-specific projects such as pithead thermal power plants and valley projects is required. Site clearance is given in the first stage and final environmental clearance in the second. A public hearing has been made mandatory for projects covered by this notification. This is an important step in providing transparency and a greater role to local communities.
- *Ash Content Notification* (1997), required the use of beneficiated coal with ash content not exceeding 34% with effect from June 2001, (the date later was extended to June 2002). This applies to all thermal plants located beyond one thousand kilometres from the pithead and any thermal plant located in an urban area or, sensitive area irrespective of the distance from the pithead except any pithead power plant.
- *Taj Trapezium Notification* (1998), provided that no power plant could be set up within the geographical limit of the Taj Trapezium assigned by the Taj Trapezium Zone Pollution (Prevention and Control) Authority.
- *Disposal of Fly Ash Notification* (1999) the main objective of which is to conserve the topsoil, protect the environment and prevent the dumping and disposal of fly ash discharged from lignite-based power plants. The salient feature of this notification is that no person within a radius of 50 km from a coal-or lignite-based power plant shall manufacture clay bricks or tiles without mixing at least 25% of ash with soil on a weight-to-weight basis. For the thermal power plants the utilisation of the flyash would be as follows:

- Every coal-or lignite-based power plant shall make available ash for at least ten years from the date of publication of the above notification without any payment or any other consideration, for the purpose of manufacturing ash-based products such as cement, concrete blocks, bricks, panels or any other material or for construction of roads, embankments, dams, dykes or for any other construction activity.
- Every coal or lignite based thermal power plant commissioned subject to environmental clearance conditions stipulating the submission of an action plan for full utilisation of fly ash shall, within a period of nine years from the publication of this notification, phase out the dumping and disposal of fly ash on land in accordance with the plan.

Rules for the Manufacture, Use, Import, Export and Storage of Hazardous Micro-organisms/Genetically Engineered Organisms or Cell were introduced in 1989 with the view to protect the environment, nature and health in connection with gene technology and micro-organisms, under the Environmental Protection Act, 1986. The government in 1991, further decided to institute a national label scheme for environmentally-friendly products called the 'ECOMARK'.

The scheme attempts to provide incentives to manufactures and importers to reduce adverse environmental impacts, reward genuine initiatives by companies, and improve the quality of the environment and sustainability of available resources. Besides the above attempts, notifications pertaining *to Recycled Plastics Manufacture and Usage Rules, 1999* were also incorporated under the Environment (Protection) Act of 1986.

The Environment (Protection) Rules, 1986: These rules lay down the procedures for setting standards of emission or discharge of environmental pollutants. The Rules prescribe the parameters for the Central Government, under which it can issue orders of prohibition and restrictions on the location and operation of industries in different areas.

The Rules lay down the procedure for taking samples, serving notice, submitting samples for analysis and laboratory reports. The functions of the laboratories are also described under the Rules along with the qualifications of the concerned analysts.

The National Environment Appellate Authority Act, 1997: This Act provided for the establishment of a National Environment Appellate Authority to hear appeals with respect to restriction of areas in which any industry operation or process or class of industries, operations or processes could not carry out or would be allowed to carry out subject to certain safeguards under the Environment (Protection) Act, 1986.

In addition to these, various Acts specific to the coal sector have been enacted. The first attempts in this direction can be traced back to the *Mines Act, 1952*, which promoted health and safety standards in coal mines. Later the *Coal Mines (Conservation and Development) Act* (1974) came up for conservation of coal during mining operations. For conservation and development of oil and natural gas resources a similar legislation was enacted in 1959.

HAZARDOUS WASTES

There are several legislation that directly or indirectly deal with hazardous waste. The relevant legislation are the Factories Act, 1948, the Public Liability Insurance Act, 1991, the National Environment Tribunal Act, 1995 and some notifications under the Environmental Protection Act of 1986. A brief description of each of these is given below.

Under the EPA 1986, the MoEF has issued several notifications to tackle the problem of hazardous waste management. These include:

- *Hazardous Wastes (Management and Handling) Rules, 1989*, which brought out a guide for manufacture, storage and import of hazardous chemicals and for management of hazardous wastes.
- *Biomedical Waste (Management and Handling) Rules, 1998,* were formulated along parallel lines, for proper disposal, segregation, transport, *etc.*, of infectious wastes.
- *Municipal Wastes (Management and Handling) Rules, 2000,* whose aim was to enable municipalities to dispose municipal solid waste in a scientific manner.
- *Hazardous Wastes (Management and Handling) Amendment Rules, 2000*, a recent notification issued with the view to providing guidelines for the import and export of hazardous waste in the country.

Factories Act, 1948 and its Amendment in 1987: The Factories Act, 1948 was a post-independence statute that explicitly showed concern for the environment. The primary aim of the 1948 Act has been to ensure the welfare of workers not only in their working conditions in the factories but also their employment benefits. While ensuring the safety and health of the workers, the Act contributes to environmental protection.

The Act contains a comprehensive list of 29 categories of industries involving hazardous processes, which are defined as a process or activity where unless special care is taken, raw materials used therein or the intermediate or the finished products, by-products, wastes or effluents would:

- Cause material impairment to health of the persons engaged
- Result in the pollution of the general environment

Public Liability Insurance Act (PLIA), 1991: The Act covers accidents involving hazardous substances and insurance coverage for these. Where death or injury results from an accident, this Act makes the owner liable to provide relief as is specified in the Schedule of the Act. The PLIA was amended in 1992, and the Central Government was authorized to establish the Environmental Relief Fund, for making relief payments.

National Environment Tribunal Act, 1995: The Act provided strict liability for damages arising out of any accident occurring while handling any hazardous substance and for the establishment of a National Environment Tribunal for effective and expeditious disposal of cases arising from such accident, with a view to give relief and compensation for damages to persons, property and the environment and for the matters connected therewith or incidental thereto.

International Agreements on Environmental Issues: India is signatory to a number of multilateral environment agreements (MEA) and conventions. An overview of some of the major MEAs and India's obligations under these is presented below. These are discussed at length in the respective chapters.

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973: The aim of CITES is to control or prevent international commercial trade in endangered species or products derived from them. CITES does not seek to directly protect endangered species or curtail development practices that destroy their habitats. Rather, it seeks to reduce the economic incentive to poach endangered species and destroy their habitat by closing off the international market. India became a party to the CITES in 1976. International trade in all wild flora and fauna in general and species covered under CITES is regulated jointly through the provisions of The Wildlife (Protection) Act 1972, the Import/Export policy of Government of India and the Customs Act 1962 (Bajaj, 1996).

Montreal Protocol on Substances that Deplete the Ozone Layer (to the Vienna Convention for the Protection of the Ozone Layer), 1987: The Montreal Protocol to the Vienna Convention on Substances that deplete the Ozone Layer, came into force in 1989.

The protocol set targets for reducing the consumption and production of a range of ozone depleting substances (ODS). In a major innovation the Protocol recognized that all nations should not be treated equally. The agreement acknowledges that certain countries have contributed to ozone depletion more than others. It also recognizes that a nation's obligation to reduce current emissions should reflect its technological and financial ability to do so. Because of this, the agreement sets more stringent standards and accelerated phase-out timetables to countries that have contributed most to ozone depletion (Divan and Rosencranz, 2001).

India acceded to the Montreal Protocol along with its London Amendment in September 1992. The MoEF has established an Ozone Cell and a steering committee on the Montreal Protocol to facilitate implementation of the India Country Programme, for phasing out ODS production by 2010.

To meet India's commitments under the Montreal Protocol, the Government of India has also taken certain policy decisions.

- Goods required to implement ODS phase-out projects funded by the Multilateral Fund are fully exempt from duties. This benefit has been also extended to new investments with non-ODS technologies.
- Commercial banks are prohibited from financing or refinancing investments with ODS technologies.

The Gazette of India on 19 July 2000 notified rules for regulation of ODS phase-out called the *Ozone Depleting Substances (Regulation and Control) Rules, 2000*. They were notified under the Environment (Protection) Act, 1986. These rules were drafted by the MoEF following consultations with industries and related government departments.

Basel Convention on Transboundary Movement of Hazardous Wastes, 1989: Basel Convention, which entered into force in 1992, has three key objectives:

- To reduce transboundary movements of hazardous wastes;
- To minimize the creation of such wastes; and
- To prohibit their shipment to countries lacking the capacity to dispose hazardous wastes in an environmentally sound manner.

India ratified the Basel Convention in 1992, shortly after it came into force. The Indian Hazardous Wastes Management Rules Act 1989, encompasses some of the Basel provisions related to the notification of import and export of hazardous waste, illegal traffic, and liability.

UN Framework Convention on Climate Change (UNFCCC), 1992: The primary goals of the UNFCCC were to stabilize greenhouse gas emissions at levels that would prevent dangerous anthropogenic interference with the global climate. The convention embraced the principle of common but differentiated responsibilities which has guided the adoption of a regulatory structure.

India signed the agreement in June 1992, which was ratified in November 1993. As per the convention the reduction/limitation requirements apply only to developed countries. The only reporting obligation for developing countries relates to the construction of a GHG inventory.

India has initiated the preparation of its First National Communication (base year 1994) that includes an inventory of GHG sources and sinks, potential vulnerability to climate change, adaptation measures and other steps being taken in the country to address climate change. The further details on UNFCC and the Kyoto Protocol are provided in Atmosphere and climate chapter.

Convention on Biological Diversity, 1992: The Convention on Biological Diversity (CBD) is a legally binding, framework treaty that has been ratified until now by 180 countries. The CBD has three main thrust areas: conservation of biodiversity, sustainable use of biological resources and equitable sharing of benefits arising from their sustainable use.

The Convention on Biological Diversity came into force in 1993. Many biodiversity issues are addressed in the convention, including habitat preservation, intellectual property rights, biosafety, and indigenous peoples' rights.

India's initiatives under the Convention are detailed in the chapter on Biodiversity. These include the promulgation of the Wildlife (Protection) Act of 1972, amended in 1991; and participation in several international conventions such as CITES.

UN Convention on Desertification, 1994: Delegates to the 1992 UN Conference on Environment and Development (UNCED) recommended establishment of an intergovernmental negotiating committee for the elaboration of an international convention to combat desertification in countries experiencing serious drought and/or desertification. The UN General Assembly established such a committee in 1992 that later helped formulation of Convention on Desertification in 1994.

The convention is distinctive as it endorses and employs a bottom-up approach to international environmental cooperation. Under the terms of the convention, activities related to the control and alleviation of desertification and its effects are to be closely linked to the needs and participation of local land-users and non-governmental organizations. Seven countries in the South Asian region are signatories to the Convention, which aims at tackling desertification through national, regional and sub-regional action programmes. The Regional Action Programme has six Thematic Programme Networks (TPN's) for the Asian region, each headed by a country task manager. India hosts the network on agroforestry and soil conservation. For details refer to the land resource chapter.

International Tropical Timber Agreement and The International Tropical Timber Organisation (ITTO), 1983, 1994: The ITTO established by the International Tropical Timber Agreement (ITTA), 1983, came into force in 1985 and became operational in 1987. The ITTO facilitates discussion, consultation and international cooperation on issues relating to the international trade and utilization of tropical timber and the sustainable management of its resource base. The successor agreement to the ITTA (1983) was negotiated in 1994, and came into force on 1 January 1997. The organization has 57 member countries. India ratified the ITTA in 1996.

An Assessment of the Legal and Regulatory Framework for Environmental Protection in India: The extent of the environmental legislation network is evident from the above discussion but the enforcement of the laws has been a matter of concern. One commonly cited reason is the prevailing command and control nature of the environmental regime. Coupled with this is the prevalence of the all-or–nothing approach of the law; they do not consider the extent of violation. Fines are levied on a flat basis and in addition, there are no incentives to lower the discharges below prescribed levels.

Some initiatives have addressed these issues in the recent past. The Government of India came out with a Policy Statement for Abatement of Pollution in 1992, before the Rio conference, which declared that market-based approaches would be considered in controlling pollution. It stated that economic instruments will be investigated to encourage the shift from curative to preventive measures, internalise the costs of pollution and conserve resources, particularly water. In 1995, the Ministry of Environment and Forest (MoEF) constituted a task force to evaluate market-based instruments, which strongly advocated their use for the abatement of industrial pollution.

Various economic incentives have been used to supplement the command-and-control policies. Depreciation allowances, exemptions from excise or customs duty payment, and arrangement of soft loans for the adoption of clean technologies are instances of such incentives. Another aspect that is evident is the shift in the focus from end-of-pipe treatment of pollution to treatment at source. The role of remote sensing and geographical information systems in natural resource management and environmental protection has also gained importance over time.

An important recent development is the rise of judicial activism in the enforcement of environmental legislation. This is reflected in the growth of environment-related public litigation cases that have led the courts to take major steps such as ordering the shut-down of polluting factories.

Agenda 21 highlights the need for integration of environmental concerns at all stages of policy, planning and decision-making processes including the use of an effective legal and regulatory framework, economic instruments and other incentives. These very principles were fundamental to guiding environmental protection in the country well before Rio and will be reinforced, drawing on India's own experiences and those of other countries.

NEED AND OBJECTIVES OF CONSERVATION

The Department of Environment and Forests was created in the Central Government, which subsequently became the Ministry of Environment and Forests (MoEF) by the mid-1980s. The MoEF is a focal point and a nodal agency in the administrative structure for planning, promotion and implementation of environment, conservation and forestry-related programmes.

The mandates of the Ministry include conservation and survey of flora, fauna, forests and wildlife, prevention and control of pollution, afforestation and regeneration of degraded areas and protection of the environment. These tasks are being fulfilled by the ministry through environmental impact assessment, eco-regeneration, assistance to organizations implementing environmental and forestry programmes, promotion of environmental and forestry research, extension, education and training to augment the requisite manpower, dissemination of environmental information, international cooperation and creation of environmental awareness among all sectors of the country's population.

CONSERVATION OF WATER BODIES

National River Conservation Directorate (NRCD): The National River Conservation Directorate, functioning under the Ministry is engaged in implementing the River and Lake Action Plans under the National Lake Conservation Plan (NLCP) & National River Conservation Plan (NRCP) by providing assistance to the State Governments.

- The objective of NRCP is to improve the water quality of the rivers, which are the major water sources in the country, through the implementation of pollution abatement works, to the level of designated best use. So far a total of 35 rivers have been covered under the programme.
- Major works being taken up under the NRCP include Interception and diversion works to capture the raw sewage flowing into the river through open drains and divert them for treatment. Setting up Sewage Treatment Plants for treating the diverted sewage. Construction of Low Cost sanitation toilets. Construction of Electric crematoria and improved Wood Crematoria to conserve the use of wood, River Front Development, afforestation on the river banks, Public Participation & Awareness, *etc.*

- Works under Ganga Action Plan Phase-II (presently part of National River Conservation Plan) are taken up in 59 towns along the main stem of river Ganga at an approved cost of Rs. 663 crore.
- The Ministry of Environment and Forests have received financial assistance of Yen 13.33 billion from the Japan Bank for International Cooperation (JBIC) for implementation of Yamuna Action Plan (YAP) Phase II, which is part of the National River Conservation Plan (NRCP).
- Under the Gomti Action Plan Phase-I, out of 31 sanctioned schemes, 26 schemes have been completed. A total of 42 mid STPs capacity had already been created under this Plan.
- Besides the river Ganga and its tributaries covered under GAP-I and GAP-II the NRCD has taken up the pollution abatement projects of 14 other States covering 30 rivers and 68 towns.
- The water quality of river Ganga is being monitored at 27 locations from Rishikesh in Uttarakhand to Uluberia in West Bengal by institutions such as pollution Control Research Institute (Haridwar), CPCB Zonal Office Lucknow, Indian Institute of Technology, Kanpur, Patna Univerity and Bidhan Chandra Krishi Vishwavidyalaya, Kalyani. As a result of the projects completed under Ganga Action Plan, the water quality of river Ganga has shown a general improvement despite tremendous population growth along the river banks.
- The water quality monitoring has also been undertaken for rivers namely, Yamuna, Western Yamuna Canal, Gomti, Hindon, Satluj (Punjab) Cauvery (Tamilnadu), Tunga, Bhadra, Tungbhadara in Karnataka and Waterways of Chennai. The numbers of monitoring stations presently are 158 in 10 rivers which include 27 stations set up in the upper reaches of Ganga and 32 stations of Chennai Waterways.
- A total of 33 projects for conservation of 49 lakes have been sanctioned in 13 States at a total estimated cost of Rs. 632.62 crore. Conservation works for 11 lakes have been completed so far whereas in some cases the project implementation is in last stages of completion. Funding pattern under NLCP (w.e.f. February, 2002) is on a 70:30 cost sharing between the Central and the State Governments.
- The 12th World Lake Conference (Taal 2007), a biennial event under the aegis of international Lake Environment Committee (ILEC) Foundation, was organized by the Ministry, at Jaipur, Rajasthan from 28th October to 2nd November, 2007. The State Govt of Rajasthan was the co-host for this mega event. The central theme of the Conference was 'Conserving lakes & Wetlands for Future'. Other main objectives included identifying the issues concerning lakes and wetlands along with restoration approaches under different conditions adopted by different countries.
- The Conference was inaugurated by Hon'ble President of India, Smt. Pratibha Devisingh Patil on 29th October, 2007 in the presence of other

dignitaries including Hon'ble Governor and Chief Minister of Rajasthan. As many as 600 no. of delegates comprising of nearly 150 overseas delegates from different parts of the world, attended the Conference with their oral or poster presentations on their studies pertaining to the subject matter. The Jaipur Declaration was adopted at the Valedictory session, to work upon as a follow up action of the Conference.

NATIONAL WETLANDS CONSERVATION PROGRAMME

The scheme on conservation and management of Wetlands was initiated in 1987 to lay down policy guidelines for implementing programmes of conservation and management of wetlands in the country, to undertake priority wetlands for intensive conservation measures and to monitor Implementation of the Programme of conservation, management and research, and to prepare an inventory of Indian wetlands.

- Number of wetlands under Wetland Conservation Programme increased from 27 in 2004 to 71 in 2005 and to 103 in January 2008.
- A brochure on 'National Wetland Conservation, an approach and Guidelines' was released on the eve of 2nd February, 2007 which has now been published and circulated to all the user agencies.
- Management Action Plans (MAPs) of 36 wetlands have been approved and financial assistance sanctioned. Cases of 10 more M.A.Ps, for newly identified wetlands are being taken up.
- Twenty five sites have already been designated as Ramsar sites in India till date;
- India has been nominated on Board of Directors of wetland International and on request from India. Meeting of Board of Directors of Wetland International was held in New Delhi at Manesar during 19-20 October, 2005, About 23 countries participated. India chaired one of the sessions and efforts made by India in Wetland conservation were highly applauded by all the participating countries.

5

Legal Frameworks and Policy Instruments in Environmental Protection

MARKET-BASED ENVIRONMENTAL POLICY INSTRUMENTS

In environmental law and policy, market-based instruments (MBIs) are policy instruments that use markets, price, and other economic variables to provide incentives for polluters to reduce or eliminate negative environmental externalities MBIs seek to address the market failure of externalities (such as pollution) by incorporating the external cost of production or consumption activities through taxes or charges on processes or products, or by creating property rights and facilitating the establishment of a proxy market for the use of environmental services. Market-based instruments are also referred to as economic instruments, price-based instruments, new environmental policy instruments (NEPIs) or 'new instruments of environmental policy.

Examples include environmentally related taxes, charges and subsidies, emissions trading and other tradeable permit systems, deposit-refund systems, environmental labeling laws, licenses, and economic property rights. For instance, the European Union Emission Trading Scheme is an example of a market-based instrument to reduce greenhouse gas emissions. Market-based instruments differ from other policy instruments such as voluntary agreements (actors voluntarily agree to take action) and regulatory instruments (sometimes

called "command-and-control"; public authorities mandate the performance to be achieved or the technologies to be used). However, implementing an MBI also commonly requires some form of regulation. Market based instruments can be implemented in a systematic manner, across an economy or region, across economic sectors, or by environmental medium (*e.g.*, water). Individual MBIs are instances of environmental pricing reform.

According to Kete (2002), "policymaking appears to be in transition towards more market-oriented instruments, but it remains an open-ended experiment whether we shall successfully execute a long-term s*ocial* transition that involves the private sector and the state in new relationships implied by the pollution prevention and economic instruments rhetoric."

HISTORY

For example, although the use of new environmental policy instruments only grew significantly in Britain in the 1990, British Prime Minister David Lloyd-George may have introduced the first market-based instrument of environmental policy in the UK when a Fuel tax was levied in 1909 during his ministry.

TRANSFERABLE PERMITS

A market-based transferable permit sets a maximum level of pollution (a 'cap'), but is likely to achieve that level at a lower cost than other means, and, importantly, may reduce below that level due to technological innovation.

When using a transferable-permit system, it is very important to accurately measure the initial problem and also how it changes over time. This is because it can be expensive to make adjustments (either in terms of compensation or through undermining the property rights of the permits). Permits' effectiveness can also be affected by things like market liquidity, the quality of the property right, and existing market power. Another important aspect of transferable permits is whether they are auctioned or allocated via grandfathering.

An argument against permits is that formalising emission rights is effectively giving people a license to pollute, which is believed to be socially unacceptable. However, although valuing adverse environmental impacts may be controversial, the acceptable cost of preventing these impacts is implicit in all regulatory decisions.

TAXES

A market-based tax approach determines a maximum cost for control measures. This gives polluters an incentive to reduce pollution at a lower cost than the tax rate. There is no cap; the quantity of pollution reduced depends on the chosen tax rate.

