ENVC 24 : Energy and Environment

Part-4 : Energy Management - Planning - Policy

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Energy Management

- Principles of Environmental Management.
- Policy and Legal Aspects of EM.
- Environmental Impact Assessment (EIA).
- EIA Documentation and Processes.
- Environmental Auditing.
- Life Cycle Assessment (LCA).
- Environmental Management System Standards.
- Environmental Management Techniques.
- Environmental Design.
- Environmental Economics.

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Environmental Management (EM)

- **Unplanned developmental activities as well as ever-increasing population have caused enormous strain on the environment resources & hence societies across the world face several problems of environmental degradation. However, it is imperative to maintain a balance between the capacity of the environment & the sustainable utilization of resources. This is only possible by understanding the environment in its totality & the principles of its scientific management.**

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- EM represents the management of various activities, including environmental action plan, conservation of resources, environmental status evaluation, environmental legislation, administration & focuses more on implementation, monitoring, auditing, practice & real-world issues than on theoretical planning.

Definition & Scope of EM

- (i) The process of allocating natural and artificial resources so as to make optimum use of the environment in satisfying basic human needs at the minimum & more if possible, on a sustainable basis (Jolly, 1978). (ii) A generic description of a process undertaken by systems-oriented professionals with a natural science, social science or less commonly, an engineering, law, or design background, tackling problems of the human altered environment on an interdisciplinary basis from a quantitative &/or futuristic viewpoint (Dorney, 1989).

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- Characteristics of EM ➔ (i) It is often used as a generic term, (ii) It supports sustainable development, (iii) It deals with a world affected by human beings. (iv) It demands a multidisciplinary or interdisciplinary approach, (v) It has to integrate different development viewpoints, (vi) It seeks to integrate science, social science, policy-making & planning, (vii) It recognizes the desirability of meeting, & if possible exceeding basic human needs, (viii) The time-scale involved extends beyond the short-term & concerns range from local to global, (ix) It should show opportunities as well as address threats & problems.

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Goals of EM

Goals of EM is an approach for environmental supervision integrating ecology, policy-making, planning & social development include **(i)** preventing & resolving environmental problems, **(ii)** establishing limits, **(iii)** establishing & nurturing institutions that effectively support environmental research, monitoring & management, **(iv)** identifying threats and opportunities, **(v)** sustaining & if possible, improving existing resources, **(vi)** improving the quality of life, **(vii)** identifying environmentally sound technologies or policies.

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- **Need for EM** ➔ World population is **7.6 billion** & the growth of human population is **83 million** annually (**1.1%**). In the last 10000 years, the population of the world has increased over a 1000-fold & much of that change has occurred in the last century ***(from 1 billion in 1800 to 7.6 billion in 2017)***. This phenomenal growth in population has put pressure on the means of subsistence, throwing it out of balance with the environment. The interaction between population & environment is very complex & dynamic.

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Need for EM

- We are yet to understand this complex inter-relationship at its micro-level & its spatio-temporal ramifications over a region or the globe in its entirety. What is certain is that as the population grows, the level of consumption of natural resources & production of wastes proportionately increases. We know that the environment is constantly changing due to human activities, leading to problems as soil erosion, floods, droughts, climate changes, desertification & general degradation of the environment. In a finite world there are limits, & there indeed are complex environment-population linkages and feedback. Sustainable development is therefore necessary to sustain the quality of life without exceeding environmental limits.

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- **Need for Sustainable Development** **The great surge in development & technology over the last two centuries has contributed to the increase in quantities of chemicals sufficient to damage natural systems on a grand scale over the world. Acid rain, desertification, destruction of species, greenhouse modification & ozone layer depletion are well known examples of these impacts.**

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Need for Sustainable Development

- Protection of the natural ecosystem has long-term benefits for humans in utilitarian terms through maintenance of gene pools, bio-diversity and other potentially useful factors & in spiritual terms, through living in harmony with nature. **The ecosystem's intrinsic values and rights, regardless of human needs, therefore, should be taken into account apart from considering it a resource to be exploited for human settlement, food & energy production.**

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- Sustainable development is imperative. It is defined as a pattern of social & structured economic transformation (i.e.,development), which optimizes the economic & societal benefits available in the present, without jeopardizing the likely potential for similar benefits in the future. A primary goal of sustainable development is to achieve a reasonable & equitably distributed level of economic well being that can perpetuate continuously for many human generations. This implies using natural resources in a renewable manner that does not eliminate or degrade them, or diminish their usefulness for future generations. It further implies using non-renewable mineral resources in a manner that does not unnecessarily preclude easy access to them by future generations.

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Need for Sustainable Development

- **Definition** **(i)** Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. **(ii)** Sustainable development ensures that the maximum rate of resource consumption & waste discharge for a selected development portfolio would be sustained indefinitely, in a defined planning region, without progressively impairing its bio-productivity conservation & ecological integrity.

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Approach of EM to achieve Sustainability

- Ad hoc approach → This means an approach developed in reaction to a specific situation
- Problem-solving approach → This refers to an approach that follows a series of logical steps to identify problems, needs and solutions.
- Systems approach → This approach focuses on ecosystem (e.g., mountain; high latitude, savannah; desert; island; lake, etc.), agro-ecosystem, etc.
- Regional approach → This is based on ecological zones or biogeophysical units such as watershed, river basin, coastal zone, islands, etc.
- Specialist discipline approach → This refers to the approach often adopted by professionals like air quality management, water quality management, land management, environmental health, urban management, conservation area management, etc.
- Voluntary sector approach → This represents the approach NGOs encourage &/or support.

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Evolution of EM techniques

- One of the outcomes of the 3-decades of policy development since 1970 has been the evolution of the techniques for the analysis and management of environmental effects. The tools considered are (i) Environment assessment (EA), (ii) Economic assessment, usually through cost-benefit analysis (CBA), (iii) Environmental Impact Statement (EIS), (iv) Environment audits, (v) Waste minimisation programs & EM systems. (vi) Life cycle assessments (LCA), (vii) Environmental design (ED).

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- Participants in EM ➔ Following two groups involved in environment & development: **(i)** People or governments who are uninformed of the implications of development, or who are unable to voice their views adequately & affect change, **(ii)** Consultants, scientists, economists, bankers & those bent on riches or blinkered by concern for sovereignty, religion or national security.

Participants in EM

- In any given EM situation, there are likely to be a number of different perspectives & hence various possible responses. An environmental manager has to grasp the sum total of the perspectives & try to avoid conflicts between participants & minimize damage to the environment. The participants of EM can be categorized as **existing users**, **groups seeking change**, **groups with little control**, **the public**, **facilitators** & **controllers**.

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➔ **Existing Users** This category refers to those who currently use land or other resources. Those using the environment or resources usually evolve *rights* & develop *management skills*. However, problems arise where unwritten traditional strategies & rights break down or taken illegally typically by incoming migrants & settlers, urban elites or powerful commercial organizations. Worldwide, the expropriation of common resources from traditional users has become a problem.

Participants of EM

There has been a growing practice of seeking to consult & involve local people (i.e., native groups) in EM to understand & make wider use of native knowledge. EM can learn a lot from the study of local people's livelihood strategies. Since 1975-1985 UN Decade for Women, there has been an interest in studying the role of women in EM. According to the different perspectives adopted, these studies take different shapes as:

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Women, environment & development ➔ **This focuses on women as having a special relationship with the environment as its users & managers.**

Gender and development ➔ **This seeks gender as a key dimension of social difference affecting people's experiences, concerns & capabilities.**

Women in development ➔ **This focuses on reasons for women's exclusion or marginalization from decision-making & receipt of the benefits of development.**

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Participants of EM

- **Groups seeking change** This category consists of governments (with conflicting demands from various ministries or policy-makers), commerce (e.g. national, local, MNC's etc.), individuals seeking personal gain or seeking to change the prevailing situation, international agencies, NGOs, media, academics etc. It is probably the exception to the rule for special-interest groups not to control policy-making & development, although a few do so with the aim of improving environmental care. The environmental manager should be vigilant for such control & seek to reduce it, if it acts against environmental quality. When EM involves more than one country, which is often the case, negotiation skills are at least as important as access to technology, knowledge & management strategies.

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- **Groups with little control** This category consists of the poor with no option but to over-exploit what is available without investing in improvement – refugees, migrants, relocates, eco-refugees (i.e., those forced to move or marginalized so that they change the environment to survive), workers in industry/mining, etc. who face health and safety challenges while carrying out changes.

Participants of EM

Many identify poverty, alleviation & environmental care as two challenges for those in charge of development. These two issues are closely related, although linkages are unclear & complex.

- It is often claimed that the poor degrade their environment in an effort to survive. Getting people out of poverty may be important for protecting the environment, but environmental managers must consider each local case to be sure of causes. For example, the causes of environmental degradation in urban areas may lie with policies affecting agriculturalists hundreds of kms away, causing them to migrate & increase city population. There are also situations where there is likely to be poverty related environment stress: cities where population growth is outstripping employment & infrastructure; marginal often vulnerable land where people have relocated, areas where traditional livelihood strategies are degenerating.

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Participants of EM

- **The Public** People, who are affected as bystanders, may wish to develop, conserve or change practices (if aware of what is happening) & those out of global concern form part of this category. The public usually consists of more than one group of people who probably have different, perhaps conflicting, views & goals with powerful groups dominating the situation. Environmental managers must establish the needs of the weak & ensure that they are not ignored, yet work with the influential. Sustainable development strategies need to be designed to fit local conditions & to be coordinated to ensure that one locality does not conflict with another. EM should act as mediator & catalyst to develop collaborative approaches.

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- Advantages of public involvement in EM are: **(i)** The public may be able to provide advice on management considering local conditions, **(ii)** Often planning & management should be more accountable & careful, **(iii)** Fears & opposition to management may be reduced if people are informed, **(iv)** The communication gap between the experts & locals can be reduced.

Participants of EM

- **Facilitators** This category consists of funding agencies, consultants, planners, workers including migrants affected by health and safety issues, etc. Funding bodies can support **environmentally desirable developments** or withhold money **until proposals are modified to meet required standards**. Starting with the World Bank in the early **1970**s, most funding bodies have developed **EM units, guidelines & manuals**. There is also a huge diversity of bodies conducting research aimed at improving EM: universities, private research companies, independent international research institutes & UN/UN-related agencies. Most research is applied in response to perceived needs, but some is anticipatory & warns about possible threats & potentially useful strategies.

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- The skills of environmental managers & ecologists are vital to determine the best strategies for the survival of fauna & flora, to organize sustainable land & resource use. NGO's have become important watchdogs of corporate, Government & special - interest group activities. They have a multifaceted role: lobbying at international meetings & at national government level; media campaigning to increase public awareness & empowerment; fund-raising for conservation & EM, environmental education; researching environmentally sound strategies & approaches; acting as ginger groups to identify environmental problems & fight for their control etc.

Environment & Ethics

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- It's concerned with issue of responsible personal conduct w.r.t. natural landscapes, resources, species & non-human organisms. It is cluster of beliefs, values & norms regarding how humans should interact on environment with environment. Human effects the today have consequences for the future & so discussions of environmental ethics also involve the rights of future generations. The arguments for & against various principles in environmental ethics are made more complex because of conflicting values. The resolution of the resulting conflict requires that we recognize differing values & have a basic scientific knowledge about the environment as well as the ability to clearly formulate a logical argument.

