Environmental Management

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Abbreviations

ARWSP - Accelerated Rural Water Supply Programme
ATP - Adenosine triphosphate
CBD - Convention on Biological Diversity
CECAB - Canadian Environmental Certification Approvals Board
CHO - Carbohydrates
CIS - Commonwealth of Independent States
CITES - Convention on International Trade in Endangered Species of Wild Fauna and Flora
CNG - Compressed Natural Gas
COFI - Committee on Fisheries
COP - Conference of the Parties
CPCB - Central Pollution Control Board
CPM - Continuous Particulate Measurement
CREP - Corporate Responsibility For Environmental Protection
CRF - Calamity Relief Fund
DDP - Desert Development Programme
DPAP - Drought Prone Area Programme
EAP - Environmental Action Programme
ELD - Environmental Liability Directive
EMAS - Eco-Management and Audit Scheme
EMP - Environmental Management Plan
EMS - Environmental Management System
EOC - Emergency Operation Centre
EPA - Environment Protection Act
ESFs - Emergency Support Functions
GLCs - Ground Level Concentrations
HPC - High Power Committee
HVAC - Heating Ventilation Air Conditioning
IDNDR - International Decade for Natural Disaster Reduction
ISO - International Organisation for Standardisation
ITTA - International Tropical Timber Agreement
ITTC - International Tropical Timber Council
IWDP - Integrated Wasteland Development Programme
LOI - Letter Of Intent
MEA - Multilateral Environment Agreements
MoEF - Ministry of Environment and Forests
NA&ED - National Afforestation & Eco-development Programme
NAAQS - National Ambient Air Quality Standards
NCCF - National Calamity Contingency Fund
NOC - No Objection Certificate
ODS - Ozone Depleting Substances
PDCA - Plan-Do-Check-Act
PDSA - Plan, Do, Study, Act
PLIA - Public Liability Insurance Act
PM - Particulate Matter
PPEs - Personal Protective Equipments
PPGs - Pollution Prevention Guidelines
SCBD - Secretariat of the Convention on Biological Diversity
SCG - State Crisis Group
SECR - State Emergency Control Room
SEM - State Emergency Manager
SEMPC - State Emergency Management Planning Committee

SGRY - Sampurn Grameen Rozgar Yojana
SMF - Stack Monitoring Facility
SOP - Standard Operating Procedure
SPCB - State Pollution Control Board
SPFS - Special Programme for Food Security
SPS - Sanitary and Phytosanitary Measures
TAG - Technical Advisory Group
TBT - Technical Barriers to Trade
TPNs - Thematic Programme Networks
TRIPs - Trade-related Aspects of Intellectual Property Rights
UNCED - UN Conference on Environment and Development
UNCTAD - United Nations Conference on Trade and Development
UNFCCC - United Nations Framework Convention on Climate Change
WBCSD - World Business Council for Sustainable Development
WCED - World Commission on Environment and Development
WPA - Wildlife Protection Act
WTO - World Trade Organisation

Chapter I

Environmental Management

Aim

The aim of this chapter is to:

- introduce environmental management
- explain evolution of the concept
- explicate the fundamentals of sustainable development

Objectives

The objectives of this chapter are to:

- enlist sustainable environment
- elucidate sustainable environment
- explain principles of sustainable development

Learning outcome

At the end of this chapter, you will be able to:

- identify the sustainable economy
- understand the critique of the concept of sustainable development
- define sustainability

1.1 Introduction

Over ages, man, with his desirable and non-desirable activities, has affected the environment unquestionably and sometimes irrevocably. However, awareness of the damage has also given rise to a lot of clamour about minimising these effects. Across the globe, governments, trade associations, supply chains and other social and financial stakeholders are bent on pressing the issue further. The concept of environment management is the offspring of this widespread awareness about the human impact on the environment.

Now the key question is: what is environmental management? In layman's language, it is the process by which environmental health is regulated. Human beings cannot aspire to manage the environment themselves, but it is the process of taking steps and behaviour to have a positive effect on the environment. Environmental management involves the wise use of activity and resources to impact the world. Many organisations develop a management plan or system to implement, manage and maintain environmental goals. Management plans for the environment are conceptualised by many companies and organisations, because taking care of the planet has become the prime responsibility of everybody in every type of profession.

1.2 Evolution of the Concept

Since prehistoric times, the human race has gathered environmental experience and has created strategies for making the best possible use of nature. To facilitate management of resource-utilisation, people developed taboos, superstitions and common rights, devised laws to improve conservation and even engaged in national resource inventories (such as, the twelfth century AD Doomsday survey). While a few managed to maintain practical lifestyles for long durations, the thought that pre-modern people 'close to nature' brought about slight environmental harm is mostly an Arcadian myth. In fact, people in the prehistoric era, using fire and weapons of flint, bone, wood and leather, managed to change the vegetation of a majority of continents and most likely eradicated numerous species of large mammals (Tudge, 1995).

Developments observed in the late twentieth century make it imperative that environmental management should be accurately comprehended. Such developments include, but are not limited to, global pollution, loss of biodiversity, soil degradation and urban sprawl. The challenges are enormous; however, there has been progress in perceiving the composition and function of the environment, in examining impacts, data-handling and analysis, modelling, evaluation and planning. It is the responsibility of environmental management to organise and concentrate on such advancements, to augment human welfare and diminish or curb further destruction of earth and its organisms.

Technological optimism evident in the west, chiefly from the 1830s onwards and articulated in natural resources management, weakened somewhat after 1945 since environmental issues became a prime concern in people's consciousness (Mitchell, 1997). Some degree of efforts were put in to ascertain that natural resources utilisation was incorporated in social as well as economic progress before the 1970s, e.g., integrated or comprehensive regional planning and management was put into practice as early as the 1930s with the institution of river basin bodies (Barrow, 1997). Urban and regional planning has roots in holistic ecosystem approaches as well things that have of late caught the attention of those interested in environmental management (Slocombe, 1993:290).

Nevertheless, natural resources management (in contrast with environmental management) is more related to specific components of the earth resources, that have utility and can be exploited mostly for short-term and which prove advantageous to special interest groups organisations or governments. Moreover, natural resources management responses to issues are likely to be reactive and usually depend on quick-fix technological methods and a project-by-project approach. Natural resources managers usually hail from a narrow range of disciplines, characteristically with limited sociological and environmental proficiency. Their management can be authoritarian and may not succeed in reaching out to the public; they also are likely to overlook offsite and delayed impacts. Owing to these anomalies, natural resources management has lost ground to environmental management in the last 40 years or so.

1.2.1 Definition and Scope

There is no precise universal definition of environmental management. The reason lies in the vast scope of the subject and diversity of specialism involved therein. An attempt, nonetheless, has been made to compile various significant definitions of environmental management. That exercise precipitates to the following characteristics of environmental management:

- It is mostly used as a generic term.
- It supports sustainable development.
- It is concerned with that sphere of nature, which is affected by humans. (Unfortunately, we can presently boast of very few natural regions that are free of human interference.)
- It calls for multidisciplinary and interdisciplinary approach.
- It encompasses various paradigms of development.
- It takes cues from physical sciences, social sciences, policy-making and planning.
- The timescale involved is often long and the environmental concerns range from local to global.
- It assists us to identify and address problems simultaneously.

1.2.2 Fundamentals and Goals

In 1975, Laurence Sewell thought that the environmental manager ought to be capable to control both social institutions as well as suitable technologies. However, it should execute these with the perception of an artist, understanding of a poet and, maybe, the ethical purity and willpower of a pious devotee.

The nature of environmental management

Environmental management is a way to reach out for environmental conservation, which consolidates ecology, policy-making, planning and social development. Its objectives consist of the following aspects:

- The obstacle and motion of environmental issues.
- Ascertaining restrictions.
- Ascertaining and fostering institutions that efficiently back up environmental research, observation and management.
- Caution of threats and recognising better prospects.
- Supporting and in all probability enhancing the ‘quality of life’.
- Recognising new technology or procedures that are constructive.

It is obvious that these objectives obscure a lot of issues. Obviously, short-term objectives must be set in and contained by a universal vision (Dorney, 1989: 5). Without a universal vision, it is not easy to circumvent split decision-making or to implement a long-term vision or to arrange and recognise critical assignments. Environmental management as a result demands ‘scoping’ (determining the objectives and putting restrictions on hard work) prior to taking some action. From the early 1970s, famous texts have frequently published about the environmental variations. Any invasion into nature has several effects, a lot of which are erratic (environmental management should deal with the unanticipated).

- Since ‘everything is connected’, humans as well as nature are inseparably tied up together; what one individual does, has an effect on the others (environmental management should think about the series of events, looking further than the confined and short-term).
- A lot of care has to be taken that the substances manufactured by humans are not obstructing any of the earth’s biogeochemical procedures (environmental management should keep an eye on the natural procedures and human actions to make sure no critical process is disturbed).

In the past few years, a number of environmental managers have started to put across their universal vision and objectives by publishing an environmental policy declaration to demonstrate the purpose, recognise priorities as well as principles and provide the main reason behind it. While this notifies the public, it does not promise healthy practices in environmental management. Environmental managers should believe that there is a most advantageous equilibrium between environmental protection and permitting human actions. Ascertaining where that balance is

placed is mostly dependant on ethics. Clark (1989) disputed that at its core, environmental management asks the following two questions:

- What type of planet do we desire?
- What type of planet can we acquire?

Although agreement of a most advantageous balance can be attained, the way to environmental management objectives might take diverse ways. Environmental management has not developed in seclusion. Regional planners frequently implement a human ecology method; other planners implement a systems analysis or an ecosystem method. For example, McHarg (1969) used river basins and Doxiadis (1977) attempted to create a science of planning settlement in equilibrium with nature- ekistics. Rapoport (1993) identified two key segments: those who implement a horticultural implied comparison, Garden earth and those who favour the one, that is, technological-spaceship earth. The diversity of challenges and the truth that a lot of different aspects are engaged (e.g., the public, business interests, professions, local and national government, special interest groups and the charitable segment), implies that when it comes down to it, environmental managers usually focus on an area, ecosystem, area of activity or resource.

Environmental managers who may not be able to accomplish their goals could be criticised (or taken to court), get disrespected by their employers and lose public faith. Therefore, like a majority of supervisors, environmental managers are liable to follow risk-aversion procedures together with the following steps:

- Working to secure minimum standards.
- Implementing tolerable restrictions.
- Following a ‘win-win’ or ‘least regrets’ method (i.e., measures which derive advantages, no matter what the outcome and measures which strive to decrease unnecessary effects respectively)

In actuality, all these techniques aim at preserving or safeguarding the environment except if public expenditure is extremely high. The following preventive measures are not free of cost. In a majority of situations, it has proved to be expensive since quite a few things have to be given up to keep the escape options open.

1.2.3 Environmental Management System

Environmental management system (EMS) refers to the management of an organisation’s environmental programmes in a comprehensive, systematic, planned and documented manner. It includes the organisational structure, planning and resources for developing, implementing and maintaining policy for environmental protection.

EMS Model

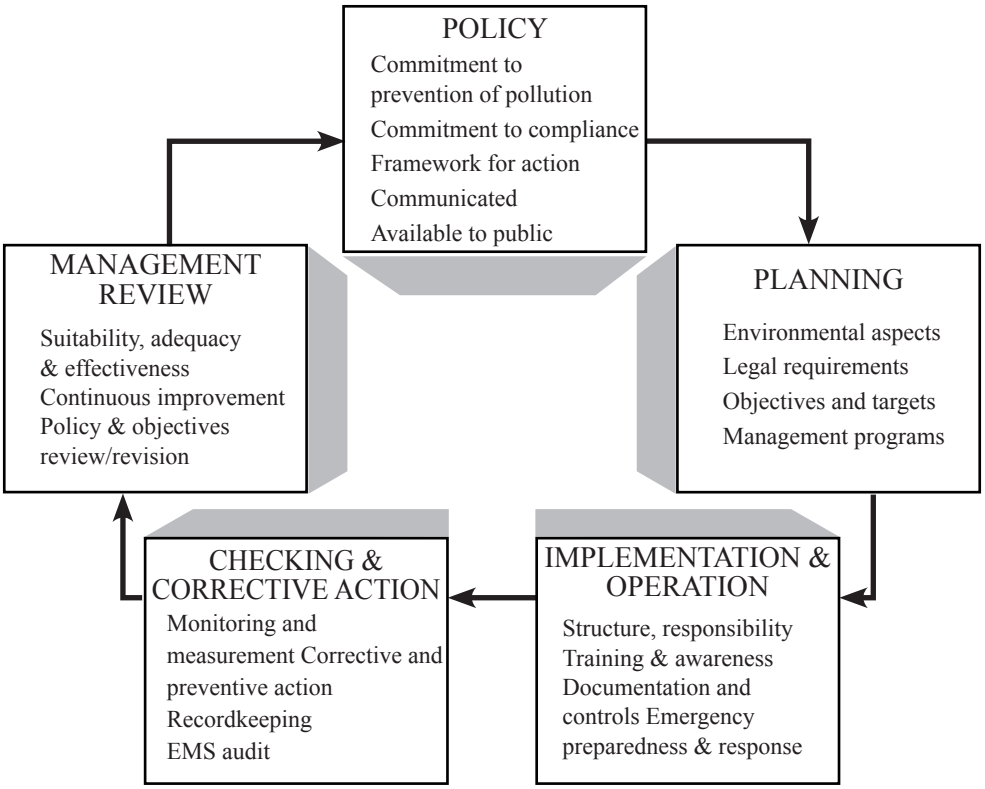

Fig. 1.1 EMS continuous improvement cycle
(Source: http://www.slideshare.net/RajendraGhuge/environmentmanagemnent-notes)

An EMS follows a Plan-Do-Check-Act cycle (PDCA). The diagram shows the three-fold process of developing an environmental policy, planning the EMS and then implementing it. The process also entails checking the system and acting on the findings. The model is continuous because an EMS is a process of continual improvement in which an organisation is reviewing and revising the system on a continual basis. This model can be employed by a wide range of organisations right from manufacturing facilities to service industries to government agencies.

1.3 Fundamentals of Sustainable Development

The fundamentals of sustainable development are explained in detail in the following paragraphs.

Sustainability

In common parlance, sustainability means the capacity to endure. In ecology, it is a term describing how biological systems remain diverse and productive over a period of time. For human beings and for the purpose of our discussion, sustainability should be understood as the potential for long-term maintenance of well-being, which in turn rests with the well-being of the natural world and the responsible use of natural resources.

Sustainable development

This term can now be deduced from the above definitions of sustainability. Sustainable development is a pattern of resource use that aims to meet human needs while preserving the environment with a view that these needs can be met not only in the present, but also for future generations. Sustainable development embraces the prime, interdependent and indivisible areas of environmental protection, economic development and social development.