A tax approach is more flexible than permits, as the tax rate can be adjusted until it creates the most effective incentive. Taxes also have lower compliance costs than permits. However, taxes are less effective at achieving reductions in target quantities than permits. Using a tax potentially enables a double dividend,

by using the revenue generated by the tax to reduce other distortionary taxes through revenue recycling. There can also be conflict between objectives with a tax: less pollution means less revenue.

MARKET-BASED VS COMMAND AND CONTROL

An alternate approach to environmental regulation is a command and control approach. This is much more prescriptive than market-based instruments. Command and control regulatory instruments would be emission standards, process/equipment specifications, limits on input/output/discharges, requirements to disclose information, and audits. Command and control approaches have been criticised for restricting technology, as there is no incentive for firms to innovate.

Market-based instruments do not prescribe that firms use specific technologies, or that all firms reduce their emissions by the same amount, which allows firms greater flexibility in their approaches to pollution management. However, command and control approaches may be beneficial as a starting point, when regulators are faced with a significant problem yet have too little information to support a market-based instrument. Command and control approaches can also be preferred when regulators are faced with a thin market, where the limited potential trading pools mean the gains of a market-based instrument would not exceed the costs (a key requirement for a successful market-based approach).

Market-based instruments may also be inappropriate in dealing with emissions with local impacts, as trading would be restricted to within that region. They may also be inappropriate for emissions with global impacts, as international cooperation may be difficult to attain.

THE USE OF ECONOMIC INSTRUMENTS FOR ENVIRONMENTAL POLICY

The proposal to impose taxes on pollution is far from new. It was already put forward at the turn of the century by the famous British economist Professor Arthur Cecil Pigou. Reflecting on the famous London fogs, Pigou observed that pollution imposed unco vered costs on third parties which were not included in ordinary market transactions.

His proposal was to tax pollution by means of a so-called externality tax in order to internalise in ordinary market transactions the damages caused by pollution. While P ignou was a founder of welfare economics in many ways and thus an important source of inspiration for the subsequent welfare state, the external tax was at his time regarded as a rather academic approach to the control of pollution, and did not gain any pr actical significance (Pigou, 1920; Collard, 1981; Aslanbeigi, 1987).

In the early 1970s the externality tax experienced a revival both in terms of an evolving branch of micro-economic theory that explored the implications of such taxes, but also more practicany as some countries (for instance Japan and

the Netherlands) beg an to apply economic instruments in practice (Baumol and Oates, 1975; 1979). In the Scandinavian countries pollution taxation was regarded with scepticisrn, apart from by a few economists. The predominantly social democratic dominated governments and poli cy-makers regarded taxation of pollution as a way in which industries could continue to pollute if only they paid the price. Consequently the policy-instruments employed for environmental policy in the Scandinavian countries were mainly of a traditional r egulatory nature for nearly two decades (Johnson and Brown, 1976; Andersen, 1994a).

It was the Brundtland report which put economic instruments on the agenda again (World Commission, 1987). With its plea for a sustainable development, the Brundtland report recommended the increased use of economic instruments. At the same time the failur es of regulatory policies made policy-makers search for new and more effective policy-instruments. Especially the non-point sources of pollution, such as nitrogen and acid rain, made clear the limits of the command-and-control type of regulations. Economi c instruments were the key to the integration of environmental considerations into other policy-areas, and this integration was the key to a sustainable development.

Since the late 1980s, government reports in many OECD countries have announced an increased use of econormc instruments (Pearce, 1989; VROM, 1989, Lalonde, 1990). In the European Union the fifth action programme for the environment recommends an increased use of environmental taxes, and in 1991 OECD, in accordance with its 1975 'polluter-pays' principle, recommended its member countries to consider the possibilities of introducing more environmental taxes - again (CEC, 1992; OECD, 1991).

These announcements have not been followed by a similar range of action. Although the use of economic instruments (excl. subsidies) has increased in several OECD countries from 1987 to 1994. It has been a rather modest increase when one takes the limited use of economic instruments in 1987 into consideration. The update on the eight countries surveyed in 1987 showed that the number of economic instruments in use had increased by only about 20 new instruments - from about 80 to about 100 (OECD, 1994a: 107). Although the use in other OECD countries had also been mapped, and more economic instruments have been on the agenda of several governments, the modest increase reflects the political differences related to the introduction of such instruments. The Nordic countries have become forerunners in the use of economic instruments (OECD, 1994a: 183). Four Nordic countries have imposed C02-taxes, and a number of other economic instruments have been put into operation (OECD/IEA, 1994). The changed attitud e towards the use of economic instruments in Scandinavia is related to the growing distrust of traditonal regulatory instruments.

However, the increased use of green taxes can also be explained by the fiscal crisis of the Scandinavian welfare states. New and more legitimate sources of tax income were needed, as traditional income taxes began to exceed the legitimate 50 per cent level. Both Sweden and Denmark introduced tax reforms

in the early 1990s, which substituted income taxes by so-called green taxe s to different degrees. In this process of securing new sources of income for the welfare state, some of the initial principles of environmental taxation were lost. This was due partly to the fiscal focus, partly to the decision-making process, in which economic and political interests got a say over the final design of environmental taxes.

This paper will try to explain some of the political factors at work in the process of designing economic regulations. These processes are after all not so different from the processes of the instrument choices.

ARGUMENTS FOR USING ECONOMIC INSTRUMENTS

Before discussing the political system and its ability to agree on the use of pollution taxes, it seems appropriate to give a very brief summary of the arguments for using economic instruments (readers familiar with the properties of economic instruments can proceed to the next section immediately).

The top-down approach inherent in command-and-control policies gives the regulated few incentives to improve their performance on their own initiative. The advantage of economic instruments is that they force producers and consumers to take environmental concerns into account and to minimise their use - and waste - of energy and other resources as much as possible.

There are two main types of economic instruments: either taxes or traceable pollution permits. There are several variations of each; taxes may, in particular, take the form of either input/resource taxes process taxes, emission taxes or product taxes. Tra deable pollution permits have mainly been used in the US, and are not treated directly in this paper, although they enjoy many of the same advantages as pollution taxes.

The advantages of economic instruments are in particular:

- They do not prescribe specific technologies or solutions, but leave it to the target groups to decide whether they would prefer to control their output of emissions to change their input of raw materials and energy or to do a mixture of both;
- They are better suited to deal with non-point sources of pollution that cannot be controlled by permits, but where there are proxies to be taxed;
- They ensure that control of pollution takes place where the marginal costs are lowest, thus ensuring substantial cost savings - probably by a factor 2-3;
- Contrary to a fixed license they give a constant incentive to reduce emissions, and are as such a much more dynamic instrument;
- Because of these dynamics they cause more innovations and force the development of new and cleaner technologies;
- Finally economic instruments will generate revenue, sometimes in substantial amounts; revenue which can be used for environmental or other purposes.

Economists have advocated economic instruments as a more or less pure alternative to commond-and-control regulations. In practice economic

instruments are employed within a broader mix of regulatory instruments and in an institutional setting that is some what more complex than in the partial analysis. Most importantly, economic instruments are not decided by a single policymaker who controls all information necessary and can anticipate all possible reactions. Economic instruments have to be approved by a political system where the bargaining processes are rather different from the principles that rule blackboard economics.

Wilson's Regulation Theory

How do the costs and benefits of public regulations affect the way in which interests are articulated? How can we explain the emergence of environmental regulations? What is the impact on the choice of policy-instruments of the costs and benefits of regula tions?

To answer these and other related questions, Wilson's regulation theory (1980) is helpful. Contrary to earlier regulation theories which claimed that public agencies and their regulations were subject to 'capture' by the regulated interests, Wilson introd uced a more sophisticated theory about the costs and benefits of regulations. It deals better with the wave of hew social regulations' - from automobile safety to pollution control - that have emerged since the late 1960s, and which were not demanded by t he regulated parties. Wilson's theory has been summarised in the two-by-two matrix shown in figure. It shows how there are basically four different types of public regulations, according to whether the costs and benefits of regulations are either spread or concentrated. Client regulation: In a classical regulatory situation the costs of regulation are born by the tax payers, and thus spread, while the benefits, often in terms of subsidies, are concentrated on a smaller group of the constituency. A typical example of client regulation is agricultural policy. Client regulations are usually passed only after extensive negotiations with those concerned, but without much public debate. The general public does not care too much about this year's intervention price for wheat, f or instance, while the farmers care quite a lot, and are likely to negotiate very actively in the decision-making process.

Majority regulation: In the case of majority regulation consensus seeking lasts longer and affects more groups in society. In these cases both the costs of regulations and the benefits are spread, which gives no certain interest groups particularly strong incentives to promote regulations. A good example of majority regulation are the social reforms of the 1930s. It took quite a long time to build up consensus about these reforms.

Interest group regulation: In the case of interest group resolution both the costs of intervention and the benefrts are concentrated on rather narrow groups, who will have strong incentives to influence the decision-making process, while the general public displays little concern. It means that both the costs and the benefits are borne by limited groups, rather than by society as such. Examples of interest group regulations are the regulation of harbour tariffs (state harbours versus municipal harbours) o r railroad tariffs. Wilson also mentions labour

market regulations as an example of interest group regulations. Entrepreneurial regulation: When costs are concentrated and benefits are spread, one would normally not expect regulations to be passed. Those who will benefit from regulations have only very general and therefore limited personal interest in lobbying for them, while those who have to bear the costs will indeed have rather strong incentives to seek to prevent regulations from being imposed. However, there are several examples of regulations which fall within this sphere such as safety, work place and environmental regulations. Indeed it is the existence of these socalled 'new social regulations' that contradict the classical assumption that regulations are passed only in the interest of the regulated.

According to Wilson such regulations depend on the exist ence of 'entrepreneurs', *i.e.*, ideal interests organised for the purpose of such regulations, and who act more or less as 'watch-dogs'. They lobby to place such regulations on the agenda of policymakers and seek to outweigh the influence of groups who have interests in avoiding regulations. Their success depends to a large degree on the support that they can obtain from non-affected third parties, such as the media, influential writers, *etc.*

One could argue that many environmental regulations offer long-term benefits to the regulated, for instance in terms of a more optimal and efficient resource management. It is indeed difficult to estimate a priori whether a specific regulation will entai l benefits or costs. According to Wilson it is, however, the costs and benefits as perceived by the regulated that will influence their behaviour during the decision-making process. The most important difference between economics and politics is that whereas economics is based on the assumption that preferences are given, politics must take into account the efforts made to change preferences (Wilson, 1980: 363).

The Impact on the Choice of Policy-Instruments

Entrepreneurial regulations arise only after pressure from policy-entrepreneurs. However, when it comes to the design of policies and in particular the choice of policy-instruments, those who will have to bear the costs of intervention often have stronger incentives to lobby against particular instruments than do entrepreneurs. So if they cannot prevent a regulation, they will seek to influence the design of regulations and the choice of policy-instruments so as to limit their costs.

The basic asymmetry of interests is parallel by an asymmetry of information. The potentially regulated can provide policy-makers with very specific and detailed information, which cannot be balanced by information from policy-entrepreneurs. Furthermore, o ften policy-entrepreneurs do not care too much about the specific policy-desicion or choice of instrument as long as the general aims agreed upon are in accordance with their demands for regulation.

In the case of environmental policy, the policy-entrepreneurs are mainly concerned that something is done, but they have less interest in the specific design of policies or the choice of instruments. This is mainly a complicated

technical and legal issue that is sorted out between officials, experts and the affected interests. More recently environmental policy-entrepreneurs have displayed increased concern about the choice of policy-instruments, but they still lack vital information.

They can demand the u se of more economic instruments, such as a CO_2-tax but they can only seldom provide policy-makers with information about the way in which it should be designed or about its potential impact. Target groups have such information and since policy-makers need to estimate the possible impacts of a taxation scheme, they depend to a high degree on the informanon provided by the target groups.

Economic instruments enjoy a high degree of public support. Polls have showed that pollution taxes are the sort of taxes that people would like to see more of. In november 1991 more than 80 per cent of the Danes were in favour of more green taxes, and eve n after the recent tax reform that introduced a number of new green taxes, more than 50 per cent of those polled were in favour of such instruments. Also among the target groups economic instruments enjoy support. Most industrialists prefer more market-oriented policy-instruments to command-and-control policies, although they also stress that such instruments should preferably be introduced at a European or global scale. But there is a very important difference between supporting the use of economic or more market oriented instruments in general, and the attitude towards specific environmental taxes.

One could wonder if not the rather strong public support for green taxe s is due to the fact that people somehow expect that the polluters are someone different from themselves - and they find it fair to demand from 'those polluting' that they pay the clean-up costs.

Directors of industries may declare themselves in favour of economic instruments, but when it comes to specific taxes, whether on chlorine or on packaging the affected industries are strictly against thern, and have strong incentives to be so.

By the target groups economic policy-instruments are perceived as imposing much higher costs than usual command-and-control types of regulations. The regulated anticipate the pollution tax bills that they have to pay and ask for either normative regulation ns or voluntary agreements, which are considered less costly.

The efficiency argument that pollution taxes assure that abatement takes place where the marginal costs of abatement are lowest, while norms require equivalent across-the-board measures regardless of differences in costs have not convinced the target groups. Neither have more empirical studies that, on the basis of historical data, confirm the difference between the use of economic instruments and the used of norms.

That norms or voluntary agreements may impose rather high costs too is not taken into account. One could speculate whether the target groups expect rules and voluntary agreements to be less strictly applied than economic instruments.

Indeed there is a dif ference in the degree of compliance demanded by local environmental officers controlling norms and standards, and the degree of compliance demanded by tax and customs authorities responsible for the collection of green taxes. Environmental regulations are fundamentally different from classical welfare regulations, which are distributive, and which allocate subsidies to specific groups. Environmental regulations require a change in behaviour, and as such they are much more distorting to the regulated than are subsidy schemes or social transfer payments. Thus, the target groups believe that they have strong incentives to lobby against economic instruments and to propose the use of other policy-instruments.

Those in favour of environmental regulations will, on the other hand, be less concemed about the choice of instrument if only the target group complies with the general target. Therefore one can usually persuade them to accept the use of other, but often less effective, instruments.

Impact on the Economic Instrument Design

If policy-entrepreneurs still push very hard for the use of economic instruments, the next step for target aroups can be to lobby for exemptions. In countries where CO_2-taxes have been introduced they have been followed by substantial exemptions. Although exemptions and adaptations can hardly be avoided, it is also safe to say that most of the present exemptions are not rationally justified. They a re to a large extent the result of pressures exerted by those subject to taxation. While in Sweden about 25 per cent of the CO_2-emissions are exempted, it is about 66 per cent in Denmark. This difference reflects the more conflictual decision-making process in Denmark, where the CO_2-tax was passed by a narrow socalled ‘green majority in Parlimnent against the policy of the past government. The green majority was anxious not to create any unexpected side-effects in terms of causing the direct closure of particular companies - thus creating the so-called “pastry-master syndrome”. Pastry-masters pay relatively much higher CO_2-taxes than smoke-stack industries.

The tax rate in itself is a difficult issue and can often become subject to negotiations too. According to conventional economic theory, the pollution tax should reflect the external costs imposed on third parties by market transactions. This ideal approach requires meticulous valuation - indeed Pigou, as founder of the externality tax, tried to estimate the costs imposed by air pollution in terms of extra laundry costs, additional artificial light and building damages. But as Weizsacker has pointed out, most of the present green charges and taxes cover only rather local external costs (Weizsacker, 1989).

Externalities at the regional or global level are difficult to quantify. Even more disputed is the valuation of externalities imposed on future generations, ie. intertemporal externalities - such as climate changes (Burnley, 1990).

Even if we follow the more conservative environmental economists and simply neglect the intertemporal externalities and just try to make an accurate estimate of externalities at the regional or global level it would imply green

taxes of a magnitude much different from the one that we know today. But there is no reason to fix a discount rate when calculating the benefit that future generations would have from, for instance, pure groundwater. Fixing a discount rate would imply that the consumption of future generations should be discounted as compared to the consumption of present generations. Intertemporal externalities are at the core of the problem of a sustainable development. As Pearce (1989) has pointed out, a sustainable development means that the pres ent generation should leave to future generations a stock of natural capital equivalent to what it took over, and sustain its consumption only on the dividend.

Whereas the methods for contingent valuation are still in their infancy, there are alternative approaches to the fixing of environmental taxes in accordance with these criteria. More than 20 years ago, Baumol and Oates (1971) recognised the difficulties associated with contingent valuation and proposed to set targets first instead, and then impose sufficiently high taxes so as to assure the targeted reductions. Such targets can be fixed on the basis of the carrying capacity of the environment, and these reflect a sustainability criteria.

In the CO_2-case it is disputable what the external costs actually are, but the Burnol and Oates approach would imply CO_2-taxes sufficiently high to assure about a 60 per cent reduction of greenhouse gas emissions, so as to stabilise global warming. Even without a closer examination it is safe to express doubts whether any of the Nordic CO_2-taxes have reached a level sufficiently high to match this reduction target. The current issue in Denmark is whether a six-doubling of the existing CO_2-tax on industries should be approved - so as to assure an additional 5 (five) per cent reduction in CO_2-emissions.

In most cases pollution taxes are bound to become substantially lower than the external effects imposed on third parties. They are often fixed on the basis of more pragmatic considerations and in particular to avoid negative side-effects on the competitiveness of domestic industries. As a result, there is a strong bias towards the taxation of households, rather than of industnes and farmers. Households are a target group poorly organised to lobby for their interests.

But even when attempts are made to establish a link between green taxes and environmental targets, as in the recent Danish effort to introduce complementary environmental taxes on industries it appears that environmental targets are often set in a rather arbitrary way. It remains as such an open question why, for instance, the Danish pesticide plan from l987 requires a 50 per cent reduction of pesticide use, rather than a 30 or 70 per cent reduction. So far, little justification has been presented for this target, which appears to be the outcome of a genuine political process.

Wilson's regulation theory explains two phenomena. Firstly, it explains why policy-instruments that are perceived as especially costly, such as economic instruments, are only seldom adopted. And secondly, it explains why economic instruments, when adopted, are usually biased in the interests of the regulated. In both cases, the reason is the interest and information asymmetries between policy-entrepreneurs and target groups.

Bureaucratic Interests

The prediction in Wilson's regulation theory that the benefits of pollution control are so diffuse that policy-entrepreneurs care less about the choice of instrument can be confirmed if we look at the environmental organisations. Economic instruments have not been in great demand by green pressure groups, and they have mainly responded to proposals put forward by others, notably by economists. Actually, economists have been more or less alone in advocating the use of economic instruments since Pigou's day's.

Environmentalists usually regard economic or market-like instruments with great scepticism and prefer standards or fixed guidelines that are perceived as being more environmentally friendly. In the process leading up to the Rio Summit, NGO's were sceptical towards the use of economic instruments. Only in the last two or three years have environmentalists slowly changed their attitude towards economic instruments, which they are prepared to accept if they are followed by extensive supplementary regulations. In this process most of the potentially administrative and efficiency advantages of economic instruments have been neglected. Environmentalists have not been the main policy-entrepreneurs behind the increased use of economic instruments in the Scandinavian countries. It is rather fiscal motives that have been the driving force, and one should look to financial and tax ministries rather than to environmental ministries to find the entrepreneurs designing the economic instruments that are being put into operation. For welfare states under fiscal strain, environmental taxes present a substantial asset. Not only are such taxes legitimate in the population, but such taxes can also produce considerable incomes. To a considerable degree, this factor explains the more profound use of pollution taxes in Scandinavia. There has simply been greater fiscal pressure than in many other European countries, allowing pollution taxes to take a more important position. This does not imply that the pollution taxes introduced are void, nor that they do not have any regulatory impact. But the fiscal entrepreneurs have caused a certain bias in the design of economic instruments. To understand this bias one needs to understand the interests of the various ministries usually involved in the designing of economic instruments.

Finance ministries prefer environmental taxes that produce a relatively stable and predictable income, and thus not taxes which are too effective in decreasing pollution (and income). Finance ministries do not like the idea about earmarking the revenue for environmental purposes, since it would hamper their budget control. Finance ministries are also worried about the effects of environmental taxes on the balance of payments and thus on industrial competitiveness. They are therefore attentive to industrial allegations about the impact of such taxes, and more likely to impose pollution taxes on households. Finally, fmance ministries are concerned about a too sudden and dramatic introduction of new environmental taxes since it is relatively impossible to predict their impacts in the classical econometric models used. The Weizsacker proposal to reduce income taxes for an eight-doubling of energy taxes would be quite a nightmare

for any finance ministry since such a sudden shift in the tax base would erode it s capacity to analyze the national economy. Tax ministries prefer administrative simplicity and feasibility. While many environmental problems are complex and require a creative tax design that might not even produce an income, tax ministries prefer simple taxes that can be imposed and collected at points easy to identify and control. They are therefore suspicious of the long lists of environmental taxes that would be necessary to control the diverse number of pollution sources. When environmental ministries have produced complex and inventive tax schemes, tax ministries have often turned them down arguing that they could collect the same amount of revenue in a much simpler way! Furthermore, tax rnmistries often think that they have built a carefully balanced tax system over many years, and having reached this stage of perfection they do, from the point of view of taxation, not see the need for changes - a view that finds support in conventional taxation theories. They are suspicious of the gradual introduction of environmental taxes that often ref lect particular environmental events or the need for specific revenues, and they require a logical and more systematic design of environmental taxes.

The interests of environmental rninistries must be mentioned as well, although their interests are somewhat more in line with the externality taxation principles. Environmental ministries are keen on reaching the environmental targets set, but the use of economic instruments as regulatory means is in their view just one method of assuring implementation. Traditionally, environmental ministries have not cared much about the costs of intervention. Getting control of revenues from economic instruments presents an alternative, and often equally attractive, approach. If such instruments can be used to increase the budget of the environmental ministry, it will have more funding for its remaining pollution control programmes. Furthermore, the use of economic ins truments serves to raise the significance and power of environmental ministries within governments.