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Environmental Philosophy

- It is that wing of philosophy that expresses anxiety with natural environment & livelihood of humans. Main areas of interest for philosophers include defining environment & it's value, environmentalism & deep ecology, endangered species & restoration of nature. It's major components are environmental ethics, theology, environmental aesthetics and ecofeminism. Aldo Leopold formulated ecological restoration focusing on Land ethic, defined a new link between nature & people with a stage for modern conservation movement. For embracing this ethic, ecologically literate citizens are required, who can also solve global environmental challenges.

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- Environmental Concerns in India ➲ We can categorize environmental concerns in India as those arising from negative effects of the very process of development, conditions of poverty & under development. The major problems which encompass the area of EM are:

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- Out of a total area of about 329 million hectares, 175 million hectares of land require special treatment to restore them for productive and profitable use. Land degradation is caused by water & wind erosion (159 million ha), salinity & alkalinity(8 million ha), river action & other factors (7 million ha).

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- The forest wealth is dwindling due to overgrazing & over-exploitation both for commercial & household needs, encroachments, unsustainable practices including certain practices of shifting cultivation & developmental activities such as roads, buildings, irrigation & power projects.

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- The recorded forest cover in the country is about **75 million hectare**, which is **19.5%** of the total geographical area against the national goal of **33%** in the plains & **66%** for hilly regions. Even within this area, a meager **11%** constitutes forests with **40%** or more of *crown cover*. The annual rate of loss of the forest cover is **47,500 hectares**.

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- The major rivers of the country are facing problems of pollution & siltation. The coastline is under stress & coastal areas have been construction, severely waste damaged disposal due near to the indiscriminate water-line & aquaculture. Coastal vegetation including mangroves & sea grasses is facing extinction. The mountain ecosystems are under threat of serious degradation.

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Environmental Concerns in India

- India is witnessing a rising requirement for forest based goods due to which, there is extensive deforestation leading to severe loss of natural resources & in turn erosion of valuable topsoil is threatening the livelihood & security of millions of hill people & also encroachment into ***forest protected areas***. (As a result of requirement of 70 million m^3 of round wood/year in India by the end of the decade & its transportation, there is fear that this could result in loss of high conservation value forests & biodiversity elsewhere).

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- Increasing demand for water for different sectors such as agriculture, domestic, energy generation, industry that resulted in depletion of water source. The quality of groundwater is being affected due to chemical pollution and due to the ingress of seawater in coastal areas.

Environmental Concerns in India

- Absence of an integrated land & water use policy for the country has resulted in a heavy toll of basic natural assets. Coral reef ecosystems are adversely affected by indiscriminate exploitation of corals for production of lime, recreational use & for ornamental trade. Island ecosystems are subjected to pressures of various forms, including migration of people from the main land.

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- Pollution arising from toxic wastes & non-biodegradable consumer articles is on the rise. A large number of industries & other development projects are sited close to heavily populated urban centers, leading to over congestion & over pollution, as also the diversion of population & natural resources from the rural areas.
- Mechanism to naturally arrive at a reliable estimate of total greenhouse gas emissions in the country, among various sources such as agriculture, animals, energy production & consumption, forestry & land use change, waste management etc., is inadequate. More such reliable data is essential for negotiating international law, treaties, protocols & conventions on environment-related problems, where developing countries are unduly pressurized.

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Environmenal Policies

Environmental policies may be either enacted as laws by governing bodies or created & enforced by government agencies. They may originate from local, national or foreign governments & address an array of issues including air or water quality, fossil fuel extraction, energy conservation, habitat protection or restoration, pesticide use, storage/disposal of hazardous materials, recycling & trafficking in endangered species. An environmental policy being interdisciplinary in nature draws together technology, economics, natural & social sciences. In order to develop sustainable policies, therefore, it is necessary to have sound knowledge of the actual & potential environmental impacts of certain activities & some knowledge of the technical characteristics, economic costs, social acceptability & possible side effects of alternative policy options.

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- The quality of the environment has both direct & indirect effect on the standard of living. This does not mean that environmental degradation is simply a by-product of economic activities, it is also the consequence of the priorities set by States in their economic policies. These policies generally aim at stimulating production & as a consequence, tend to ignore their implications for the environment.

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Environmenal Policies

Past experience shows that economic policies may actually have more impact on the quality of the environment, than those policies explicitly designed to protect the environment.

Economics One sign of a sustainable economy is when the costs of environment & health caused by economic growth have been added to consumer prices & when economic policy instruments support sustainable development. Environmental policies should supplement economic instruments. Environmental policies involve certain measures aimed at achieving a sound environment. They are usually developed in the context of public policy, based on economic theory, which focuses more on the level of costs and benefits associated with the implementation of environmental policies than on the quality of the environment. When governments propose & subsequently implement strict standards, sectors that pollute the environment will have to take measures, and this cannot be achieved without incurring extra costs. Polluting industries are often keen to highlight the likely costs they have to incur due to the proposed environmental measures.

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- The definition of the property rights of natural resources plays a vital role in the distributional effects of environmental policies. The implementation of strict standards & regulations will effect a change in the definition of property rights. For example, industries polluting the rivers will be confronted with regulations that prevent them from, or reduce their opportunities for, using the rivers. However, throughout the process of formulating the regulations, polluting industries will try to influence & stifle the policies.

Environmental Policies

The immediate benefits resulting from environmental policies are extremely difficult to assess. As a consequence, the costs of environmental measures are often paid more attention than the benefits resulting from the implementation of the policy.

- The definition of the property rights of natural resources plays a vital role in the distributional effects of environmental policies. The implementation of strict standards & regulations will effect a change in the definition of property rights. For example, industries polluting the rivers will be confronted with regulations that prevent them from, or reduce their opportunities for, using the rivers. However, throughout the process of formulating the regulations, polluting industries will try to influence & stifle the policies.
- Sectoral economic policies that influence the environmental policies directly or indirectly ➡ ***Agricultural sector:*** Virtually the entire food cycle attracts huge direct or indirect subsidies at a cost to taxpayers & consumers. These subsidies send farmers far more powerful signals than do the small grants, usually provided for soil & water conservation.

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Environmental Policies

They encourage farmers to occupy marginal land and to clear forests & woodlands, make excessive use of pesticides, fertilizers & use underground and surface waters in irrigation indiscriminately. ***Forestry sector:*** The pressures on forests throughout the world vary greatly in both developed & developing countries, which are reinforced by government policies. The logging & forestry industry attracts a variety of direct & indirect subsidies. The perverse incentives that encourage the over harvesting of temperate as well as tropical forests also mark world-trade in forest products.

Environmental Policies

They encourage farmers to occupy marginal land and to clear forests & woodlands, make excessive use of pesticides, fertilizers & use underground and surface waters in irrigation indiscriminately. ***Forestry sector:*** The pressures on forests throughout the world vary greatly in both developed & developing countries, which are reinforced by government policies. The logging & forestry industry attracts a variety of direct & indirect subsidies. The perverse incentives that encourage the over harvesting of temperate as well as tropical forests also mark world-trade in forest products. ***Transport sector:*** This sector, especially motor vehicles, also benefits from economic policies that are ecologically perverse. Fuel taxes in many jurisdictions still fail to distinguish between the environmental effects of different types of fuel (e.g., petrol or diesel, leaded or unleaded). The tax & tariff structure, direct & indirect subsidies, encourage heavier & more energy-intensive vehicles & road freight, as opposed to rail transport in many countries. In addition, in some countries, private vehicle expenses can be deducted from taxable income.

Environmental Policies

Energy sector: The major obstacle to energy efficiency is the existing framework of incentives for energy exploration, development & consumption. These incentives underwrite coal, oil and gas, ignore the costs of air, land & water pollution & seem to favour inefficiency and waste. While industrialized countries have been spending billions to distort the market & consumer prices in ways that actively promote acid rain & global warming, they have been spending only a few million on measures to promote energy efficiency. As long as pollution problems are mainly national, there is a need for a strong national authority. However, environmental problems are becoming increasingly international or global. This complicates the environmental policies considerably. On the one hand, international co-operation in the fighting of environmental problems is absolutely necessary. On the other hand, different countries have different economic interests. Furthermore, polluting sectors are not evenly distributed among countries. Economic based environment policies have been designed to facilitate economic growth & allow business while ensuring the sustainability of the environment & achieve economic efficiency.

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Environmental Policies

Industries Industries are a measure of a country's economic growth. Consequently, countries have a tendency to protect their polluting industries, in particular when they are relatively important economically. However, the growing interest in EM has fuelled certain industries to adopt policies that are economically feasible & which helps curb environmental degradation. Various factors drive the development of a managed approach to environmental performance. These include the following:

Environmental Policies

Industries Industries are a measure of a country's economic growth. Consequently, countries have a tendency to protect their polluting industries, in particular when they are relatively important economically. However, the growing interest in EM has fuelled certain industries to adopt policies that are economically feasible & which helps curb environmental degradation. Various factors drive the development of a managed approach to environmental performance. These include the following:

- The need to meet increasingly stricter environmental regulations.
- Stakeholder pressure (e.g., pressure from shareholders, insurers and investors).
- Supply-chain pressure from customers.
- Historically poor relations with regulatory bodies and local communities.

Many industries have established ***EM systems*** (EMS) to tackle activities, which either pose a serious threat to ecosystems in the event of accidents or involve significant expenditure because of the costs associated with raw material use and/or waste disposal.

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Environmental Policies

An EMS is "***the part of an overall management system that includes organizational structure, planning activities, responsibilities, practices, procedures, processes & resources for developing, implementing, achieving reviewing and maintaining the environmental policy***". EMS aims to help organizations achieve sound environmental performance by identifying key activities which impact, already or potentially, on the environment & by putting in place management controls to ensure that organization continues to meet its legal & policy requirements to deal with these impacts.

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Environmental Policies

For example, by reducing the use of certain hazardous substances, some organizations in India have achieved major improvements in their air emissions & as a result, they came out of the strict controls imposed on them by the Environmental Protection Act (EPA) 1990. In addition, they have gained a better working environment for their employees & eliminated a difficult raw material storage hazard.

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Agriculture Agriculture has a major impact on the environment, on land, water & biodiversity. Over the last 10 - 15 years, the environmental performance of agriculture has been mixed. For example, nitrogen and pesticide loading in water remain relatively high & risks of soil erosion & water resource depletion persist in many regions & countries. Recently however there have been improvements in wildlife habitats, landscapes & sinks for greenhouse gases provided by agriculture, but the most significant progress has occurred where environmental pressures have been greatest. Main environmental impacts of agriculture may be characterized through the beneficial or harmful contribution of agricultural activities to:

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Environmental Policies

- soil quality (e.g., erosion, nutrient supply, moisture balance, salinity, etc.).
- land quality (e.g., ecological management of agricultural land).
- water quality (e.g., nutrient, pesticide and sediment run-off & leaching, salinity).
- water quantity (e.g., irrigation consumption, use efficiency, water retention capacity, flood prevention, etc.).
- air quality (e.g., emissions of dust, odours, ammonia & greenhouse gas, absorption of carbon dioxide, etc.).
- bio-diversity (e.g., farm and indigenous animal and plant diversity).
- wildlife and semi-natural habitats (e.g., diversity of animal & plant habitats associated with farming).
- rural landscape (e.g., environmental features of areas shaped by farming, including those associated with historic buildings & landmarks etc.).