The report of the World Commission on Environment and Development suggested strategies for dealing with accelerating deterioration of the human environment and natural resources and the consequences of that deterioration for economic and social development. Failing to manage the environment and sustaining the development process are two sides of a balance which countries find difficult to balance, especially in the present times. In turn, they find it an enormous task to focus on conserving the environment.

Environment and development are not separate challenges; they are inexorably linked in a complex system of causality. Development cannot subsist upon a deteriorating environmental resource-base; the environment cannot be protected when growth fails to count the costs of environmental destruction in the final checklist. These problems have to be countered jointly and managed by the respective governments; they will have to join hands to design solutions in terms of government policies. Such government policies can then be implemented by measures like finance, cooperation, capacity-building, education and public awareness, transfer of environmentally sound technology, science for sustainable development, international institutions, legal measures, information dissemination, etc.

All definitions of sustainable development presume that we see the world as a system that connects space and time. The reason is obvious. When you assume the whole world as one entity, you tend to believe that the onus of taking care of it rests upon you. Certain realisations dawn on you: air pollution from North America affects the air quality in Asia; that pesticides sprayed in Argentina could harm fish stocks off the coast of Australia. Over time, you also start to evaluate and appreciate the decisions our grandparents made about how to farm the land because they affect modern agricultural practice. Similarly, the economic policies we endorse today will have a definite impact on urban poverty, when our children grow into adults. This is what is meant by presuming the world as a system connected in space and time. The concept of sustainable development is rooted in this sort of systems thinking. It helps us understand our world and ourselves.

1.3.1 Principles of Sustainable Development

For sustainable development to be plausible in the future, we must be ready and willing to maintain our natural capital assets. It is high time we understand and accept that our social wealth has come with a price tag. The price we have paid is intangible and irrevocable erosion of our natural resources. These resources are exhaustive and their depletion has been harming the environment incessantly. As humans, as trustees of this wealth, we have failed miserably to use this wealth to generate adequate levels of secondary or tertiary industries, which would enable us to maintain a satisfactory level of financial prosperity while redirecting the resources back to maintain our natural resource base at the same time. Instead, we are being increasingly forced to liquidate our natural resources in the name of economies of scale and governments' commitments to free trade and global competitiveness.

There has been a mention of a vicious circle in this regard. Sustainable development is difficult to maintain without maintaining the growth rates, which, in turn, are difficult to maintain without harming the environment. There is a grain of truth in this statement, indeed. To a large extent, it appears to present before you a vision for transforming our currently growth-oriented socioeconomic system to one that is balanced on an emerging ecological worldview's vision of environmental sustainability and social justice. We know that vision to be an ideal, though. Therefore, the major debate rests on how to balance the two sides. Within this perspective, there is a growing body of literature that agrees on a broad set of principles for sustainability to guide us toward these goals. These principles will emphasise upon our political and economic institutions the importance of realising that our natural resources are limited and must not be overutilised.

Some ecological components from the emerging worldview include the following principles:

- The value of biological diversity.
- Ecological limitations on human activity.
- The intimately intertwined and systemic nature of the planet's abiotic and biotic components.
- Thermodynamic irreversibility of natural processes.
- The recognition of the dynamic, constantly evolving and often unpredictable properties of natural systems.

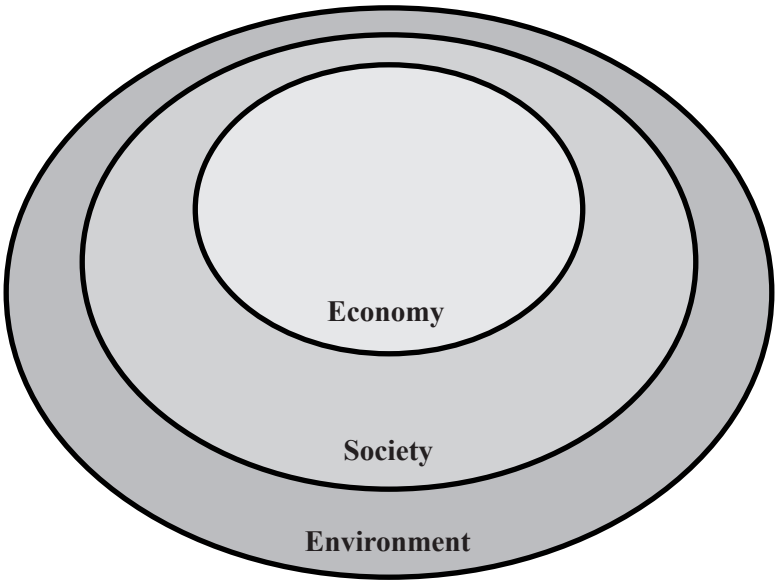

Fig. 1.2 A representation of sustainability
(Source: http://www.slideshare.net/RajendraGhuge/environmentmanagemnent-notes)

Successful sustainable development involves a comprehensive understanding of policy and issues as well as a balanced understanding of technical and financial realities. Emphasis is placed on understanding how the many diverse elements of 'green' design and sustainable technologies and related cost implications can truly result in a well-defined and manageable sustainable development plan. It is intended for professionals whose roles include supervising and managing sustainable programmes.

1.3.2 Sustainable Economy

The ability to sustain a quality environment depends on the ability to foster a strong and sustainable economy. Such an economy is more efficient and derives greater social benefits from the utilisation of fewer environmental assets. In addition, a sustainable economy can make way for the means for increased environmental protection and conservation, while also offering the society alternatives to undue exploitation of natural resources. A sustainable economy is, therefore, very important for the betterment of the society and the increase in the standard of living of the people and the future of humanity.

Some important facets of sustainable development are given below. If we, as humanity, need to meet the challenges of growing population and managing resources, so that they can be utilised without harming the environment, these principles must take centre stage in all our lives.

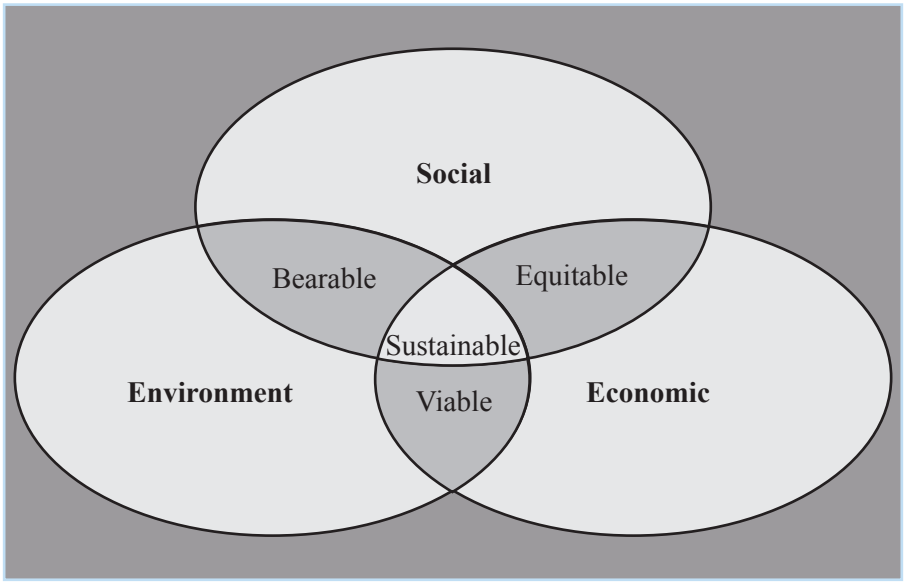

Fig. 1.3 Scheme of sustainable development
(Source: http://www.slideshare.net/RajendraGhuge/environmentmanagemnent-notes)

The following are some of the facets of sustainable development:

- Inspire diversified economic development: Development that augments employment and other benefits derived from a given stock of resources should be prioritised.
- Encourage efficient economic development: Development that reduces waste and makes efficient use of resources should be inspired.
- Ensure that all renewable resources are used in a manner that is sustainable over a long-term: Renewable resources include soils, wild and domesticated organisms and ecosystems. Renewable resources should not be used at rates that exceed their capacity to renew themselves.
- Ascertain that nonrenewable resources are not exhausted and sufficient quantities are left for utilisation by future generations: Nonrenewable resources should not be used at rates that exceed our capacity to create substitutes for them.
- Economic activity should work within the capacity of ecosystems: It should strive to assimilate or process the waste associated with such activity.
- Stimulate environmentally sound economic activity: This must be done through a combination of educational awareness, political and legal measures and economic instruments.
- Inspire attitudinal and behavioural change: These profound economic changes can shape themselves only as a result of altered behaviours and attitudes.

The concept of carrying capacity is often defined as the maximum population that can be supported in a given habitat without permanently inflicting any damage to the ecosystem. However, in terms of human life, the issue of 'quality of life' cannot be discounted. How individuals and communities define quality of life will contribute to their impact on the larger environment. For instance, in case of a community that values a rich and luxurious lifestyle, the carrying capacity of the environment depletes. Therefore, the definition above might be amended by substituting 'the optimal population' for the phrase 'the maximum population'.

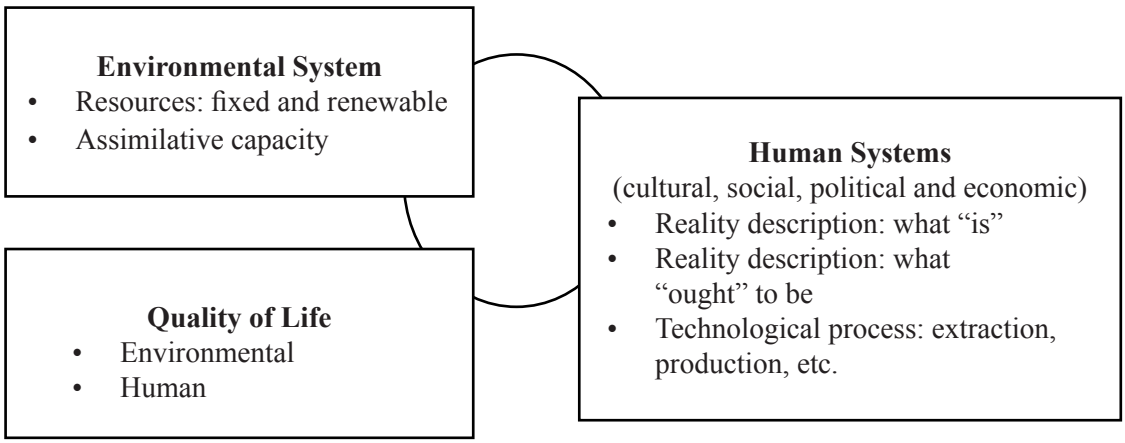

Fig. 1.4 Carrying capacity and quality of life (adapted from Mabbutt 1985)
(Source: http://www.slideshare.net/RajendraGhuge/environmentmanagemnent-notes)

Consequently, carrying capacity, in terms of human systems, can be further defined as, "Carrying capacity means the level of human activity (including population dynamics and economic activity) that a region can sustain (including consideration of import and export of resources and waste residuals) at acceptable 'quality-of-life' levels in perpetuity." (Mabbutt, 1985)

The long-term goals of the ecological world view

The Brundtland Commission, formerly the World Commission on Environment and Development (WCED), was convened by the United Nations in 1983. It was created to address growing concerns "about the accelerating deterioration of the human environment and natural resources and the consequences of that deterioration for economic and social development."

The Brundtland Report has argued eloquently why we must reverse the current degradation of the environment, which was "first seen as mainly a problem of the rich nations and a side effect of industrial wealth which has become a survival issue for developing nations." The report points out the link between the problems and prospects of the planetary environment and those of human societies, both rich and poor. It had to find an acceptable compromise between the North's concern about a global demographic explosion and a rapidly deteriorating environment and the South's insistence that economic development and social opportunities must be given a higher priority than environmental protection.

It places our species at the centre of the evolutionary process and consequently, perceives and evaluates the planet's ecology in terms of human needs and values. A growing number of environmental writers find this perception not only grossly limited but also ultimately liable to be fraught with its own danger. They call for a 'common future', that is, eco-centric, placing equal value and significance on all species without exception. For many, the ecological worldview should include the following standards and goals:

- Human interference with the nonhuman world is excessive and the situation is rapidly worsening.
- Policies must therefore be changed. These policies, in essence, should affect the basic economic, technological and ideological structures. The resulting state of affairs will be essentially different from that of today.
- There must be recognition that both human and nonhuman living beings have value in themselves. Nonhuman life is intrinsically valuable regardless of its value to humans.
- The richness and diversity of living beings (human and non-human) has an innate value.
- Humans have no right to reduce this richness and diversity, except when it is occasionally compelled to satisfy vital human needs.
- The flourishing of human life and cultures is compatible with a substantial decrease in the global population. The flourishing of nonhuman life requires such a decrease.
- The appreciation of a high quality of life will have to supersede that of a high material standard of life (as measured by economic and materialistic criteria).

1.3.3 Sustainable Environment

A healthy environment is the solid foundation on which the system of a country depends. Therefore, it cannot and should not be tampered with. The essential role that ecosystems play in supporting our society establishes an environment that must be respected in all land, resource and economic decisions. Our priority must, in all situations, be to maintain and retain natural systems for present and future generations through the following steps:

- Conserve life-support services: Certain ecological processes sustain productivity, adaptability and capacity for the renewal of lands, water, air and all the life on earth. These processes include maintaining the chemical balance of the planet, stabilising the climate, recycling nutrients, breaking down pollutants and cleansing air and water, stabilising water flow, forming and regenerating soil and supplying food and a suitable habitat for all species.
- Conserve biological diversity in genes, species and ecosystems: This incorporates the total amount of plant, animal and other species that constitute the planet earth; the variety of different genetic stocks in each species and the variety of different ecosystems. There are three reasons for conserving the diversity of nature as a matter of principle, all species have a right to exist by virtue of their intrinsic value; as a matter of survival, the diversity of life is a requisite for optimising the biotic and abiotic conditions for the continuation of life and as a matter of economic benefit, diversity of nature is the ultimate source of everything, including food, shelter and other resources. Hence, we must strive to respect the integrity of natural systems and to restore previously degraded environments.
- Attempt to anticipate and prevent adverse environmental impacts: When making land and resource decisions, one must adopt a precautionary approach, exercise caution and special concern for natural values and appreciate the fact that human understanding of nature is incomplete.
- Practice full cost accounting: We have to make sure that environmental and social costs are included in the process of maintaining the ecosystems and the people concerned need to account for land, resource use, species depletion and economic decisions.
- Recognise our responsibility to protect the global environment: We must exercise stewardship, reduce consumption to sustainable levels, avoid importing or exporting ecological stresses and help meet the global challenge of sustainably supporting the human population.
- Respect the intrinsic value of nature: Environment must be protected for human consumption and enjoyment. We should not take undue advantage of the environment that we possess today and ruin it or create a worse one for the future generations; that will lead to our downfall and degradation, as a society.