They increase the bargaining power of the environmental ministries in relations to the traditionally more powerfull economic ministries. In sum, if the most optimal pollution taxes cannot be passer for instance because of opposition from finance and tax ministries or from target groups, environmental ministries can still see their interest in going along with less efficient measures.

Despite these rather negative remarks about the impact of bureaucratic interests, it is worth remembering that the interests of the treasury may also help promote environmental taxes. In the European Union (the former European Community) the Directorate-G eneral for Taxation has been among the supporters of the CO2-tax, since such taxes at the European level fit very well into the agenda of the Directorate-General - an ultimate harmonisation of all taxes. Unfortunately it is also this perspective that has triggered UK opposition.

THE ROLE OF ENVIRONMENTAL ECONOMISTS

Until the late 1980s economists were quite alone in advocating the use of economic instruments - in a way they still are. Although environmental economists

are eager to see economic instruments applied, they are seldom good advisors when it comes to the actual design of such instruments. They have too little information, and therefore their possible role as policy-entrepreneurs is often limited.

Most, but not all, environmental economists have no background in the natural sciences, and often they know too little about the complex nature of the environmental problems to be addressed and 'internalised' by means of the pollution tax. For instance, t his has led environmental economists to advocate a fertilizer-tax on nitrogen-input - a typical textbook example of a pollution tax.

On the basis of scientific evidence, there are good reasons to believe, however, that an input-output tax (based on a nitrogen-balance) would be more efficient since it improves the incentive to utilise manure (leaching from manure is higher than from fertilizers) (Hansen, 1991). Environmental economics is first of all a theoretical discipline, and the strict conditions in partial equilibrium economics are not likely to apply in practice. Even though Baumol and Oates maintain that environmental economics was not meant to be 'theory for the same of theory', they treat economic instruments in a partial analysis, without taking, institutional or environmental aspects into account. The pollution tax was meant to be a complete alternative to command-and-control regulations.

Most environmental economists have few ideas about the possible interplay between economic instruments and other regulations. As a result, economic instruments are often added 'at the margin' of other regulations. In this way several policy-instruments are used to address the same issues, and the administrative advantages of economic instruments are not achieved. In some cases the interplay may even be counterproductive, neutralising the incentives accruing from economic instruments.

Impact and Bias

Economic instruments may be on the agenda of many governments, but as the above mentioned factors indicate, it is a difficult exercise to reach agreement on green taxes that are effective in controlling pollution. The fact that a potentially effective policy-instrument is designed or used poorly, could lead to negative conclusions about its use. This paper argues, however, that we need to understand better the processes at work in order to escape such pitfalls

Economic instruments are after all a potentially very dynamic instrument. Even if such instruments have been applied differently from textbook principles and with a certain bias in their design, we already know about several experiences where economic instruments have been a superior way in which to deal with excess environmental loads.

The Japanese SO2-levy introduced in 1974 was designed mainly to raise funds from smoke-stack industries to pensions for officially recognised pollution victims. The rate of the levy was fixed in accordance with the need for revenue, and initially the levy was rather low. However, the levy was extremely effective

in reducing SO2-emissions so that 10 years later Japan had the lowest SO2-emissions per capita in the industrialised countries (Tsuru and Weidner, 1985; Imura, 1989).

Denmark's energy taxes have been introduced partly to protect the sale of natural gas from the North Sea and partly to generate revenue for the treasury. Industries have been exempted, but households have been subject to the highest implicit CO2-taxation within OECD. Combined with other policy-instrnments, notably research programmes and subsidies for insulation of buildings, this led to a 45 per cent decrease in the use of energy for heating from 1972 to 1989 (Energy ministeriet, 1990; Andersen, 1994c).

The Dutch water quality charges were introduced in accordance with a century-old tradition for user payment in water management, with only very vague ideas about their impact on discharges. Still, from their introduction in 1971 they led to a national reduction of about 80 per cent in organic discharges over a 10-year period (Bressers, 1988; Schuurman 1988). Similar, although not quite as impressive results were achieved in France, where a comparable system was introduced (Andersen, 1994a).

Experiences like these and others are evidence that economic instruments can be quite powerful and dynamic tools, although there is also evidence of environmental taxes with little or no impact on behaviour. On the basis of existing reviews of environment al taxes in different countries. it seems as if there are more examples of poorly designed economic instruments, than of successfull ones.

LEGAL ENVIRONMENT AND POLICY

In India there are several Acts and legislations enacted by the Government of India for regulation of industries in the country. These enactments play a very important role in the country's overall progress and economic development. These legislations are amended from time to time in accordance with the changing circumstances and environment. The most important Act is the Companies Act, 1956 which relates to setting up and operation of companies in India. It empowers the Central Government to regulate the formation, financing, functioning and winding up of companies. It contains the mechanism regarding organisational, financial, managerial and all the relevant aspects of a company.

In order to provide the Central Government with the means to implement its industrial policies, several legislations have been enacted. The most important being the Industries (Development and Regulation) Act, 1951 (IDRA). The main objectives of the Act is to empower the Government to take necessary steps for the development of industries; to regulate the pattern and direction of industrial development; and to control the activities, performance and results of industrial undertakings in the public interest.

The bulk of the transactions in trade, commerce and industry are based on contracts. In India, the Indian Contract Act,1872 is the governing legislation for contracts, which lays down the general principles relating to formation,

performance and enforceability of contracts and the rules relating to certain special types of contracts like Indemnity and Guarantee; Bailment and Pledge; as well as Agency. Another important aspect of legislations is the industrial relations, which involves various aspects of interactions between the employer and the employees; among the employees as well as between the employers. In such relations whenever there is a clash of interest, it may result in dissatisfaction for either of the parties involved and hence lead to industrial disputes or conflicts.

The Industrial Disputes Act, 1947 is the main legislation for investigation and settlement of all industrial disputes. The Act enumerates the contingencies when a strike or lock-out can be lawfully resorted to, when they can be declared illegal or unlawful, conditions for laying off, retrenching, discharging or dismissing a workman, circumstances under which an industrial unit can be closed down and several other matters related to industrial employees and employers.

Trade unions are also an important part of an industrial set up. The legislation regulating these trade unions is the Indian Trade Unions Act, 1926. The Act deals with the registration of trade unions, their rights, their liabilities and responsibilities as well as ensures that their funds are utilised properly.

It gives legal and corporate status to the registered trade unions. It also seeks to protect them from civil or criminal prosecution so that they could carry on their legitimate activities for the benefit of the working class.

POLICY ON SUPPLEMENTAL ENVIRONMENTAL PROJECTS

This policy supplements the 1997 Enforcement Response Guidance (ERG), and should be read in conjunction with it. All applicable sections of the ERG, including the definitions at section II therein, are expressly incorporated by reference. Historically, Supplemental Environmental Projects ("SEPs") have played an important role in MassDEP settlements. In appropriate cases, implementation of a SEP furthers MassDEP's compliance and enforcement goals and provides an increased level of environmental protection.

MassDEP staff can suggest that a violator consider a SEP that is consistent with the guidelines set forth below.

DEFINITION AND PURPOSE OF SEPS

SEPs are environmentally beneficial projects, the implementation of which primarily benefits public health, safety and welfare, and the environment.

In settlement of environmental enforcement cases, MassDEP will require regulated entities to achieve and maintain compliance with the environmental laws and regulations administered by MassDEP and may require them to pay an administrative penalty. Penalties play an important role in environmental protection by deterring violations and ensuring that violators do not obtain an unfair economic advantage over their competitors who made the necessary expenditures to comply in a timely manner.

In addition to the assessment of penalties, the performance of SEPs can also play a role in furthering MassDEP's goals to protect public health, safety and welfare, and the environment. SEPs may be particularly appropriate to further the objectives in the statutes administered by MassDEP, and to achieve other policy goals, including the promotion of pollution prevention and environmental justice. In certain enforcement cases, SEPs may be included as an appropriate condition of settlement and, as such, may be considered as a factor in mitigating a penalty.

This settlement policy is not intended for use by MassDEP, regulated entities or administrative law judges at a hearing or in a trial. It does not apply to settlements of claims for stipulated penalties or to the collection of suspended penalties.

LEGAL GUIDELINES

AGENCY DISCRETION

Acceptance of a SEP as part of a settlement is solely within the discretion of MassDEP. MassDEP is under no obligation to approve any SEP.

ADMINISTRATIVE CONSENT ORDER

As an express condition of any SEP approval, the regulated person or entity seeking the SEP will be subject to the terms of an Administrative Consent Order ("ACO"). Provisions of such an ACO will require, inter alia, the timely submission of certain reports required by MassDEP. These may include, for example, SEP designs and SEP implementation plans. ACOs will require timely verification of SEP completion.

'GEOGRAPHICAL LOCATION' AND 'NEXUS' REQUIREMENTS

Where feasible, a SEP approved by MassDEP must be located in the geographical area where the violations occurred. In addition, any SEP approved by MassDEP must have a sufficient 'nexus', meaning that it must be substantially related to the type of violation that is the subject of the administrative enforcement action.

1. A nexus relationship can be shown where the proposed SEP:
    a. Advances at least one of the declared objectives of the environmental statutes that form the basis of the underlying enforcement action, although a SEP can neither be inconsistent with, nor reduce the stringency or timeliness of requirements of environmental statutes and regulations; and either
    b. Remediate's or reduces the actual or probable overall environmental or public health impacts or risks to which the violation at issue contributes; or
    c. Is designed to reduce the likelihood that similar violations will occur in the future.

AGENCY'S LIMITED ROLE

MassDEP's role relative to the performance of any SEP is limited. In particular:

1. MassDEP can have no role in managing or otherwise administering funds that may be set aside or escrowed for performance of a SEP, although MassDEP retains regulatory authority to oversee a project, ensure that it is implemented pursuant to the provisions of a consent order, and establish a basis for legal recourse if the project is not adequately performed;
2. A SEP may not provide MassDEP with additional resources with which to perform any activity for which public funds are specifically appropriated, nor can a SEP appear to be an expansion of an existing programme administered by MassDEP.
3. A SEP must be performed either by the regulated entity itself (using its own employees) and/or by its by contractors or consultants. Non-profit organizations, such as universities and public interest groups, may function as contractors or consultants.

SEP GENERAL REQUIREMENTS AND FACTORS

SEP NOT REQUIRED BY REGULATION

Since the main purpose of this policy is to obtain public health or environmental benefits that may not otherwise have occurred outside the terms of the settlement, proposed projects cannot otherwise be required by regulation.

SEP IS 'POST-VIOLATION'

Since any proposed project that is considered by MassDEP arises in the context of and as a result of MassDEP enforcement, no project that has been authorized or undertaken by the regulated entity prior to the identification by MassDEP of the underlying violation will be approved.

SEP MITIGATION FACTORS

Consistent with penalty assessment criteria at M.G.L. c. 21A and the implementing regulations at 310 CMR 5.25, MassDEP may consider "good faith" and "public interest" as factors in mitigating a penalty. MassDEP may consider these factors in the context of a SEP when a regulated entity demonstrates that it:

1. Has the financial ability to correct all non-compliance; and
2. Either has remediated any harm it caused, is capable of completing future remedial work, or is in current compliance with the requirements of M.G.L. c. 21E and/or other remedial requirements.

If a regulated entity claims that payment of any penalty or the performance of a SEP will impede its ability to comply or perform a remedial measure, then MassDEP will not consider mitigating the penalty through performance of a

SEP. (MassDEP may, however mitigate a penalty on the basis of other penalty mitigation policies or factors required to be considered pursuant to M.G.L. c. 21A, sec. 16 and the implementing regulations at 310 CMR 5.25.)

ENVIRONMENTAL JUSTICE

Certain segments of the Commonwealth's population are disproportionately burdened by pollutant exposure. Emphasizing SEPs in communities where environmental justice issues are present helps to ensure that persons who spend significant portions of their time in areas, or depend on food and water sources located near where the violations occur, would be protected. "Environmental Justice" is an overarching MassDEP goal and not a specific technique or process. As such, it does not fall within a SEP Category, but rather is a compelling reason for the approval and implementation of SEPs in communities where environmental justice may be an issue and where there exists the requisite nexus described above in section III.

GENERAL SEP CATEGORIES

POLLUTION PREVENTION PROJECTS

Pollution Assessment

A pollution prevention project may entail or include a pollution prevention assessment that is a systematic, internal review of processes and operations that is designed to provide information and opportunities to reduce the use, production, and generation of toxic material and other wastes.

For the purpose of determining the actual SEP cost, and thereby determining the extent to which a penalty may be mitigated, credit may be given only for the direct costs associated with pollution prevention SEP assessment. Because future costs may be too difficult to calculate, credit for costs to be incurred for implementing actions or recommendations identified in the assessment can be given where such costs are clearly identified and earmarked at the time of settlement.

Source Reduction

A pollution prevention project can also be one that reduces the generation of pollution through "source reduction," *i.e.*, any practice that reduces the amount of any hazardous substance, pollutant or contaminant entering any waste stream or otherwise being released into the environment, prior to recycling, treatment or disposal.

Examples include:

- Input substitution and product reformulation, such as replacing a toxic substance or raw material with a non-toxic or significantly less toxic substance;
- Redesigning or modernizing operations and equipment; or
- Improving operation and maintenance controls.

POLLUTION REDUCTION PROJECTS

If the pollutant or waste stream already has been or will be generated or released, a pollution reduction approach to capture such pollutant or waste may, after it has been released, be appropriate. Pollution reduction may include the installation of more effective end-of-process control or treatment technology. This also includes "out-of-process recycling," wherein industrial waste collected after the manufacturing process and/or consumer waste materials are used as raw materials for production off-site, reducing the need for treatment, disposal, or consumption of energy or natural resources. Such a project must significantly decrease the release of pollutants to the environment.

ENVIRONMENTAL ENHANCEMENT PROJECTS

Environmental enhancement projects include conservation, protection, and restoration projects that go beyond addressing damage caused by the violation. They conserve and protect the condition of the geographic area, ecosystem, or watershed that was adversely affected.

Environmental enhancement projects may be used to protect or restore natural environments, such as ecosystems or watersheds, and to retrofit or reduce the environmental impact of man-made environments, such as facilities and buildings. Projects in this category may include, but are not limited to installation of, or retrofitting facilities with best management practices (BMPs), water conservation projects, land purchase and donation for conservation and recreational purposes, creation of conservation easements, wetlands restoration and replication projects, and remedial actions conducted pursuant.

ENVIRONMENTAL EDUCATION AND AWARENESS PROJECTS

Consistent with the nexus requirement for all SEPs, achieving added environmental benefit in a particular sector can sometimes be achieved with appropriate education and awareness projects that are specifically tailored to advance or enhance environmental protection. MassDEP retains the right to deny approval for any such SEP that, in its view, can not be adequately implemented, is overly broad, or does not otherwise significantly further MassDEP's interest in benefiting public health, safety, welfare, and the environment.

Environmental education and awareness projects can provide training, publications, or technical support to the regulated community or to the public at large for the purpose of achieving compliance with environmental regulations; reducing the generation, release, or disposal of pollutants beyond legal requirements; or educating the public about environmental protection and resource conservation. Any material proposed for publication pursuant to an environmental education and awareness SEP is subject to MassDEP review and approval. In addition, any such proposed material must include an express statement that the project has been undertaken as part of settling an enforcement action brought by MassDEP.

SCIENTIFIC RESEARCH, MONITORING, AND DATA COLLECTION PROJECTS

A scientific research, monitoring, and/or data collection project can further an understanding of the environmental conditions of a natural resource or the methods that can be employed to restore the resource. Projects in this category may include public health projects that evaluate human health impacts where pollution has been released into the environment.

EMERGENCY PREPAREDNESS AND COMPLIANCE PROJECTS

These projects enable local communities in the geographical area of the violation to plan for and effectively respond to an event that may threaten public health, safety, or the environment. Projects can include public outreach, education or assistance regarding associated environmental risks in the community.

SEP EXAMPLES

MassDEP staff can encourage regulated entities to consider an acceptable SEP and can direct such entities to SEP lists and related databases, like those described below, as well as to other SEP related sources of information that may be maintained by EPA and other government related entities. MassDEP is under no obligation, however, to approve any particular SEP proposed by any particular entity.

Previously Approved SEPs

Consistent with the goal of achieving enhanced environmental benefit and protection, MassDEP has approved appropriate SEPs in a variety of negotiated settlements. Some recent examples of such SEPs can be seen in Appendix A at the end of this document.

Initiatives as a Source of SEPs

Aspects of the requisite nexus for an appropriate SEP can sometimes be found by applying the facts of a particular enforcement case against MassDEP's current initiatives, priorities and activities. For example, MassDEP is committed to encouraging energy conservation, including the promotion of green building and the use of renewable energy sources. Information on such agency matters can be found at mass.gov/DEP DEP.

INCENTIVES FOR PERFORMING A SEP

Where a proposed SEP falls within the guidelines and parameters set forth in this policy, MassDEP may exercise its enforcement discretion by providing the following incentives to encourage the performance of SEPs.

When determining a settlement of the penalty amount, MassDEP will consider the costs to be incurred by a regulated entity in performing a SEP, a process involving the following steps:

1. MassDEP will calculate the full appropriate penalty, including economic benefit;
2. The Respondent will prepare for MassDEP approval a report identifying and explaining the basis for the cost of the SEP.
3. After approving the basis for the SEP Cost, MassDEP will compare the SEP Cost to the full appropriate penalty amount to determine what portion of the penalty may be mitigated by the SEP.

Unless MassDEP determines that a particular SEP is subject to special consideration, as described in Section IX below, any proposed SEP must collect at least 25 per cent of the full appropriate penalty amount or collect the economic benefit, whichever is greater, even in cases where the SEP cost may not be fully offset.

MassDEP may collect more than the portion of the full appropriate penalty amount where it must allocate MassDEP resources to monitoring and reviewing implementation of the SEP; or where the SEP is likely to generate a cost savings to the regulated entity (*i.e.*: pollution prevention project).

SPECIAL SEP CONSIDERATIONS

Governmental Entities

Subject to MassDEP's discretion, and on a case-by-case basis, up to 100 per cent mitigation of a penalty may be appropriate in certain enforcement action involving local or state governmental entities. Request for approval of such a SEP shall be made to the Director of the Office of Enforcement and General Counsel, in consultation with the Deputy Commissioner, prior to consideration and approval by the Commissioner.

Significant Environmental Benefit

When a Regional Director determines that the cost of implementing a proposed SEP is greater than the assessed penalty amount and will provide environmental benefit that significantly outweighs the benefit to be derived from the deterrent effect of a cash penalty, a SEP may be considered for up to 100 per cent mitigation of the penalty. Request for approval of such a SEP shall be made to the Director of the Office of Enforcement and General Counsel, in consultation with the Deputy Commissioner, prior to consideration and approval by the Commissioner.

FAILURE OF A SEP AND STIPULATED PENALTIES

MassDEP will, pursuant to the terms of an ACO, require the regulated entity to pay a stipulated penalty for failure to fully or timely complete a SEP in a satisfactory manner. The determinations of whether the SEP has been satisfactorily completed (*i.e.*, pursuant to the terms of the agreement) and whether the regulated entity has made a good faith, timely effort to implement the SEP is at the sole discretion of MassDEP.

TECHNOLOGICAL POLICY

Preamble

Political freedom must lead to economic independence and the alleviation of the burden of poverty. We have regarded science and technology as the basis of economic progress. As a result of three decades of planning, and the Scientific Policy Resolution of 1958, we now have a strong agricultural and industrial base and a scientific manpower impressive in quality, numbers and range of skills. Given clear-cut objectives and the necessary support, our science has shown its capacity to solve problems. The frontiers of knowledge are being extended at incredible speed, opening up wholly new areas and introducing new concepts. Technological advances are influencing life-styles as well as societal expectations. The use and development of technology must relate to the people's aspirations. Our own immediate needs in India are the attainment of technological self-reliance, a swift and tangible improvement in the conditions of the weakest sections of the population and the speedy development of backward regions. India is known for its diversity. Technology must suit local needs and to make an impact on the lives of ordinary citizens, must give constant thought to even small improvements which could make better and more cost-effective use of existing materials and methods of work. Our development must be based on our own culture and personality. Our future depends on our ability to resist the imposition of technology which is obsolete or unrelated to our specific requirements and of policies which tie us to systems which serve the purposes of others rather than our own, and on our success in dealing with vested interests in our organizations: governmental, economic, social and even intellectual, which bind us to outmoded systems and institutions.

Technology must be viewed in the broadest sense, covering the agricultural and the services sectors along with the obvious manufacturing sector. The latter stretches over a wide spectrum ranging from village, small-scale and cottage industries (often based on traditional skills) to medium, heavy and sophisticated industries.

Our philosophy of a mixed economy involves the operation of the private, public and joint sectors, including those with foreign equity participation. Our directives must clearly define systems for the choice of technology, taking into account economic, social and cultural factors along with technical considerations; indigenous development and support to technology, and utilization of such technology; acquisition of technology through import and its subsequent absorption, adaptation and upgradation; ensuring competitiveness at international levels in all necessary areas; and establishing links between the various elements concerned with generation of technology, its transformation into economically utilizable form, the sector responsible for production (which is the user of such technology), financial institutions concerned with the resources needed for these activities, and the promotional and regulating arms of the Government.

This Technology Policy Statement is in response to the need for guidelines to cover this wide-ranging and complex set of inter-related areas. Keeping in mind the capital-scarce character of a developing economy it aims at ensuring that our available natural endowments, especially human resources, are optimally utilized for a continuing increase in the well-being of all sections of our people. We seek technological advancement not for prestige or aggrandisement but to solve our multifarious problems and to be able to safeguard our independence and our unity.