Environmental Policies

- Agricultural policies in India provide substantial farm support, often linked to commodity production affecting resource use, farming practices & environmental performance. Reconciling food production & environmental goals however is a challenge. But, reconciling them implies that the rights & responsibilities of farmers regarding farm practices need to be clearly defined & applied – thus the situations under which they are entitled to remuneration or obliged to pay PPP (polluter-pays-principle. Defining who pays and who is paid for the desired level of environmental performance has important implications for the distribution of income and wealth.

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Role of agro-environmental policies When private & public mechanisms designed to facilitate the improvement & diffusion of appropriate farming practices & market forces are not enough to ensure the supply to meet the demand of environmental services, specific agriculture-environmental measures at the farm level may be needed.

Environmental Policies

- Such measures may be necessary to reduce the environmental harm, or enhance the environmental benefits of farming activities. When designing & implementing such policy measures, a number of general policy principles should be taken into account in the choice of the type of policy incentive or disincentive – payment or tax.

Environmental Policies

- Such measures may be necessary to reduce the environmental harm, or enhance the environmental benefits of farming activities. When designing & implementing such policy measures, a number of general policy principles should be taken into account in the choice of the type of policy incentive or disincentive – payment or tax.
- The PPP applies to reducing environmental harm for which farmers, as any other polluter, should be accountable. However, the PPP guiding principles recognize the possibility of different property rights and reference levels among countries, with the possibility of offering transitional financial incentives to encourage farmers to adopt appropriate production practices for improving their environmental performance through reducing environmental harm. It includes the case of transitional financial assistance provided to stimulate the development of new pollution control technologies & abatement equipment to achieve a better environmental performance through improved production practices.

Environmental Policies

- **General policy principle** When markets do not exist to allocate costs & benefits of agriculture-environmental impacts & outputs, policy action may be needed to account for environmental targets & the costs to ensure of not respecting the provision of environmental benefits. When designing & implementing policy measures, the environmental problem needs to be clearly defined & the following principles for policy design need to be kept in mind:
- The necessary condition for a welfare gain from implementing an agriculture-environmental policy measure is that the resulting environmental benefits **exceed the costs associated with the policy**. These costs include those due to a reduction in outputs, associated with more environmentally friendly technologies & practices, transaction (administrative) costs of policy implementation & enforcement.
- When farmers & other economic agents provide a specific environmental service, the level of benefit should be clearly specified & efforts made to ensure that the **most efficient operator is the provider**.

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Environmental Policies

- When a specific environmental outcome is jointly the result of agricultural output, a wide range of policy options & approaches may achieve its provision by an individual farmer that either provides positive incentives (through, for example, a payment) or negative incentives (e.g., a tax). If incentives were set correctly, it would be in the individual farmer's interest to achieve the outcome and receive the incentive payment, or achieve the outcome and avoid paying the tax. The effectiveness of either a tax or a payment depends not only on whether it correctly confronts the farmer with the opportunity costs of not respecting environmental requirements, but also on the degree to which the associated obligations can be enforced and tailored to local environmental circumstances and demands. The more the payment or tax is tailored to specific circumstances, the larger the need for monitoring, the lower the probability of individual control & the higher the transaction costs.

An environmental policy that conserves the ecosystem is a wise attempt to manage the environment.

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Environmental Policy Instruments (EPI)

- EPI refers to official actions taken to curb & remove the negative environmental impacts caused by society. The methods, laws, administration & decisions relating to these actions are collectively termed environmental policy. An EPI is divided into economic, information & legal measures. Indicators of sustainable development frequently measure the status of development or pressures directed at it. Indicators of EPI reflect society's reaction & the steps taken to make sustainable development possible.

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- Three different categories are used to classify EPI :

  (i) Regulatory instruments that mandate specific behaviour.

  (ii) Market-based instruments that act as incentives for particular activities.

  (iii) Information-based instruments that seek to change behaviour through the provision of information.

Governments may establish formal cleaner production strategies or programmes to act as a framework for the coordinated implementation of subsequent & more specific policy instruments. Cleaner production strategies may take one/combination of the following shapes:

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Environmental Policy Instruments (EPI)

- **Product Bans:** The imposition of a ban or defined phase-out schedule for a particular product or substance is an authoritarian means of promoting cleaner production. This may be implemented through application of the product choice or substitution principle.
- **Extended producer responsibility (EPR):** EPR aims at making environmental improvements throughout the life cycle of a product by making the manufacturer responsible for various aspects of the product's life cycle. In particular, this could include the take-back recycling and final disposal of the product.
- **Cleaner production audits:** As part of their permitting requirements, it is mandatory for production industries to carry out cleaner production audits of their plants & to implement findings as long as they do not harm the environment.
- **Mandatory EMS and reporting:** In terms of integrated permit conditions, it is mandatory for production industries to implement a structured EMS & make public information on their environmental performance.

Environmental Policy Instruments (EPI)

- **Financial and technical incentives:** Governments may stimulate cleaner production measures by providing grants, loans and favourable tax regimes, &/or by supplying targeted technical assistance to relevant industrial enterprises.

Regulatory Instruments

Since the inception of environmental policy, the predominant strategy for polution control has generally been through the use of regulatory instruments. Usually, a public authority sets standards & then inspects, monitors and enforces compliance to these standards, punishing transgressions with formal legal sanction. These regulations may specify an environmental goal such as the reduction of carbon dioxide emissions by a specified date. They may also mandate the use of a particular technology or process. Such an approach gives the regulator the maximum authority to control where & how resources will be allocated to achieve environmental objectives. Also, this provides the regulator with a reasonable degree of predictability as to how much the pollution levels will be reduced.

Environmental Policy Instruments (EPI)

Specified & negotiated compliance The specified compliance approach imposes the precise & specific demands on the regulated communities without any scope for bargaining & exceptions. However, this approach has some significant drawbacks in that the regulated community may tend to become alienated from the authorities & united in its opposition to the rules and regulations.

The negotiated compliance approach, by contrast, adopts a more cooperative approach between the regulators & the regulated in setting & enforcing standards. This shared responsibility between the government & industry enhances the likelihood of a more open exchange of information between the parties & allows greater flexibility regarding the means of meeting the standard. Moreover, a number of countries have started to develop regulations where attainment of certain targets (e.g., recycling targets) is required while concrete means of achieving such targets are left in the hands of industries (non-prescriptive regulations).

Environmental Policy Instruments (EPI)

This, in turn, may increase the economic efficiency of the regulation and may be conducive to the adoption of innovative, preventative approaches.

Indeed, with the growing appreciation of the limits of conventional policy instruments, many governments are encouraging the adoption of self-regulatory & co-regulatory policy instruments for promoting cleaner production.

Market-based instruments

Market-based instruments generally seek to address the market failure of environmental externalities either by incorporating the external cost of a firm's polluting activities into the firm's private cost (for example, through taxation), or by creating property rights & facilitating the establishment of a proxy market (for example, by using tradable pollution permits). Before introducing any new economic instruments, governments should identify & evaluate any economic incentives that may already be in operation, either explicitly or implicitly.

Environmental Policy Instruments (EPI)

These include, for example, the use of subsidies to make local industries more competitive. Many of these policies lead to artificially low prices for resources, such as energy and water & as a result of which these resources may be overused, creating both pollution & shortages. Government assessments of such policies are needed before other economic instruments are applied.

Taxes, fees and charges may be used to promote cleaner production practices by raising the costs of unwanted outputs or by providing incentives to promote more efficient use of natural resources. In some instances, it may be appropriate to use the revenues generated from these instruments to support cleaner production activities & thereby stimulating preventative approaches. A significant constraint against the more widespread adoption of market-based instruments, however, is that it is not always politically feasible to set taxes at a sufficiently high level to achieve desired environmental goals. Governments often face resistance, if taxation related to environment is taken merely as a means of increasing its revenues.

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Environmental Policy Instruments (EPI)

Governments may be able to avoid some obstacles by earmarking the corrected charges or shifting tax sources. In any case, the successful implementation of such instruments requires a system of monitoring, revenue collection and enforcement as well as measures to combat possible corruption.

Financial subsidies, (e.g., low-interest loans, direct grants or preferential tax treatment) can be targeted to specific industries to stimulate technological development. Governments must, however, carefully examine how subsidies work to ensure that they are not misused resulting in environmentally counter-productive behaviour.

Information-based strategies

In addition to creating an appropriate regulatory & financial framework for cleaner production, government may further stimulate the adoption of cleaner production practices through the use of informational measures. These may be used to provide the right incentive (e.g., through the public disclosure of a firm's environmental performance) as well as to build capacity within industry (e.g., through the publication & dissemination of relevant case studies).

Environmental Policy Instruments (EPI)

A few examples of information-based strategies are:

- Promoting the adoption of targeted, high profile demonstration projects, to demonstrate the techniques & cost-saving opportunities associated with cleaner production.
- Encouraging educational institutions to incorporate preventative EM within their curricula, particularly within engineering and business courses.
- Requiring public disclosure of information on environmental performance by, for example, establishing a pollutant release and transfer register, stimulating greater voluntary corporate reporting and requiring the provision of information on specific materials.
- Initiating &/or consumption supporting such as measures eco-labelling that address schemes & environmental product declarations.
- Promoting the adoption of effective training initiatives.
- Issuing high profile awards for enterprises that have effectively implemented cleaner production.

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Environmental Laws & Legislation

- Environmental law refers to rules and regulations governing human conduct likely to affect the environment. It reflects the legislative measures & the administrative & judicial structures to protect the environment. However, it is difficult to define precisely the boundaries of environmental law in the same way as we define, say, the law of contract explained in detail later in this chapter. Unlike the traditional legal subjects such as contract, which are well developed, environmental law is still in its infancy. Nevertheless, attention is now increasingly focused on the rationalization and streamlining of existing measures rather than the development of substantial law.

Environmental law aids in ➡

- regulation of resource use.
- protection of the environment and biodiversity.
- mediation, conflict resolution and conciliation.
- formulation of stable, unambiguous undertakings & agreements.

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Environmental Laws & Legislation

- Legislations have evolved in response to problems, so that there is often a delay between the need & the establishment of satisfactory law. Without effective legislation, resource use, pollution control, conservation and most fields of human activity are likely to fall into chaos & conflict. Law can encourage satisfactory performance, enable authorities to punish those who infringe EM legislation, confiscate faulty equipment or close a company. It may also be possible for employee, bystanders & product or service users to sue for damages, if they are harmed. Environmental laws, in essence, are indispensable instruments in curbing environmental degradation. Environmental laws can be categorized as public & private laws depending on the environmental issue.

Private and public law

Based on the environmental nuisance cases the legal actions are taken to understand to which category the environmental issue relates to; there is a need to know about private and public law.

Environmental Laws & Legislation

- Private law includes law of contracts, law of torts, law of property & the law of obligations, is the part of legal system that involves relationships between individuals. It is a private BILL enacted into law which is applied to individual or corporation. Labour law, commercial law, corporation's law & competition law come under private law. This law when observed as common law shows relationship between governments & private individuals. Law of contract are governed by private law that affects the relationships between the individuals without the intervention of the state or Government.
- Public law is a theory of law governing the relationships individuals & the state. The major sub divisions of this law are constitutional law, administrative law & criminal law. For most lawyers & clients this law is how public authorities make decisions. That explains the irrelevant & relevant factors considered by public for which reasons may be important or not. They also analyse whether the decision maker complied with all legal requirements along with EC law regulations to make a decision.