This is imperative for ecological and societal sustainability as well. In the last century, the planetary population quadrupled beyond the figure reached by our species in the previous 3 million years or more. It will grow six-fold in the next half century. This is a major alarm considering the argument that the human impact on the ecosystems of the planet is obtained by the number of people multiplied by how much energy and raw materials each person and social group uses and wastes.

There will be a small chunk of people consuming a lot or a lot of people consuming a little. Though the earth's ability to restore itself and absorb wastes can be enhanced by careful management, there is a limit. It is crucial to know the optimal population that the planet can support. Although we have yet to determine these precise confines, there are clear indicators of what can and cannot be done and what stage human society has scaled today. Unfortunately for us, the signs are not that heartening.

Sustainable aquaculture development

Aquaculture is currently contributing and will continue to contribute, a major share in boosting global fish production and in meeting the rising demand for fishery products. A recent session of the FAO Committee on Fisheries (COFI) stressed the increasingly important and complementary role of aquaculture and inland capture fisheries in fish production for human nutrition and poverty alleviation in many rural areas.

Aquaculture, just like all other food production practices, is facing challenges for sustainable development. Most aqua-farmers, like their terrestrial counterparts, are continuously pursuing ways and means of improving their production practices, so that they are more efficient and cost-effective. Awareness of potential environmental problems has developed significantly. Efforts are underway to further improve human-capacity, resource-use and environmental management in aquaculture. COFI emphasised enhancement of inland fish production through farming systems that integrated aquaculture and agriculture and integrated utilisation of small and medium-size water bodies.

Integrated aquaculture has a variety of benefits for farmers in addition to the production of fish for consumption or sale. In Asia, for example, rice farmers use certain species of fish to fight rice pests such as the golden snail. With rice-fish farming, they boost their rice yields and harvest the fish. Under FAO's Special Programme for Food Security (SPFS), farmers in Zambia are introducing small ponds into their home gardens for irrigation and aquaculture. Mud residing at the bottom of fishponds is also found to be an organic mineral-rich fertilizer. In traditional, exclusive aquaculture, fish can be bred in open waters, such as lakes, estuaries or coastal bays, where they feed on naturally available nutrients or in farm ponds, where they can be fed with by-products from the farm. In China, more than five species of carp are traditionally bred jointly to make the best use of feeds and ponds.

The promotion of sustainable aquaculture development calls for creation and maintenance of 'enabling environments', more specifically those environments, which focus on ensuring uninterrupted human resource development and capacity building. The FAO Code of Conduct for Responsible Fisheries enlists principles and provisions in support of sustainable aquaculture development. The Code recognises Special Requirements of Developing Countries and its Article 5 addresses these specific needs, especially in the areas of financial and technical-assistance, technology-transfer, training and scientific cooperation.

1.3.4 The Notion of Capital in Sustainable Development

The sustainable development debate is based on the premise that societies require the management of three types of capital (economic, social and natural), which may be non-substitutable and whose consumption might be irreversible. Daly (1991), for example, points to the fact that natural capital cannot necessarily be substituted by economic capital. It is possible that we can find ways to replace some natural resources. However, isn't it much more likely that we will never be able to replace eco-system services such as the protection provided by the ozone layer or the climate stabilising function of the Amazonian forest? In fact, natural capital, social capital and economic capital are often complementary to each other; they function collectively. A further obstacle to substitutability lies also in the multi-functionality of many natural resources. Forests, for example, not only provide the raw material for paper (which can be substituted quite easily), but they also maintain biodiversity, regulate water flow and absorb CO2 (which is not always substitutable).

Another problem with the deterioration of natural and social capital lies in their partial irreversibility. The loss in biodiversity, for example, is often definite. The same can be true for cultural diversity. For example, with rapid spread of globalisation, the rates of dropping of indigenous languages are alarming. Moreover, the depletion of natural and social capital may have non-linear consequences. Consumption of natural and social capital may have no observable impact until a certain threshold is reached. A lake can, for example, absorb nutrients for a long time while actually increasing its productivity. However, once an optimum level of algae is reached, lack of oxygen will cause the lake's ecosystem to break down all of a sudden.

Market failure

If the degradation of natural and social capital has such conspicuous consequence, the question naturally arises as to why action is not taken more systematically to alleviate the same. Cohen and Winn (2007) point to the following four types of market failures as possible explanations:

- While the benefits of natural or social capital depletion can usually be privatised, the costs are often externalised (i.e., they are borne not by the party responsible, but by society in general).
- Natural capital is often undervalued by society, since we are not fully conversant with the real cost of depletion of natural capital.
- Information asymmetry, which is the link between a cause and its effects, is often obscured, making it difficult for actors to make informed choices.
- Cohen and Winn close with the fourth realisation that contrary to the economic theory, many firms are not perfect optimisers. They postulate that firms often do not optimise resource allocation because they are caught in a 'business as usual' mentality.

The business case for sustainable development

The most broadly accepted criterion for corporate sustainability constitutes a firm's efficient use of natural capital. This eco-efficiency is usually calculated as the economic value added by a firm in relation to its aggregated ecological impact. This idea has been popularised by the World Business Council for Sustainable Development (WBCSD) under the following definition, "Eco-efficiency is achieved by the delivery of competitively-priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life-cycle to a level at least in line with the earth's carrying capacity", (DeSimone and Popoff, 1997: 47).

The second criterion for corporate sustainability is similar to the eco-efficiency concept but much less explored so far; it is called socio-efficiency. Socio-efficiency elucidates the relation between a firm's value-added as well as social impact. Whereas, it can be assumed that most corporate impacts on the environment are detrimental and negative (apart from rare exceptions, such as the planting of trees), this is not true of social impacts. Social impacts might be positive (e.g., corporate giving, creation of employment) or negative (e.g., work accidents, mobbing of employees, human rights abuses). Depending on the type of impact, socio-efficiency tries to minimise negative social impacts or maximise positive social impacts in relation to the value added.

Both eco-efficiency and socio-efficiency are concerned predominantly with augmenting economic sustainability. In this process, they instrumentalise both natural and social capital, aiming to extract benefits from win-win situations. However, as Dyllick and Hockerts point out, the business case will not be the lone factor sufficient to materialise sustainable development. These researchers point to eco-effectiveness, socio-effectiveness, sufficiency and eco-equity as the four criteria that need to be fulfilled if sustainable development is to be achieved.

1.3.5 Critique of the Concept of Sustainable Development

The concept of 'Sustainable Development' gives rise to enormous critique at different levels, which is explained in the paragraphs below.

Purpose

Various writers have put their finger on the population control agenda that apparently underlies the concept of sustainable development. Maria Sophia Aguirre writes, "Sustainable development is a policy approach that has gained quite a lot of popularity in recent years, especially in international circles. By attaching a specific interpretation to sustainability, population-control policies have become an overriding approach to development, thus becoming the primary tool used to 'promote' economic development in developing countries and to protect the environment."

Mary Jo Anderson suggests that the real purpose of sustainable development is to contain and limit economic development in developing countries and in so doing, control population growth. There has been a suggestion that this is the reason behind low-income agriculture still being considered the focus of most programmes. Joan Veon, a businesswoman and international reporter, who covered 64 global meetings on sustainable development, posits that, "Sustainable development has continued to evolve as that of protecting the world's resources, while its true agenda is to control the world's resources. It should be noted that Agenda 21 sets up the global infrastructure needed to manage, count and control all of the world's assets."

Consequences

John Baden views the notion of sustainable development as dangerous because the consequences have unknown effects. He writes, "In economy like in ecology, the interdependence rule applies. Isolated actions are impossible. A policy which is not carefully enough thought will carry along various perverse and adverse effects for the ecology as much as for the economy. Many suggestions to save our environment and to promote a model of 'sustainable development' risk indeed leading to reverse effects." Moreover, he evokes the bounds of public action, which are underlined by the public choice theory: the quest by politicians of their own interests, lobby pressure, partial disclosure, etc.

He develops his critique by noting the vagueness of the expression, which can cover anything: It is a gateway to interventionist proceedings which can be against the principle of freedom and without proven efficacy. Against this notion, he is a proponent of private property to impel the producers and the consumers to save the natural resources. According to Baden, "the improvement of environment quality depends on the market economy and the existence of legitimate and protected property rights." They enable the effective practice of personal responsibility and the development of mechanisms to protect the environment. The State can, in this context, "create conditions which encourage the people to save the environment."

Vagueness of the term

Some criticise the term 'sustainable development', stating that the term is too vague. For example, both Jean-Marc Jancovici and the philosopher Luc Ferry express this view. The latter writes about sustainable development, "I know that this term is obligatory, but I find it also absurd or rather so vague that it says nothing." Luc Ferry adds that the term is trivial by a proof of contradiction, "who would like to be a proponent of an untenable development! Of course no one! The term is more charming than meaningful. Everything must be done so that it does not turn into Russian-type administrative planning with ill-effects."

Basis

Sylvie Brunel, French geographer and specialist of the Third World, in his 'A qui profite le développement durable (Who benefits from sustainable development?)' (2008)' develops a critique of the foundation of the very concept of sustainable development, with its binary vision of the world. He proposes that it can be compared to the Christian vision of Good and Evil, an idealised nature where the human being is an animal like the others or even an alien. Nature, as Rousseau propounded is better than the human being. It is a parasite, harmful for the nature. However, the human is the one who protects the biodiversity, where normally only the strong survive.

Moreover, she believes that the ideas of sustainable development can hide a will to protectionism from the developed country to impede the development of the other countries. For Sylvie Brunel, sustainable development serves as a pretext for protectionism and she has "… the feeling about sustainable development that it is perfectly helping out the capitalism."

The proponents of de-growth reckon that the term 'sustainable development' is an oxymoron. According to them, on a planet where 20% of the population consumes 80% of the natural resources, sustainable development cannot be possible for this 20%. "According to the origin of the concept of sustainable development, a development which meets the needs of the present without compromising the ability of future generations to meet their own needs, the right term for the developed countries should be a sustainable de-growth."

Summary

- Over ages, man, with his desirable and non-desirable activities, has affected the environment unquestionably and sometimes irrevocably.
- The concept of environment management is the offspring of this widespread awareness about the human impact on the environment.
- Environmental management involves the wise use of activity and resources to impact the world.
- Many organisations develop a management plan or system to implement, manage and maintain environmental goals.
- Technological optimism evident in the west, chiefly from the 1830s onwards and articulated in natural resources management, weakened somewhat after 1945 since environmental issues became a prime concern in people's consciousness (Mitchell, 1997).
- Natural resources managers usually hail from a narrow range of disciplines, characteristically with limited sociological and environmental proficiency.
- Environmental management is a way to reach out for environmental conservation, which consolidates ecology, policy-making, planning and social development.
- Environmental management system (EMS) refers to the management of an organisation's environmental programmes in a comprehensive, systematic, planned and documented manner.
- Sustainable development embraces the prime, interdependent and indivisible areas of environmental protection, economic development and social development.
- The Brundtland Commission, formerly the World Commission on Environment and Development (WCED), was convened by the United Nations in 1983.
- A healthy environment is the solid foundation on which the system of a country depends.
- Both eco-efficiency and socio-efficiency are concerned predominantly with augmenting economic sustainability.
- Sustainable development has continued to evolve as that of protecting the world's resources while its true agenda is to control the world's resources. It should be noted that Agenda 21 sets up the global infrastructure needed to manage, count and control all of the world's assets.

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Self Assessment

1. The concept of environment management is the offspring of this widespread awareness about the human _____ on the environment.
   a. being
   b. impact
   c. behaviour
   d. race

2. Environmental management involves the wise use of activity and resources to impact the_____.
   a. nation
   b. country
   c. world
   d. state

3. Which of the following was evident, chiefly from the 1830s onwards and articulated in natural resources management, weakened somewhat after 1945, since environmental issues became a prime concern in people's consciousness (Mitchell, 1997)?
   a. Scientific research evident in the west
   b. Industrial success evident in the east
   c. Logical practice evident in the west
   d. Technological optimism evident in the west

4. Match the following

1. Sustainability	A. Embraces the prime, interdependent and indivisible areas of environmental protection, economic development and social development.
2. Sustainable development	B. It should strive to assimilate or process the waste associated with such activity.
3. Inspire diversified economic development	C. It means the capacity to endure.
4. Inspire attitudinal and behavioural change	D. Development that augments employment and other benefits derived from a given stock of resources should be prioritised.

   a. 1-C, 2-A, 3-D, 4-B
   b. 1-A, 2-C, 3-B, 4-D
   c. 1-B, 2-D, 3-C, 4-A
   d. 1-D, 2-B, 3-A, 4-C

5. When and who thought that the environmental manager ought to be capable to control both social institutions as well as suitable technologies, however should execute these with the perception of an artist, understanding of a poet and, maybe, the ethical purity and willpower of a pious devotee?
   a. In 1985, Laurence Sewell (1965: ix)
   b. In 1915, Laurence Sewell (1915: ix)
   c. In 1975, Laurence Sewell (1975: ix)
   d. In 1965, Laurence Sewell (1940: ix)

6. Which of the following is a way to reach out for environmental conservation, which consolidates ecology, policy making, planning and social development?
   a. Sustainable development
   b. Environmental management
   c. Sustainable
   d. Natural resources management

7. Which of the following statement is false?
   a. There is a precise universal definition of environmental management.
   b. Environmental management is mostly used as a generic term.
   c. Environmental management supports sustainable development.
   d. Environmental management encompasses various paradigms of development.

8. What refers to the management of an organisation's environmental programmes in a comprehensive, systematic, planned and documented manner?
   a. Sustainable development
   b. Sustainable Economy
   c. Human system
   d. Environmental management system (EMS)

9. Which of the following statement is true?
   a. An environment serves as a tool to improve environmental performance.
   b. An environmental management system (EMS) serves as a tool to improve environmental performance..
   c. An important management system (IMS) serves as a tool to improve environmental performance.
   d. An environmental management source (EMS) serves as a tool to improve environmental performance.