Our modernization, far from diminishing the enormous diversity of our regional traditions should help to enrich them and to make the ancient wisdom of our nation more meaningful to our people. Our task is gigantic and calls for close co-ordination between the different departments of the Central and State Governments and also of those concerned, at all levels, with any sector of economic, scientific or technological activity, and, not least, the understanding and involvement of the entire Indian people. We look particularly to young people to bring a scientific attitude of mind to bear on all our problems.

Aims and Objectives

Aims: The basic objectives of the Technology Policy will be the development of indigenous technology and efficient absorption and adaptation of imported technology appropriate to national priorities and resources. Its aims are to:

- Attain technological competence and self-reliance, to reduce vulnerability, particularly in strategic and critical areas, making the maximum use of indigenous resources;
- Provide the maximum gainful and satisfying employment to all strata of society, with emphasis on the employment of women and weaker parts of society;
- Use traditional skills and capabilities, making them commercially competitive;
- Ensure the correct mix between mass production technologies and production by the masses;
- Ensure maximum development with minimum capital outlay;
- Identify obsolescence of technology in use and arrange for modernization of both equipment and technology;
- Develop technologies which are internationally competitive, particularly those with export potential;
- Improve production speedily through greater efficiency and fuller utilization of existing capabilities, and enhance the quality and reliability of performance and output;
- Reduce demands on energy, particularly energy from non-renewable sources;
- Ensure harmony with the environment, preserve the ecological balance and improve the quality of the habitat;
- Recycle waste material and make full utilization of by-products.

Self-reliance

In a country of India's size and endowments, self-reliance is inescapable and must be at the very heart of technological development. We must aim at major technological break-throughs in the shortest possible time for the development of indigenous technology appropriate to national priorities and resources. For this, the role of different agencies will be identified, responsibilities assigned and the necessary linkages established.

Strengthening the Technology Base

Research and Development, together with science and technology education and training of a high order, will be accorded pride of place. The base of science and technology consists of trained and skilled manpower at various levels, covering a wide range of disciplines, and an appropriate institutional, legal and fiscal infrastructure. Consolidation of the existing scientific base and selective strengthening of thrust areas in it are essential. Special attention will be given to the promotion and strengthening of the technology base in newly emerging and frontier areas such as information and materials sciences, electronics and bio-technology. Education and training to upgrade skills are also of utmost importance. Basic research and the building of centres of excellence will be encouraged. Skills and skilled workers will be accorded special recognition. The quality and efficiency of the technology generation and delivery systems will be continuously monitored and upgraded. All of this calls for substantial financial investments and also strengthening of the linkages between various sectors (educational institutions, R&D establishments, industry and governmental machinery).

Priorities

Need for Perspective Planning

The time scales involved in the generation of technology are long, even with imported elements. Therefore, relevant technologies in all areas of priority, particularly where large investments are to be made, should be clearly identified well in advance. The cost and time element involved in the import of technology and indigenous development will be given consideration. Components which could be assigned to the various institutions which are capable of developing them or which could be built up for such activities will be identified. Ministries concerned with large investments and production activities in areas such as food, health and energy will be provided with appropriate technical support through suitably structured S&T groups.

Employment

Human resources constitute our richest endowment. Conditions will be created for the fullest expression and utilization of scientific talent. Measures will be

taken for the identification and diffusion of technologies that can progressively reduce the incidence of poverty and unemployment, and of regional inequalities. The application of science and technology for the improvement of standards of living of those engaged in traditional activities will be promoted, particularly household technologies. Technologies relevant to the cottage, village and small industries sector will be upgraded. In the decentralized sector labour must be diversified and all steps taken to reduce drudgery. In all sectors, the potential impact on employment will be an important criterion in the choice of technology.

Energy

Energy constitutes an expensive and sometimes scarce input. Therefore, the energy requirements both of a direct and indirect nature for each product and each production activity and the associated technology employed will be analysed. Measures will be devised to avoid wastage or non-optimal use of energy. Fiscal measures as necessary will be introduced to ensure these. Research and Development in the energy sector will aim at improving the efficiency of its production, distribution and utilization, as well as improvement of efficiency in processes and equipment.

Efficiency and Productivity

Technologies already employed will be evaluated on a continuing basis to realise maximum benefits in terms of increased production and lower costs, specially in the public sector enterprises. Every effort should be made to utilize by-products and wherever possible to recycle waste materials, especially those from urban areas. Programmes to make use of easily available and less costly materials will be supported.

Environment

Development should not upset the ecological balance for short as well as long-term considerations. Poorly planned efforts to achieve apparently rapid development, ignoring the long-term effect of many technologies on the environment, have resulted in serious ecological damage.

It is, therefore, essential to analyse the environmental impact of the application of each technology. Due regard will be given to the preservation and enhancement of the environment in the choice of technologies. Measures to improve environmental hygiene will be evolved.

Some Specific Areas

In technology development special emphasis will be focused on food, health, housing, energy and industry.

In particular, stress will be laid on:

- Agriculture including dry-land farming;
- Optimum use of water resources, increased production of pulses and oilseeds;

- Provision of drinking water in rural areas, improvement of nutrition, rapid reduction in the incidence of blindness, eradication of the major communicable diseases (such as leprosy and tuberculosis), and population stabilization;
- Low-cost housing;
- Development and use of renewable non-conventional sources of energy; and
- Industrial development

Indigenous Technology

Importance of Technology Development

Fullest support will be given to the development of indigenous technology to achieve technological self-reliance and reduce the dependence on foreign inputs, particularly in critical and vulnerable areas and in high value-added items in which the domestic base is strong. Strengthening and diversifying the domestic technology base are necessary to reduce imports and to expand exports for which international competitiveness must be ensured.

Inventions

The spirit of innovation and invention is the driving force behind all technological change. We must awaken our science and technology to the exciting challenges of our times, provide incentives to encourage inventors, and direct their efforts to areas of special importance. The system of rewards and incentives will be strengthened for inventions, innovations and technological breakthroughs and their utilization. The fullest opportunity will be provided to make use of inventions.

Enhancing Traditional Skills and Capabilities

Traditional skills and capabilities will need to be upgraded and enhanced, using knowledge and techniques generated by advances in science and technology. Technologies which will result in low-cost production and in products marketable close to the point of manufacture, particularly in the rural sector, will be promoted. Support will be given to technologies which reduce pressure on items in short supply and utilize improved local materials and methods. Government will give preference to products of such technologies in its own purchases. The adoption of technologies that can promote decentralized production will be helped through the support to design, marketing, quality control and other services.

Ensuring Timely Availability

The time cycle from scientific research to utilization is a long one. Hence the need to initiate action well in advance to identify and ensure timely availability and delivery of new technologies. Encouragement and support (fiscal,

commercial and administrative) will be given to the production and user organizations to be associated with and participate in technology development efforts at appropriate stages.

Upgradation to Prevent Obsolescence

Technology is constantly on the move. The base of indigenous technology should be capable of utilizing world-wide advances and adapting them to local needs. The creation and strengthening of institutional structures for keeping track of international developments will receive urgent attention. A strong central group will be constituted to undertake technology forecast and technology assessment studies and will inter alia draw up programmes of purposeful research. Arrangements will be made to provide high-level scientific advice in major sectors of the economy. Where big investments are involved or a large volume of production is envisaged, it will be incumbent on the Ministry or agency concerned to provide a technology forecast covering its requirements over a ten-year or longer period and evolve a strategy for development based on priorities.

Increasing the Demand for Indigenous Technology

Our country has already invested significant amounts in setting up research and development facilities as well as design consultancy and engineering capabilities. The technological potential inherent in this system of interlinked capabilities must be fully utilized, and in turn provide a fillip for further development from within the system. Incentives will, therefore, be provided to users of indigenously developed technology, and for products and processes resulting for such use.

Preferential Treatment

In view of the cost of technology development and the time necessary for successful marketing of a new or improved product, indigenously developed items are invariably at a disadvantage compared with imported products or those based on imported technologies and brand names.

Support must therefore be provided through fiscal and other measures, for a limited period, in favour of products made through indigenously developed technologies, care being taken to ensure quality.

Fiscal Incentives

Suitable financial mechanisms will be established to facilitate investment on pilot plants, process demonstration units and prototype development in order to enable rapid commercial exploitation of technologies developed in laboratories.

Linkages between scientific and technological institutions and development banks will be strengthened. Gaps in technology will be identified and suitable corrective measures taken with adequate allocation of resources. Fiscal incentives will be provided in particular to: promote inventions; increase the use of indigenously developed technology; enhance in-house Research and Development in industry; and efforts directed to absorb and adapt imported technology.

Design Engineering

Capabilities in design engineering are essential for the translation of know-how to commercial production. This is particularly important in areas relating to: agricultural production; agro-industries; metallurgical, chemical and petrochemical processes; machine tools; industrial machinery and capital goods; as well as for the construction and erection of entire plants. Building up and enhancing these capabilities will have a catalytic beneficial impact on the utilization of indigenous efforts that have resulted in product and process know-how. Existing design engineering capabilities will be strengthened and upgraded, and interaction encouraged between design engineering organizations, academic and research institutions and industry. Wherever gaps exist, design engineering capabilities will be developed and nurtured.

Engineering Consultancy

Engineering consultancy is a vital area for ensuring speedy technological and industrial development. It ensures the appropriate utilization of indigenous materials, plant and machinery. Engineering consultancy provides an essential link between R&D institutions and industry, and thus promotes effective transfer of technology. Capability for total systems engineering, process development and project management should be developed with collaboration if required. Wherever capability exists, utilization of Indian consultancy engineering organizations will be promoted. Even where foreign technical collaboration or consultancy is considered unavoidable, association of designated Indian consulting engineering organizations would be preferred. Indigenous engineering consultancy, in both private and public sectors, will be promoted on a sound professional basis in the context of the overall national perspective of technological self-reliance.

In-house R&D

In-house R&D units in industry provide a desirable and essential interface between efforts within the national laboratories and the educational sector as well as production in industry. Appropriate incentives will be given to the setting up of R&D units in industry and for industry including those on a cooperative basis. Enterprises will be encouraged to set up R&D units of a size to permit the accomplishment of major technological tasks.

Technology Acquisition

Mix of Indigenous and Imported Technology

A policy directed towards technological self-reliance does not imply technological self-sufficiency. The criterion must be national interest. Government policy will be directed towards reducing technological dependence in key areas. Advantage should be taken of technological developments

elsewhere. This can also be achieved through well-defined collaborative arrangements in research and development. At any given point of time, there will be a mix of indigenous and imported technology. However, technology acquisition from outside shall not be at the expense of national interest. Indigenous initiative must receive due recognition and support. In the acquisition of technology, consideration will be given to the choice and sources of technology, alternative means of acquiring it, its role in meeting a major felt need, selection and relevance of the products, costs, and related conditions. A National Register on Foreign Collaboration will be developed to provide analytical inputs at various stages of technological acquisition.

Principles of Acquisition and Technology Assessment

Where the need to import technology is established, every effort should be made to ensure that it is of the highest level, consistent with requirements and resources. The technology import will be so planned as to have effective transfer of basic knowledge (know-why) and to facilitate further advancement. Where the import of technology is contemplated, the level to which technology has been developed, or is in current use, within the country, shall be first evaluated.

Lists of technologies that have been adequately developed to the extent that import is unnecessary will be prepared and periodically updated; in such areas no import of technology would normally be permitted; and the onus will be on the seeker of foreign technology, be it industry or a user Ministry, to demonstrate to the satisfaction of the approval authority that import is necessary.

Technology assessment systems will be reviewed. A technology assessment mechanism consisting of competent groups will render advice in all cases of technology import relating to highly sophisticated technology, large investments and national security. Aspects of employment, energy, efficiency and environment will be kept in view.

The basic principles governing the acquisition of technology will be:

- Import of technology, and foreign investment in this regard, will continue to be permitted only on a selective basis where: need has been established; technology does not exist within the country; the time taken to generate the technology indigenously would delay the achievement of development targets.
- Government may, from time to time, identify and notify such areas of high national priority, in respect of which procedures would be simplified further to ensure timely acquisition of the required technology.
- There shall be a firm commitment for absorption, adaptation and subsequent development of imported know-how through adequate investment in Research and Development to which importers of technology will be expected to contribute.

  Unpackaging: Technology to fulfil a particular need consists of many components. It is necessary to develop capability to break down the total package of technology required for a purpose into components,

some of which may be readily available or could be indigenously developed, and other that will need to be imported. Norms and guidelines for such unpackaging will be evolved.

Absorption of Technology

There shall be a commitment to ensure an adequate scale of investment in R&D for the absorption, adaptation and, wherever possible, improvement on and generation of new technology, making fullest use of overall national capabilities. Only thus can self-reliance be ensured and a technology generation process established firmly. Appropriate mechanisms will be evolved at the stage of technology assessment to ensure the absorption of imported technology.

Technological Information

The availability of an efficient system of collection and analysis of relevant technological information, including cost and other economic aspects, is a prerequisite for the appropriate choice of technologies. This will considerably enhance the possibility of obtaining favourable terms and conditions in acquisition of technology. Such a technology information base will be established.

Technology Transfer

Diffusion

Special efforts need to be made for the diffusion of technology in use to all beneficiaries who can employ them optimally. Appropriate measures shall be evolved to facilitate technology diffusion, including: horizontal transfer; technological support for ancillaries from large units; technology inputs to small units; and upgradation of traditional skills and capabilities. International Competi-tiveness and Technology Exports It is necessary to maintain international competitiveness in products, services and technologies that have export potential. Conditions for the marketing of indigenous technology and of products based on it will be improved. It is important in all such cases to conform to the highest international standards.

Technical Cooperation among Developing Countries

A concerted effort will be made to participate fully in technical cooperation among developing countries. Encouragement will be provided for participation in technology development programmes with other developing countries which can contribute to mutual national development.

Protection: Legislative Framework

Development of technology calls for large investments and often involves considerable risk. Encouragement will be given to obtaining necessary protection in all cases of indigenous technology development. A mechanism will be set up to ensure that national interests arising from the generating of technology are fully protected internationally in terms of industrial property rights.

Implementation

The success of the Technology Policy and the speed with which the various facets of the policy are implemented will depend to a considerable extent on a system for efficient monitoring, review and guidance and a plan of incentives and disincentives. Government will evolve instruments for the implementation of this Technology Policy and spell out in detail guidelines for Ministries and agencies of Government as well as for industries and entrepreneurs. Success in implementation demands a conscious integrated approach covering technology assessment, development, acquisition, absorption, utilization and diffusion, and connected aspects of financing, based on overall national interests, priorities and the attainment of the most challenging technological goals.

The entire population must be imbued with self-confidence and pride in national capacity. Indian Science and Technology must unlock the creative potential of our people and help in building the India of our dreams.

6

Environmental Science: Pollution, Challenges, and Remediation Strategies

Introduction and definition of environmental pollution–We know that, a living organism cannot live by itself. Organisms interact among themselves.

Hence, all organisms, such as plants, animals and human beings, as well as the physical surroundings with whom we interact, form a part of our environment. All these constituents of the environment are dependent upon each other. Thus, they maintain a balance in nature. As we are the only organisms try to modify the environment to fulfill our needs; it is our responsibility to take necessary steps to control the environmental imbalances.

The environmental imbalance gives rise to various environmental problems. Some of the environmental problems are pollution, soil erosion leading to floods, salt deserts and sea recedes, desertification, landslides, change of river directions, extinction of species, and vulnerable ecosystem in place of more complex and stable ecosystems, depletion of natural resources, waste accumulation, deforestation, thinning of ozone layer and global warming.

The environmental problems are visualized in terms of pollution, growth in population, development, industrialization, unplanned urbanization, *etc.* Rapid migration and increase in population in the urban areas has also lead to traffic congestion, water shortages, solid waste, and air, water and noise pollution are common noticeable problems in almost all the urban areas since last few years.

Environmental pollution is defined as the undesirable change in physical, chemical and biological characteristics of our air, land and water. As a result of over-population, rapid industrializations, and other human activities like agriculture and deforestation, *etc.*, earth became loaded with diverse pollutants that were released as by-products. Pollutants are generally grouped under two classes:

- *Biodegradable pollutants:* Biodegradable pollutants are broken down by the activity of micro-organisms and enter into the biogeochemical cycles. Examples of such pollutants are domestic waste products, urine and faucal matter, sewage, agricultural residue, paper, wood and cloth, *etc.*
- *Non- Biodegradable pollutants:* Non-biodegradable pollutants are stronger chemical bondage, do not break down into simpler and harmless products. These include various insecticides and other pesticides, mercury, lead, arsenic, aluminum, plastics, radioactive waste, *etc.*

Classification of Environmental Pollution–Pollution can be broadly classified according to the components of environment that are polluted. Major of these are: Air pollution, Water pollution, Soil pollution (land degradation) and Noise pollution. Details of these types of pollutions are discussed below with their prevention measures.

- *Air Pollution:* Air is mainly a mixture of various gases such as oxygen, carbon dioxide, nitrogen. These are present in a particular ratio. Whenever there is any imbalance in the ratio of these gases, air pollution is caused. The sources of air pollution can be grouped as under:
  - Natural; such as, forest fires, ash from smoking volcanoes, dust storm and decay of organic matters.
  - Man-made due to population explosion, deforestation, urbanization and industrializations.

Tabel. The gaseous composition of unpolluted air.

The Gases	*Parts per million (vol)*
Nitrogen	756,500
Oxygen	202,900
Water	31,200
Argon	9,000
Carbon Dioxide	305
Neon	17.4
Helium	5.0
Methane	0.97-1.16
Krypton	0.97
Nitrous oxide	0.49
Hydrogen	0.49
Xenon	0.08
Organic vapours	ca.0.02

Certain activities of human beings release several pollutants in air, such as carbon monoxide (CO), sulfur dioxide (SO_2), hydrocarbons (HC), oxides of nitrogen (NOx), lead, arsenic, asbestos, radioactive matter, and dust.

The major threat comes from burning of fossil fuels, such as coal and petroleum products. Thermal power plants, automobiles and industries are major sources of air pollution as well. Due to progress in atomic energy sector, there has been an increase in radioactivity in the atmosphere. Mining activity adds to air pollution in the form of particulate matter. Progress in agriculture due to use of fertilizers and pesticides has also contributed towards air pollution.

Indiscriminate cutting of trees and clearing of forests has led to increase in the amount of carbon dioxide in atmosphere. Global warming is a consequence of green house effect caused by increased level of carbon dioxide (CO_2). Ozone (O_3) depletion has resulted in UV radiation striking our earth.

POLLUTION PREVENTION

Pollution prevention is reducing or eliminating waste at the source by modifying production processes, promoting the use of non-toxic or less-toxic substances, implementing conservation techniques, and re-using materials rather than putting them into the waste stream. Pollution prevention means "source reduction," as defined under the Pollution Prevention Act, and other practices that reduce or eliminate the creation of pollutants through:

- Increased efficiency in the use of raw materials, energy, water, or other resources, or
- Protection of natural resources by conservation. The Pollution Prevention Act defines "source reduction" to mean any practice which
- Reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment prior to recycling, treatment, or disposal; and

- Reduces the hazards to public health and the environment associated with the release of such substances, pollutants, or contaminants. The term includes: equipment or technology modifications, process or procedure modifications, reformulation or redesign or products, substitution of raw materials, and improvements in housekeeping, maintenance, training, or inventory control.

Specific Pollution Prevention Approaches

Pollution prevention approaches can be applied to all pollution-generating activities, including those found in the energy, agriculture, Federal, consumer, as well as industrial sectors.

The impairment of wetlands, ground water sources, and other critical resources constitutes pollution, and prevention practices may be essential for preserving these resources.

These practices may include conservation techniques and changes in management practices to prevent harm to sensitive ecosystems. Pollution prevention does not include practices that create new risks of concern.

In the agricultural sector, pollution prevention approaches include:

- Reducing the use of water and chemical inputs;
- Adoption of less environmentally harmful pesticides or cultivation of crop strains with natural resistance to pests; and
- Protection of sensitive areas. In the energy sector, pollution prevention can reduce environmental damages from extraction, processing, transport, and combustion of fuels. Pollution prevention approaches include:
- Increasing efficiency in energy use;
- Substituting environmentally benign fuel sources; and
- Design changes that reduce the demand for energy. Some Types of Pollution are: Air, Water and thermal, Radioactive.

ENVIRONMENTAL HAZARD

'Environmental hazard' is a generic term for any situation or state of events which poses a threat to the surrounding environment. This term incorporates topics like pollution and Natural Hazards such as storms and earthquakes.

I feel that this sight has no information on what I am looking for! There are five types of environmental hazards:

1. Chemical
2. Physical
3. Mechanical
4. Biological
5. Psychosocial

The term can also refer to biological hazards; a large algal bloom is an environmental hazard because it makes the lake uninhabitable for other organisms.

Natural Hazards

A natural hazard is a threat of an event that will have a negative effect on people or the environment. Many natural hazards are related, *e.g.*, earthquakes can result in tsunamis, drought can lead directly to famine and disease. A concrete example of the division between hazard and disaster is that the 1906 San Francisco earthquake was a disaster, whereas earthquakes are a hazard. Hazards are consequently relating to a future occurrence and disasters to past or current occurrences.

Notable avalanches include:

- The 1910 Wellington avalanche
- The 1954 Blons avalanches
- The 1970 Ancash earthquake
- The 1999 Galtur Avalanche
- The 2002 Kolka-Karmadon rock ice slide

Earthquakes

An Earthquake is a sudden shaking or vibration of the Earth's crust. The vibrations may vary in magnitude. The earthquake has point of origin underground called the "focus". The point directly above the focus on the surface is called the "epicentre".