Environmental Laws & Legislation

This law governs activities of public bodies such as environment agency & regulates the relationship between state and individuals.

- Private law can be used in environmental cases when the claimer is against someone causing a nuisance. This nuisance can be causing personal injury, trespassing on the land etc. In these cases it is better to be familiar with private law and environmental law with science background to win the case & to judge which ones are not worth pursuing the case.
- Environmental law is practised in the public interest for public benefit in the form of groups or individuals seeking environmental protections. Strength of law lies in its potential elasticity that represents the basis for developing an environmental action unconnected to land and capable of protecting wider community interests.

Environmental Laws & Legislation

- Public interest rarely happens whereas the law that is practised in private interest in the form of groups or individuals who are responsible for polluting or committing environmentally destructive activities who can also avoid violating these environmental laws in the process are usually common cases issues. This clearly shows private law plays negative role in environmental cases. This law balances only individual interests such as challenging uses of land rather than environmental protection.

Objectives and principles of legislation

- The objectives of environmental legislation are to provide a set of enforceable & standard rules to contribute to the pursuit of:

(i) preserving, protecting & improving the quality of the environment.

(ii) protecting human health.

(iii) utilizing natural resources in a prudent and rational way.

(iv) promoting measures at international level to deal with regional or worldwide environmental problems.

Environmental Laws & Legislation

- Environmental legislation seeks to regulate pollution of the natural environment in relation to air, noise, vibration, water, radiation & soil. It contains rules relating to the conservation of the natural environment, the protection of endangered species, the promotion of biological diversity, the protection of forests & the pursuit of environmentally friendly agriculture. With regard to the human environment, it seeks to protect human beings (the consumer) against contaminated food, dangerous or defective products,economic harm and danger in travel. With regard to the human-made environment it seeks the protection of historic & cultural environment. It seeks harmonization of standards & the enforcement of those standards through legislative provisions particularly relating to the introduction of appropriate environmental management systems to harness scarce resources.

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Environmental Laws & Legislation

- Further objectives of environmental legislation are to set standards such as achieving a high level of protection by taking into account the diversity of situations in the various regions, to give a legal basis to the precautionary principle whereby legislative action is taken where there is no reason to believe that substances or energy or materials introduced directly or indirectly into the environment, may, or are likely to create, hazards to human health, harm living resources, damage communities or interfere with other legitimate uses. This can be done even where there is no conclusive evidence of a cause or relationship between inputs and their effects and to give a legal basis to the principle that preventive action should be taken as prevention & if successful, to advise all the detailed legislation relating to steps to be taken to cure a problem.

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Environmental Laws & Legislation

- Environmental legislation is generally based on the principles that environmental damage should, as a priority, be rectified at source & that the polluter should pay. Environmental protection requirements should be integrated into the definition & implementation of legislation relating to non-environmental issues. Where crossborder matters relating to provisions primarily of a fiscal matter, measures concerning town & country planning & land use (other than waste management), management of water resources & measures significantly affecting the choice between different energy resources & the general structure of energy supply, decisions should only be adopted with unanimous agreement between the participants.
- Other legal principles produced by the expert group are that countries must:
  - Conserve and use the environment including its natural resources for the benefit of both the present & future generations.
  - Maintain ecosystems & ecological processes essential for the functioning of the biosphere, & preserve biological diversity.

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Environmental Laws & Legislation

- Observe the principle of optimum sustainable yield in use when dealing with natural resources & ecosystems.
- Establish adequate environmental protection standards & monitor changes & publish relevant data on environmental quality & resource use.

Evolution of Environmental Legislation in India

- The ***Indian Forest Act*** (1927) consolidates the law relating to forests, the transit of forest-produce & the duty leviable on timber & other forest products.
- The ***Prevention of Cruelty to Animals Act*** was enacted in 1960 to prevent the infliction of unnecessary suffering on the animals & to amend the laws relating to the prevention of cruelty to animals. As a promotion for enactment of this act there was formation of animal board of India.
- In ***1966 Indian Forest Service*** was constituted under the All India Services Act, 1951 by the Gov. of India. The main aim of their service is to implement the country's ***National Forest Policy*** which envisages scientific management of forest & to exploit them on a sustained basis primarily for timber products.

- ***Wild life Act*** enacted in the year 1972 with the objective of effectively protecting the wildlife of the country & to control poaching, smuggling & illegal trade in wildlife & its derivatives. This act was amended in January 2003. To strengthen the act – the Ministry has proposed further amendments in the law by introducing more rigid measures. Main objective is to provide protection to the flora & fauna & also to ecologically important protected areas.
- ***Water Act*** was enacted in 1974 to provide for the prevention & control of water pollution & for water maintenance in the country. The ***Water cess Act*** was enacted in 1977, to provide for the levy and collection of a cess on water consumed by persons operating & carrying on certain types of industrial activities. The act was last amended in 2003.
- ***Forest Conservation Act*** was enacted in 1980 to protect & conserve country's forest.

- ***Air Act*** (1981) was amended in 1987 to provide for prevention control & abatement of air pollution in India.
- ***Environment protection Act*** (1986) came into existence after 14 years of UN conference with an objective of protection & improvement of the country. Later on the amendments were done to it in 1991.
- ***The Man & Biosphere (MAB) programme*** of UNESCO was launched in 1971; India joined it in 1988 after formation of bioreserve committee. Purpose of this is to develop a base for rational use or conservation of natural resources while improving the relationship between the man & environment. The coastal line in India (7860 km) consists of Malvan (Maharashtra), Okha (Gujarat), Mandapam (TN), Gangetic Sundarbans (WB) as well as Lakshadweep & Andaman-Nikobar islands, which are rich in marine flora & fauna. India has established 15 bioreserves – first one at Nokrek (Meghalaya) in 1988.

- ***Hazardous waste rules*** (1989) were framed in which hazardous chemicals list was finalized.
- ***Eco-Mark Scheme of India*** was introduced in 1991 to increase the environmental awareness amongst citizens. This scheme aimed at encouraging the public to purchase products which are ecofriendly.
- ***Public liability insurance act*** was enacted in 1991 to provide for damages to victims of an accident which occurs as a result of handling hazardous substances (owners associated with the production or handling).
- ***National Environment Tribunal*** (1995) is for strict liability for damage arising out of accidents caused from handling of hazardous waste.
- ***Biomedical Waste Rules*** (1998) deals with collection, reception, storage, treatment & disposal of the waste.

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- ***The Noise Pollution Rules*** (2000) the state government categorized industrial, commercial & residential or silence zones to implement noise standards.
- The ***Biodiversity Act*** (2002) was born out of India's attempt to realize the objectives mentioned in the UN-convention on biological Diversity (CBD) enacted in 1992 states that country should use their own biological resources.
- The ***Scheduled Tribes & Other Traditional Forest Dwellers (Recognition of Forest Rights) Act*** (2006) recognizes the rights of forest-dwelling Scheduled Tribes & other traditional forest dwellers over the forest areas inhabited by them. This act also provides framework for their rights.
- The ***National Environment Appellate Authority (NEAA)*** was set up by the ministry of environment & forests to address cases in which environment clearances are required in certain restricted areas.

It was established by the *National Environment Appellate Authority Act* (1997) to hear appeals w.r.t. restriction of areas in which any industries, operations or processes, operations or processes shall or shall not be carried out, subject to certain safeguards under the *Environment Protection Act* (1986). The Authority shall become defunct & the Act shall stand repealed upon the enactment of the *National Green Tribunal Bill* (2009) currently pending in Parliament.

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Environmental Impact Assessment (EIA)

- **Environment Assessment (EA)** involves the study to determine any unique environmental attributes from endangered species to existing hazardous waste to historical significance. EA procedure ensures consideration of environmental implications before making a final decision of assessing the environment attribute. Process of assessment analyses the effects on environment & is useful for reporting those effects undertaking a public consultation exercise & lastly it reveals decision to public after reviewing the comment of the report. One of the main strengths of EA is its flexibility. Project planning processes can integrate EA as essential step giving sensitivity to the social & economic as well as environmental impacts of projects. In this way, project managers can compensate shortcomings in the project planning process.

Environmental Impact Assessment (EIA)

- For example, a project which failed to adequately consult the community at the outset can take advantage of the EA to involve the community in a necessary exchange of ideas and views. The EA can help establish & strengthen decision-making & communication mechanisms within a project. It can also pave the way for introducing innovations. An EA may reveal sound environmental, social or economic reasons for shifting a project's direction. In view of the primacy accorded the opinions & aspirations of local people, the EA process may also function as a project control mechanism. While the EA should not be expected to correct all the weaknesses of a flawed planning process, when properly designed & executed, it can be a valuable tool for project implementation. When the role of the EA is more restricted, the situation can work in reverse. Other project planning activities can be used to gather necessary information for the EA and to create support for the EA process. Each project manager must decide how much importance to accord each planning.

EA, EIA & SEA

- **Dependency of EA Duration** → **(i)** Size and complexity of the proposed project, **(ii)** extent of co-operation received from the project sponsor & local government, **(iii)** level of interest & support demonstrated by the community, **(iv)** ability of the project team to sustain interest in the EA, **(v)** skills of the EA team, **(vi)** EA techniques employed.
- In principle, EA can be undertaken for **(a)** ***Individual projects*** such as a dam, motorway, airport or factory and call it as Environmental Impact Assessment (EIA). **(b)** ***Plans, Programs & Policies (PPP)*** & call it as Strategic Environmental Assessment (SEA).
- Remarkable growth of interest have emerged in environmental issues, sustainability & better management of development in harmony with environment. Associated with this, the introduction of new legislation emanating from national & international agencies (e.g., European Commission) that seek to influence the relationship between development & environment.

EA, EIA & SEA

- EIA is defined as an activity designed to identify, predict the impact of legislative proposals, policies, programs, projects & operational procedures on the bio-geophysical environment, on the health & well being of human beings, to interpret & communicate information about the impact. EIA *focuses* on problems, conflicts or natural resource constraints that could affect the viability of a project. It also *examines* implications of a project that might harm people, their homeland or their livelihoods, or other nearby developments. After predicting the problems, a EIA *identifies* measures to minimize the problems & *outlines* ways to improve project's suitability for its proposed environment. In last three-decades, EIA has been recognized as the most valuable, interdisciplinary & objective decision-making tool w.r.t. alternate routes for development, process technologies & project sites. It is considered an ideal anticipatory mechanism allowing measures that ensure environmental compatibility in our quest for socio-economic development. EIA is wider in scope & less-quantitative than other techniques, such as cost-benefit analysis & has the potential to be a basis for negotiation among the developers, public interest groups & planning regulators.