10. The concept of '_____' gives rise to enormous critique at different levels.
    a. Sustainable development
    b. Environmental management
    c. Human system
    d. Healthy environment

Chapter II

Energy Management

Aim

The aim of this chapter is to:

- introduce energy management
- explain fundamentals of energy management
- explicate fossil fuel use

Objectives

The objectives of this chapter are to:

- enlist home energy management
- elucidate energy production and trade
- explain energy balance ecosystem concepts

Learning outcome

At the end of this chapter, you will be able to:

- identify the types of fossil fuel energy
- understand the benefits and limitations of fossil fuels
- define competency-based strategies

2.1 Introduction

'Energy management' is a term that has many pronged implications. However, our focus will be directed at saving energy in businesses, public-sector/government organisations and homes.

Meaning of energy-saving

With respect to energy-saving, energy management is the process of monitoring, controlling and conserving energy in a building or organisation. Characteristically, it is inclusive of the following steps:

- Metering energy consumption and collecting data.
- Discerning ways and options to save energy and estimating how much energy can be saved by managing to do all of this.
- Analysing meter data to determine, quantify routine energy waste, and investigate energy savings that you could make by replacing equipment (e.g., lighting) or by upgrading your building's insulation are examples of energy management.
- Taking action to target the opportunities to save energy (i.e., tackling the routine waste and replacing or upgrading the inefficient equipment).
- You would typically commence with the best opportunities first.
- Tracking progress by analysing meter data to see how well your energy-saving efforts have worked.

2.2 Energy Management

Many people use 'energy management' to refer specifically to those energy-saving efforts that focus on making better use of existing buildings and equipment. Strictly speaking, this limits the scope of energy management to behavioural aspects of energy-saving, although the use of cheap control equipments, such as timer switches is often included in the definition as well.

2.2.1 Fundamentals of Energy Management

The term 'energy management' does not pertain to saving energy in buildings alone, it is also employed in other fields. The features of energy management are as follows:

- Energy management is undertaken by energy suppliers (or utility companies) in order to ensure that their power stations and renewable energy sources generate adequate energy to fulfill demand (the amount of energy that their customers need).
- Energy management is used to allude to techniques for managing and controlling one's own level of personal energy.
- It also has relevance in aviation, as energy management is a skill that aircraft pilots learn in some shape.

2.2.2 Home Energy Management

Most people desire that the home energy-management system should afford description of the amount of energy being consumed, techniques to make their home energy efficient or tools to manage their energy needs without compromising on quality.

A good home energy-management system should possess the following qualities:

- Simplicity: Many people want the system to demonstrate daily energy consumption. They want to know how much energy they will conserve by switching off major home appliances like refrigerators, heating and air-conditioning systems. A simple and effective device is the thermostat software to automate heating and cooling. This lowers the bills while maintaining the desired level of comfort.
- Utility-free: Some home energy management systems only work when they can be integrated with power meters installed by electric utilities. However, there are devices, which can be used without being attached to any meter. These are plug-in devices which can be used for household and commercial establishments and save as much as 30% electricity. These devices optimise voltage and current demands thus reducing active power demands and thereby saving electricity.

- Rule setting: There are web-based interfaces, which enable control of home energy use. A consumer can allocate and declare a certain amount of money he wants to pay for electricity. The energy management system manages the power flow between various appliances and directs power to the appliance, which is doing important functions at that time. For example, more power is directed to the lighting system during the night and so on.
- Remote control: Controlling home appliances remotely is the latest drift in home energy management. It is now possible to leave an appliance on and the energy management system will switch it off at the appropriate time. For example, the washing machine can be loaded before one leaves the house and it will be automatically switched off. Switching on the AC or heater before one reaches home can be done remotely. Mobile applications which allow one to switch on and off the appliances from the phone are being designed. Simple measures like adding insulation, tinting of window glass, using skylight for illumination, CFL bulbs and solar heaters conserve huge amounts of energy.

Importance of energy management

Energy management is the answer to energy conservation and economical use of money. Keeping in view the global need to save energy, energy conservation at home is of great importance. This global need affects energy prices, emissions targets and legislation, all of which lead to several compelling reasons why one should save energy. Controlling and reducing home energy consumption is important, because it enables the following:

- Reduction in costs: This is gaining importance as energy costs rise.
- Reduction is carbon emissions and environmental damage: This mitigates environmental damage as well as the cost-related implications of carbon taxes and so on. Organisations can reduce their carbon footprints to promote a green, sustainable and healthy environment.
- Reduce risks: The more energy is consumed, the greater the risk that energy price increases or supply shortages could seriously affect the day-to-day working of the household. With energy management, one can condense this risk by reducing demand for energy and by controlling it to make it more predictable.

The global need to save energy

The term 'energy management' has come to the forefront because of a global immediate need to save energy. The environmental damage that this consumption is doing is tremendous. The main reasons for energy conservation are as follows: Globally, we need to save energy to achieve the following:

- Reduce the damage to the planet due to human activities. Earth has limited supply of resources and it is important to make these resources last.
- Reduce our dependence on fossil fuels that are becoming increasingly limited in supply.

2.2.3 Controlling and Reducing Energy Consumption in Organisation

Energy management is the means of controlling and reducing your organisation's energy consumption. This is of pivotal importance since it enables organisations to achieve the following:

- Reduce costs: This is becoming increasingly important as energy costs are on the rise.
- Reduce carbon emissions: It is necessary to reduce carbon emissions owing to the environmental damage that they cause. Another aspect of increased carbon emissions is cost-related implications of carbon taxes. Organisations look forward to maintaining a minimal carbon footprint in order to promote a green, sustainable image, which would help that organisation achieve better social acceptance.
- Reduce risks: Energy consumption is directly proportional to risk or rising prices and inversely proportional to supply. Moreover, if there is risk of increase of energy price or shortage of supply, it could have a negative impact on profitability. It may even put the future of the business/organisation in jeopardy. With energy management, you can reduce this risk by reducing your demand for energy and by controlling it in order to make it more predictable.

Energy management is vital since it will help the company at various points. In the present scenario, it is probable that there will be an aggressive energy-consumption reduction target in the near future. An understanding of effective energy management would prove useful in meeting those targets.

2.2.4 Best Ways to Manage Energy Consumption

There are four integral steps to the energy-management process, which have been discussed below.

Metering your energy consumption and collecting the data

As a rule of thumb, extensive and detailed data is most beneficial. The old school approach to energy-data collection is to take meter readings once a week or once a month manually. However, this poses difficulty since; it is a less efficient way of collecting data as compared to data that is made available easily and automatically from the modern approach. The modern approach to energy-data collection is to install interval metering systems that automatically measure and record energy consumption at short, regular intervals, such as every 15-minute or half hour.

Detailed interval energy consumption data allows one to see patterns of energy waste that would be impossible to see otherwise. For example, weekly or monthly meter readings cannot show the consumption of energy at different times of the day or on different days of the week. In addition, these patterns make it much easier to determine if energy is being wasted or is not being utilised properly in your building.

Finding and quantifying opportunities to save energy

The detailed meter data will be invaluable for determining and quantifying energy-saving opportunities. The easiest and most cost-effective energy-saving opportunities typically require little or no capital investment.For example, many companies and private households possess advanced control systems that could and should, be controlling HVAC (Heating Ventilation Air conditioning). However, the lack of knowledge of the facilities-management staff may result in wastage of energy while heating or cooling an empty building.

One of the simplest ways to save a significant amount of energy is to encourage staff to switch off equipments at the end of each working day. Examining detailed interval energy data is the ideal way to locate routine energy waste. This can be used to unearth whether the staff and electronic timers are conserving energy. This saves the owner trouble in terms of personal patrolling. This enables the employer to establish who or what is causing the energy wastage. In addition, detailed interval data, is crucial in identifying the amount of energy being wasted at different times. For example, if it is identified that energy is being wasted by equipment left on over the weekends, one can take the following steps:

- Use interval data to calculate how much energy (in kWh) is being used each weekend.
- Estimate the proportion of the energy that is being wasted (by equipment that should be switched off).
- Calculate an estimate of the total kWh that is wasted each weekend.
- Alternatively, if you are unaware of the proportion of energy that is being wasted by the equipment left on unnecessarily, one could visit the building one evening to ensure that everything that should be switched off is switched off.
- Look back at the data for that evening to see how many kW were being used after you switched everything off.
- Subtract the target kW figure (b) from the typical kW figure for weekends to estimate the potential savings in kW (power).
- Multiply the kW savings by the number of hours over the weekend to get the total potential kWh energy savings for a weekend.

Targeting the opportunities to save energy

Finding opportunities to save energy is not the sole answer to energy conservation. For those energy-saving opportunities that require you to motivate people to save energy, it is important to comprehend how systems work and how they make the planet a better place to stay in. It may require hard work, but if you can convince people, saving energy will be achievable without investing anything other than time.

Tracking your progress at saving energy

Once you have taken action to save energy, it is important to take feedback about the following actions and determine the efficacy of your actions:

- Energy savings that stem from behavioural changes (e.g., getting people to switch off their computers before going home) need frequent attention to ensure that they remain effective and achieve their maximum potential.
- If you have invested money in new equipment, you may want to determine whether the energy savings you predicted have been achieved.
- If you have corrected faulty timers or control-equipment settings, you would need to keep checking back to ensure that everything is still working as it should be. Simple things like a power cut can easily cause timers to revert to factory settings, if you are not keeping an eye on your energy-consumption patterns, you can easily miss such problems.
- If you have been given energy-saving targets, then you will need to provide evidence that you are either meeting these goals or making progress towards these goals.

2.2.5 Managing Energy Consumption Effectively: An Ongoing Process

Continuous monitoring of data is necessary to ensure that there is no hindrance or decline in energy conservation. If consumption is not being monitored accurately, it will not work as energy consumption will not work efficiently and in due course it will lead to an increase in the wastage of energy, and more energy. It is to be expected that the equipment will break down or lose efficiency and that people will forget the good habits you worked hard on to encourage in the past.

Therefore, at a minimum, monthly or weekly monitoring of energy data is advisable to ensure that nothing has gone wrong. It is unfortunate when easy-to-fix faults such as misconfigured timers remain unnoticed for months on end, resulting in a huge energy bill that could have easily been avoided. Ideally, the energy-management drive is an ongoing effort to find new opportunities (step 1), to target them (step 2) and to track progress at making ongoing energy savings (step 3). Managing energy consumption does not have to be a full-time job, but will achieve much better results, if it is made a part of regular routine

2.3 Fossil Fuel Use

Fossil fuels are fuels formed by natural resources through processes, such as anaerobic decomposition of buried dead organisms. The age of the organisms and their resulting fossil fuels is typically millions of years and sometimes exceeds 650 million years. The fossil fuels include coal, petroleum and natural gas, which contain high percentages of carbon.

Fossil fuels range from volatile materials with low carbon: hydrogen ratios like methane, to liquid petroleum to nonvolatile materials composed of almost pure carbon like anthracite coal. Methane can be found in hydrocarbon fields alone, associated with oil or in the form of methane clathrates. It is generally accepted that they are formed from the fossilised remains of dead plants and animals by exposure to heat and pressure in the earth's crust over millions of years.

2.3.1 Characteristics, Origin, Applications and Effects

Human beings need energy for most of their activities. Energy is needed for domestic, industrial and agriculture use. This is an industrial process, which can be performed using various sources. These sources can be either renewable or non-renewable. Renewable energy is the energy that can be reutilised by various and can be renewed will therefore not run out easily. However, non-renewable energy sources are limited and there is a threat that they will run out, if they are not used sparingly.

Nowadays many renewable energy sources are available for use, for example, solar and wind energy and water power. Ironically, we still gain most of our energy from non-renewable energy sources, commonly known as fossil fuels. The non-renewability of these sources collaterally increased the price of these fuels and it is anticipated that such rates of fuel will rise to a point where they are no longer economically feasible.

Fossil fuels comprise deposits of once-living organisms. The organic matter undergoes various transformations through the ages and takes centuries to form. Fossil fuels principally consist of carbon and hydrogen bonds. There are three types of fossil fuels, which can all be used for energy provision, coal, oil and natural gas. Coal is a solid fossil fuel formed over millions of years by decay of land vegetation. When layers are compacted and heated over time, deposits are turned into coal. Coal is relatively abundant compared to the other two fossil fuels. Analysts predict that worldwide coal-use will increase as oil supplies become scarcer. Current coal supplies could last for 200 years or more. Coal is usually found in mines where it is mined with a great deal of difficulty. Since the middle of the 20th century, coal-usage has doubled. Since 1996, its application has been on a steady. Many developing countries have to depend on coal for their energy needs because it is a more economical alternative to oil and natural gas. The characteristics of oil and natural gas are as follows:

- Oil: Oil is fossil fuel formed from the remains of marine microorganisms deposited on the sea floor. Over a span of millions of years, these deposits that lie under rock and sediment turn into oil. This oil can be extracted by large drilling platforms. Oil is the most widely used fossil fuel. Crude oil consists of many different organic compounds, which are transformed into products in a refining process. Oil is used for energy for various purposes like cars, jets, roads and so on. However, oil reserves are not abundant. Many wars have been fought over oil supplies. A well-known example is the Gulf War of 1991. Oil is mainly found in countries like Russia, Saudi Arabia, Nigeria, Venezuela, Iraq, Iran and the USA.
- Natural gas: A gaseous fossil fuel, which is multipurpose, abundant and relatively clean when compared to coal and oil. Like oil, it is formed from the remains of marine microorganisms. It is a relatively new type of energy source. Until 1999, more coal was used than natural gas. Natural gas has now overtaken coal in developed countries. However, people are afraid that, like oil, natural gas supplies will run out. It is also estimated by some scientists that it may happen by the middle or end of the 21st century. Natural gas mainly consists of methane (CH4). Natural gas is found in highly compressed form in small volumes at large depths in the earth. Like oil, it is brought to the surface by drilling. Natural gas reserves are more evenly distributed around the globe than oil supplies.