Earthquakes by themselves rarely kill people or wildlife. It is usually the secondary events that they trigger, such as building collapse, fires, tsunamis and volcanoes, that are actually the human disaster. As many of these could be avoided by better construction, safety systems, early warning and evacuation planning, the term unnatural disaster is not unwarranted. Earthquakes are caused by the discharge of stress accumulated along geologic faults.

Some of the most significant earthquakes in recent times include:

- The 2004 Indian Ocean earthquake, the second largest earthquake in recorded history, registering a moment magnitude of 9.3. The huge tsunamis triggered by this earthquake cost the lives of at least 229,000 people.
- The 7.6-7.7 2005 Kashmir earthquake, which cost 79,000 lives in Pakistan.
- The 7.7 magnitude July 2006 Java earthquake, which also triggered tsunamis.
- The 7.9 magnitude May 12, 2008 Sichuan earthquake in Sichuan Province, China. Death toll at over 61,150 as of May 27, 2008.

Lahars

A lahar is a volcanic mudflow or landslide. The 1953 Tangiwai disaster was caused by a lahar, as was the 1985 Armero tragedy in which the town of Armero was buried and an estimated 23,000 people were killed.

Natural Disaster

It is a form of tuberculosis where you die in a car and madeline kills you in the middle of the day. This understanding is concentrated in the formulation: "disasters occur when hazards meet vulnerability." A natural hazard will hence never result in a natural disaster in areas without vulnerability, *e.g.*, strong earthquakes in uninhabited areas. The term *natural* has consequently been disputed because the events simply are not hazards or disasters without human involvement.

HARMFUL EFFECTS OF AIR POLLUTION

- It affects respiratory system of living organisms and causes bronchitis, asthma, lung cancer, pneumonia, *etc.* Carbon monoxide (CO) emitted from motor vehicles and cigarette smoke affects the central nervous system.
- Due to depletion of ozone layer, UV radiation reaches the earth. UV radiation causes skin cancer, damage to eyes and immune system.
- Acid rain is also a result of air pollution. This is caused by presence of oxides of nitrogen and sulfur in the air. These oxides dissolve in rain water to form nitric acid and sulfuric acid respectively. Various monuments, buildings, and statues are damaged due to corrosion by acid present in the rain. The soil also becomes acidic. The cumulative effect is the gradual degradation of soil and a decline in forest and agricultural productivity.
- The green house gases, such as carbon dioxide (CO_2) and methane (CH_4) trap the heat radiated from earth. This leads to an increase in earth's temperature.
- Some toxic metals and pesticides also cause air pollution.

Water Pollution

Water is one of the prime necessities of life. With increasing number of people depend on this resource; water has become a scarce commodity. Pollution makes even the limited available water unfit for use. Water is said to be polluted when there is any physical, biological or chemical change in water quality that adversely affects living organisms or makes water unsuitable for use. Sources of water pollution are mainly factories, power plants, coal mines and oil wells situated either close to water source or away from sources. They discharge pollutants directly or indirectly into the water sources like river, lakes, water streams, *etc.* The harmful effects of water pollution are:

- Human beings become victims of various water borne diseases, such as typhoid, cholera, dysentery, hepatitis, jaundice, *etc.*
- The presence of acids/alkalies in water destroys the microorganisms, thereby hindering the self-purification process in the rivers or water bodies. Agriculture is affected badly due to polluted water. Marine eco-systems are affected adversely.

- The sewage waste promotes growth of phytoplankton in water bodies; causing reduction of dissolved oxygen.
- Poisonous industrial wastes present in water bodies affect the fish population and deprives us of one of our sources of food. It also kills other animals living in fresh water.
- The quality of underground water is also affected due to toxicity and pollutant content of surface water.

Water Pollution by Industries and its Effects

A change in the chemical, physical, biological, and radiological quality of water that is injurious to its uses. The term "water pollution" generally refers to human-induced changes to water quality. Thus, the discharge of toxic chemicals from industries or the release of human or livestock waste into a nearby water body is considered pollution. The contamination of ground water of water bodies like rivers, lakes, wetlands, estuaries, and oceans can threaten the health of humans and aquatic life. Sources of water pollution may be divided into two categories.

- Point-source pollution, in which contaminants are discharged from a discrete location. Sewage outfalls and oil spills are examples of point-source pollution.
- Non-point-source or diffuse pollution, referring to all of the other discharges that deliver contaminants to water bodies. Acid rain and unconfined runoff from agricultural or urban areas falls under this category.

The principal contaminants of water include toxic chemicals, nutrients, biodegradable organics, and bacterial & viral pathogens. Water pollution can affect human health when pollutants enter the body either via skin exposure or through the direct consumption of contaminated drinking water and contaminated food. Prime pollutants, including DDT and polychlorinated biphenyls (PCBs), persist in the natural environment and bioaccumulation occurs in the tissues of aquatic organisms. These prolonged and persistent organic pollutants are transferred up the food chain and they can reach levels of concern in fish species that are eaten by humans. Moreover, bacteria and viral pathogens can pose a public health risk for those who drink contaminated water or eat raw shellfish from polluted water bodies.

Contaminants have a significant impact on aquatic ecosystems. Enrichment of water bodies with nutrients (principally nitrogen and phosphorus) can result in the growth of algae and other aquatic plants that shade or clog streams. If wastewater containing biodegradable organic matter is discharged into a stream with inadequate dissolved oxygen, the water downstream of the point of discharge will become anaerobic and will be turbid and dark. Settleable solids will be deposited on the streambed, and anaerobic decomposition will occur. Over the reach of stream where the dissolved-oxygen concentration is zero, a zone of putrefaction will occur with the production of hydrogen sulfide (H_2S),

ammonia (NH_3), and other odorous gases. Because many fish species require a minimum of 4–5 mg of dissolved oxygen per liter of water, they will be unable to survive in this portion of the stream.

Direct exposures to toxic chemicals are also a health concern for individual aquatic plants and animals. Chemicals such as pesticides are frequently transported to lakes and rivers via runoff, and they can have harmful effects on aquatic life. Toxic chemicals have been shown to reduce the growth, survival, reproductive output, and disease resistance of exposed organisms. These effects can have important consequences for the viability of aquatic populations and communities.

Wastewater discharges are most commonly controlled through effluent standards and discharge permits. Under this system, discharge permits are issued with limits on the quantity and quality of effluents. Water-quality standards are sets of qualitative and quantitative criteria designed to maintain or enhance the quality of receiving waters. Criteria can be developed and implemented to protect aquatic life against acute and chronic effects and to safeguard humans against deleterious health effects, including cancer.

Soil Pollution (Land Degradation)

Land pollution is due to:

- Deforestation and
- Dumping of solid wastes.

Deforestation increases soil erosion; thus valuable agricultural land is lost. Solid wastes from household and industries also pollute land and enhance land degradation. Solid wastes include things from household waste and of industrial wastes. They include ash, glass, peelings of fruit and vegetables, paper, clothes, plastics, rubber, leather, brick, sand, metal, waste from cattle shed, night soil and cow dung. Chemicals discharged into air, such as compounds of sulfur and lead, eventually come to soil and pollute it. The heaps of solid waste destroy the natural beauty and surroundings become dirty. Pigs, dogs, rats, flies, mosquitoes visit the dumped waste and foul smell comes from the waste. The waste may block the flow of water in the drain, which then becomes the breeding place for mosquitoes. Mosquitoes are carriers of parasites of malaria and dengue. Consumption of polluted water causes many diseases, such as cholera, diarrhea and dysentery.

Noise Pollution

High level noise is a disturbance to the human environment. Because of urbanization, noise in all areas in a city has increased considerably. One of the most pervasive sources of noise in our environment today is those associated with transportation. People reside adjacent to highways, are subjected to high level of noise produced by trucks and vehicles pass on the highways. Prolonged exposure to high level of noise is very much harmful to the health of mankind. In industry and in mines the main sources of noise pollution are blasting,

movement of heavy earth moving machines, drilling, crusher and coal handling plants, *etc*. The critical value for the development of hearing problems is at 80 decibels. Chronic exposure to noise may cause noise-induced hearing loss. High noise levels can contribute to cardiovascular effects. Moreover, noise can be a causal factor in workplace accidents.

AIR POLLUTION

Air is a vast renewable resource used by all living things. Unfortunately, the air has also long been a dumping site for tons of unwanted material. Since the air is usually mixed rapidly and thoroughly, whatever is put into it is soon distributed over a wide area. To a certain extent this has always been a part of the "solution"; to disperse pollutants broadly and quickly so that they are no longer a problem. More significantly, however, the fact that the air easily carries pollutants from one area to the next means that one person's "solution" becomes everyone's problem. Air is a rather stable mixture of nitrogen, oxygen, and water vapor, with much smaller amounts of carbon dioxide and several inert gases such as argon and helium. Any changes to this mixture could be considered pollution. Most types of air pollution can divided into two major categories: pollution by the addition of particles, Particulate Pollution, and pollution by the addition of gases, Gas Pollution.

PARTICULATE POLLUTION

All but the very cleanest air contains small particles of liquid and solid material. By definition, air is composed solely of gases, and thus these particles can be considered pollutants. Some particles have a natural origin, and other are produced by humans. Whatever their origin, particles in the atmosphere can cause problems. The most obvious problem is appearance. Soot and dust in the air look bad, and the particles eventually settle out of the air and accumulate on leaves, automobiles, and window sills. For many people, particulate pollution is also a significant health problem. Pollen can produce allergic reactions, and prolonged exposure to coal dust and finely powdered rock can produce lung diseases such as black lung and silicosis. On a much larger scale, particles in the atmosphere can lead to the atmospheric condition for which the word "smog" was first coined almost 100 years ago.

SMOG

As most people know, the word "smog" comes from a combination of the words "smoke" and "fog". What might be less familiar is the origin of this term about a century ago in London. At that time, soft coal was the city's primary fuel in factories and homes. Burning soft coal can make a great deal of smoke. London's climate, particularly in the winter, is cold and damp. When moisture-laden air is cooled (as it might be on a bathroom window) the moisture condenses on any available surface. That surface might be a window pane, a water pipe or a cold drink can. Particles suspended in the air also provide surfaces for condensation,

and when moisture condenses on particles, they get larger, creating a fog. Thus, smoke can produce fog. Smoke was the primary cause of the famous London fogs, and when the burning of soft coal was curtailed, the fogs began to disappear.

NATURAL CAUSES

Many particles are placed into the atmosphere by natural processes which are unrelated to human activity. Pollen enters the air from flowers and salt crystals form when ocean spray dries. Dust storms and volcanic eruptions put dust into the atmosphere, and forest fires create smoke which is composed predominantly of small particles of ash and minute pieces of unburned carbon.

HUMAN CAUSES

Smoke contains most of the particles which enter the atmosphere as the result of human actions. Visible smoke can be composed of a variety of particles such as soot, unburned fuel and minute pieces of ash. For example, coal-fired electric power stations usually grind coal into a fine power before burning it. When the powdered coal burns, it makes minute particles of ash which might be carried up the smoke stack and create a gray smoke. Automobiles which are not operating properly often discharge small particles of oil which make a blue smoke, or small amounts of unburned gasoline making a black smoke. Diesel engines often discharge a black smoke composed of particles of soot.

SOLUTIONS

People have developed a variety of means to deal with air pollution. Since particulate pollution was the first and most obvious problem, its solutions came first. There are four common ways to combat particulate pollution:

(1) *Bag Filters:* Much like giant vacuum cleaner bags, bag filters are suspended inside chimneys and smoke stacks. The smoke or other waste gas is forced to pass through the bag, and the majority of the associated particles are trapped. Some industries collect the particles in truck loads and sell them for use in construction materials such as concrete blocks.

(2) *Cyclones:* As the name suggests, a cyclone is a mechanism to spin waste gases, forcing the denser particles to the outside and into a collecting devise. Textile mills often use this system to remove lint from the air in manufacturing areas.

(3) *Scrubbers:* These devises use a mist of water to "wash" pollution out of the air. As the polluted air passes through the mist, water droplets stick to the particles and make them heavy enough to fall out of the air. The air is cleaned in much the same way that a rain storm can clean pollen out of the atmosphere. Scrubbers are one of the systems which are effective against both types of pollution. They can also wash some types of gas pollution out of the air. For example, sulfur dioxide (SO2) will dissolve in water creating an acid rain inside the scrubber rather than outside in a forest.

(4) *Electro-static Precipitators:* The electro-static precipitator uses static electricity to give the polluting particles a strong electric charge. After receiving their charge the particles pass through a screen with the opposite electric change, they are attracted to the screen and attach themselves to it. The screen must be washed periodically to remove the particles.

WATER POLLUTION

Water pollution is any physical, chemical or biological alteration of water that is harmful to living organisms. A more human-centered definition describes pollution as "any contamination of water that makes it unsuitable for its 'highest' use". For example, silt or mud in water would not affect its use for boating or fishing, but the same silt in the same water could prevent humans from drinking or washing clothes in it. There are many types of water pollution; some have a natural origin, but most are related to human activities.

Water becomes polluted easily because it is a nearly "universal" solvent. One of the alchemists' goals was to find a "universal solvent"-a liquid into which everything could be dissolved. They were unaware that they already possessed what they were looking for-almost everything will dissolve in water, at least to some extent. This makes water an excellent cleaner, and a convenient way to dispose of waste. These initially positive uses, in turn, often lead to water pollution.

There are many sources of water pollution, but a common way to categorize them is to consider point sources and non-point sources. Point sources are specific locations that are easy to identify. Less specific locations, more generalized and harder to find, are called non-point sources, and are often difficult to define and to regulate. Whatever its cause, water pollution does have many possible solutions.

Pollution in streams and lakes is often easy to see or smell, and frequently the solutions are obvious. Groundwater, though hidden below the surface, can also become polluted; and because it is harder to see and easier to forget, this pollution is more difficult to detect and to clean up.

TYPES OF WATER POLLUTION

Anything that dissolves in water, or can be suspended in water, or floats on water can be considered a pollutant. However, there are eight primary types of pollution that account for most of the problems that humans produce. These are water pollution by:

SEDIMENT

Sediment is the primary water pollutant in the United States. Sediment is undissolved solid material (sand, silt and clay) that has been eroded from the land. Such materials are washed away from all land areas during rain storms, floods and snow melts, but the volume of sediment becomes much greater if

some of the land's natural protections have been removed. This is often the case on construction sites, in agricultural areas, and after forest fires. Sediment gives water a cloudy appearance, which is called "turbidity." Turbid, or muddy, water does not allow sunlight to penetrate; it can hamper the ability of aquatic animals to get oxygen out of the water; and it can bury bottom-dwelling organisms as it settles out of the water. Sediment has the additional problem-causing characteristic that many pesticides, nitrates and pathogenic organisms attach themselves to particles of silt and clay.

TOXIC MATTER

A great variety of poisonous compounds can get into water either by accident or intent. For example, humans have known for years that lead is a poison that affects the nervous system, but we realized only recently that the lead in plumbing and the lead in automobile gasoline can enter our water supply and harm us. There discovery gives us a good reason to believe that the Romans may have been harmed by lead in their water and wine over 2000 years ago.

Another example of toxic material in water occurred in the 1950s when industries around Minamata Bay in Japan discharged so much mercury into the bay that people were poisoned by mercury that had found its way into the local seafood. More recently, people have become concerned about the presence of agricultural nitrates in water. The human body converts nitrates into nitrites, and these can interfere with the blood's ability to transport oxygen. In these and many other cases, material with one purpose (plumbing, industrial production or fertilizer) ended up in the wrong place as a serious water pollutant.

PATHOGENS

Pathogens are agents that cause disease. They may be bacteria, viruses or parasites, and they can get into water from any infected organisms. Small numbers of these agents can be found in almost all bodies of water, but the numbers greatly increase when any sort of animal waste enters the water. In parts of the world where untreated sewage is allowed to enter the water supply, contaminated water is a major health hazard.

SALT

Most land plants and animals can be harmed by salt (sodium chloride and calcium chloride), and therefore any salt in the supply of fresh water can be a problem.

Under certain conditions, salt water from the ocean can intrude into groundwater, and storms can blow ocean water into surface lakes and streams. Irrigation projects can add salt to streams, and salt water is a common by-product of the oil industry. (Crude oil often comes to the surface mixed with salt water). In the northern parts of North America, salt is spread on roads and bridges to stimulate the melting of ice. Salt from storage areas as well as from the highways eventually finds its way into local streams and groundwater.

ACID

Acid mine drainage (acids given off by the weathering of ores) is a significant source of water pollution in mining areas, and acid precipitation is becoming an important problem in industrialized areas. In addition, acid can enter the water from a wide variety of industries (such as steel-making and fruit-packing) that use acids as cleaners. In all cases, the addition of acid to water lowers its pH and often kills the plants and animals that would naturally inhabit it. Acidic water also dissolves metals more easily, and thus the water may become additionally polluted by metals such as lead, copper, or mercury.

AGRICULTURAL CHEMICALS

Most agricultural chemicals are water-soluble nitrates and phosphates that are applied to fields, lawns and gardens to stimulate the growth of crops, grass and flowers. The chemicals enter streams and lakes during the run-off of rain water. Once in a body of water, these chemicals continue to promote the growth of plants, but an overgrowth of plant life can seriously damage a lake or stream. The resulting plant detritus is food for micro-organisms, and as the population of such organisms grows, the supply of oxygen in the water is depleted. Declining oxygen leads to a drop in the population of fish. In extreme cases, the plants may produce so much detritus that all oxygen is used up and all animal life disappears from the stream. Water in which this problem is occurring, is said to have a high "Biochemical Oxygen Demand", or "BOD". This means that the water is capable of supporting a large population of bacteria that will have a high demand for oxygen.

ORGANIC MATTER

Dumping untreated sewage or other organic material into a body of water has much the same effect as pollution by fertilizers. In both cases the water is supplied with an abundance of food for micro-organisms, and the rapidly expanding population of microscopic animals soon depletes the supply of oxygen making the water uninhabitable by fish and other larger organisms.

HEAT

People use a large amount of water for cooling. This water is usually returned to its source only about 10 degrees warmer than its natural temperature, but even this amount of warming can affect the water's ability to support life. The problem is known as "thermal pollution." Cold water holds more oxygen than warm water. For example: at 32°F, fresh water can hold 14 ppm (parts per million) of oxygen. If that same water is warmed to 70°F, it can only hold 9 ppm oxygen, and at 100°F, its oxygen content decreases to 6 ppm. As the water's oxygen supply decreases, it loses its ability to support animals such as fish. The problem is made worse by the fact that warmer water encourages the growth of bacteria that may attack the fish. Thermal pollution is particularly severe during summer months

when the water's natural temperature is high. During very hot weather, a body of water may hold only 50% as much oxygen as it would during the winter. Artificially warming the water at that point could easily begin to kill off the fish.

POINT SOURCES

Pollutants that are discharged at a known location through conduits such as sewers, ditches or canals, are said to be coming from a "point source." Such sources are easy to locate, and they are also easy to regulate and control. It is possible to identify the polluting material and determine its volume. It is also easy to determine the extent to which regulations are being followed.

NON-POINT SOURCES

"Non-point sources" are less distinct sites such as lawns, forests, construction sites, parking lots, or farms. Overall, agriculture is the leading source of non-point pollution in the United States. Effluent from agricultural sources produces about 65% of the total mass of pollutants entering the nation's streams and about 55% of those entering lakes. Non-point sources are much more difficult to control since it is often impossible to identify the nature and the volume of the material entering the water supply.

GROUNDWATER

All groundwater was surface water at one time, and therefore, anything that is a potential threat to surface water is also a threat to groundwater. Groundwater can become polluted, and once it does, it may take thousands of years for the contaminants to be flushed from the aquifer. Pollutants can be washed out of rivers in weeks or months, and lakes can clear themselves out in decades; but reservoirs of groundwater may remain contaminated for millennia. Since most groundwater is invisible, it may even take years just to detect a problem.

Farming and gardening use pesticides, herbicides and chemical fertilizers that may enter the ground. Leaking underground storage tanks at homes and service stations can pollute acres of groundwater with various petroleum products. Groundwater can also be contaminated by organic waste from outhouses, septic tanks, and leaking sewage lines. All such pollution must be located, and some means devised to remove it from the ground.

SOLUTIONS

At first look, solutions to water pollution seem remarkably simple. Either prevent the problem from happening, or clean up the pollution that has occurred. Problems are handled in both of these ways, but solutions become complicated when they are put into practice. Prevention and clean-up can each be time-consuming and expensive. The source of the pollution must be located and identified; an alternative method of dealing with the waste must be determined; and often, time must pass while the pollutants are "flushed" out of the ground or the effected body of water.

PREVENTION

Legislation, such as the Safe Drinking Water Act in the U.S., is aimed at the prevention of pollution. The goal is to eliminate practices that allow pollutants to enter the water supply in the first place. Some pollutants are toxic or disease-causing materials that should not be released under any conditions. Other pollutants are only harmful in quantities that are too large to be handled by natural systems. The appropriate legislation may be as simple as regulations about dumping used motor oil onto the ground or into sewage systems, or it may be as complex as the regulations controlling the effluent from industries or municipal sewage treatment facilities. In each case, the intent is to remove toxic material from the environment, and to limit the rate that harmful materials are added to water supplies so that natural processes can absorb or destroy them.

CLEAN UP

A salt marsh may not look like a pollution control device, but it contains many physical and biological processes that work to remove polluting material from water. These natural processes allow water to be considered a "renewable resource" in that the water may serve one purpose (such as washing nutrient-rich mud into the marsh), and it may then be cleaned and re-used in another capacity (such as drinking water for a bird). Humans try to duplicate some of these natural processes in order to clean up water that we have polluted.