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Principle of EIA

- General principle of assessment applies to EIA & to other assessment processes. There are several other processes that relate closely to the review of environmental impacts that may result from a proposed project. The following are well-recognized processes (i) Social Impact Assessment. (ii) Risk Assessment. (iii) Life Cycle Analysis, (iv) Energy Analysis, (v) Health Impact Assessment. (vi) Regulatory Impact Assessment. (vii) Species Impact Assessment. (viii) Technology Assessment. (ix) Economic Assessment. (x) Cumulative Impact Assessment. (xi) Strategic Environmental Assessment. (xii) Integrated Impact Assessment.
- Energy Analysis focus on a particular part of the environment. *Life Cycle Analysis* enable consideration of all those parts of the environment that are relevant to the assessment. Also, depending on how the terms (like health) are defined for the study, it covers most of the issues in EIA. e.g., *Technology Assessment* include review of the impacts on ecosystems & air quality. Broadly EIA cover the issues of other assessment processes –

Principle of EIA

for example: (a) Social aspects (such as impacts on employment, community interaction), (b) Risks (such as threats to native animals, water supplies), (c) Life cycle (such as the impacts at each stage of the project design through to operation & closure), (d) Energy (such as use of non-renewable energy sources, Greenhouse gas emissions) etc.

- There exists connections between different forms of assessment. Essential difference between them is how the terms or scope of assessment are defined narrowly or broadly. Otherwise, they all follow the same general principle. With all the assessment approaches, they are designed to identify potential impacts of a development, action or project. To do this, the assessor needs to use personal experience (including available knowledge) to think broadly about the changes that are possible & whether those impacts will be positive/negative. Particular approaches emphasis specific types of impacts (i.e. on health, social groups). All have same approach although each may have individual language & detailed techniques. Most assessment processes include a second step. After identifying the impacts, they also consider what may be needed to avoid adverse impacts.

Steps in EIA

EIA represents a systematic process that examines the environmental consequences of the development actions, in advance. The emphasis of a EIA is on prevention & therefore is more proactive than reactive in nature. The EIA process involves a number of steps, some of which are listed below:

- **Project screening :** This entails the application of EIA to those projects that may have significant environmental impacts. It is quite likely however that screening is done partly by the EIA regulations, operating in a country at the time of assessment.
- **Scoping :** This step seeks to identify, at an early stage, the key, significant environmental issues from among a host of possible impacts of a project & all the available alternatives.
- **Consideration of alternatives :** This seeks to ensure that the proponent has considered other feasible approaches, including alternative project locations, scales, processes, layouts, operating condition and the no-action option.

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Steps in EIA

- **Description of the project/development action :** This step seeks to clarify the purpose & rationale of the project & understand its various characteristics , including the stages of development, location and processes.
- **Description of the environmental baseline :** This includes the establishment of both the present and future state of the environment, in the absence of the project, taking into account the changes resulting from natural events & from other human activities.
- **Identification of key impacts :** This brings together the previous steps with a view to ensuring that all potentially significant environmental impacts (adverse and beneficial) are identified & taken into account in the process.
- **The prediction of impacts :** This step aims to identify the likely magnitude of the change (i.e. impact) in the environment when the project is implemented in comparison with the situation when the project is not carried out.

Steps in EIA

- **Evaluation and assessment of significance :** This seeks to assess the relative significance of the predicted impacts to allow a focus on key adverse impacts. Formal definition of significance is the product of consequence and likelihood as Significance = Consequence * Likelihood.
- **Mitigation :** This involves the introduction of measures to avoid, reduce, remedy or compensate for any significant adverse impacts.
- **Public consultation & participation :** This aims to assure the quality, comprehensiveness & effectiveness of the EIA, as well as to ensure that public's views are adequately taken into consideration in the decision-making process.
- **EIS presentation :** This is a vital step in the process. If done badly, much good work in the EIA may be negated.
- **Review :** This involves a systematic appraisal of the quality of the EIS, as a contribution to the decision-making process.

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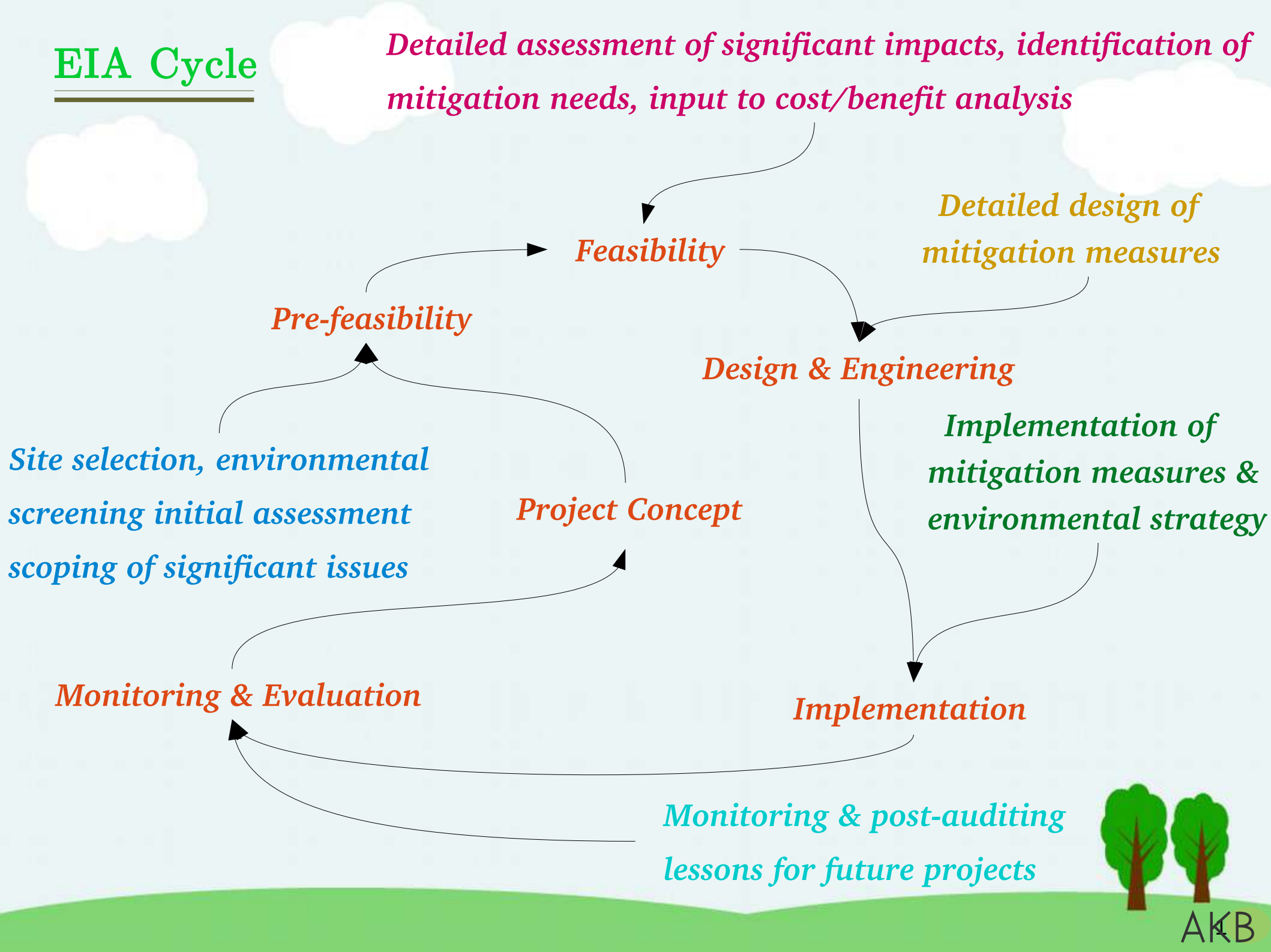
Steps in EIA

- **Decision-making :** At this stage, decisions are made by the relevant authority of the EIS (including consultation responses) together with other material considerations as to whether to accept, defer or reject the project.
- **Post-decision monitoring :** This involves the recording of outcomes associated with development impacts, after the decision to proceed with the project. It can contribute to effective project management.
- **Auditing :** This follows monitoring and involves comparing actual outcomes with predicted outcomes & can be used to assess the quality of predictions & the effectiveness of mitigation. It provides a vital step in the EIA learning process.

EIA Cycle


Detailed assessment of significant impacts, identification of mitigation needs, input to cost/benefit analysis
Feasibility
Detailed design of mitigation measures
Pre-feasibility
Design & Engineering
Site selection, environmental screening initial assessment scoping of significant issues
Project Concept
Implementation of mitigation measures & environmental strategy
Monitoring & Evaluation
Implementation
Monitoring & post-auditing lessons for future projects

Environmental impact statement (EIS)

EIS provides documentation of the information & estimates derived from the various steps in the EIA process. The information contained in a EIS provides the decision-makers/regulators with valuable information that could ultimately contribute to either the abandonment or substantial modification of a proposed development action. A typical EIS contains the following three parts

- **Part 1 – Methods and key issues:** This part deals with the statement of methods used & a summary of key issues.
- **Part 2 – Background to the proposed development:** This part deals with preliminary studies (i.e. need, planning, alternatives, site selection etc.), site description/baseline conditions, description of proposed development & construction activities & programs.
- **Part 3 – Environmental impact assessments on topic areas:** This part deals with land use, landscape & visual quality, geology, topography & soils, hydrology & water quality, air quality & climate, terrestrial & aquatic ecology, noise, transport, socio-economic & inter-relationships between effects.

Evolution of EIA in India

EIA in India had started in 1976-77, when the Planning Commission asked the then DST to examine the river-valley projects from the environmental angle. This was subsequently extended to cover those projects, which required approval of the Public Investment Board. These were administrative decisions that lacked the legislative support. Government of India enacted the Environment (Protection) Act in 1986. To achieve the objectives of the Act, one of the decisions taken was to make EIA statutory. In 2000, law for amended making EIA statutory for 30 activities. Besides this, the Government of India under Environment (Protection) Act 1986 issued a number of EIA notifications, which are: Prohibiting location of industries except those related to Tourism in a belt of 1km from high tide mark from the Revdanda Creek upto Devgarh Point (near Shrivardhan) as well as in 1km belt along the banks of Rajpuri Creek in Murud Janjira area in the Raigarh district of Maharashtra (1989). Restricting location of industries, mining operations & regulating other activities in Doon Valley (1989). Regulating activities in the coastal stretches of the country by classifying them as coastal regulation zone (1991). Restricting industrial activities which could lead to pollution & congestion in the north west Assam (1996).

Strategic Environmental Assessment (SEA)

- Recent trends in EIA is its application at earlier more strategic stages of development at the level of policies, plans & programs - known as SEA. SEA is defined as the formalized, systematic & comprehensive process of evaluating the environmental impacts of a Policy, Plan or Program (PPP) & its alternatives, including the preparation of a written report on the findings of that evaluation,& using the findings in publicly accountable decision-making. EIA of policies, plans & programs, keeping in mind that the process of evaluating environmental impacts at a strategic level, is not necessarily the same as that at a project level. PPPs are tiered – a policy provides a framework for the establishment of plans, plans provide frameworks for programs & programs lead to projects. A hierarchy exists between policies, plans & programs with policies are at the top level of conceptualization & generality; plans are one level down from policies, & programs. Programs make plans more specific by including a time schedule for specific activities. Implementation of a program involves carrying out specific projects, which can be subjected to traditional EIA.