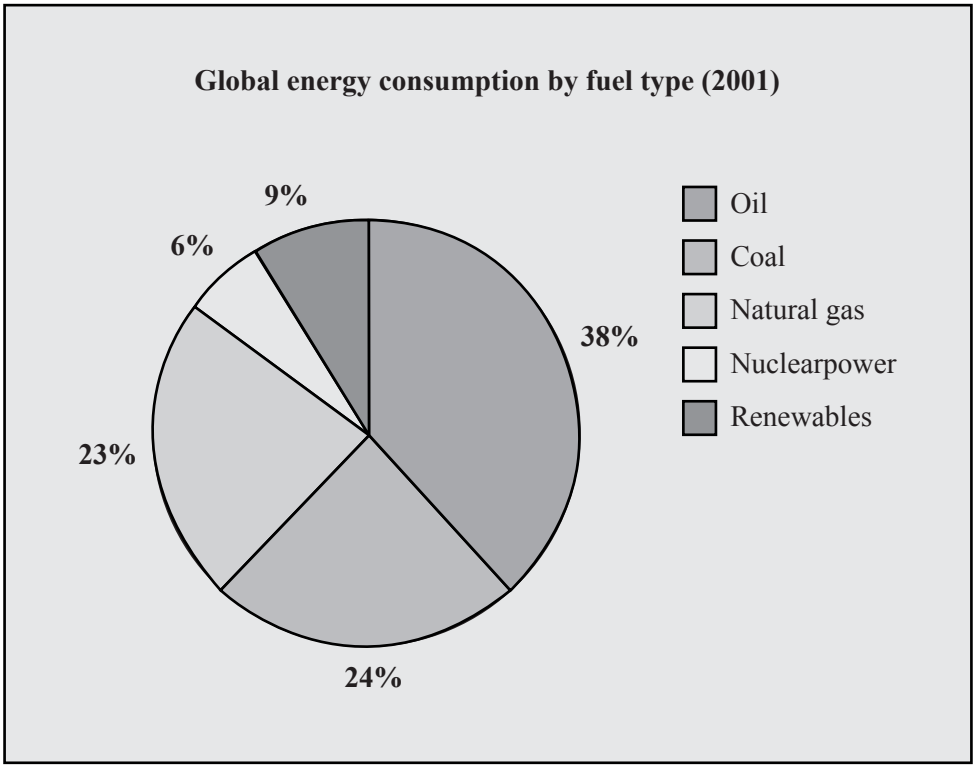

Fig. 2.1 Global energy consumption by fuel type
(Source: http://www.slideshare.net/RajendraGhuge/environmentmanagemnent-notes)

Energy gained from burning fossil fuels is converted to electricity and heat in commercial power plants. When fossil fuels are burned, carbon and hydrogen react with oxygen in the air to form carbon dioxide (CO2) and water (H2O). During this reaction, heat is released which further amplifies the reaction. Electricity is generated by transforming mechanical energy (heat) to electrical energy in a turbine or generator. Though the investment, in terms of time and money, required to build a power plant is very high, yet the efficiency in converting fuel to energy is very high. It is common for surplus electricity to be created. Electricity demands vary throughout the year and provision must meet the peak, i.e., the highest possible demand within a year. If demands are higher than the supply, it will cause temporary blackouts, as there will be not enough electricity to be supplied throughout the year. An example of this is India, where this is a common occurrence.

Historically, fossil fuels were available in abundance and were easy to obtain and transport. Today, there is growing awareness that the supply is running out and that it will take centuries to be replenished. Both sources and sinks of fossil fuels are limiting in their use. Sources are deep layers in the earth and sinks are, for example, air and water, which absorb fossil fuel waste products.

However, use of fossil fuels leads to negative environmental repercussion in terms of pollution. Examples are greenhouse gas accumulation, acidification, air pollution, water pollution, damage to land surface and ground-level ozone. Sulphur and nitrogen, which are inherent in fossil fuel structures combine with oxygen during the process of combustion and for noxious gases like sulfur dioxide and nitrogen oxide and so on. When these gases mix with water, they form acids, which is detrimental to human and animal health. It also causes damage to property. 30% of all carbon dioxide emissions in the air are attributed to carbon combustion. Natural gas does not release as much carbon dioxide because of its methane structure. Coal combustion results in the highest number of emissions in the world. Coal may result in underground fires that are virtually impossible to extinguish. Coal dust can also explode. The precarious nature of coal mining makes it a dangerous profession. Oil on the other hand, may end up in soil or water in its raw form, for example, during oil spills or wars. Such oil spills are damaging for marine flora and fauna.

Even with such potentially detrimental repercussions, fossil fuels continue to be used. They are a preferred source of energy, since renewable sources of energy have higher generation and maintenance costs. Renewable energy is very expensive as compared to non-renewable energy and its use can only be sustained if supported by government grants. Some environmental scientists predict that fossil fuel prices will increase in the coming century because of their scarcity. This may cause an ensuing transfer to renewable energy sources. According to Bjorn Lomborg, this situation is inexorable. This is only one of the perspectives on the future of fossil fuel use. Some maintain that fossil fuels cannot be entirely replaced by renewable sources of energy.

2.3.2 Importance

Fossil fuel is accorded immense importance since its combustion produces significant amounts of energy. The use of coal as a fuel predates recorded history. Coal was employed to run furnaces for the melting of metal ore. Semi-solid hydrocarbons from seeps were used as fuel, for waterproofing and embalming.

Commercial exploitation of petroleum as a replacement for animal fat in oil lamps began in the nineteenth century. Natural gas, once flared-off as an unneeded byproduct of petroleum production, is now considered a very valuable resource. Heavy crude oil, which is much more viscous than conventional crude oil and tar sands, where bitumen is found mixed with sand and clay, is considered an important source of fossil fuel. Oil shale and similar materials are sedimentary rocks containing kerogen, a complex mixture of high-molecular weight organic compounds, which yield synthetic crude oil when heated (pyrolyzed). These materials are yet to be exploited commercially. These fuels are employed in internal combustion engines, fossil fuel power stations and other uses.

Prior to the latter half of the eighteenth century, windmills or watermills provided energy required for industry, such as mills and for other uses such as sawing wood, pumping water and burning wood or peat for domestic heat. The wide-scale use of fossil fuels, coal at first and petroleum later, to fire steam engines, enabled the Industrial Revolution. This was accompanied by use of gaslights that required natural gas or coal gas for lighting. The invention of the internal combustion engine and its use in automobiles and trucks greatly increased the demand for gasoline and

diesel oil, both made from fossil fuels. Other forms of transportation, railways and aircraft, also required fossil fuels. The other foremost use for fossil fuels is in generating electricity and the petrochemical industry. Tar, a leftover of petroleum extraction, is used in the construction of roads.

Uses of fossil fuels

'Fossil fuels' is the name given to a group of substances believed to have been formed by the decomposition of plant and animal matter under intense pressure and heat over hundreds of millions of years. The key forms of fossil fuels are coal, oil and natural gas. According to the Department of Energy, fossil fuels are used for more than 85 percent of all energy consumption in the U.S.

- Electricity: Fossil fuels, particularly coal, are used in power plants for electricity production.
- Transportation: While there has been some transition toward hybrid and electric vehicles, the vast majority of vehicles require fossil fuels to operate.
- Heating: Most heating needs are met through fossil fuel-based heating oil and natural gas or indirectly through fossil fuel-generated electricity.
- Cooling: Like heating, most cooling systems rely directly or indirectly on fossil fuel provided energy.
- Considerations: While fossil fuels are the core source of current energy production, they are considered a limited, nonrenewable and polluting energy source. These factors will ultimately require the development of large-scale alternatives.

Fossil fuel energy

The types of fossil fuel energy are discussed in the following paragraphs.

Oil

Oil is a thick, black, viscous liquid that is also called petroleum. It is found deep below the earth's surface, usually between layers of rock. Oil mining entails digging of oil well, pumping of oil and the subsequent shipping of oil. Oil that is pumped out is carried in pipelines and large tanker ships. A refinery changes the oil into products like gasoline, jet fuel and diesel fuel. It is also burned in factories and power plants to produce electricity. When the oil is burned, it produces gases that make a turbine turn in order to create electricity.

Natural gas

Natural gas is lighter than air. Its main component is methane, which is a simple chemical compound made up of carbon and hydrogen atoms. This gas is highly inflammable. Natural gas reserves are found near oil reserves in the ground. The process of extraction of natural gas is similar to that of oil. Natural gas is obtained by pumping it from the ground and transporting it through large pipelines. Natural gas is mixed with a chemical in order to give it a distinct smell like rotten eggs as it is not possible to differentiate between the gas and the environment. This is done to ensure detection in instances of gas leaks. This odour infused gas is then utilised for industrial and domestic use. It is also used to generate electricity. Natural gas is burned to produce heat, which boils water, creating steam, which passes through a turbine to generate electricity.

Coal

Coal comes in several different forms ranging from hard black rocks to soft brown dirt. There are different grades of coal and a few grades will burn hotter and cleaner than others. Coal is used to create more than half of all the electricity made in the US. In some states, many coal beds are located near the surface. Coal is extracted by mining. It is usually transported by trains to power plants where it is burned to produce steam. The steam turns turbines which produce electricity.

Benefits of fossil fuels

One of the biggest benefits of fossil fuels is their cost. Coal, oil and natural gas are abundant today and are relatively inexpensive to drill or mine. In fact, coal is the only fossil fuel that is found everywhere in abundance when compared to other fossil fuels which are not found in most parts of the world. Thus, electricity and fuels for transportation and heating are available to everyone because their costs are contained.

Limitations of fossil fuels

The limitations of fossil fuels are listed as follows:

- Non-renewable resource: Fossil fuels are a non-renewable resource. Fossil fuels take millions of years to develop under extreme conditions. Once they are used, they can no longer be a part of our energy mix.
- Environmental impact: Fossil fuel combustion has a negative environmental impact. Its use has contributed to global climate change, acid rain and ozone problems. There are new technologies under development that could help in making fossil fuels much more efficient and cleaner. These technologies could keep fossil fuels in the energy mix for the future.
- Geographical considerations: Controlling fossil fuel resources is of pivotal importance since these fuels play an important role in powering our lifestyles and economy. The United States is one of the countries that have large amounts of deposits of coal, which is one of the main fuels for electricity generation. The biggest supply of oil is not in the US, but in the Middle East. Any disruptions in that supply or increase in the cost of that supply could have huge effects on the daily lives of its citizens. Shipping the oil across the ocean can lead to other risks such as oil spills.
- Supply and demand: The reason fossil fuels are mainly relied on is due to its supply and demand. Coal is currently an abundant resource and the US government continues efforts to keep a steady supply of oil flowing to the United States, which has ensured it feasibility for consumers.

India has a very limited supply of fossil fuels and it forms a large part of India's imports, specially the crude oil. While the US has considerable deposits of coal and natural gas, most oil is imported. The overwhelming dependence on foreign oil, as a nation means that it is not in control of the price or amounts available, which can lead to problems like the energy crisis of the 1970s. During this time, the US foreign sources of oil declined to trade with them for political reasons. Gasoline was rationed. There were long queues to purchase small quantities of gasoline. Rampant corruption and black marketing for those products ensued. People with odd and even numbered license plates could purchase gas only on certain days. Americans became aware of how much they relied on foreign sources of oil. However, since then, their dependence on foreign oil has increased, not decreased.

2.4 Energy Production and Trade

The transformation of energy in an ecosystem begins first with the input of energy from the sun. The process of photosynthesis captures energy from the sun. Carbon dioxide is combined with hydrogen (derived from the splitting of water molecules) to produce carbohydrates (CHO). Energy is stored in the high-energy bonds of adenosine triphosphate or ATP.

The prophet Isaah said 'all flesh is grass', thereby earning him the title of the first ecologist because virtually all energy available to organisms originates in plants. It is called primary production as it involves the first process of converting the energy from the sun into other forms of energy. This process is termed photosynthesis. Herbivores obtain their energy by consuming plants or plant products, carnivores eat herbivores and detritivores consume the droppings and carcasses of us all.

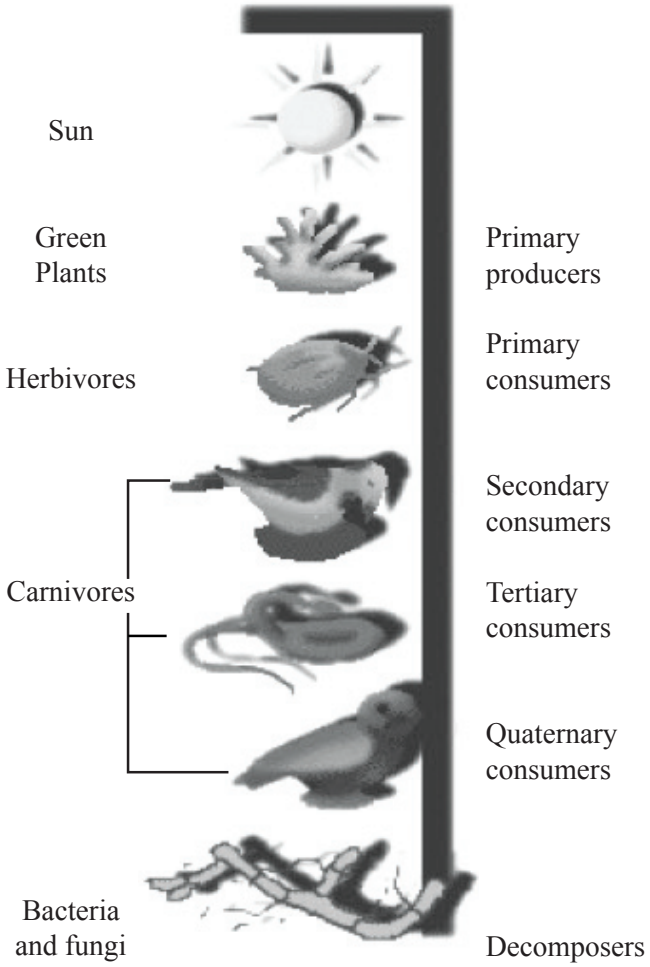

Fig. 2.2 Formation of fossil fuel
(Source: http://www.slideshare.net/RajendraGhuge/environmentmanagemnent-notes)

Fig. 2.2 portrays a simple food chain in which energy from the sun, captured by plant photosynthesis, flows from trophic level to trophic level via the food chain. A trophic level is composed of organisms that make a living in the same way, i.e., they are all primary producers (plants), primary consumers (herbivores) or secondary consumers (carnivores). Dead tissue and waste products are produced at all levels. Scavengers, detritivores and decomposers then consume such 'waste'. Creatures like vultures and microorganisms like bacteria are responsible for this. Consumers of carcasses and fallen leaves may be other animals, such as crows and beetles, but ultimately microbes complete the job of decomposition. Not surprisingly, the amount of primary production varies a great deal from place-to-place due to differences in the amount of solar radiation and the availability of nutrients and water.

Energy transfer through the food chain is inefficient. This means that less energy is available at the herbivore level than at the primary producer-level, less yet at the carnivore-level and so on. The result is a pyramid of energy, with important implications for understanding the quantity of life that can be supported.

We usually assume that the food chain comprises green plants, herbivores and so on. These are referred to as grazer food chains because living plants are directly consumed. In many circumstances, the principal energy input is not green plants, but dead organic matter. These are called detritus food chains. Examples include the forest floor or a woodland stream in a forested area, a salt marsh and most importantly, the ocean floor in very deep areas where all sunlight is extinguished at depths of 1000metres and above. However, the organisation of biological systems is much more complicated and cannot be represented by a simple 'chain'. They are difficult to understand as well. There are many food links and chains in an ecosystem and we refer to all of these linkages as a food web. Food webs can be extremely complicated, where it appears that 'everything is connected to everything else' and it is important to understand what the most important linkages are in any particular food web.