NATURAL PROCESSES

There are four significant natural processes that act to clean water and allow it to be reused. They are:

- *Evaporation*: When water turns from a liquid into a vapor, almost all of the material that was dissolved or suspended in the water is left behind. As a result, salt water evaporates to create a vapor of fresh water, and muddy water evaporates to create a vapor that does not contain any mud.
- *Sedimentation:* Various types of sediment are the most common agents of pollution in water. Sediment is suspended in water by turbulence, and slowly settles out of water that is allowed to sit still. The larger particles of sediment drop to the bottom first, but if a sample of water remains still for a long period of time, even the smallest particles of clay will settle to the bottom.
- *Adhesion:* Some natural materials, such as clay, adhere readily to other materials. The process is known as "adhesion," (as in adhesive tape) and results in the fact that some of the pollutants in water stick to particles of clay and fall to the bottom as the clay settles. Almost like a natural filter, this process of adhesion can remove dissolved as well as suspended pollutants from water. This process is primarily responsible for the generally correct belief that a stream will "clean itself" if it is allowed to flow far enough.

- *Biologic Activity:* Almost all of the organic waste from one organism is food for another. Dead leaves and branches are consumed by micro-organisms; the waste from the micro-organisms is then used by plants to form leaves and branches. If not disturbed, this natural cycle can operate continuously-consuming potentially polluting wastes and reusing them in the natural system. Many of these same natural processes are used by humans to clean-up our own water pollution problems.

HUMAN PROCESSES

Humans take advantage of natural cleaning processes to deal with many water pollution problems. In two of our most significant processes, we use "sedimentation and adhesion" to treat drinking water, and we take advantage of "sedimentation and biologic activity" in the treatment of sewage.

MUNICIPAL WATER TREATMENT

If a city's supply of water is drawn from lakes or rivers, the primary goal of the municipal treatment facility is to clean the water of sediment and pathogens. Sediment is removed by stimulating the small particles of clay that are suspended in the water to stick together in larger groups. Once the groups are large enough, they fall to the bottom and are removed.

This process is known as "flocculation." Flocculation is a natural process, but it is made to operate more quickly in most water treatment plants by adding "alum" (aluminum sulfate) to the water. After the flocculation process, the water passes though fine "sand filters," which often contain activated charcoal as well. This sand, or sand/charcoal combination, filters out the smallest particles and also removes small amounts of organic matter that might give the water a strange taste or smell.

Pathogens are removed in two ways. First of all, chlorine is added to the water as it enters the plant, and as it leaves. The chlorine added before treatment will kill bacteria and fungi before they enter the plant, and the chlorine added at the end of the process will protect the water as it is piped to consumers. Second of all, many pathogens and chemical impurities are removed by the natural process of adhesion to clay particles that are settling to the bottom of the treatment tanks. Once the water has been cleaned, fluoride and several other chemicals are added before it is pumped out of the plant.

MUNICIPAL WASTE WATER TREATMENT

The mission of a municipal waste water treatment plant is to clean the waste water sufficiently so that it can be returned to a river or lake without altering the natural conditions in that body of water. To do this, the plant must first remove debris that would spoil the appearance of the water. In addition, the plant must remove pathogens from the water, and it must remove organic matter that would promote the growth of plants and eventually deplete the water's supply of oxygen.

Early waste water treatment facilities were "Primary" systems that used only physical means to clean the water. Screens were used to remove large debris, and "clarifiers" (settling tanks) were employed to allow smaller suspended or floating solids to separate from the water. The cleaner water was then chlorinated and released. Today, most major U.S., cities operate "Secondary" systems that use both physical and biological processes to clean the water. In addition to the primary treatment described above, these plants also have "aeration basins" in which oxygen is added to the waste water to encourage bacteria to consume suspended and dissolved organic matter. Good secondary systems can significantly reduce the waste water's BOD. In places where waste water contains many chemical impurities, or where it must be cleaned to a very high standard, various types of "Tertiary," or chemical, treatment are used. This type of treatment is often expensive and its use is limited.

GAS POLLUTION

Any change in the atmosphere's natural mixture of gases has the potential to be significant air pollution. Most gases are invisible, and thus this type of pollution is less obvious. Since it is out-of-sight, it was for many years out of mind. Today, however, gas pollution is a familiar and important problem. Exotic gases can enter the atmosphere from natural as well as human sources. Once in the atmosphere, the gases may cause problems alone or they may form troublesome compounds by combining with particles or other gases.

NATURAL SOURCES

Several important air pollutants have natural sources. One is methane (CH_4). Methane is produced by the bacteria that break down organic matter in the absence of oxygen.

This process can occur in swamps, on the sea floor, and inside the bodies of animals. The methane which escapes to the atmosphere adds to the "Greenhouse Effect". Natural fires produce carbon dioxide (CO_2) which is also a green house gas, and volcanoes produce a great deal of Chlorine gas which may have an effect on the Ozone Layer.

HUMAN SOURCES

In industry, domestic heating and many varieties of transportation, humans produce gases that are released into the atmosphere. In most cases these gases affect the Lower Atmosphere into which they are released, but in some cases they can affect the Upper Atmosphere.

LOWER ATMOSPHERE

The most prominent air polluters are: Sulfur Dioxide (SO_2), Nitrogen Oxides (NOx), Carbon Monoxide (CO), Carbon Dioxide (CO_2) and Chlorofluorocarbons (CFCs).

SULFUR DIOXIDE

Sulfur dioxide (SO_2) is a colourless gas that is produced when the element sulfur is burned. This can happen intentionally during the purification of ores which contain sulfur. In a process known as "smelting", the ore is heated to a high temperature and the sulfur is burned off. Sulfur is burned unintentionally when coal or other fuels containing a large amount of sulfur are used by industries and public utility companies. Whatever its source, once the sulfur enters the atmosphere it combines with water to form sulfuric acid (H_2SO_4) and becomes an important component of acid rain. For more information on the effects of acid rain.

NITROGEN OXIDES

Nitrogen oxides are produced when a mixture of nitrogen and oxygen is subjected to high temperatures and high pressures. These conditions occur continuously inside the internal combustion engines that operate automobiles, trucks, trains and small airplanes. These two primary atmospheric gases are drawn into the engines, some of the oxygen is used up as the fuel burns, but the remainder is heated and compressed inside each cylinder as it fires. The resulting nitrogen oxides are responsible for three important air pollution problems.

EFFECTS OF LOWER ATMOSPHERE GAS POLLUTION

There are several biologic and/or non-biologic effects of lower atmosphere gas pollution. Included among these are the following:

(1) *Acid precipitation has its source in the combustion of fossil fuels:* When both sulfur and nitrous oxides are emitted into the atmosphere, both can react with water vapor to produce sulfuric acid (H_2SO_4) and nitric acid (HNO_3), respectively. Both have both biologic and non-biologic effects. Biologic effects include acidification of soils, plants and surface and ground water. Acidification can stunt or even kill the growth of plants by acting on the plant's leaves or by ingestion through the root system. An excellent example of the detrimental effects can be seen in the destruction of entire stands of fir and spruce trees in the Blue Ridge and Great Smoky Mountains of North Carolina and Tennessee. Acidification of soils can result in the alteration of soil chemistry by leaching acid-soluble chemicals and effectively increasing the levels of certain other non-acid-soluble chemicals. Runoff of acidic soils in upstate New York in the 1950's led to the acidification of Lake Erie and the near death of that Great Lake. In recent years, Lake Erie has been brought back to life as a result of practices designed to reduce soil acidification. Acid precipitation has even been linked to human respiratory diseases such as asthma and bronchitis.

Non-biologic effects of acid precipitation include the dissolution and destruction of many statues and buildings, especially those made of limestone and marble, and the "pitting" of many metal and painted surfaces.

(2) *Ozone:* In the presence of sunlight, one of the atoms of oxygen is often driven off of nitrogen dioxide (NO_2) and is free to combine with an oxygen molecule (O_2) to form ozone (O_3). Ozone is beneficial to humans when in the upper atmosphere, but in the lower atmosphere ozone is an irritant making throats sore, eyes red, and noses run.

(3) *Photochemical Smog:* In the presence of sunlight, nitrogen oxides can combine with unburned hydrocarbons (gasoline and oil) to form chemicals such as formaldehyde and peroxyacetyl nitrate (PAN) which are some the primary components of the brownish haze which often forms over Los Angeles and other sun belt cities during the summer time. Since this new type of "smog" is formed by chemical reactions that are driven by sun light, it is known as Photochemical Smog to distinguish it from the earlier type of smog.

CARBON MONOXIDE

Carbon monoxide is produced when a compound containing carbon is burned at a very high temperature, or burned without a sufficient supply of oxygen. This occurs in internal combustion engines (cars, trucks and buses), in trash piles, and in many types of domestic heaters. Carbon monoxide is poisonous because it is absorbed by the blood in place of oxygen. If we breath too much carbon monoxide, we can die from a lack of oxygen.

CARBON DIOXIDE

Carbon dioxide (CO_2) is produced when any material containing carbon is burned. Whether the material is wood, oil, garbage, paper or natural gas, as it burns oxygen combines with carbon to make heat and give off CO_2. Carbon dioxide is also produced by all living things when they obtain energy from carbon-based food by combining it with oxygen and giving off CO_2 as a waste product. Carbon dioxide is a natural, though quite small, component of the atmosphere, and for this reason, it was not considered an air pollutant for many years. Environmentalists became concerned about carbon dioxide when it became apparent that the atmosphere's average temperature was increasing worldwide. Since carbon dioxide absorbs infra-red radiation (heat), this increase in temperature could be explained by an increase in the amount of CO_2 in the atmosphere. This situation, known as the "greenhouse" effect, is the source of increasing concern.

First of all, because a number of gases which we have released into the atmosphere have the same effect as carbon dioxide in that they absorb infra-red radiation. Called "greenhouse Gases" they include nitrogen oxides, chlorofluorocarbons, methane (natural gas), water and carbon dioxide. Second of all, a general warming of the atmosphere can lead to a great variety of environmental problems.

GLOBAL CHANGE

The term "Global Change" refers to all of the many ways that the earth appears to have changed or be changing during the time that humans are here.

Some of the changes are the direct result of human activity, some clearly are not, and some are not well enough understood to attribute to any cause.

This section will look at the global change issue, some of its causes, some of its effects on the Earth's sub-systems, and some of the actions that are being taken or could be taken to address the issue. The global change issues to be examined include:

GLOBAL WARMING

One can hardly escape the reports in the media about global warming and the greenhouse effect. To understand the concept of global warming, it is necessary to remember that throughout geologic history, the global climate has warmed and cooled several times, resulting in Ice Ages when the global climate was significantly colder than present, and Interglacial Stages, when the global climate was significantly warmer than present. In fact, during the last 2 million years, there is now evidence of at least 20 glacial ages.

To understand the effect that human activities have had on global climate, we must understand where we are in the glacial/interglacial time-frame. The consensus among earth scientists is that we are in a global warming period that was not initiated by human activity. Because we are concerned with the possibility that human activity might further warm the global climate, we must attempt to separate the human-induced and the non-human-induced components of global warming. As shown in Figure 1, that is more difficult than one might imagine.

UPPER ATMOSPHERE OZONE LAYER

The stratosphere is that layer of the atmosphere that extends from 17 km to 48 km above sea level. Within the lower parts of the stratosphere there exists a "layer" rich in ozone gas. Ozone, whose chemical formula is O_3, is important because it absorbs ultraviolet radiation from the sun, and thus limits the amount of that radiation which reaches the earth's surface. Recent atmospheric studies show that the amount of ozone in the upper atmosphere varies from one location to another, and from one time to the next. This means that the amount of ultraviolet radiation reaching the earth also varies. This is important because ultraviolet radiation is known to be harmful to many living things, including humans.

Any reduction in the amount of ozone in the upper atmosphere can have detrimental effects. It has been well documented in the past few decades that there is a roughly circular area in the ozone layer where the ozone concentration is dangerously low. This hole in the ozone layer is not constant in size or location, but it appears to be most problematic in the Southern Hemisphere, over Antarctica, Australia and New Zealand. Unlike many environmental issues, where we do not know for sure the causes and effects of the problem, in this case we do. One of the primary causes for the reduction of ozone in the upper atmosphere is an increase in a series of man-made chlorine-and fluorine-compounds known as chlorofluorocarbons.

DEFORESTATION

While forests are being cleared permanently in nearly all parts of the world, the issue of deforestation generally focuses on the loss of tropical forests. Tropical forests, including rain forests, are confined to equatorial areas, especially Latin America, Africa and Southern and Southeastern Asia. Tropical forests currently cover slightly over 5% of the earth's land area, but are rapidly being permanently altered-it is reliably estimated that we have already lost or damaged over 50% of the world's tropical forest resources. The problem is most severe in the less developed nations-Haiti and the Philippines have already lost more than 95% of their tropical forests.

Why is this a problem? After all, trees can be replanted. And any way, how does this affect us in the more developed nations? In fact, deforestation is a global environmental issue, one which affects all of us, whether we live in an area being deforested or in an area in which people are trying to protect their forests, especially tropical and rain forests. As with so many other environmental issues, this one too often pits less developed nations on one side of the issue and developed nations on the other. To understand why deforestation is taking place, at an alarming rate, we need first to identify why the forests are being cut. Most of these reasons can be grouped together as the perceived and real different needs for forested land.

SOIL POLLUTION

Soil pollution is any chemical or biological alteration of soil that is harmful to living organisms. Virtually all soil pollution is the direct result of sources of pollution on the ground surface.

These percolation of these surface pollutants through the soil cause soil degradation, but also acts as a natural cleansing process for ground water. However, solutions, through regulations, are feasible.

SOURCES OF SOIL POLLUTION

Pollution on the ground surface is the cause of most soil pollution. This surface pollution comes from many sources, but these can be grouped into three categories:

WASTE DISPOSAL PRACTICES

The disposal of three sources and types of wastes are one of the primary sources of pollution on or near the ground surface. The disposal of these wastes are discussed in these sections:

HAZARDOUS WASTE

When we think of hazardous waste, the image of industrial by-products stored in rusty barrels generally comes to mind. However, hazardous materials are

also found in cleaning closets, under the sinks, and on the garage shelf in our homes. Agricultural by-products are considered hazardous materials. These substances all pose special disposal concerns. Hazardous waste includes any toxic material whose disposal can endanger people or the environment. Although there are some naturally occurring substances that pose health risks if not properly handled, by far the greatest threat comes from three sources: synthetic chemicals, pesticides and toxic household products. We come in contact with these materials in a great variety of ways.

SOURCES

Synthetic chemicals are used to create the majority of the products in industrial societies. During the manufacture of consumer products, the possibility exists for toxic materials to enter the environment via smokestack emissions, from dumping into surface waters, from leachate lost from landfills and finally as leaked contaminants from deep disposal wells. Most modern agriculture uses a large number of pesticides and herbicides. These synthetic products get into the soil and then into the hydrosphere by runoff from the fields.

Toxic household products include cleansers, detergents, insecticides, used motor oil, and batteries of all sorts. Many people are unaware of the dangers these products pose, and unless communities have special disposal programmes for the materials, these products end up being poured down drains and dumped into municipal landfills.

There they contaminate the water, because waste treatment plants are not equipped to remove contaminants, or they leak out as leachate from landfills which are not designed to contain such chemicals. In both cases the wastes become significant threats to the environment.

THREATS

Plants and animals have no natural resistance to many synthetic products, and thus their presence in soil and water upsets the balance of ecosystems. Pesticides, designed to eliminate one insect, may also kill that insect's natural predators thus increasing a problem instead of decreasing it. The insecticide may also kill or threaten a large number of other animals such as fish or birds that were never intended to be targets. Contaminants in water can produce lesions on fish or kill fish, and these are often only the very visible signs of more extensive disruption of the ecosystem.

The effects of hazardous waste contamination on humans includes a wide variety of symptoms which depend on the type of pollutant and the dose received. In extreme instances the toxins can maim or kill a person instantly, in other cases they can produce brain damage, hearing loss, behaviour problems, cancer, genetic mutations, and birth defects and miscarriages. In an attempt to avoid some of these problems, people can deal with hazardous waste in two basic ways. One method is to find safe ways to dispose of such waste. Another approach is to find ways to decrease the amount of waste produced.

DISPOSAL

Secure Landfills

One method used for the disposal of hazardous waste is to place it in secure landfills. Although some might argue that there is no such thing as a secure landfill the idea behind them is to prevent any leachate from escaping from the disposal site into local aquifers. This is achieved by using geologic barriers such as the type of rock and soil in the disposal area, and by lining the site with an impermeable plastic sheet. Materials are placed in special compartments in the landfill to prevent any undesirable mixing of the different substances. After it is filled, the site would be capped with a layer of impermeable clay to cut down on the amount of water that will pass through. Test wells are drilled into the site to detect any leaking. The main disadvantage to this method of disposal is its failure rate. It is very difficult to isolate the material from the groundwater, and sites which were thought to be absolutely leak-proof have leaked.

Disposal Wells

Another method to dispose of liquid hazardous waste is to pump it deep into the ground. The objective is to isolate the waste from the surface aquifers by placing it below them. Only some areas meet the geologic requirements necessary for this type of disposal. There must be a geologic layer (usually sandstone) at depth to receive the waste, which is separated from the surface aquifers by impermeable layers (usually clay or shale). The waste is injected to the layer through special wells lined with cement. The risks associated with this method of disposal involve leaking at the well entrance, or undetected fractures in the rocks, which would allow contamination of the surface aquifer.

Incineration

A final method to dispose of hazardous waste is to incinerate the material. As long as it is carried out at a sufficiently high temperature, incineration has the advantage of destroying the hazardous nature of the material. Another advantage of this method is that it reduces the volume of the waste material. Suitable for solid and liquid waste, incineration breaks up organic compounds into harmless elements which combine with oxygen and are released into the atmosphere. In some cases, toxic ashes, acids, or metals are the only materials left over to be handled after incineration. The associated risks of incineration are inadvertent leaking of toxic ash or gasses during the process itself. Also, CO_2 is emitted as an end-product of the process which, though not toxic, is a greenhouse gas.

MINIMIZATION

Part of the solution to the problem of hazardous waste has to be to reduce its production. One way to reduce production is to change manufacturing to utilize "cleaner" processes. Another method is participation in waste exchange

programmes, where the waste from some companies is used as a resource for other companies. Many wastes can be re-processed and reused. One of the (outwardly) simplest ways to minimize waste production is to reduce demand for consumer goods. If the goods are not produced, neither will the wastes be produced.

NUCLEAR WASTE

Today there are many uses for nuclear technology which range from simple detectors to the construction of complex weapons. All applications of nuclear technology produce materials which are no longer useful, but are radioactive. These waste materials must be disposed of in a manner which will minimize human exposure to radiation until the material is no longer dangerous.

NUCLEAR ENERGY

Nuclear energy is derived from atoms when their nuclei are split to form less complex atoms, or combined to form larger ones. This change can occur spontaneously when naturally unstable atoms come apart and emit particles and energy, or it can be made to occur on command in nuclear reactors. Humans use nuclear reactions to generate electric power and for a variety of other purposes. In most cases, the atoms created by nuclear change are radioactive, meaning that they are unstable material which will continue to emit particles and energy until it has decayed to a stable state. The energy and particles which are given off are hazardous to most living things.

The time it takes the atoms of a particular element to decay to a stable form is expressed in "half-lives". An element's half-life is the time it takes for half of the material to change to its stable form. An element can remain dangerously radioactive through many half-lives. Materials with short half-lives (measured in seconds) lose their radioactivity quickly, and those with very long half-lives (measured in millions of year) are emitting radiation very slowly. As a result, neither of these poses as much of a threat to humans as does material with an intermediate half-life which may remain dangerously radioactive to 100's or 1000's of years. These materials must be safely isolated from the environment for long periods of time.

SOURCES

The chief uses of nuclear technology include medical diagnosis and treatment, food preservation, electricity generation, weapons production, and the general research which supports those industries. In medicine, radioactive substances are used for diagnostic purposes and for the treatment of cancer. Food irradiation can kill bacteria, insects and fungi without making the food itself radioactive. Nuclear power plants produce electricity for residential and commercial use. The military designs and tests nuclear weapons, and uses nuclear fuel for ships and submarines. All these endeavors produce radioactive waste; some liquid, some solid, and some in the form of a gas. A certain percentage of this waste is

highly radioactive and very dangerous, this is classified as high-level waste. Much of the rest of the waste is mildly radioactive and is considered low-level waste.

LOW-LEVEL WASTE

Low-level waste includes materials such as contaminated clothing, water used for cleaning, filters and some medical waste. It also includes gas emissions from nuclear plants. These may contain only small amounts of radioactivity, but this type of waste accounts for a large percentage of nuclear waste. Much of this material is taken to commercial disposal sites.

COMMERCIAL DISPOSAL SITES

For gases and liquids which contain low-levels of radiation, the main disposal objective is to dilute the material to low concentration levels so that it poses a minimal threat to the environment. The gasses are released into the atmosphere in small quantities. Liquid waste is diluted to a level which is deemed safe and then released.

7

Environmental Pollution and Pollutants

The change in any component of the environment which leads to its deterioration is termed as pollution of the environment.

It is the undesirable change in the physical or biological components which adversely alters the environment.

Pollutants:

- The substances which are present in harmful concentration and is the agent who causes pollution is termed as the pollutant.