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Environmental Clearance Procedure in India

- As the utility of EIA became clear, there was need to establish project clearance procedure. The first step was to define the EIA process, which is made up of the following phases: **(a)** Screening, **(b)** Scoping and consideration of alternatives, **(c)** Baseline data collection, **(d)** Impact prediction, **(e)** Assessment of alternatives, delineation of mitigation measures & environmental impact statement, **(f)** Public hearing, **(g)** Environment management plan (EMP), **(h)** Decision-making, **(i)** Monitoring the clearance conditions.
- The Ministry of Environment and Forests (MOEF) has published guidelines for different sectors, which outline the significant issues to be addressed in the EIA studies. In general, the following impacts of the project need to be assessed

Air : The changes in ambient levels and ground level concentrations due to total emissions from point, line & area sources, effects on soils, materials, vegetation & human health are to be assessed.

Environmental Clearance Procedure in India

- **Noise :** The changes in ambient levels, due to noise generated from equipment & movement of vehicles & their impact on fauna & human health are to be assessed.
- **Water :** The availability to competing users, changes in quality, sediment transport & ingress of saline water are to be assessed.
- **Land :** The changes in land use and drainage pattern, land quality including effects of waste disposal, shoreline/riverbank & their stability are to be assessed.
- **Biological :** Level of deforestation/tree-cutting & shrinkage of animal habitat, the impact on fauna & flora (including aquatic species, if any) due to contaminants/pollutants & the impact on rare & endangered species, endemic species & migratory path/route of animals are to be assessed, as also the impact on breeding & nesting grounds.
- **Socio-economic :** Impact on the local community including demographic changes, economic status, human health & increased traffic are to be assessed.

Radioactive Waste Management

- Nuclear power is the only large-scale energy-producing technology that takes full responsibility for all its waste & fully costs this into the product.
- Amount of waste generated by nuclear power is very small relative to other thermal electricity generation technologies.
- Used nuclear fuel may be treated as a resource or simply as waste.
- Nuclear waste is neither particularly hazardous nor hard to manage relative to other toxic industrial waste.
- Safe methods for the final disposal of high-level radioactive waste are technically proven. International consensus is that geological disposal is the best option.

Generation of electricity produces waste & the waste produced must be managed in ways that safeguard human health and minimize the impact on the environment. For radioactive waste, this means isolating or diluting it such that the rate or concentration of any radio-nuclides returned to the biosphere is harmless.

Radioactive Waste Management

To achieve this, practically all radioactive waste is contained & managed, with some clearly needing deep & permanent burial. From nuclear power generation, unlike all other forms of thermal electricity generation, all waste is regulated – none is allowed to cause pollution.

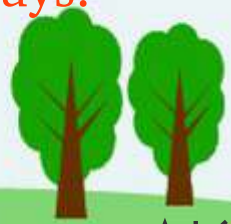
- Nuclear power is characterized by very large amount of energy produced from small amount of fuel & amount of waste produced during this process is also relatively small. However, much of the waste produced is radioactive & so must be carefully managed as hazardous material. All parts of the nuclear fuel cycle produce some radioactive waste & cost of managing & disposing of this is part of the electricity cost (i.e. it is internalized & paid for by the electricity consumers).
- All toxic waste needs be dealt with safely – not just radioactive waste – and in countries with nuclear power, radioactive waste comprises a very small proportion of total industrial hazardous waste generated.

Radioactive Waste Management

- Radioactive waste is not unique to the nuclear fuel cycle. Radioactive materials are used extensively in medicine, agriculture, research, manufacturing, non-destructive testing, and minerals exploration. Unlike other hazardous industrial materials, however, the level of hazard of all radioactive waste – its radioactivity – diminishes with time.

Types of Radioactive Waste

- Radioactive waste includes any material that is either intrinsically radioactive, or has been contaminated by radioactivity & that is deemed to have no further use. Government policy dictates whether used nuclear fuel & plutonium are categorized as waste.
- Every radionuclide has a half-life & thus for it to lose half of its radioactivity. Radionuclides with long half-lives tend to be α & β emitters – making their handling easier – while those with short half-lives tend to emit more penetrating γ-rays.



Types of Radioactive Waste

Eventually all radioactive waste decays into non-radioactive elements. More radioactive an isotope is, the faster it decays. Radioactive waste is typically classified as either low-level (LLW), intermediate-level (ILW), or high-level (HLW), dependent primarily on its level of radioactivity.

Low-level waste : LLW has a radioactive content not exceeding 4 Giga Becquerels per tonne (GBq/t) of α-activity or 12 GBq/t $\beta-\gamma$ activity. LLW does not require shielding during handling & transport & is suitable for disposal in near surface facilities. LLW is generated from hospitals and industry, as well as the nuclear fuel cycle. It comprises paper, rags, tools, clothing, filters etc. which contain small amounts of mostly short-lived radioactivity. To reduce its volume, LLW is often compacted or incinerated before disposal. LLW comprises ~ 90% of the volume but only ~ 1% of the radioactivity of all radioactive waste.

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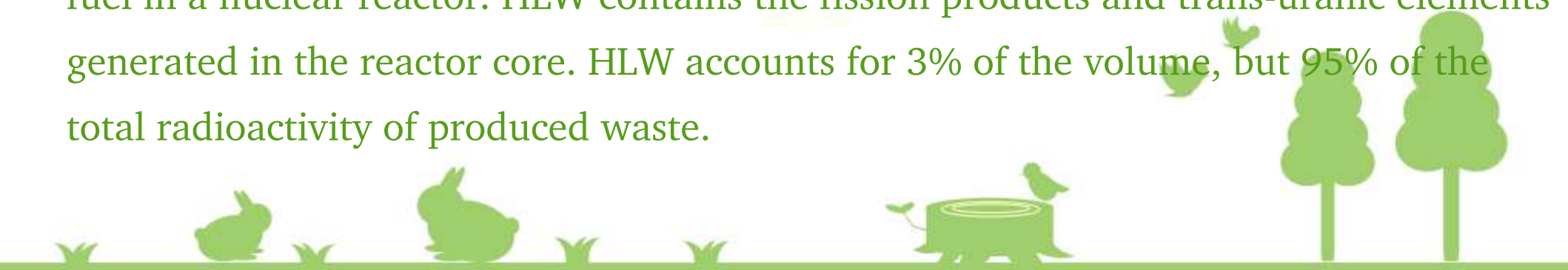
Types of Radioactive Waste

Intermediate-level waste : ILW is more radioactive than LLW, but the heat it generates ($<2\,kW/m^3$) is not sufficient to be taken into account in the design or selection of storage & disposal facilities. Due to its higher levels of radioactivity, ILW requires some shielding. ILW typically comprises resins, chemical sludges & metal fuel cladding, as well as contaminated materials from reactor decommissioning. Smaller items & any non-solids may be solidified in concrete or bitumen for disposal. It makes up some 7% of the volume and has 4% of the radioactivity of all radioactive waste.

High-level waste : HLW is sufficiently radioactive for its decay heat ($>2\,kW/m^3$) to increase its temperature & the temperature of its surroundings significantly. As a result, HLW requires cooling and shielding. HLW arises from the “burning” of Uranium fuel in a nuclear reactor. HLW contains the fission products and trans-uranic elements generated in the reactor core. HLW accounts for 3% of the volume, but 95% of the total radioactivity of produced waste.



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Types of Radioactive Waste

There are two distinct kinds of HLW: **(i)** Used fuel that has been designated as waste, **(ii)** Separated waste from reprocessing of used fuel.

- HLW has both long-lived & short-lived components, depending on the length of time it will take for the radioactivity of particular radio-nuclides to decrease to levels that are considered non-hazardous for people & the surrounding environment. If generally short-lived fission products can be separated from long-lived actinides, this distinction becomes important in management and disposal of HLW. HLW is the focus of significant attention regarding nuclear power, and is managed accordingly.

Very low-level waste : Exempt waste and VLLW contains radioactive materials at a level which is not considered harmful to people or the surrounding environment. It consists mainly of demolished material (e.g. concrete, plaster, bricks, metal, valves, piping etc.) produced during rehabilitation or dismantling operations on nuclear industrial sites. Other industries, such as food processing, chemical, steel, etc. also produce VLLW as a result of the concentration of natural radioactivity present in certain minerals used in their manufacturing processes.

Mining through to fuel fabrication

Traditional Uranium mining generates fine sandy tailings, which contain virtually all naturally occurring radioactive elements found in Uranium ore. The tailings are collected in engineered dams & covered with a layer of clay & rock to inhibit the leakage of Radon gas & to ensure long-term stability. Tailing material is often covered with water which after few months contain ~ 75% of the radioactivity of the original ore. These are NOT classified as radioactive waste!!

- Uranium oxide concentrate from mining, essentially "yellowcake" (U_3O_8) is not significantly radioactive – barely more so than the granite used in buildings. It is refined, then converted to Uranium Hexafluoride (UF_6) gas. It undergoes enrichment to increase U^{235} content from 0.7% to ~ 3.5%. It is then turned into a hard Ceramic Oxide (UO_2) for assembly as reactor fuel elements.
- Main by-product of enrichment is "Depleted Uranium" (DU, a U^{238} isotope) which is stored as UF_6 or U_3O_8. Some DU is used in applications where its extremely high density makes it valuable (e.g. for keels of yachts, military projectiles).

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Mining through to fuel fabrication

It is also used (with reprocessed Plutonium) for making mixed oxide (MOX) fuel & to dilute highly-enriched Uranium from dismantled weapons, which can then be used for reactor fuel.

Electricity generation

Major source of radioactivity arising from use of nuclear reactors for electricity comes from HLW material. Highly radioactive fission products and trans-uranic elements are produced from Uranium and Plutonium during reactor operations & are contained within the used fuel. Where countries have adopted a closed cycle & reprocess used fuel, the fission products & minor actinides are separated from Uranium & Plutonium & treated as HLW. In countries where used fuel is not reprocessed, the used fuel itself is considered a waste & so classified as HLW.

- LLW & ILW is produced as a result of general operations, such as cleaning of reactor cooling systems, fuel storage ponds & the decontamination of equipment, filters & metal components that have become radioactive as a result of their use in/near reactor.

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Reprocessing of used fuel

Any used fuel will contain partly U^{235} as well as various Plutonium isotopes which have been formed inside the reactor core & U^{238} . In total, these account for 96% of original Uranium and over half of the original energy content (ignoring U^{238}). Used nuclear fuel has long been reprocessed to extract fissile materials for recycling & to reduce volume of HLW. Several European countries, Russia, China & Japan have policies to reprocess used nuclear fuel.

- Reprocessing allows for a significant amount of Plutonium to be recovered from used fuel, which is then mixed with Depleted Uranium Oxide in a MOX fabrication plant to make fresh fuel. This process allows ~ **25-30%** more energy to be extracted from the original Uranium ore & significantly reduces the volume of HLW (~**85%**). The IAEA estimates that of the **3,70,000** metric tonnes of heavy metal (MTHM) produced since the advent of civil nuclear power production, **1,20,000** MTHM has been reprocessed. In addition, the remaining HLW is significantly less radioactive – decaying to the same level as the original ore within **9000** years (vs. **300,000** years).