2.4.1 Controls on Ecosystem Function

There are two dominant theories of the control of ecosystems. The first, called bottom-up control, states that the nutrient supply to the primary producers that ultimately controls how ecosystems function. If the nutrient supply is increased, the resulting increase in the production of autotrophs is propagated through the food web and all of the other trophic levels will respond to the increased availability of food.

The second theory, called top-down control, states that predation and grazing by higher trophic levels on lower tropic levels ultimately controls ecosystem function. For example, if you have an increase in predators, that increase will result in fewer grazers and that decrease in grazers will result, in turn, in more primary producers because fewer of them are being eaten by the grazers. Thus, the control of population numbers and overall productivity 'cascades' from the top levels of the food chain down to the bottom trophic levels.

Both the theories are accurate to some extent in various aspects and they sometimes work in tandem with each other. Neither of them works with full authority. Well, as is often the case when there is a clear dichotomy to choose from, the answer lies somewhere in the middle. For example, the 'top-down' effect is often very strong at trophic levels near the top predators, but the control weakens as you move further down the food chain. Similarly, the 'bottom-up' effect of adding nutrients usually stimulates primary production, but the stimulation of secondary production further up the food chain is less strong or is absent.

Thus, we find that both these controls operate in any system at any time and we must understand that both the systems are important and we should not underestimate the importance of any of them. The relative importance of each control helps us to predict how an ecosystem will behave or change under different circumstances, for example, in the face of a changing climate, how the ecosystem will respond and how adaptations would be made accordingly.

2.4.2 The Geography of Ecosystems

There are many different ecosystems rain forests and tundra, coral reefs and ponds, grasslands and deserts. Each of these locations has a different geography, system, human interference, etc., in them. Climate differences from place-to-place largely determine the types of ecosystems we see. The dominant vegetation influences the appearance of terrestrial ecosystems. The word 'biome' is used to depict a major vegetation type such as tropical rain forest, grassland, tundra, etc., extending over a large geographic area. It is never used for aquatic systems, such as ponds or coral reefs. It always alludes to a vegetation category that is dominant over a very large geographic scale and has a wider scope than an ecosystem.

2.5 Energy Balance Ecosystem Concepts

The concepts of energy ecosystem are explained in the paragraphs given below.

2.5.1 Ecosystem

An ecosystem comprises all the organisms living in a particular area, as well as all the nonliving, physical components of the environment with which the organisms interact, such as air, soil, water and sunlight. All these organisms along with the nonliving things create a system, which is self-working and self managing. It is all the organisms in a given area, along with the nonliving (abiotic) factors with which they interact; a biological community and its physical environment. The entire array of organisms inhabiting a particular ecosystem is called a community. In a typical ecosystem, plants and other photosynthetic organisms are the producers that provide the food. Ecosystems can be permanent or temporary. Ecosystems usually form a number of food webs.

An ecosystem is a functional unit consisting of living flora and fauna in a given area, non-living chemical and physical factors of their environment linked together through nutrient cycle and energy flow.
Ecosystems can be categorised as follows:

- Natural
  - Terrestrial ecosystem
  - Aquatic ecosystem
    - Lentic, the ecosystem of a lake, pond or swamp
    - Lotic, the ecosystem of a river, stream or spring
- Artificial, environments created by humans

Ecosystem services
Ecosystem services are 'fundamental life-support services upon which human civilisation depends', and can be direct or indirect. Examples of direct ecosystem services are pollination, wood and erosion prevention. Indirect services could be considered climate moderation, nutrient cycles and detoxifying natural substances.The services and goods an ecosystem provides are often undervalued as many of them are without market value. Some examples include the following:

- Regulating (climate, floods, nutrient balance water filtration, etc.)
- Provisioning (food, medicine, fur, etc.)
- Cultural (science, spiritual, ceremonial, recreation, aesthetic, etc.)
- Supporting (nutrient cycling, photosynthesis, soil formation, etc.)

What is an ecosystem?
An ecosystem entails the biological community that occurs in some locale and the physical and chemical factors that make up its non-living or abiotic environment. There are many examples of ecosystems, a pond, a forest, an estuary, grassland, etc. The boundaries are not fixed in any objective way, although sometimes they seem obvious, as with the shoreline of a small pond. Usually the boundaries of an ecosystem are chosen for practical reasons having to do with the goals of the particular study.

The study of ecosystems mainly consists of the study of certain processes that link the living or biotic components to the non-living or abiotic components. Energy transformations and biogeochemical cycling are the main processes that comprise the field of ecosystem ecology. As we learned earlier, when the organisms interact with each other along with the environmental surroundings in which they occur, it is called an ecosystem. We can study ecology at the level of the individual, the population, the community and the ecosystem.

Studies of individuals are concerned mostly with physiology, reproduction, development or behaviour. The study of populations usually focus on habitat, resource needs of individual species, their group behaviour, population growth and what limits their abundance or causes extinction. Various research projects try to perceive how myriad organisms interact with each other and work together in either a symbiotic, parasitic or any other relationship. For example, as predators and their prey or competitors share common needs or resources, etc.

In ecosystem ecology, we study the working system as a complete unit. This means that, rather than worrying mainly about a particular species, we try to focus on major functional aspects of the system. These functional aspects include such issues as the amount of energy that is produced by photosynthesis, how energy or materials flow along the many steps in a food chain or what controls the rate of decomposition of materials or the rate at which nutrients are recycled in the system.

Summary

- 'Energy management' is a term that has many pronged implications.
- Many people use 'energy management' to refer specifically to those energy-saving efforts that focus on making better use of existing buildings and equipment.
- Energy management is the answer to energy conservation and economical use of money.
- Keeping in view the global need to save energy, energy conservation at home is of great importance.
- The term 'energy management' has come to the forefront because of a global immediate need to save energy.
- Energy management is the means of controlling and reducing your organisation's energy consumption.
- Energy management is vital since it will help the company at various points.
- The old school approach to energy-data collection is to take meter readings once a week or once a month manually.
- The detailed meter data will be invaluable for determining and quantifying energy-saving opportunities.
- One of the simplest ways to save a significant amount of energy is to encourage staff to switch off equipment at the end of each working day.
- Continuous monitoring of data is necessary to ensure that there is no hindrance or decline in energy conservation.
- Fossil fuels are fuels formed by natural resources through processes such as anaerobic decomposition of buried dead organisms.
- Human beings need energy for most of their activities. Energy is needed for domestic, industrial and agriculture use.
- Energy gained from burning fossil fuels is converted to electricity and heat in commercial power plants.
- India has a very limited supply of fossil fuels and it forms a large part of India's imports, specially the crude oil.
- The transformation of energy in an ecosystem begins first with the input of energy from the sun.
- An ecosystem comprises all the organisms living in a particular area, as well as all the nonliving, physical components of the environment with which the organisms interact, such as air, soil, water and sunlight.
- The study of ecosystems mainly consists of the study of certain processes that link the living or biotic components to the non-living or abiotic components.

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Self Assessment

1. '_____' is a term that has many pronged implications.
   a. Energy management
   b. Environment management
   c. Resource management
   d. Nonrenewable resource

2. Which of the following is the process of monitoring, controlling and conserving energy in a building or organisation?
   a. Environment management
   b. Home energy
   c. Energy management
   d. Reduction in costs

3. Match the following

1. Photosynthesis	A. It mainly consists of methane (CH4).
2. Oil	B. This process captures energy from the sun.
3. Natural gas	C. It is a solid fossil fuel formed over millions of years by decay of land vegetation.
4. Coal	D. It is a thick, black, viscous liquid that is also called petroleum.

   a. 1-C, 2-A, 3-B, 4-D
   b. 1-A, 2-C, 3-D, 4-B
   c. 1-D, 2-B, 3-C, 4-A
   d. 1-B, 2-D, 3-A, 4-C

4. Energy management is the answer to _____ and economical use of money.
   a. energy management
   b. energy consumption
   c. energy conservation
   d. energy generation

5. Which of the following term has come to the forefront because of a global immediate need to save energy?
   a. Energy management
   b. Energy consumption
   c. Energy conservation
   d. Energy generation

6. Current coal supplies could last for _____ years or more.
   a. 50
   b. 200
   c. 30
   d. 100

7. Which of the following statement is true?
   a. Energy consumption is the means of controlling and reducing your organisation's energy consumption.
   b. Energy is the means of controlling and reducing your organisation's energy consumption.
   c. Energy management is the means of controlling and reducing your organisation's energy consumption.
   d. Energy management is the means of controlling and raising your organisation's energy consumption.

8. Which of the following statement is false?
   a. Fossil fuels comprise deposits of once-living organisms.
   b. Coal is a solid fossil fuel formed over millions of years by decay of land vegetation.
   c. Human beings need energy for few of their activities.
   d. Energy is needed for domestic, industrial and agriculture use.

9. ._____energy is the energy that can be re-utilised by various and can be renewed will therefore not run out easily.
   a. Human
   b. Renewable
   c. Chemical
   d. Mechanical

10. What comprises all the organisms living in a particular area, as well as all the nonliving, physical components of the environment with which the organisms interact, such as air, soil, water and sunlight?
   a. Energy management
   b. Nonrenewable Resource
   c. An ecosystem
   d. Energy consumption

Chapter III

Environmental Management Systems

Aim

The aim of this chapter is to:

- introduce environmental management system
- explain the key elements of EMS
- explicate ISO standards

Objectives

The objectives of this chapter are to:

- enlist the 17 requirements of the ISO 14001:2004 standard
- elucidate the environmental management system
- explain PDCA (plan-do-check-act)

Learning outcome

At the end of this chapter, you will be able to:

- identify PDCA, EMAS
- understand environmental auditing
- recognise energy efficiency

3.1 Introduction

Environmental Management System (EMS) refers to the management of an organisation's environmental programmes in a comprehensive, systematic, planned and documented manner. It includes the organisational structure, planning and resources for developing, implementing and maintaining policy for environmental protection.

An environmental management system (EMS) provides the following:

- Serves as a tool to improve environmental performance.
- Provides a systematic way of managing an organisation's environmental affairs.
- Is the aspect of the organisation's overall management structure that addresses immediate and long-term impacts of its products, services and processes on the environment.
- Gives order and consistency for organisations to address environmental concerns through the allocation of resources, assignment of responsibility and ongoing evaluation of practices, procedures and processes.
- Focuses on continual improvement of the system.

3.2 Environmental Management System

An EMS follows a 'plan-do-check-act cycle' or PDCA. It is the process of first developing an environmental policy, planning the EMS and then implementing it. The process incorporates checking the system and acting on it. The model is continuous because an EMS is a process of continual improvement in which an organisation is constantly reviewing and revising the system. EMS is an important tool for managing the environment effectively and efficiently. This model can be employed by a plethora of organisations with distinct areas of specialisation.

Key elements of an EMS

The key elements of an EMS are as follows:

- Policy statement: A statement of the organisation's commitment to the environment.
- Identification of significant environmental impacts: Environmental attributes of products, activities and services and their effects on the environment.
- Development of objectives and targets: Environmental goals for the organisation.
- Implementation: Plans to meet objectives and targets.
- Training: Instructions to ensure that employees are aware and capable of fulfilling their environmental responsibilities.
- Management review.

Integration of the existing environmental management activities into the EMS

An EMS is flexible and necessitates organisations to 'retool' their existing activities. An EMS establishes a management framework by which an organisation's impact on the environment can be systematically identified and reduced. For example, many organisations including counties and municipalities have active and effective pollution-prevention activities underway. These activities are an important tool to manage the ecosystems and prevent them from decaying. These could be incorporated into the overall EMS.

3.3 ISO Standards

Various ISO standards are explained in the paragraphs given below.

ISO, ISO 14000 and ISO 14001

ISO stands for the International Organisation for Standardisation, located in Geneva, Switzerland. ISO is a non-governmental organisation, which was established in 1947. The organisation mainly functions to develop voluntary technical standards that aim at making development, manufacture and supply of goods and services more efficient, safe and clean. ISO is a very vital tool in ensuring the effectiveness of hygiene and cleanliness. ISO 14000 refers to a set of voluntary standards and guidance documents to help organisations address environmental issues. These include standards for environmental management systems, environmental and EMS auditing, environmental labelling, performance-evaluation and life-cycle assessment.

In September 1996, the International Organisation for Standardisation published the first edition of ISO 14001, the environmental management systems standard. This is an international voluntary standard elucidating specific requirements for an EMS. ISO 14001 is a specification standard to which an organisation may receive certification or registration. ISO 14001 is considered the foundation document of the entire series. A second edition of ISO 14001 was published in 2004, updating the standard. In ISO 14001, many updates were made to make sure that nobody would get away with the loopholes, which were prevalent in the old system.

Questions may arise when implementing an EMS following the ISO 14001 standard. The US body that provides input into the standard's development is the US TAG (Technical Advisory Group) to the TC 207 (Technical Committee). This same body has established a formal process to respond to questions that may arise regarding clarification of the ISO 14001 (the standard). These responses reflect the interpretation of the standard as it was intended during the drafting of the standards and may be found in the 'Clarification of Intent of ISO 14001'. These standards are maintained with the help of these avenues.

The development of ISO standards

All ISO standards are generated through a voluntary, consensus-based approach. ISO has many member countries across the globe. Each member country develops its position on the standards and these positions are then negotiated with other member countries. Draft versions of the standards are sent out for formal written comment and each country casts an official vote on the drafts at the appropriate stage of the process. Within each country, myriad organisations can participate in the process. Industries, government (federal and state) and interested parties, like various non-government organisations, become a part of the system. For example, EPA and some states participated in the development of the ISO 14001 standard and are now evaluating its usefulness through a variety of pilot projects.

The 17 requirements of the ISO 14001:2004 standard

The 17 requirements of the ISO 14001:2004 standard are as follows:

- Environmental policy: Develop a statement of the organisation's commitment to the environment.
- Environmental aspects and impacts: Identify environmental attributes of products, activities and services and their effects on the environment.
- Legal and other requirements: Identify and ensure access to relevant laws and regulations.
- Objectives and targets and environmental management programme: Set environmental goals for the organisation and plan actions to achieve objectives and targets.
- Structure and responsibility: Establish roles and responsibilities within the organisation.
- Training, awareness and competence: Ensure that employees are aware and capable of their environmental responsibilities.
- Communication: Develop processes for internal and external communication on environmental management issues.
- EMS documentation: Maintain information about the EMS and related documents.
- Document control: Ensure effective management of procedures and other documents.
- Operational control: Identify, plan and manage the organisation's operations and activities in line with the policy, objectives and targets and significant aspects.
- Emergency preparedness and response: Develop procedures for preventing and responding to potential emergencies.
- Monitoring and measuring: Monitor key activities and track performance including periodic compliance evaluation.
- Evaluation of compliance: Develop procedure to periodically evaluate compliance with legal and other requirements.
- Non-conformance and corrective and preventive action: Identify and correct problems and prevent recurrences.
- Records: Keep adequate records of EMS performance.