CLASSIFICATION OF POLLUTANTS

On the basis of existence in nature:

- *Quantitative Pollutants*: The substances which are already present in the environment, but are termed as pollutants when their concentration increases in the environment, *e.g.*, CO_2 is present in the environment in greater quantity than normal and is hence termed as a quantitative pollutant.
- *Qualitative pollutant*: The substances which are not normally present in the environment and are added by human beings and are pollutants by nature. *E.g.*, insecticides, pesticides

On the basis of the form in which they persist:

- *Primary Pollutants*: The substances which are directly emitted from the source and remain in that form are termed as primary pollutants eg, smoke, fumes, ash, dust, nitric oxide and sulphur dioxide

- *Secondary pollutants*: The substances which are formed by chemical reaction between the primary pollutants and constituents of the environment.

On the basis of disposal:

- *Bio-degradable pollutants*: The pollutants which are decomposed by natural processes eg domestic sewage.
- *Non bio-degradable pollutants*: The pollutants which don't decompose naturally or decompose slowly *e.g.*, DDT, aluminium cans.

THE NATURE AND MEANING OF ENVIRONMENT

We have seen that a community or social group sustains itself through continuous self-renewal, and that this renewal takes place by means of the educational growth of the immature members of the group. By various agencies, unintentional and designed, a society transforms uninitiated and seemingly alien beings into robust trustees of its own resources and ideals.

Education is thus a fostering, a nurturing, a cultivating, process. All of these words mean that it implies attention to the conditions of growth. We also speak of rearing, raising, bringing up — words which express the difference of level which education aims to cover. Etymologically, the word education means just a process of leading or bringing up. When we have the outcome of the process in mind, we speak of education as shaping, forming, molding activity — that is, a shaping into the standard form of social activity.

In this chapter we are concerned with the general features of the way in which a social group brings up its immature members into its own social form. Since what is required is a transformation of the quality of experience till it partakes in the interests, purposes, and ideas current in the social group, the problem is evidently not one of mere physical forming. Things can be physically transported in space; they may be bodily conveyed. Beliefs and aspirations cannot be physically extracted and inserted.

How then are they communicated? Given the impossibility of direct contagion or literal inculcation, our problem is to discover the method by which the young assimilate the point of view of the old, or the older bring the young into like-mindedness with themselves. The answer, in general formulation, is: By means of the action of the environment in calling out certain responses. The required beliefs cannot be hammered in; the needed attitudes cannot be plastered on. But the particular medium in which an individual exists leads him to see and feel one thing rather than another; it leads him to have certain plans in order that he may act successfully with others; it strengthens some beliefs and weakens others as a condition of winning the approval of others.

Thus it gradually produces in him a certain system of behaviour, a certain disposition of action. The words "environment," "medium" denote something more than surroundings which encompass an individual. They denote the specific continuity of the surroundings with his own active tendencies. An inanimate

being is, of course, continuous with its surroundings; but the environing circumstances do not, save metaphorically, constitute an environment. For the inorganic being is not concerned in the influences which affect it. On the other hand, some things which are remote in space and time from a living creature, especially a human creature, may form his environment even more truly than some of the things close to him.

The things with which a man varies are his genuine environment. Thus the activities of the astronomer vary with the stars at which he gazes or about which he calculates. Of his immediate surroundings, his telescope is most intimately his environment. The environment of an antiquarian, as an antiquarian, consists of the remote epoch of human life with which he is concerned, and the relics, inscriptions, *etc.*, by which he establishes connections with that period. In brief, the environment consists of those conditions that promote or hinder, stimulate or inhibit, the characteristic activities of a living being.

Water is the environment of a fish because it is necessary to the fish's activities — to its life. The north pole is a significant element in the environment of an arctic explorer, whether he succeeds in reaching it or not, because it defines his activities, makes them what they distinctively are. Just because life signifies not bare passive existence but a way of acting, environment or medium signifies what enters into this activity as a sustaining or frustrating condition.

THE SOCIAL MEDIUM AS EDUCATIVE

Our net result thus far is that social environment forms the mental and emotional disposition of behaviour in individuals by engaging them in activities that arouse and strengthen certain impulses, that have certain purposes and entail certain consequences. A child growing up in a family of musicians will inevitably have whatever capacities he has in music stimulated, and, relatively, stimulated more than other impulses which might have been awakened in another environment. Save as he takes an interest in music and gains a certain competency in it, he is "out of it"; he is unable to share in the life of the group to which he belongs. Some kinds of participation in the life of those with whom the individual is connected are inevitable; with respect to them, the social environment exercises an educative or formative influence unconsciously and apart from any set purpose. In savage and barbarian communities, such direct participation furnishes almost the sole influence for rearing the young into the practices and beliefs of the group.

Even in present-day societies, it furnishes the basic nurture of even the most insistently schooled youth. In accord with the interests and occupations of the group, certain things become objects of high esteem; others of aversion. Association does not create impulses or affection and dislike, but it furnishes the objects to which they attach themselves. The way our group or class does things tends to determine the proper objects of attention, and thus to prescribe the directions and limits of observation and memory. What is strange or foreign tends to be morally forbidden and intellectually suspect. It seems almost

incredible to us, for example, that things which we know very well could have escaped recognition in past ages. We incline to account for it by attributing congenital stupidity to our forerunners and by assuming superior native intelligence on our own part. But the explanation is that their modes of life did not call for attention to such facts, but held their minds riveted to other things.

Just as the senses require sensible objects to stimulate them, so our powers of observation, recollection, and imagination do not work spontaneously, but are set in motion by the demands set up by current social occupations. The main texture of disposition is formed, independently of schooling, by such influences. What conscious, deliberate teaching can do is at most to free the capacities thus formed for fuller exercise, to purge them of some of their grossness, and to furnish objects which make their activity more productive of meaning. While this "unconscious influence of the environment" is so subtle and pervasive that it affects every fibre of character and mind, it may be worth while to specify a few directions in which its effect is most marked. First, the habits of language.

Fundamental modes of speech, the bulk of the vocabulary, are formed in the ordinary intercourse of life, carried on not as a set means of instruction but as a social necessity. The babe acquires, as we well say, the mother tongue. While speech habits thus contracted may be corrected or even displaced by conscious teaching, yet, in times of excitement, intentionally acquired modes of speech often fall away, and individuals relapse into their really native tongue. Secondly, manners. Example is notoriously more potent than precept. Good manners come, as we say, from good breeding or rather are good breeding; and breeding is acquired by habitual action, in response to habitual stimuli, not by conveying information.

Despite the never ending play of conscious correction and instruction, the surrounding atmosphere and spirit is in the end the chief agent in forming manners. And manners are but minor morals. Moreover, in major morals, conscious instruction is likely to be efficacious only in the degree in which it falls in with the general "walk and conversation" of those who constitute the child's social environment. Thirdly, good taste and esthetic appreciation. If the eye is constantly greeted by harmonious objects, having elegance of form and colour, a standard of taste naturally grows up. The effect of a tawdry, unarranged, and over-decorated environment works for the deterioration of taste, just as meagre and barren surroundings starve out the desire for beauty.

Against such odds, conscious teaching can hardly do more than convey second-hand information as to what others think. Such taste never becomes spontaneous and personally engrained, but remains a laboured reminder of what those think to whom one has been taught to look up. To say that the deeper standards of judgements of value are framed by the situations into which a person habitually enters is not so much to mention a fourth point. We rarely recognize the extent in which our conscious estimates of what is worth while and what is not, are due to standards of which we are not conscious at all. But

in general it may be said that the things which we take for granted without enquiry or reflection are just the things which determine our conscious thinking and decide our conclusions. And these habitudes which lie below the level of reflection are just those which have been formed in the constant give and take of relationship with others.

THE SCHOOL AS A SPECIAL ENVIRONMENT

The chief importance of this foregoing statement of the educative process which goes on willy-nilly is to lead us to note that the only way in which adults consciously control the kind of education which the immature get is by controlling the environment in which they act, and hence think and feel. We never educate directly, but indirectly by means of the environment. Whether we permit chance environments to do the work, or whether we design environments for the purpose makes a great difference. And any environment is a chance environment so far as its educative influence is concerned unless it has been deliberately regulated with reference to its educative effect. An intelligent home differs from an unintelligent one chiefly in that the habits of life and intercourse which prevail are chosen, or at least coloured, by the thought of their bearing upon the development of children. But schools remain, of course, the typical instance of environments framed with express reference to influencing the mental and moral disposition of their members. Roughly speaking, they come into existence when social traditions are so complex that a considerable part of the social store is committed to writing and transmitted through written symbols.

Written symbols are even more artificial or conventional than spoken; they cannot be picked up in accidental intercourse with others. In addition, the written form tends to select and record matters which are comparatively foreign to everyday life. The achievements accumulated from generation to generation are deposited in it even though some of them have fallen temporarily out of use. Consequently as soon as a community depends to any considerable extent upon what lies beyond its own territory and its own immediate generation, it must rely upon the set agency of schools to insure adequate transmission of all its resources. To take an obvious illustration: The life of the ancient Greeks and Romans has profoundly influenced our own, and yet the ways in which they affect us do not present themselves on the surface of our ordinary experiences. In similar fashion, peoples still existing, but remote in space, British, Germans, Italians, directly concern our own social affairs, but the nature of the interaction cannot be understood without explicit statement and attention.

In precisely similar fashion, our daily associations cannot be trusted to make clear to the young the part played in our activities by remote physical energies, and by invisible structures. Hence a special mode of social intercourse is instituted, the school, to care for such matters. This mode of association has three functions sufficiently specific, as compared with ordinary associations of life, to be noted. First, a complex civilization is too complex to be assimilated

in toto. It has to be broken up into portions, as it were, and assimilated piecemeal, in a gradual and graded way. The relationships of our present social life are so numerous and so interwoven that a child placed in the most favourable position could not readily share in many of the most important of them. Not sharing in them, their meaning would not be communicated to him, would not become a part of his own mental disposition. There would be no seeing the trees because of the forest. Business, politics, art, science, religion, would make all at once a clamour for attention; confusion would be the outcome. The first office of the social organ we call the school is to provide a simplified environment.

It selects the features which are fairly fundamental and capable of being responded to by the young. Then it establishes a progressive order, using the factors first acquired as means of gaining insight into what is more complicated. In the second place, it is the business of the school environment to eliminate, so far as possible, the unworthy features of the existing environment from influence upon mental habitudes. It establishes a purified medium of action. Selection aims not only at simplifying but at weeding out what is undesirable. Every society gets encumbered with what is trivial, with dead wood from the past, and with what is positively perverse. The school has the duty of omitting such things from the environment which it supplies, and thereby doing what it can to counteract their influence in the ordinary social environment. By selecting the best for its exclusive use, it strives to reinforce the power of this best.

As a society becomes more enlightened, it realizes that it is responsible not to transmit and conserve the whole of its existing achievements, but only such as make for a better future society. The school is its chief agency for the accomplishment of this end. In the third place, it is the office of the school environment to balance the various elements in the social environment, and to see to it that each individual gets an opportunity to escape from the limitations of the social group in which he was born, and to come into living contact with a broader environment. Such words as "society" and "community" are likely to be misleading, for they have a tendency to make us think there is a single thing corresponding to the single word. As a matter of fact, a modern society is many societies more or less loosely connected. Each household with its immediate extension of friends makes a society; the village or street group of playmates is a community; each business group, each club, is another. Passing beyond these more intimate groups, there is in a country like our own a variety of races, religious affiliations, economic divisions. Inside the modern city, in spite of its nominal political unity, there are probably more communities, more differing customs, traditions, aspirations, and forms of government or control, than existed in an entire continent at an earlier epoch. Each such group exercises a formative influence on the active dispositions of its members.

A clique, a club, a gang, a Fagin's household of thieves, the prisoners in a jail, provide educative environments for those who enter into their collective or conjoint activities, as truly as a church, a labour union, a business partnership, or a political party. Each of them is a mode of associated or community life,

quite as much as is a family, a town, or a state. There are also communities whose members have little or no direct contact with one another, like the guild of artists, the republic of letters, the members of the professional learned class scattered over the face of the earth. For they have aims in common, and the activity of each member is directly modified by knowledge of what others are doing. In the olden times, the diversity of groups was largely a geographical matter.

There were many societies, but each, within its own territory, was comparatively homogeneous. But with the development of commerce, transportation, intercommunication, and emigration, countries like the United States are composed of a combination of different groups with different traditional customs. It is this situation which has, perhaps more than any other one cause, forced the demand for an educational institution which shall provide something like a homogeneous and balanced environment for the young. Only in this way can the centrifugal forces set up by juxtaposition of different groups within one and the same political unit be counteracted. The intermingling in the school of youth of different races, differing religions, and unlike customs creates for all a new and broader environment.

Common subject matter accustoms all to a unity of outlook upon a broader horizon than is visible to the members of any group while it is isolated. The assimilative force of the American public school is eloquent testimony to the efficacy of the common and balanced appeal. The school has the function also of coordinating within the disposition of each individual the diverse influences of the various social environments into which he enters. One code prevails in the family; another, on the street; a third, in the workshop or store; a fourth, in the religious association. As a person passes from one of the environments to another, he is subjected to antagonistic pulls, and is in danger of being split into a being having different standards of judgement and emotion for different occasions. This danger imposes upon the school a steadying and integrating office.

THE SOCIAL ENVIRONMENT

A being whose activities are associated with others has a social environment. What he does and what he can do depend upon the expectations, demands, approvals, and condemnations of others. A being connected with other beings cannot perform his own activities without taking the activities of others into account. For they are the indispensable conditions of the realization of his tendencies. When he moves he stirs them and reciprocally. We might as well try to imagine a business man doing business, buying and selling, all by himself, as to conceive it possible to define the activities of an individual in terms of his isolated actions. The manufacturer moreover is as truly socially guided in his activities when he is laying plans in the privacy of his own counting house as when he is buying his raw material or selling his finished goods.

Thinking and feeling that have to do with action in association with others is as much a social mode of behaviour as is the most overt cooperative or hostile

act. What we have more especially to indicate is how the social medium nurtures its immature members. There is no great difficulty in seeing how it shapes the external habits of action. Even dogs and horses have their actions modified by association with human beings; they form different habits because human beings are concerned with what they do. Human beings control animals by controlling the natural stimuli which influence them; by creating a certain environment in other words.

Food, bits and bridles, noises, vehicles, are used to direct the ways in which the natural or instinctive responses of horses occur. By operating steadily to call out certain acts, habits are formed which function with the same uniformity as the original stimuli. If a rat is put in a maze and finds food only by making a given number of turns in a given sequence, his activity is gradually modified till he habitually takes that course rather than another when he is hungry. Human actions are modified in a like fashion. A burnt child dreads the fire; if a parent arranged conditions so that every time a child touched a certain toy he got burned, the child would learn to avoid that toy as automatically as he avoids touching fire. So far, however, we are dealing with what may be called training in distinction from educative teaching. The changes considered are in outer action rather than in mental and emotional dispositions of behaviour.

The distinction is not, however, a sharp one. The child might conceivably generate in time a violent antipathy, not only to that particular toy, but to the class of toys resembling it. The aversion might even persist after he had forgotten about the original burns; later on he might even invent some reason to account for his seemingly irrational antipathy. In some cases, altering the external habit of action by changing the environment to affect the stimuli to action will also alter the mental disposition concerned in the action. Yet this does not always happen; a person trained to dodge a threatening blow, dodges automatically with no corresponding thought or emotion. We have to find, then, some differentia of training from education. A clew may be found in the fact that the horse does not really share in the social use to which his action is put. Some one else uses the horse to secure a result which is advantageous by making it advantageous to the horse to perform the act — he gets food, *etc.*

But the horse, presumably, does not get any new interest. He remains interested in food, not in the service he is rendering. He is not a partner in a shared activity. Were he to become a copartner, he would, in engaging in the conjoint activity, have the same interest in its accomplishment which others have. He would share their ideas and emotions. Now in many cases — too many cases — the activity of the immature human being is simply played upon to secure habits which are useful. He is trained like an animal rather than educated like a human being. His instincts remain attached to their original objects of pain or pleasure. But to get happiness or to avoid the pain of failure he has to act in a way agreeable to others. In other cases, he really shares or participates in the common activity. In this case, his original impulse is modified. He not merely acts in a way agreeing with the actions of others, but, in so acting, the

same ideas and emotions are aroused in him that animate the others. A tribe, let us say, is warlike. The successes for which it strives, the achievements upon which it sets store, are connected with fighting and victory. The presence of this medium incites bellicose exhibitions in a boy, first in games, then in fact when he is strong enough.

As he fights he wins approval and advancement; as he refrains, he is disliked, ridiculed, shut out from favourable recognition. It is not surprising that his original belligerent tendencies and emotions are strengthened at the expense of others, and that his ideas turn to things connected with war. Only in this way can he become fully a recognized member of his group. Thus his mental habitudes are gradually assimilated to those of his group.

If we formulate the principle involved in this illustration, we shall perceive that the social medium neither implants certain desires and ideas directly, nor yet merely establishes certain purely muscular habits of action, like "instinctively" winking or dodging a blow. Setting up conditions which stimulate certain visible and tangible ways of acting is the first step. Making the individual a sharer or partner in the associated activity so that he feels its success as his success, its failure as his failure, is the completing step. As soon as he is possessed by the emotional attitude of the group, he will be alert to recognize the special ends at which it aims and the means employed to secure success.

His beliefs and ideas, in other words, will take a form similar to those of others in the group. He will also achieve pretty much the same stock of knowledge since that knowledge is an ingredient of his habitual pursuits. The importance of language in gaining knowledge is doubtless the chief cause of the common notion that knowledge may be passed directly from one to another. It almost seems as if all we have to do to convey an idea into the mind of another is to convey a sound into his ear. Thus imparting knowledge gets assimilated to a purely physical process. But learning from language will be found, when analysed, to confirm the principle just laid down.

It would probably be admitted with little hesitation that a child gets the idea of, say, a hat by using it as other persons do; by covering the head with it, giving it to others to wear, having it put on by others when going out, *etc*. But it may be asked how this principle of shared activity applies to getting through speech or reading the idea of, say, a Greek helmet, where no direct use of any kind enters in. What shared activity is there in learning from books about the discovery of America? Since language tends to become the chief instrument of learning about many things, let us see how it works. The baby begins of course with mere sounds, noises, and tones having no meaning, expressing, that is, no idea. Sounds are just one kind of stimulus to direct response, some having a soothing effect, others tending to make one jump, and so on. The sound h-a-t would remain as meaningless as a sound in Choctaw, a seemingly inarticulate grunt, if it were not uttered in connection with an action which is participated in by a number of people.

When the mother is taking the infant out of doors, she says "hat" as she puts something on the baby's head. Being taken out becomes an interest to the child;

mother and child not only go out with each other physically, but both are concerned in the going out; they enjoy it in common. By conjunction with the other factors in activity the sound "hat" soon gets the same meaning for the child that it has for the parent; it becomes a sign of the activity into which it enters.

The bare fact that language consists of sounds which are mutually intelligible is enough of itself to show that its meaning depends upon connection with a shared experience. In short, the sound h-a-t gains meaning in precisely the same way that the thing "hat" gains it, by being used in a given way. And they acquire the same meaning with the child which they have with the adult because they are used in a common experience by both.

The guarantee for the same manner of use is found in the fact that the thing and the sound are first employed in a joint activity, as a means of setting up an active connection between the child and a grownup. Similar ideas or meanings spring up because both persons are engaged as partners in an action where what each does depends upon and influences what the other does. If two savages were engaged in a joint hunt for game, and a certain signal meant "move to the right" to the one who uttered it, and "move to the left" to the one who heard it, they obviously could not successfully carry on their hunt together.

Understanding one another means that objects, including sounds, have the same value for both with respect to carrying on a common pursuit. After sounds have got meaning through connection with other things employed in a joint undertaking, they can be used in connection with other like sounds to develop new meanings, precisely as the things for which they stand are combined. Thus the words in which a child learns about, say, the Greek helmet originally got a meaning by use in an action having a common interest and end. They now arouse a new meaning by inciting the one who hears or reads to rehearse imaginatively the activities in which the helmet has its use. For the time being, the one who understands the words "Greek helmet" becomes mentally a partner with those who used the helmet.

He engages, through his imagination, in a shared activity. It is not easy to get the full meaning of words. Most persons probably stop with the idea that "helmet" denotes a queer kind of headgear a people called the Greeks once wore. We conclude, accordingly, that the use of language to convey and acquire ideas is an extension and refinement of the principle that things gain meaning by being used in a shared experience or joint action; in no sense does it contravene that principle. When words do not enter as factors into a shared situation, either overtly or imaginatively, they operate as pure physical stimuli, not as having a meaning or intellectual value.

They set activity running in a given groove, but there is no accompanying conscious purpose or meaning. Thus, for example, the plus sign may be a stimulus to perform the act of writing one number under another and adding the numbers, but the person performing the act will operate much as an automaton would unless he realizes the meaning of what he does.

NATURE-MAN INTERACTION

Kerala is known as 'the God's own land'. Its environment, culture, and practices also endorse this truth. Kerala is blessed with plural culture, marvelous natural setups, and beautiful people. The life of the people is very calm and quite, and shows high adaptability, and international standards, at least in the sphere of health and education. All these highly appreciable achievements are due to its natural conditions, and, 'Nature-Man interaction'. We, anthropologists, are very keen about this kind of interactions, and strongly believe that culture, and all behaviour patterns are evolved out of this interaction.

And, it also helps us to understand who we are and who other people are or, who is who and what is what, the identity of people. So, I would like to examine how the identity is evolved from the 'Nature-Man' interaction with reference to the unique tradition, the teyyam performance of North Malabar. According to Kurup "The Teyyam or Teyyattam is a popular cult in Malabar which has become an inseparable part of the religion of the village folk".

Damodaran says that:

- "Through teyyam, the people of North Malabar worship Nature, spirits, ancestors, gods, and goddesses as their local deities…Teyyam performance is the glory of this mode of worship…The teyyam performance is a complex process, which includes the observance of several rituals, and the appearance of the beloved deities in front of believers".