Reprocessing of used fuel

- Commercial reprocessing plants currently operate in France, UK & Russia. Another is being commissioned in Japan & China plans to construct one too. France undertakes reprocessing for utilities in other countries & a lot of Japan's fuel has been reprocessed there, with both waste & recycled Plutonium in MOX fuel being returned to Japan.
- Main historical & current process is Purex, a hydrometallurgical process. Main prospective ones are electro-metallurgical – often called ***pyroprocessing***, since it happens to be hot. With it, all actinide anions (notably Uranium and Plutonium) are recovered together. While not yet operational, these technologies will result in waste that only needs 300 years to reach the same level of radioactivity as the originally mined ore.

Decommissioning nuclear plants

- In the case of nuclear reactors, ~**99%** of radioactivity is associated with the fuel. Apart from any surface contamination of plant, the remaining radioactivity comes from ***activation products*** such as steel components which have long been exposed to neutron irradiation.

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Decommissioning nuclear plants

Their atoms are changed into different isotopes such as Fe^{238}, Co^{60}, Ni^{63} & C^{14}. First two are highly radioactive (emit γ-rays) but with correspondingly short half-lives, so that after 50 years from final shutdown, their hazard is much diminished. Some Cs^{137} may also be found in decommissioning wastes. Some scrap material from decommissioning may be recycled, but for uses outside the industry, very low clearance levels are applied, so most is buried & some is recycled within the industry.

Legacy waste

- In addition to the routine waste from current nuclear power generation there is legacy waste. This waste exists in several countries, that pioneered nuclear power & especially where power programs were developed out of military programs. It is sometimes voluminous & difficult to manage & arose in the course of those countries getting to a position where nuclear technology is a commercial proposition for power generation. It represents a liability which is not covered by current funding arrangements. In UK, £73 billion is estimated in addressing this waste – principally from Magnox & AGR developments & about 30% of the total is attributable to military programs. In USA, Russia & France the liabilities are also considerable.

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Non-nuclear power waste

In recent years, in both the radiological protection & radioactive waste management communities, there has been increased attention on how to effectively manage non-power related nuclear waste. All countries, including those that do not have nuclear power plants, have to manage radioactive waste generated by activities unrelated to the production of nuclear energy, including: national laboratory & university research activities; used & lost industrial gauges & radiography sources & nuclear medicine activities at hospitals. Although much of this waste is not long-lived, the variety of the sources makes any general assessment of physical or radiological characteristics difficult. The relatively source-specific nature of the waste poses questions & challenges for its management at a national level.

Treatment and Conditioning

- **Treatment** involves operations intended to change waste streams' characteristics to improve safety or economy. Treatment techniques may involve compaction to reduce volume, filtration or ion exchange to remove radionuclide content or precipitation to induce changes in composition.
- **Conditioning** is undertaken to change waste into a form that is suitable for safe handling, transportation, storage & disposal. This step typically involves the immobilisation of waste in containers. Liquid LLW & ILW are typically solidified in cement whilst HLW is dried then vitrified in a glass matrix. Immobilised waste will be placed in a container suitable for its characteristics.

Storage and Disposal

- **Storage** of waste may take place at any stage during the management process. Storage involves maintaining the waste in a manner such that it is retrievable, whilst ensuring it is isolated from the external environment. Waste may be stored to make the next stage of management easier (e.g. by allowing its natural radioactivity to decay). Storage facilities are commonly on site at the power plant, but may be also be separate from the facility where it was produced.

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- **Disposal** of waste takes place when there is no further foreseeable use for it & in the case of HLW, when radioactivity has decayed to relatively low levels after 40-50 years.

To put the production and management of nuclear waste in context, it is important to consider non-desirable by-products – most notably CO_2 emissions – of other large-scale commercial electricity generating technologies. In 2016, nuclear power plants supplied 2417 TWh of electricity – 11% of the world's total consumption. Fossil fuels supplied 67% of which coal contributed the most (8726 TWh), followed by natural gas (4933 TWh) & Oil (1068 TWh). If 11% of electricity supplied by nuclear power had been replaced by gas – by far the cleanest burning fossil fuel – an additional 2388 million tonnes of CO_2 would have been released into the atmosphere; the equivalent of putting an additional 250 million cars on road.

	Lifecycle emissions (gCO_2eq/kWh)	Estimated emissions to produce 2417 TWh electricity (million tonnes CO_2)	Potential emissions avoided through use of nuclear power (million tonnes CO_2)	Potential emissions avoided through use of nuclear (million cars equivalent)
Nuclear power	12	29	NA	NA
Gas (CCS)	490	1184	1155	c. 250
Coal	820	1981	1952	c. 400

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Environmental Auditing (EA)

An environmental audit (EA) is a systematic, independent internal review to check whether the results of environmental work tally with the targets. It studies whether the methods or means used to achieve the goals or ends are effective. EA involves studying documents & reports, interviewing key people in the organization etc. to assess the level of deviations between targets and results.

It is defined as a systematic and documented verification process of objectively obtaining & evaluating evidence to determine whether an organization's EMS conforms with audit criteria set by the organization & for communicating the results of this process to management.

Environmental audits are being used as a tool & an aid to test the effectiveness of environmental efforts at local level. They can be carried out for a number of reasons including the following: **(a)** To verify compliance, **(b)** To review implementation of policies, **(c)** To identify liabilities, **(d)** To review management systems, **(e)** To identify needs, strengths and weaknesses, **(f)** To assess environmental performance, **(g)** To promote environmental awareness.

Objectives and scope

- Objectives of an EA are to evaluate the efficiency & efficacy of resource utilization (i.e. people, machines & materials), to identify the areas of risk, environmental liabilities, weakness in management systems & problems in complying with regulatory requirements & to ensure the control on waste/pollutant generation. The areas an EA deals with can be categorized as:

Design specification and layout : While setting up an industry, adequate provisions are made in the design specification & layout to augment the production capacity but corresponding provisions to meet the environmental criteria are often overlooked. Adequate provisions are necessary to upgrade pollution control measures to meet the future environmental standards that are getting stringent day by day. The audit will help in identifying specific areas of concern to meet the future requirements of environmental measures.

Resource management : The resources include air, water, energy & other raw materials. The audit will provide data to the management on the efficient use of the resources per unit production & thereby help reduce resource consumption & waste minimization.

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Objectives and scope

Pollution control systems & procedures : The audit helps ensure that the systems & procedures governing the environmental activities/operations of pollution control equipments are rightly followed & determine the efficiency of the system in identifying conditions & inviting corrective actions in a timely and effective manner.

Emergency plans and response/safety system : As the emergency plans more often than not remain in the safe custody of senior management, staff may not have immediate access to the right action during an emergency. The problem becomes acute when new persons are employed/deployed. The review of the emergency response system will ensure adequate knowledge, alertness & readiness of the staff concerned to effectively face an emergency.

Medical & health facilities/industrial hygiene & occupational health : The productive element of an industry is dependent on the health of its human resources. The primary facilities to suit the occupational needs of the industry are therefore vital. Audit in this regard will provide an insight into the actual requirements to warn suitable orientation of existing facilities.

Objectives and scope

Confirmation to regulatory requirement : Regulatory mechanism of environmental compliance is gradually becoming more & more comprehensive. New regulations & standards are being stipulated at such a pace that they render the existing systems archaic. Factory managers may not be fully aware of the latest requirements & this will make the top management/owners vulnerable for prosecution under various environmental acts. An audit helps compare the existing status with the stipulation & standards prescribed by various agencies & ensure compliance.

Scope of an EA falls under either of the following two options: (i) To limit scope of the audit to an assessment only of the degree of compliance with policies, requirements-type documents & procedures, (ii) To assess the adequacy of the policies, requirements-type documents & procedures to begin with & given their adequacies, to assess the degree to which compliance with these documents is achieved.

The argument for limiting the audit scope only to the assessment of compliance is that the policies, requirements-type documents & procedures have been developed & approved by the key affected technical & managerial personnel.

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Objectives and scope

The audit objectives, however, should be both to assess the degree of compliance with policies, requirement documents & procedures & to assess their adequacy as well, with the following constraints:

When a function, process or area is subject to frequent, periodic audit, it need not address the adequacy of the environmental program. The large majority of the audits should address only the degree of implementation compliance with, & the adequacy of the program. When the adequacy of the program is to be addressed, there should be a higher-level overview by the management of the auditing organization, i.e. an overview of any findings related to programmatic inadequacy. The purpose of this overview should be to assure that either each issue is fresh or each issue warrants a revisit before putting other units of the organization through the perturbation of addressing the issues.

A company's motivation for carrying out an environmental audit will determine the type of audit it chooses to implement.

Types of Environmental Audits

Objective-based types : EA covers assessment of any activity that impinges on the environment. The scope & objectives of the audit more usefully distinguish different audit categories & how the audit results are to be used. However, one must note that objectives & scope are often a combination of several audit types & are usually defined on a case-by-case basis. Organizations have developed audit programs to fit their particular needs. Based on objectives, EA can be categorised as:

Liabilities audit : Compliance audit, operational risk audit, acquisition audit & health & safety audit form liabilities audit. These are often conducted as a prelude to gaining insurance cover & as a means of demonstrating the regulatory compliance. Compliance auditing is probably the most common form of EA; it is a verification process whereby the facility establishes the extent to which it is complying with environmental legislations, regulations, emission limits, etc. Operational risk concentrates on the potential frequency & consequences of environmentally damaging activities in the raw material and product storage/handling & manufacturing process. Compliance with regulations does not necessarily reduce liability due to operational risks.

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Types of Environmental Audits

Acquisition audits assess the liability due to contaminated land & and building remediation costs. Health & safety audits normally form part of health, safety & environment (HSE) audit & involve assessment of adequacy of personal protective equipment (e.g., safety shoes, goggles, helmets etc.), emergency preparedness & disaster management plans.

Management audit : Corporate audit, system audit, policy audit & issues audit form management audit. These pay considerable attention to management systems as they guide the efficient & effective running of the operations. A corporate audit is initiated by the main Board of a parent company & is concerned with organization structure, roles & responsibilities, policy implementation, awareness & communications with a subsidiary. This is carried out as a reassurance to the main Board that its aims & objectives are being implemented throughout the corporate structure. Management system audits are carried out to check the systems against the policy & standards such as British Standard 7750 or ISO 14001.

Types of Environmental Audits

Policy audit is carried out to review & reassess the relevance of policy in light of developments (legal, technical, financial) within the organization & outside. Issues audit is carried out to establish environmental management plan & targets.

Activities audit : Site audit, waste audit, product audit & cross-boundary audit form activities audit. These cover auditing of select technical & management issues. Environmental site audit examines all aspects of the facilities performance w.r.t. the environment. It combines most of the elements of other types of EA & when undertaken in depth, involve considerable time & cost. The waste audits are of two types. The first identifies & quantifies waste streams & is a precursor to waste minimization programs. The second type assesses waste management practices & procedures. Product audits cover several aspects of their environmental impacts through design, manufacture, use & disposal. Such audits are prerequisites for identifying environmentally friendly products for “Green Labelling”. Cross boundary audits assess activities, which cut across departments or business units (e.g., transport and supply chain audits).

Types of Environmental Audits

Client-driven types : Different types of audits are based on the client, who has commissioned or ordered the audit procedure:

Regulatory external audit : This often entails an examination carried out by or for an environmental regulatory agency, with the goal of ensuring that a facility is meeting the relevant legislation & regulations. The regulatory agency can use the methodology of audit as a tool to systematically enhance its overview, including the possibility of verifying the accuracy of any reports, which a company is required to submit to the authority.