- EMS audit: Periodically verify that the EMS is effective and achieving objectives and targets.
- Management review: Review the EMS.

Legislation and standards

The Environmental Liability Directive [ELD] 2004/35/EC is an instrument of paramount importance that business needs to comply with and must be included in EMS. It came into force across Europe during 2009 and became a law on 1 March, 2009 converting the various national Pollution Prevention Guidelines (PPGs), such as the UK PPG11, PPG18 and PPG21 into requirements. Failure to comply with these requirements could result in penalty in the form of fines and more significantly reformation/reinstatement costs, which can run into many millions of Euro or Dollars. Within this directive is a requirement to mitigate the effects of events such as spills and firewater (the latter is the runoff from fires). The directive makes it clear that it is the site owner's responsibility to contain spills and firewater onsite by using any form of containment apparatus, such as sealing the drains.

ISO 14000 definition

The ISO 14000 is a standard for environmental management systems that is applicable to any business, regardless of size, location or income. The aim of the standard is to reduce the environmental footprint of a business and to decrease pollution and waste that ensues business processes. The most recent version of ISO 14001 was released in 2004 by the International Organisation for Standardisation (ISO), which has a representation from committees all over the world.

The major objective of the ISO 14000 series of norms is "to promote more effective and efficient environmental management in organisations and to provide useful and usable tools, ones that are cost-effective, system-based, flexible and reflect the best organisations and the best organisational practices available for gathering, interpreting and communicating environmentally relevant information." The intended result is the enhancement of environmental performance. It works as a source of guidance for introducing and adopting environmental management systems based on the ideal universal practices, in the same way that the ISO 9000 series on quality management systems, which is now widely applied, represents a tool for technology transfer of the best available quality management practices.

The ISO 14000 environmental management standards exist to help organisations minimise their operations' negative effects upon the environment. In structure, it is similar to ISO 9000 quality management and both can be implemented synchronously. In order for an organisation to be awarded an ISO 14001 certificate, it must be externally audited by an audit body that has been accredited by an accreditation body. In the UK, this is the UKAS. Certification auditors need to be accredited by the International Registrar of Certification Auditors. The certification body has to be accredited by the ANSI-ASQ National Accreditation Board in the USA or the National Accreditation Board in Ireland.

- ISO 14001 environmental management systems: Requirements with guidance for use.
- ISO 14004 environmental management systems: General guidelines on principles, systems and support techniques
- ISO 14015 environmental assessment of sites and organisations
- ISO 14020 series (14020 to 14025): Environmental labels and declarations
- ISO 14031 environmental performance evaluation: Guidelines
- ISO 14040 series (14040 to 14049): Life Cycle Assessment (LCA) discusses pre-production planning and environment goal setting
- ISO 14050 terms and definitions
- ISO 14062 discusses making improvements to environmental impact goals.
- ISO 14063 environmental communication: Guidelines and examples
- ISO 19011, which specifies one audit protocol for both 14000 and 9000 series standards together

This replaces ISO 14011 meta-evaluation (how to determine if your intended regulatory tools worked). ISO 19011 is now the only recommended way to determine this.

ISO 14001 definition

ISO 14001 defines an environmental audit, as "ISO 14001 is the environmental standard against which organisations are assessed. It specifies the requirements for an EMS, which provides a framework for an organisation to control the environmental impacts of its activities, products and services."

Three types of audit

According to Mattsson and Olsson, there are three types of audits as follows:

- Liability audit
- Management audit
- Functional audit (sometimes called an activity or issues audit)

Liability audits assess compliance with legal obligations. Management audits verify that an environmental management strategy meets its stated objectives. An activity audit may investigate a specific area, such as energy or water-use.

EMAS description

EMAS is generally a site-based registration system with due consideration provided to off-site activities that may have a bearing upon the products and services of the primary site. Within the UK, an extension to the scheme has been agreed upon for local government operations, who may also register their Environmental Management Systems to the EMAS regulations.

EMAS requires an existing environmental policy within the organisation, fully supported by senior management and outlining the policies of the company, not only to the staff but also to the public and other stakeholders. The policy needs to clarify compliance with environmental regulations that may affect the organisation and stress a commitment to continued improvement. Emphasis has been placed on policy as this provides direction for the remaining management system.

Those companies who have witnessed ISO9000 assessments are aware that the policy is frequently discussed during assessment; many staff members are asked if they understand or are aware of the policy. Any problems associated with the policy are seldom serious. The Environmental Policy is different. It forms initial foundation for the management system and is more stringently reviewed than the similar ISO9000 Policy. The statement must be publicised in non-technical language, so that it can be understood by majority of its readers. It should relate to the sites within the organisation encompassed by the management system, it should provide an overview of the company's activities on the site and a description of those activities. A clear picture of the company's operations is presented by the authorities to the lawmakers.

In addition to a summary of the process, the statement requires quantifiable data on current emissions and environmental effects emanating from the site, waste generated, raw materials utilised, energy and water resources consumed and any other environmental aspect that may relate to operations on the site. The preparatory review is a part of an EMAS assessment. This is not the case for BS7750. The environmental review must be comprehensive in consideration of input processes and output at the site. This control process is fashioned to identify all relevant environmental aspects that may arise from existence on the site. These may relate to current operations, they may relate to future, perhaps even unplanned future activities and they will certainly relate to the activities performed on site in the past (i.e., contamination of land). These processes are very important in order to ensure that the rules and regulations are enforced.

The initial or preparatory review will also include a wide-ranging consideration of the legislation, which may affect the site, whether it is currently being complied with and perhaps even, whether copies of the legislation are available. Many of the environmental assessments that have been undertaken highlighted that companies are often unaware of the legislations that impinge upon them. Thus, they often do not meet the requirements of such legislations. Enforcing these legislations is critical for protecting the environment and other related processes.

The company can declare its primary environmental objectives that have the propensity to have maximum environmental impact. In order to gain most benefits, these will become the primary areas of consideration within the improvement process and the company's environmental programme. The programme will incorporate plans to achieve specific goals or targets along the route to a specific goal and describe the means to reach those objectives such that they are real and achievable. The Environmental Management System provides further detail on the environmental programme. The EMS establishes procedures, work instructions and controls to ensure that implementation of the policy and achievement of the targets can become a reality. Communication is a vital factor, enabling people in the organisation to be aware of their responsibilities and of the objectives of the scheme and able to contribute to its success.

3.4 The Environmental Management System

As with ISO9000, the Environmental Management System requires a planned comprehensive periodic audit to ensure that it is effective in operation, is meeting specified goals and the system continues to perform in accordance with the relevant regulations and standards. The audits are designed to provide additional information in order to exercise effective management of the system, provide information on practices, which differ from the current procedures or offer an opportunity for improvement. Under EMAS, the minimum frequency for an audit is at least once every three years. The companies can have an audit more frequently if they are willing to do so.

Most companies produce routine annual reports and accounts that entail details of activities of the organisation over the previous year and its plans for the future. EMAS generally expects a similar system for the company's environmental performance. It expects a periodic statement, which incorporates performance during the previous period, a set of current performance data and notice of any particular plans for the future that may have an effect upon the environmental performance of the organisation, whether detrimental or beneficial. The peculiarity with EMAS is that the policy statement, the programme, the management system and audit cycles are reviewed and validated by an external accredited EMAS verifier. The verifier not only provides a registration service, but is also required to confirm and perhaps even sign the company's periodic environmental statements.

3.4.1 PDCA (Plan-Do-Check-Act)

It is an iterative four-step problem-solving process typically used in business process improvement. It is also known as the Deming cycle, Shewhart cycle, Deming wheel or plan do-study-act.

Meaning-The PDCA cycle

The PDCA cycle involves the following aspects which are described in the paragraphs below.

Plan

PDCA cycle establishes the objectives and processes necessary to deliver results in accordance with the expected output. By making the expected output the focus, it differs from other techniques as the completeness and accuracy of the specification is part of the improvement.

Do

PDCA cycle implements the new processes on a small-scale if possible.

Check

PDCA cycle measures the new processes and compares the results against the expected results to ascertain any differences.

Act

PDCA cycle analyses the differences in order to determine their cause. Each will be part of either one or more of the P-D-C-A steps. Determine where changes must be applied so that they also engender improvement. When a check through these four steps does not result in the need to improve, the scope is refined. PDCA is applied to this nascent scope and the cycle is repeated, until there is a plan that involves improvement.

PDCA

PDCA was made popular by Dr. W. Edwards Deming, who is considered father of modern quality control by many; however, he always referred to it as the 'Shewhart cycle'. Later in Deming's career, he modified PDCA to 'Plan, Do, Study, Act' (PDSA) to elucidate his recommendations in a better manner.

The concept of PDCA is based on the scientific method that was developed from the work of Francis Bacon (Novum Organum, 1620). The scientific method can be written as 'hypothesis', 'experiment', 'evaluation' or plan, do and check. Shewhart delineates manufacture under 'control' under statistical control as a three-step process of specification, production and inspection. He also specifically relates this to the scientific method of hypothesis, experiment and evaluation. Shewhart says the statistician "must help to change the demand (for goods) by showing how to close up the tolerance range and to improve the quality of goods." Clearly, Shewhart intended the analyst to take actions based on the conclusions of the evaluation. Deming noticed, during his lectures in Japan in the early 1950's, that the Japanese participants shortened the steps to the now traditional plan, do, check and act. Deming preferred plan, do, study and act because 'study' has connotations in English closer to Shewhart's intent than 'check'.

A fundamental principle of the scientific method and PDSA is the iteration that once a hypothesis is confirmed (or negated), executing the cycle will extend the knowledge further. Repeating the PDSA cycle can bring us closer to the goal, which is usually a perfect operation and output. In Six Sigma programmes, the PDSA cycle is called 'define measure, analyse, improve, control' (DMAIC). The iterative nature of the cycle must be explicitly added to the DMAIC procedure. This procedure also forms an important feature in the management of energy systems.

PDSA should be repeatedly implemented in spirals of increasing knowledge of the system that converge on the ultimate goal, each cycle closer than the previous. One can envision an open coil spring, with each loop being one cycle of the scientific method PDSA and each complete cycle indicating an increase in our knowledge of the system under study. This approach is based on the belief that our knowledge and skills are limited but improving. Especially at the start of a project, key information may not be known. The PDSA scientific method provides feedback to justify our guesses (hypotheses) and increase our knowledge. Rather than enter 'analysis paralysis' to get it perfect the first time, it is better to be approximately right than exactly wrong. There is a greater probability of being right this way. With improved knowledge, we may choose to refine or alter the goal (ideal state). Certainly, the PDSA approach can bring us closer to whatever goal we choose.

Rate of change, i.e., rate of improvement, is a key competitive factor in today's world. PDSA allows for major 'jumps' in performance ('breakthroughs' often desired in a Western approach), as well as Kaizen (frequent small improvements associated with an Eastern approach). The PDSA approach is normally a cumbersome process, which entails detailed efforts from the people involved. In the United States, as a PDSA approach is usually associated with a sizable project involving numerous people's time, thus managers want to see large 'breakthrough' improvements to justify the effort expended. However, scientific method and PDSA apply to all sorts of projects and improvement activities.

The power of Deming's concept lies in its apparent simplicity. The concept of feedback in the scientific method, in the abstract sense, is today firmly rooted in education. This concept is easy to adapt when compared to other concepts. While apparently easy to comprehend, it is often difficult to accomplish on an on-going basis due to the intellectual difficulty of judging one's proposals (hypotheses) based on measured results. Many people have an emotional fear of being proved 'wrong', even by objective measurements. To avoid such comparisons, we may instead cite complacency, distractions, loss of focus, lack of commitment, re-assigned priorities, lack of resources, etc.

3.4.2 Energy Efficiency

In a slightly different context, EMS can also refer to a system in an organisation to achieve energy efficiency through well laid out procedures and methods and to ensure continual improvement, which will spread awareness of energy efficiency throughout an entire organisation.

Automated control of building energy

The term Energy Management System can also refer to a computer system, which is designed specifically for automated control and monitoring of the heating, ventilation and lighting needs of a building or group of buildings, such as university campuses, office buildings or factories. Most of these Energy Management Systems also facilitate reading of electricity, gas and water meters. The data obtained from these can then be employed to produce trend-analysis and annual consumption forecasts.

The word environment refers to a vast area. The protection of the environment is vital for sustainable human development. Relevant factors of the environment include food, water, energy, natural resources, toxic substances, etc. Energy is one of the most important factors of the environment. Energy management is critical to our future economic prosperity and environmental well-being. Energy is essential for the functioning of most of the industrialised world as well as developing and under-developed nations. Yet, at the same time energy production and consumption causes degradation of the environment of the industrialised world. Developing countries are also not bereft of problems of a similar kind.

Energy management is one of the most critical issues for the future as so much of the world is dependent upon it. Thus, we need to comprehend the traditional sources of energy and their quality, availability and environmental effects, as well as the potential alternatives for energy and the effects of these upon the natural environment and modern industrial economies. Over the past two hundred years, the use of primary energy sources in manufacturing or processing has evolved from simply using locally available resources, such as waterpower, firewood or coal. The transition from coal to a petroleum-based fuel economy took place during the twentieth century. With changes to the oil market in the year 2000, which caught media attention around the world, there is further interest in the ongoing transition to renewable energy sources. Managing energy is now a basic feature in the global economy and environment. Fossil fuels in the form of oil, natural gas and coal comprise approximately 80% of the world's energy use. We now face a world where the environmental impacts of combusting fossil fuels, such as coal and oil are identified as unsustainable in the long-term. The need to turn to an increasing use of sustainable and renewable energy sources is clearly agreed.

3.4.3 EMAS

The EU Eco-Management and Audit Scheme (EMAS) is a management tool for companies and other organisations to evaluate reports and improve their environmental performance. The scheme has been available for participation of companies since 1995. It was originally restricted to companies in industrial sectors. This system has considerably increased the efficiency of the systems involved and has made the process more transparent. Since 2001, EMAS has been open to all economic sectors including both public and private services.

In 2009, EMAS regulation was revised and modified for the second time. Regulation (EC) No 1221/2009 of the European Parliament and of the Council of 25 November 2009 on the voluntary participation by organisations in a community eco-management and audit scheme (EMAS) was published on 22 December, 2009 and entered into force on 11 January, 2010.