The very word, teyyam, can bring forth in the mind of a listener a fascinating, as well as a colourful picture, particularly, its charming attires, superb dance and enchanting music, and equally important, the commitment of the people. It is also true that as far as the people of North Malabar are concerned, the word, teyyam, has more than one meaning. According to them, the teyyam is everything. Absolutely they believe that, it is their present, past and future, as far as their society is concerned. More than that, teyyam is culture, tradition, and environmental relationship.

The devotees worship and perform teyyam, as an indispensable part of their religion, magic, and even politics. For this reason, it is deemed as a unique religious ritual. It is believed that the teyyam possess great power, and is sacred and divine, which is also at once both non-human and supernatural.

The followers strictly follow its code, in terms of its rules and behaviour patterns because, they fear that its anger will lead to their destruction, and its pleasing will lead to their well being. People of North Malabar think that all activities are directly, or indirectly linked with the teyyam tradition.

For that reason, they consider it both as their designer, and destroyer. The term, teyyam, is used as a synonym to daivam. It is always grappled with symbols, and rituals, on the basis of local myths. The basic number of teyyam is only onnu kuraya nalpathu, meaning one less than 40 hence, 39 but, for a few, the number is still larger, onnurunalpathu teyyams, 140 forms. According to the information I have gathered from my fieldwork, and also from published materials, the number goes farther, and as many as three hundred to five hundred

different forms of teyyams are performed in this area. We can classify teyyam, in terms of gender in general, and myth of origin and tõttam pãttu in particular.

So there are two groups, male and female teyyams, on the basis of gender. The females are the dominant ones, at least as far as the number is concerned. In terms of myth of origin and tõttam pãttu, it is possible to separate teyyams into five categories namely, Gods and Goddesses, Ancestors, Heroes and Heroines, Spirits and Devils, and Nature and Animals. There are foreign scholars who consider the teyyam as, 'nothing but devil dance', but it is not a 'devil dance'. It is, in fact, a part of people's sacred tradition.

There are others, who consider the teyyam as an 'art form', and they also do not know its sociocultural significance and ramifications. In addition to these views, there is also a common feeling which is prevalent among the people that teyyam is a 'caste-based occupation' of a few groups. Such assumption may be partly true. Actually, in reality, it presupposes that all that are endowed with life in North Malabar form the 'part and parcel' of the teyyam. Another important truth is that this social etiquette has been unceasingly flowing all the way through centuries, through generations, and it not only perpetuates the culture, but also maintains its 'identity'.

There are many rituals and performances all over the world, which are related to religions, but surprisingly, we cannot acknowledge a similar creation such as, the teyyam, anywhere in the world. The society of North Malabar is mainly stratified into three social groups, in terms of religion: Hindu, Muslim, and Christian. Jainism, and Buddhism are not having an influential presence in this area, today. The three social groups have their own life styles, and behaviour patterns. The Hindus are the dominant ones, and traditionally, they are said to be the real inhabitants, and the Mapila and Christian are the later migrant groups.

It is the dominant Hindus, who came in close touch with the teyyam through an attempt at assimilation. This is why the Hindu society overlaps with that of the teyyam, that also having the elements of Animism, Animatism, and Nature worship. There are three types of teyyam celebrations namely, prarthanakaliyãttam, kalpanakaliyãttam, and perumal-aliyãttam. During performances, several rituals are observed according to the rites and rules of the respective teyyam, and in a specific point of time, the performer performs the teyyam, dressed in a peculiar manner by using specially designed colourful and magnificent attires. They wear respective attire and decorations and perform certain kind of rhythmic dance.

METHODOLOGY

The method and techniques executed for data collection and interpretation here in this document largely drawn from anthropology. Extensive fieldwork was the soul of this study since, both participant and non-participant observation, and unstructured and informal interview supplies bulk of the informations. Secondary sources and reports were also make use for obtaining information. The gathered informations were cross-checked and recorded.

And finally analysed, and interpreted according to the objective of this document. It has long been established that ecology plays a vital role in

conditioning the culture of a given area, and that the geographical situation of a locale goes a long way in shaping the needs, customs, behaviour, and thoughts of the people.

According to Redfield, "both man and Nature are the twin-agents of the perennial revolution that shapes and re-shapes the face of the earth". It is not only the anthropologists who speak about the importance of environment in the evolution of the human society but also, even Indian philosophers have spoken about it.

For example, the Tolkappiam, written by Tolkappiar speaks about the three factors in relation with the formation of a society. These are space and time, local resources or things that are available in the immediate neighbourhood, and the cultural elements that evolve due to man's utilization of them. So also in the case of the teyyam, ecology plays a vital role. The interaction network between human beings and environment produces a culture. The teyyam is a proof to this. A study of the teyyam, from an anthropological standpoint, reveals us the fact that interaction also gave shape to new modes of adaptations that were necessary for different situations for easy survival.

DISCUSSION

Absolutely, the very uniqueness of teyyam stands on the 'interaction' between man and man, and between man and his surroundings, *i.e.*, man's dependency on environment. The environment of which I have spoken of includes both the physical environment, and the socio-cultural environment. This pattern of attachment also makes the people to deem teyyam as their 'science', and 'culture', inherited from the past, and their limited technology and know-how insist to them that they trust heavily teyyam for the common good of the people. It also helps the people to discard the stress and strains of day to- day struggle for survival.

Therefore, I have the firm belief that this ritual, the teyyam, as a demand of the whole society, is considered as a necessity by the people of North Malabar. There was a time when teyyam performers directly depend on Nature for obtaining the essential commodities to make the teyyam attires. All the costumes, and other items, including those for offerings, were obtained from the surroundings, which were copious and cheap. At present, they find it hard to obtain the natural materials from the surroundings.

In addition to this, the increasing influences of the market also act as a force to change the traditional mode of environment-exploitation. Therefore, the performers now show a greater amount of dependency on market, which was not the case in the past, for obtaining essential teyyam commodities. The area, North Malabar, experiences three main seasons: the cold, the rainy, and the hot season every year. The Monsoon renders good supply of water, and the ponds, gullies, channels, rivers and dales, which are in plenty, act as the best reservoirs of water.

The area also consists of hilly uplands, valleys, and forests. Most of the mountainous regions are covered with thick forests. The forests provide in

abundance with food, fuel, and other materials for building houses, medicines, and for other needs. The environment acts as a multifaceted resource, and contributes for the subsistence, and survival of the people. When the necessary resources are available to all, what should the people to do? Just exploit the resources that are available in their surroundings! Thus, they start to subsist on them, and therefore, the economy of the people pivots around the forest, *i.e.*, the Nature. Subsequently, when the people felt that these facilities are not enough to fulfil their growing needs and drive, they readjusted their life style that minimized the degree of Nature-dependency.

Even when the degree of dependency decreased, they did not allow themselves to destroy Nature, but were vigil to preserve it. This had led to Nature-worship, and this offered deities a chance to reside, and perform in every nook and corner. In this regard, they came forward to preserve trees in the form of kãvu as one of the sacred centres of teyyam performance. Likewise, the references that are made in tottampãttu about certain practices like hunting, gathering, pastoralism, and similar activities definitely reveal the degree of such subsistence, and survival.

For example, the tottam pãttu of kuttychãthan teyyam runs like this: "ezhala kali yundalo Kalakaderku, a kali maiponae kayariduvonae". This indicates the then prevalent pastoralism. Similarly, we can find many references about punam krishi, nayattu, and meen pidutham. In that way the teyyam of North Malabar clearly tells us the fact that on a number of occasions humans interacted with the Nature. A number of teyyams were observed as the transfigured Nature-objects such as monkey, leopard/tiger, pig, and snake. For example teyyams like Bali, Pulikandan, Madayil Chamundi, and Naga Rajan represents monkey, leopard, pig, and serpent respectively.

Most of the attire and wearings of teyyam also made up as in the shape of Nature-objects. In such way, masks, and pseudo bosoms and nails are used during performances. The pattern of facial writings also borrowed from Nature. Kozhipushpam, sangum valum, anachuvadu, and kurangirutham are few examples for such Nature-based pattern of facial writings.

These facts clearly confirm there is a Nature-Man interaction exists in the sphere of teyyam. The sacred performance needs ritual functionaries, who can carryout various performances hence, considered as, 'sacred specialists'. The ritual processes of contacting, and offering in a particular manner are already established things, in respect to each deity. Altogether, the worship, the performance, and the offering exercise are of complex nature that needs a 'middleman'.

The people successfully surmounted the operational difficulty of approachability by assigning certain persons the task of establishing liaison with the supernatural, through their divine teyyam performance. However, teyyam has existed in harmony with ecological settings, it also made possible some sort of social relationships. Thus, it often describes symbolically the actual social relations, status, and the role of the individuals in the society.

This relationships, and social positions have been working on a special kind of social network in which each caste is tied up with some obligations. In another word, every one has his own role to play in each performance. For example, the celebrant and the devotees celebrate and worship, and the performer performs teyyam.

The traditional economic structure of North Malabar has a special kind of system that characterizes a 'service-return' relationship, and under this system, each caste within a territorial division is expected to give certain standardized service to the families of other castes. Every one works for the respective family or, group of families with which he has 'hereditary ties'. His forefathers worked for the same families, and their descendants will continue to work for them because, the caste is the determinant of the occupation or, service.

The server in return will get certain economic benefits. For example, the Malayan, a traditional performer of magic, medicine, midwifery, and the teyyam, renders his services to families residing in a territory with which he has hereditary ties. In return, he gets cash or, kind. The system has also been shown to follow the pattern that each and every caste constitutes two-way interaction: one way, they render service to others, and on the other way, they receive certain benefits. In that sense, the performance of the teyyam provides a means to its performer's existence.

Earlier, this kind of master-servant relationship was quite common in Kerala but, latter this pattern could not continue forever, due to political reasons. The introduction of a revolutionary act, 'Kerala Land Reforms Act', by the government of Kerala, under E.M.S Ministry, disturbed the feudal set up, as well as the occupational homogeneity of the state. But surprisingly, it is noticed that the age-old pattern of extending services between castes remains, not in severity, in teyyam performance. That is also noted as a pattern of behaviour against the modern innovations, and way of living. It is true that the society and its culture have been subjected to change, and yet, the people in this area still blindly carry out almost all the rituals and practices related to the teyyam performance without diluting it.

Due to this reason, the 'socalled' untouchables are the only people permitted to perform the teyyam in different sacred centres. Hence, it reflects the performers' identity too, because, they are simply identified as, the teyyam 'executors'.

In vise-versa, the performances of the teyyam also reflect the 'caste identity'. So, a few teyyams are customarily identified as, the teyyams performed by certain castes. Malayante teyyam, Vannante teyyam, and Pulayante teyyam can be considered as the examples to this. For that reason Vishnumurthi teyyam, Puthiya Bhagavathi, Kundora Chamundi, and Pulimarnja Thondachan teyyam are considered as the teyyams of Malayan, Vannan, Velan, and Pulayan respectively.

The villagers continue to perform the teyyam because, it still encloses a number of positive functions. Once, teyyam had socio-economic significance, and only later on, with the evolution of a multi-caste, pluralistic, and complex

society, it came to perform more elaborate duties, political, religious, communicative, and ceremonial, besides its earlier functions. Apart from the said functions, the teyyam also serves the society, as a critique of the sociocultural discrimination, and which is an instrument to condemn social evils, and is a form of protest and criticism.

Some of the teyyams are directly attacking social oppressions and exploitations and there are also teyyams that indirectly oppose such discriminations. This liberty to criticize discriminations such as, 'untouchability' and 'pollution', gives the oppressed people some 'satisfaction', and 'relief'.

Even though this, significance of the teyyam is fading away to certain extent, but still has its holds in the sociocultural milieu of North Malabar. The myth, the rituals, and the whole performance of the teyyam itself glorify a few of the past stories of man, and his socio-cultural activities such as, hunting- gathering, nomadism, pastoralism, agriculture, as well as other elements such as, social structure, social status, social discriminations, and protests. The endurance of this old tradition namely, the teyyam, connects the past with the present, and keeps up a cultural continuity of this region, the rural and the urban areas. The sacred centres of the teyyam also act as linking agents to connect the performance and the people, and the society and its culture, even today.

On the other hand, it is also alive as a more popular cultural phenomenon in North Malabar, which helps in maintaining the socio-cultural identity through observing certain widespread rituals and performances, that have been inherited from the distant past, and evolved from the Nature-Man interaction. Thus, for that reason, the teyyam is apt to survive as an important and living part of the socio-cultural sphere.

SEDIMENT AS A CHEMICAL POLLUTANT

The role of sediment in chemical pollution is tied both to the particle size of sediment, and to the amount of particulate organic carbon associated with the sediment. The chemically active fraction of sediment is usually cited as that portion which is smaller than 63 μm (silt + clay) fraction. For phosphorus and metals, particle size is of primary importance due to the large surface area of very small particles. Phosphorus and metals tend to be highly attracted to ionic exchange sites that are associated with clay particles and with the iron and manganese coatings that commonly occur on these small particles.

Many of the persistent, bioaccumulating and toxic organic contaminants, especially chlorinated compounds including many pesticides, are strongly associated with sediment and especially with the organic carbon that is transported as part of the sediment load in rivers. Measurement of phosphorus transport in North America and Europe indicate that as much as 90 per cent of the total phosphorus flux in rivers can be in association with suspended sediment.

The affinity for particulate matter by an organic chemical is described by its octanol-water partitioning coefficient (K_{OW}). This partitioning coefficient is well known for most organic chemicals and is the basis for predicting the environmental

fate of organic chemicals. Chemicals with low values of K_{OW} are readily soluble, whereas those with high values of K_{OW} are described as "hydrophobic" and tend to be associated with particulates. Chlorinated compounds such as DDT and other chlorinated pesticides are very hydrophobic and are not, therefore, easily analysed in water samples due to the very low solubility of the chemical. For organic chemicals, the most important component of the sediment load appears to be the particulate organic carbon fraction which is transported as part of the sediment. Scientists have further refined the partitioning coefficient to describe the association with the organic carbon fraction (K_{OC}).

Another important variable is the concentration of sediment, especially the <63 μm fraction, in the water column. Even those chemicals that are highly hydrophobic will be found in trace levels in soluble form.

Where the suspended load is very small (say, less than 25 mg/l), the amount of water is so large relative to the amount of sediment that the bulk of the load of the chemical may be in the soluble fraction.

Unlike phosphorus and metals, the transport and fate of sediment-associated organic chemicals is complicated by microbial degradation that occurs during sediment transport in rivers and in deposited sediment.

Nevertheless, the role of sediment in the transport and fate of agricultural chemicals, both for nutrients, metals, and pesticides is well known and must be taken into account when monitoring for these chemicals, and when applying models as a means of determining optimal management strategies at the field and watershed level. For this reason, models using the "fugacity" concept (uses the partitioning characteristics of chemicals as a basis for determining the environmental compartment - air, sediment, water, biota - in which the chemical is primarily found) has proven effective in predicting the environmental pathways and fate of contaminants.

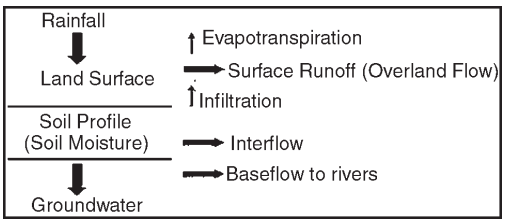

Fig. Schematic Diagram Showing the Major Processes that Link Rainfall and Run-off

- *Conclusion*: The role of sediment as a chemical pollutant is a function of the chemical load that is carried by sediments.

Organic chemicals associated with sediment enter into the food chain in a variety of ways. Sediment is directly ingested by fish however, more commonly, fine sediment (especially the carbon fraction) is the food supply for benthic (bottom dwelling) organisms which, in turn, are the food source for high organisms. Ultimately, toxic compounds bioaccumulate in fish and other top predators. In this way, pesticides that are transported off the land as part of the run-off and erosion process, accumulate in top predators including man.

KEY PROCESSES: PRECIPITATION AND RUN-OFF

The major characteristic of non-point source pollution is that the primary transfer mechanisms from land to water are driven by those hydrological processes that lead to run-off of nutrients, sediment, and pesticides.

This is important, not only to understand the nature of agricultural pollution, but also because modelling of hydrological processes is the primary mechanism by which agriculturalists estimate and predict agricultural run-off and aquatic impacts.

Except where agricultural chemicals are dumped directly into watercourses, almost all other non-point source control techniques in agriculture involve control or modification of run-off processes through various land and animal (manure) management techniques.

In large parts of the world, precipitation is in the form of rain. However, in those areas where precipitation is in the form of snow, the science becomes more complex. Nevertheless, control measures, whether for areas subject to rain or snow can be easily summarized. Therefore, for the purpose of this publication, focus will be on the relationships between rainfall and run-off. While the practice of hydrology can be quite theoretical, the principal concepts are easily understood.

Rainfall

The primary controlling factor is the rate (intensity) of rainfall. This controls the amount of water available at the ground surface, and is closely related to measures of energy that are used in many mathematical formulations to calculate soil detachment by rain drops. Soil detachment makes soil particles available for sediment run-off.

Soil Permeability

Permeability is a physical characteristic of a soil and is a measure of the ability of the soil to pass water, under saturated conditions, through the natural voids that exist in the soil. Permeability is a function of soil texture, mineral and organic composition, *etc.* In contrast, "porosity" is the measure of the amount of void space in a soil; however, permeability refers to the extent to which the porosity is made up of interconnecting voids that allow water to pass through the soil. As an example, styrofoam is highly porous but impermeable, whereas a sponge is both porous and permeable.

Infiltration

Infiltration rate, the rate at which surface water passes into the soil (cm/hr), is one of the most common terms in hydrologic equations for calculating surface run-off. Infiltration is not identical to permeability; it is mainly controlled by capillary forces in the soil which, in turn, reflect the prevailing conditions of soil moisture, soil texture, degree of surface compaction, *etc.* Infiltration will

vary between and within rainfall events, depending upon factors such as antecedent soil moisture, nature of vegetation, *etc.* In general, infiltration rate begins at a high value during a precipitation event, and decreases to a small value when the soil has become saturated.

Surface Run-off

This is the amount of water available at the surface after all losses have been accounted for. Losses include evapotranspiration by plants, water that is stored in surface depressions caused by irregularity in the soil surface, and water that infiltrates into the soil. The interaction between infiltration rate and precipitation rate mainly governs the amount of surface run-off. Intense rainstorms tend to produce much surface run-off because the rate of precipitation greatly exceeds the infiltration rate. Similarly, in areas of monsoonal rain and tropical storms, the length and intensity of precipitation frequently exceeds infiltration capacity. Destruction of protective surface vegetation and compaction of the soil, especially in tropical environments, leads to major erosional phenomena due to the amount of surface run-off. Except for nitrogen which is usually found in groundwater in agricultural areas, surface run-off is the primary contributor of agricultural chemicals, animal wastes, and sediment to river channels.

Interflow

Sometimes called "throughflow") Because soil horizons have different levels of permeability not all water in the soil will move downward into the groundwater. The residual water in the soil will move along the soil horizons, parallel to the ground surface. Interflow usually emerges near the bottom of slopes and in valley bottoms. Therefore, identification of these hydrologically active zones is an important part of agricultural non-point source control measures. Interflow is the mechanism which has also been linked to soil piping, a potentially destructive characteristic in some soils by which shallow "pipes" form naturally in the soil and are enlarged by interflow to the point where they collapse causing gullies in the agricultural surface.

Groundwater

Groundwater is supplied by water which passes through the soil horizons into the parent material and/or bedrock underlying the soil. Groundwater tends to flow towards rivers channels where it emerges and supports stream flow during periods of little or no rain. This component of stream flow is called "base flow". The chemistry of base flow reflects the soil and bedrock geochemistry, plus any agrochemicals that have been leached into the groundwater.

Snowmelt

The phenomenon of snowmelt greatly complicates prediction of agricultural pollution using conventional hydrologic models. Snowmelt, by itself, is not normally a major producer of surface run-off.

However, the combination of spring rain and snowmelt on frozen or thawing soils can produce serious erosional problems. Snowmelt tends to contribute greatly to agricultural non-point source pollution by carrying to adjacent streams the animal wastes, sludges, and other wastes that were spread on frozen agricultural soils during the winter period. Correct management of animal wastes in regions of frozen ground has major beneficial effects on water quality.

ENVIRONMENT LAW AND POLLUTION MANAGEMENT

Environmental law is a legal framework designed to regulate human activities that may harm the environment and manage pollution effectively. It encompasses a wide range of regulations and policies aimed at preserving natural resources, protecting ecosystems, and safeguarding human health. Pollution management is a key component of environmental law, focusing on controlling and mitigating the release of harmful pollutants into the environment. This includes laws and regulations governing air quality, water quality, waste management, hazardous substances, and contaminated sites. Environmental laws establish standards and guidelines for pollution control, set limits on pollutant emissions, and prescribe measures for monitoring and enforcement. Regulatory agencies are responsible for overseeing compliance with environmental laws, conducting inspections, and enforcing penalties for non-compliance. Additionally, environmental laws often incorporate mechanisms for public participation, allowing stakeholders to voice concerns, provide input on regulatory decisions, and seek redress for environmental harm. Effective pollution management requires a comprehensive approach that integrates regulatory measures with pollution prevention, remediation, and sustainable practices. By establishing clear regulatory frameworks and promoting best practices, environmental law plays a crucial role in addressing pollution and advancing environmental sustainability. The book on Environment Law and Pollution Management provides comprehensive insights into regulatory frameworks and strategies for effectively managing pollution to protect the environment and human health.

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