Independent external audit : This is conducted by external auditors entitled to perform audits. As the environmental factors have gained importance for a firm's market relations, shareholders such as banks & investment funds, insurance companies, environmental groups, potential buyers, customers, local government & environmentally-aware citizens are demanding independent external audits to assess how the firm deals with environmental issues.

Types of Environmental Audits

Internal environmental audit : This often involves an inquiry commissioned by management. In practice, such audits are commonly ordered by senior management located at some distance, in both physical & operational senses, from the factory or site of environmental concern. In such cases, the environmental audits are internal in that the results will remain within the organization. However, for the facility under investigation, the internal audit will have the same effect as an external audit. One reason why firms conduct internal environmental audits is to diminish their liability to pay fines, damages or clean-up costs as the result of breaking the law (e.g., releasing more emissions than permitted).

Third-party audit : These represent the audits certifying organisations carry out to verify as to whether internal/external audits meet the standards set.

4 general steps involved in an audit procedure: (a) Audit preparation, (b) A systematic scrutiny or review of a facility, (c) Reporting, (d) Follow up.

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Energy Audit in Chemical Industry

- Chemical industry forms the backbone of the industrial & agricultural development in India & also provides building blocks for downstream industries. To understand the extent of energy being wasted, it is essential to know the amount of energy being consumed. Energy audit is an inspection, survey & analysis of energy flows for energy conservation to reduce the amount of energy input into the system without negatively affecting the output.
- India's economic growth over next 25 years is expected to derive more from light manufacturing & services than from heavy industry, so that the industrial share of total energy consumption falls from **72%** in 2006 to **64%** in 2030. The changes are accompanied by shifts in India's industrial fuel mix, with electricity use growing more rapidly than coal use in the industrial sector. The Indian chemical industry was the 5th largest in the world & 2nd largest in Asia (after China). The volume of major chemicals amounted to 8.3 million metric tons (MMT) in 2011-12. Among various sectors contributing to Green House Gas (GHG) emissions, the contribution of the industrial sector is significant.

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Thus, mitigating GHG emissions from the industrial sector offers the best means of reducing overall GHG emissions. Therefore, energy conservation means less reliance on energy imports & less GHG emissions. It can be achieved either by reducing total energy use or by increasing the production rate per unit of energy used. On the other hand, improving energy efficiency is the key to reducing GHG emissions.

Objective of Energy Audit in Chemical Industry

Primary objective is to determine ways to reduce energy consumption per unit of product output or to lower its operating costs. The present scenario of energy demand in chemical industries is the indication of energy conservation & optimum utilization of renewable sources of energy. Considering the scenario of the Indian industrial sector & its energy utilization efficiency, there is urgent need to review manufacturing technologies & present energy management approach. Owing to old/obsolete industrial technologies/machinery, the extent of energy wastage is very high. Energy Conservation potential has been projected between **30-40%**.

Objective of Energy Audit in Chemical Industry

Effective management of energy-consuming systems can lead to significant cost & energy savings as well as increased comfort, lower maintenance costs & extended equipment life. Energy audit evaluates the efficiency of all building & process systems that use energy. Energy audits don't save money & energy for companies unless recommendations are implemented. Audit reports should be designed to encourage implementation but often they impede it instead.

- Energy crisis all over the world in the '70s warned mankind & forced it to think about the appropriate utilization of the energy resources on Earth for sustainable development. Energy crisis had led to many innovations as well as R&D programs in all sectors related to energy. It is well known that energy sector has its own impact on the progress and development of any nation. Availability of various energy resources & in house capability to use it in the appropriate manner for productive development of a nation is a key factor in the economic growth of the country.

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Objective of Energy Audit in Chemical Industry

The present scenario of energy demand in chemical industries is the indication of energy conservation & optimum utilization of renewable energy sources. Following are the objectives: (a) To study electrical & thermal energy consumption pattern in chemical industry, (b) To determine efficiency of hot air generator by direct & indirect method, (c) To recognize energy saving opportunities & suggest possible application of renewable energy.

- Audit should consider (1) Cost of heat when derived from natural gas & biomass fuel. (2) High-pressure steam cost at the boiler with natural gas & biomass fuel. (3) Medium-pressure steam cost when passed through a pressure relieve valve (PRV). (4) Low-pressure (LP) steam cost when passed through a steam turbine, (5) LP steam cost when condensate is & isn't returned, (6) Cost of condensate when returned at 190°F & 130°F, (7) Cost of compressed air distributed to process plants.

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Obstacles in Improving Performance of Waste Management

- There are two kinds of solid waste recycling:

(a) Product recycling: considered a necessary & alternative solution for new production & could be a player to the complete production/ to the component as:

- Product recycling maintaining its shape, texture & its high value after maintains or development & reuse for the same purposes or otherwise.
- Product recycling after disassembly & assigning its components & parts for the production & collection process.

(b) Material recycling: Recyclable materials may originate from a wide range of sources including home & industry. They include glass, paper, aluminum, asphalt, iron, textiles & plastics. Biodegradable waste, such as food waste or garden waste is also recyclable with the assistance of microorganisms through composting or Anaerobic Digestion.

Obstacles in Improving Performance of Waste Management

- Implementation of **3R** strategy to minimize quantity of wastes is not effective enough because of some barriers. Previous studies have proven that issues regarding practicing waste minimization are common among industrial sectors. Lack of awareness, knowledge & information, inappropriate packaging, lack of time, old technologies & incapability in implementation of institutional, governance & economic factors & old technologies are the prevalent obstacles of practicing waste minimization by industrial sectors.

  (i) Awareness & knowledge issues : Scientists demonstrated that awareness plays an effective role in recycling activities & noted that environmental knowledge plays a fundamental role in forming waste management behavior. Poor attitudes of personnel, technology deficiency, lack of trained personnel & knowledge provision by the authorities were realized as obstacles in food & drink industries, which when coupled with high demand of packaging cause a considerable amount of waste generated. Government was responsible for achievement of sustainable waste management.

Obstacles in Improving Performance of Waste Management

It was also suggested that campaigning for awareness played an effective role in enhancing the awareness & helps change attitudes & perception toward solid waste management.

(ii) Technology issues : Research results considered technology as a barrier in waste management in Asian countries. In analysis of waste minimization in small & medium enterprises, it was revealed that technology is an efficient tool which offers a great opportunity in waste minimization.

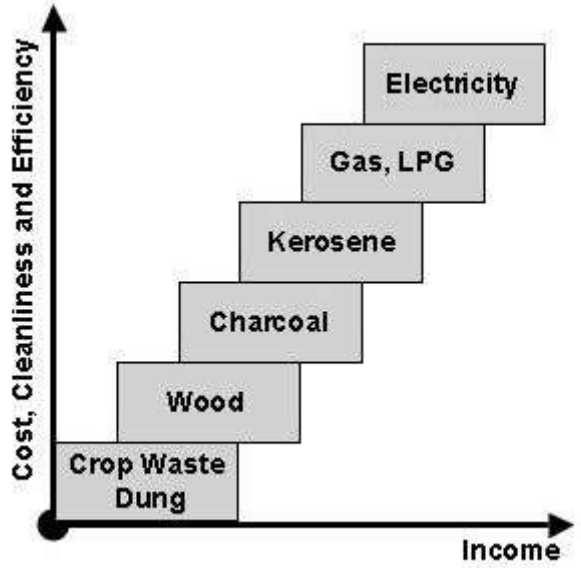
(iii) Governance issues : Moving toward greater emphasis in developing countries, common issues can be seen regarding ineffectual government monitoring & solid wastes management laws. Ineffective enforcement is preventive factor in implementation of 3R strategy for minimizing the waste. Inadequate facilities for wastes collection & the absence of expertise beside insufficient regulations are the barriers in waste management. Lack of dynamic partnership between industries & local Authorities were hindering factors for efficient waste-reduction & sustainable

Obstacles in Improving Performance of Waste Management

development principles. A regulatory framework was introduced as an effective instrument in controlling waste arising. Also, lack of regulatory framework implied that in many Asian countries, waste management laws do not enforce well. Additionally, the absence of appropriate guideline in factories may prevent manufactures from recognizing their chances for improving their activities regarding sustainable development targets.

(iv) Other issues : Weakness in packaging of products may affect waste minimization practices, such as using non-recyclable material & inefficient managing of packaging. It may also be considered that the absence of time is a preventive factor in perception of waste management. In other research, lack of time hampers the effective implementation of regulations enforcement & noted that fiscal aspects played fundamental role in waste minimization implementation & the absences of financial support is a fundamental barrier in wastes management. Following an appropriate practice of waste minimization, cost saving by any company can be achieved.

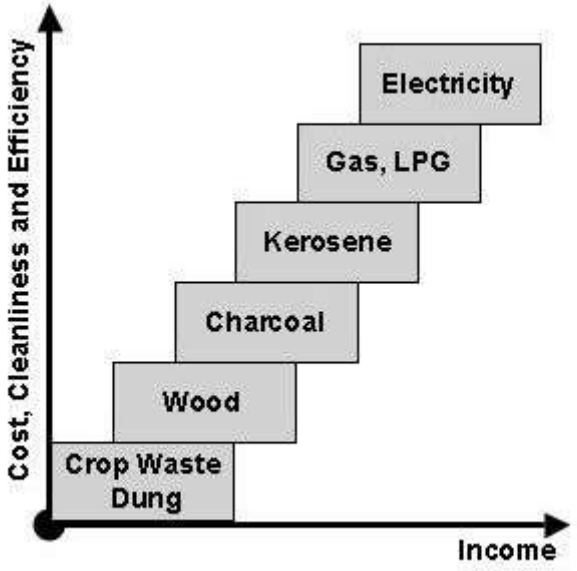
Energy Ladder in Rural India



Domestic or household sector is a complex field for analysis, as far as the energy-consumption is concerned, this sector uses both the commercial/non-commercial forms of energy. Besides, consumption of any particular energy form depends upon various economic and socio-economic factors. One of the major factors on which the choice of energy dependents is the income of households. Generally it can be observed that the poorer households depend on non-commercial sources of energy, available at ~ 0 cost. Energy forms like fuelwood, animal & agricultural wastes assume importance for such households. Again, with an increase in incomes & change in the occupation structure of household, different kinds of energy sources are demanded. E.g. with increase in income of household, after meeting essentials like food, clothing etc. Household expenditure would be for a better quality of fuel, which can be from crop wastes to fuelwood to kerosene, or from kerosene to LPG. If all the sources of fuel which are prefered one after the

Energy Ladder in Rural India

other in a vertical scale, one can observe that starting from fuelwood, different rungs will lead to LPG & electricity. This hypothetical ladder scale is called ***Energy Ladder***.



The concept of energy ladder indicates that the pattern of energy use in different households varies with their economic status & each step of the ladder corresponds to different & more sophisticated energy carrier, & the step to which the household climbs the ladder depends mainly on its income. The ladder can be from fuelwood, cowdung, agricultural wastes, to coal, kerosene, charcoal to LPG & electricity. The height of the ladder step is determined by factors like capital cost of the fuel utilizing device, price of the energy & household energy consumption.

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Energy Management

We posed Energy Management Planning & Policy as a optimal route to manage renewable & non-renewable energy resources. We also posed how nuclear waste are categorized and briefly touched on environment audit leading to green-technology & energy ladder in rural India.

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