3.4.4 Eco-Management and Audit Scheme

The Eco-Management and Audit Scheme (EMAS) is the EU voluntary instrument, which acknowledge organisations that improve their environmental performance on a continuous-basis.

An increasing number of companies are taking up this project to be a part of their system. More than 4,100 registered organisations are legally compliant, run an environmental management system and report on their environmental performance through the publication of independently verified environmental statements. They are recognised by the EMAS logo, which guarantees the reliability of the information provided. Certified organisations include industrial companies, small and medium enterprises, services, third sector organisations, administrations and international organisations (including the European Commission and the European Parliament themselves).

Requirements

The following are some requirements, which must be fulfilled by organisations in order to obtain the registration of EMAS:

- The organisation must have a policy related to the environment
- There must be an onsite review of the policy
- There must be clear objectives of the organisation regarding environment, on the basis of the policy and review discussed above
- Audit of the matter related to the environment
- A clear statement by the organisation regarding the environment

3.5 Environmental Auditing

Environmental audits are intended to quantify environmental performance and environmental position. In this way, they perform an analogous (similar) function to financial audits. An environmental audit report ideally contains a statement of environmental performance and environmental position and may aim to define steps to be taken to sustain or improve indicators of such performance and position.

However, access to manage this system is limited. Interested parties need to go through a process of evaluation to become eligible to enforce this system. Environmental auditors can obtain certification through a written exam and an acceptance of the Environmental Auditor Association code of ethics. Depending on the nature of the audit, there are several different designations to choose from CECAB (Canadian Environmental Certification Approvals Board).

Environmental auditing is a management tool to evaluate environment management systems systematically and objectively. It has the following objectives:

- Waste prevention and reduction
- Assessing compliance with regulatory requirements
- Placing environmental information in the public domain

Compliance with regulatory norms, through an adoption of clean technologies and improvement in management practices for prevention and control of pollution, is not only mandatory, but also has wide acceptance among the industrial community. Charter on Corporate Responsibility for Environmental Protection (CREP) also calls for commitment and voluntary initiatives of industry for responsible care of the environment, which will help in building a partnership for pollution control.

There are a few ambiguities in this system. Industries use these ambiguities to their own advantage. It is a fact that enforcement agencies are often not fully equipped in terms of labour and other infrastructure to identify violation of pollution control norms by industries. As there is high probability that enforcement agencies may monitor only limited number of industries spread over in different areas in the entire state, the government intends to introduce a new scheme called 'Environmental Auditing Scheme'. Thus, to make sure that there are no loopholes in the system, technically qualified professionals (Auditors) become a link between industries, enforcement agencies and association of industries in this scheme. This scheme works in tandem with added vital elements of accountability and transparency.

The scheme intends to carry out the following action plan:

- Identification of highly polluting industries in different sectors.
- Development of Standard Operating Procedures/Protocols in different sectors to assist the industry in developing self-audit programmes at individual facilities for evaluating their compliance with the environmental requirements under the environmental laws and regulations for monitoring the pollution.
- Developing training modules to train regulators, industrial and environmental auditors and imparting training to the stakeholders (auditors/industries/regulators).
- Identification and accreditation of the environmental auditors.

- Development of MIS system to process the environmental auditing reports.
- Support and guidance to industries to mitigate the pollution.

3.5.1 Impact Assessment and Environmental Auditing

Environmental impact assessment is the mandatory assessment of compliance of planned activities, such as planning documents, programmes and projects, with environmental protection requirements and with the principles of sustainable development, with the aim of determining the optimum solution. It becomes an important tool in managing and understanding the effects of the organisation on the environment.

On the other hand, environmental audit is the assessment of the compliance of environmental administration and performance of an operating business with environmental protection requirements, with sound environmental practice in general and with the principles of sustainable development. Environmental auditing is mandatory only in cases stipulated by law.

Environmental audits are being used as a tool and an aid to test the effectiveness of environmental efforts at the local-level. These audits should be carried out with transparency and honesty and the results should be made public. An environmental audit is a systematic, independent internal review to check whether the results of environmental work tally with the targets. An environmental audit also focuses on the effectiveness of the methods used to achieve goals. To be more precise, the work of an environmental audit is to examine documents and reports to determine whether there are any deviations between targets and results. This is done by interviewing key people in the organisation. An environmental audit will confirm whether the environmental targets have been attained.

The concept of environmental auditing is closely related to the following monitoring, norms and standards:

Environmental Monitoring	Environmental Norms	Environmental Standards
Environmental monitoring is the systematic observation of the state of the environment and of the factors influencing it. Its main purposes are to forecast changes to the state of the environment and to provide initial data for planning documents, programmes and projects. The procedure of environmental monitoring shall be established by law.	Environmental norms are reference figures or use rates of natural resources per production unit established for the quality of the environment, the volume of waste or per production unit.	Environmental standards are documents setting rules, guidelines and numeric values defined by the involved parties and regulating activities or results of activities, which either have or are likely to have impact on the state of the environment.

Table 3.1 Environmental auditing norms and standards

These audits are conducted at regular intervals by various personnel who are involved in the process. During a typical environmental audit, a team of qualified inspectors, either employees of the organisation being audited or contractor personnel, conducts a comprehensive examination of a plant or other facilities to determine whether it is complying with environmental laws and regulations. Employing checklists and audit protocols and relying on professional judgement and evaluations of site-specific conditions, the team systematically verifies compliance with applicable requirements. The team may also evaluate the effectiveness of current systems to manage compliance and assess the environmental risks associated with facility's operations.

Summary

- Environmental Management System (EMS) refers to the management of an organisation's environmental programmes in a comprehensive, systematic, planned and documented manner.
- An EMS follows a 'plan-do-check-act cycle' or PDCA.
- EMS is an important tool for managing the environment effectively and efficiently.
- An EMS is flexible and necessitates organisations to 'retool' their existing activities.
- ISO stands for the International Organisation for Standardisation, located in Geneva, Switzerland.
- ISO is a non-governmental organisation, which was established in 1947.
- In September 1996, the International Organisation for Standardisation published the first edition of ISO 14001, the environmental management systems standard.
- All ISO standards are generated through a voluntary, consensus-based approach. ISO has many member countries across the globe.
- The ISO 14000 is a standard for environmental management systems that is applicable to any business, regardless of size, location or income.
- ISO 14001 defines an environmental audit, as "ISO 14001 is the environmental standard against which organisations are assessed."
- EMAS is generally a site-based registration system with due consideration provided to off-site activities that may have a bearing upon the products and services of the primary site.
- Environmental audits are intended to quantify environmental performance and environmental position.
- Environmental auditing is a management tool to evaluate environment management systems systematically and objectively.
- Environmental audits are being used as a tool and an aid to test the effectiveness of environmental efforts at the local-level.

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Self Assessment

1. What refers to the management of an organisation's environmental programmes in a comprehensive, systematic, planned and documented manner?
   a. Energy management
   b. Environmental Management System (EMS)
   c. Resource management
   d. 'Plan-do-check-act cycle' or PDCA

2. What is the process of first developing an environmental policy, planning the EMS and then implementing it?
   a. EMS
   b. ISO
   c. ELD
   d. PDCA

3. Match the following

1. An EMS	A. Is a non-governmental organisation.
2. ISO	B. Follows a 'plan-do-check-act cycle' or PDCA.
3. PDCA	C. It came into force across Europe during 2009 and became a law on 1 March 2009
4. The Environmental Liability Directive	D. It is an iterative four-step problem-solving process typically used in business process improvement.

   a. 1-C, 2-D, 3-A, 4-B
   b. 1-A, 2-B, 3-C, 4-D
   c. 1-B, 2-A, 3-D, 4-C
   d. 1-D, 2-C, 3-B, 4-A

4. When was ISO established?
   a. 1947
   b. 1957
   c. 1943
   d. 1962

5. When did the International Organisation for Standardisation publish the first edition of ISO 14001, the environmental management systems standard?
   a. September 1916
   b. September 1967
   c. September 1996
   d. September 1998

6. _____audits assess compliance with legal obligations.
   a. Management
   b. Functional
   c. Environment
   d. Liability

7. Which of the following is also known as the Deming cycle?
   a. EMS
   b. PDCA
   c. EMAS
   d. ISO

8. _____ audits verify that an Environmental Management Strategy meets its stated objectives.
   a. Management
   b. Functional
   c. Environment
   d. Liability

9. _____management is critical to our future economic prosperity and environmental well-being.
   a. Environment
   b. Energy
   c. Deming
   d. Functional

10. Which of the following statement is true?
   a. Management is critical to our future economic prosperity and environmental well-being.
   b. Energy management is not important to our future economic prosperity and environmental well-being.
   c. PDCA is critical to our future economic prosperity and environmental well-being.
   d. Energy management is critical to our future economic prosperity and environmental well-being.

Chapter IV

Environmental Laws

Aim

The aim of this chapter is to:

- introduce environmental law
- explain patent laws
- explicate pollution and waste management

Objectives

The objectives of this chapter are to:

- enlist the composition of board
- elucidate the air (prevention and control of pollution) act, 1981
- explain the water (prevention and control of pollution) act, 1974

Learning outcome

At the end of this chapter, you will be able to:

- identify costs of pollution to human health and tourism industry
- understand pollution from mining
- define air pollution

4.1 Introduction

Environmental law is a complex and interlocking body of treaties, conventions, statutes, regulations and common law that very broadly, operate to regulate the interaction of humanity and the rest of the biophysical or natural environment toward the purpose of reducing the impacts of human activity, both on the natural environment and on humanity itself. It is indispensible and would have damaging repercussions, if broken. Environmental law encompasses the following major areas:

- Pollution control and remediation
- Resource conservation and management

Laws dealing with pollution are often media-limited, i.e., pertain only to a single environmental medium, such as air, water (whether surface water, groundwater or oceans), soil, etc. These control both emissions of pollutants into the medium, as well as the liability for exceeding permitted emissions and responsibility for cleanup. The rules and regulations are binding and are rapidly gaining importance in India and across the world.

Laws regarding resource conservation and management generally focus on a single resource like natural resources (forests, mineral deposits or animal species) or more intangible resources (scenic areas or sites of high archaeological value). They also provide guidelines for and limitations on the conservation, disturbance and use of those resources. If these resources are not managed properly, there can be extensive damage to society as a whole. These areas are not mutually exclusive, for example, laws governing water pollution in lakes and rivers may conserve the recreational value of such water bodies. Furthermore, many laws that are not exclusively 'environmental' nonetheless include significant environmental components and integrate environmental policy decisions. Municipal, state and national laws regarding development, land use and infrastructure are examples of the sort. These laws need to be updated to make sure that everybody makes a collective effort to manage the environment and the systems around it.

In the Constitution of India, it is clearly stated that it is the duty of the state to "protect and improve the environment and to safeguard forests and wildlife of the country." It imposes a duty on every citizen to protect and improve the natural environment including forests, lakes, rivers and wildlife. Reference to the environment has also been made in the Directive Principles of State Policy as well as the Fundamental Rights. The Department of Environment was established in India in 1980 to ensure a healthy environment for the country. This later became the Ministry of Environment and Forests in 1985.

The constitutional provisions are supported by a number of laws, acts, rules and notifications. The Environment Protection Act of 1986(EPA) came into force soon after the Bhopal Gas Tragedy and is considered an umbrella legislation as it fills many gaps in the existing laws. Thereafter, a large number of laws came into existence as problems began arising, e.g., Handling and Management of Hazardous Waste Rules in 1989.

4.2 Patent Laws

The patent system in India is administered under the superintendence of the Controller-General of Patents, Designs, Trademarks and Geographical Indications. The Office of the Controller-General functions under the Department of Industrial Policy and Promotion, Ministry of Commerce and Industry. There are four patent offices in India. The Head Office is located at Kolkata and other patent offices are located at Delhi, Mumbai and Chennai. The Controller General delegates his powers to the Sr. Joint Controller, Joint Controllers, Deputy Controllers and Assistant Controllers. Examiners of patents in each office discharge their duties according to the direction of the Controllers. Hierarchy of Officers in Patent office is as follows:

- Controller-General of Patents, Designs, Trademarks & GI
- Examiners of Patents & Designs
- Assistant Controller of Patents & Designs
- Deputy Controller of Patents & Designs
- Joint Controller of Patents & Designs
- Senior Joint Controller of Patents & Designs

Patentable inventions

A patent can be granted for an invention, which may be related to any process or product. The word Invention has been defined under the Patents Act 1970 as, "An invention means a new product or process involving an inventive step and capable of industrial application [S. 2(1) (j)]." 'New invention' is defined as any invention or technology which has not been anticipated by publication in any document or used in the country or elsewhere in the world before the date of filing of patent application with complete specification, i.e., the subject matter has not fallen in public domain or that it does not form part of the state of the art. Capable of industrial application, in relation to an invention, means that the invention is capable of being made or used in an industry [S.2 (1) (ac)]. Therefore, the criteria for an invention to be patentable are as follows:

- An invention must be novel
- Has an inventive step
- Is capable of industrial application

To be patentable, an invention should fall within the scope of patentable subject matter as defined by the patent statute. The invention must relate to a machine, article or substance produced by manufacture or the process of manufacture of an article. A patent may also be obtained for an improvement of an article or of a process of manufacture. With regard to medicine or drug and certain classes of chemicals, no patent is granted for the product itself, even if new, only the process of manufacturing the substance is patentable. Product patents for drugs and food materials are now available in India. If any substance falls outside the scope of patentable subject matter, it cannot be patentable.

4.3 Pollution and Waste Management

Pollution and waste management aims to facilitate and develop programmes, projects, co-operative management and policy mechanisms, measures and decision-support systems to ensure integrated pollution and waste management. Pollution and waste management also aims to achieve the following:

- Ensures efficient and effective provision of staff for the new structure and development of personnel.
- Collects analyses and disseminates relevant and current information regarding pollution and waste management.
- Promotes programmes on pollution and waste management that gives effect to integrated pollution and waste management
- Promotes public participation in environmental governance and decision-making with respect to integrated pollution and waste management
- Provides efficient and effective support to all clients and ensure co-operative governance to achieve integrated pollution and waste management
- Develops and implements pollution and waste management legislation, policies, norms, standards and guidelines and ensures compliance with relevant environmental legislation.

4.3.1 Pollution and Small Islands

Pacific island countries, like the rest of the world, face serious problems regarding disposal of wastes and pollution. Although organic and most metal wastes can be recycled, this is practised in a limited way in most rural areas. Increased urbanisation and a growing population have accelerated problems regarding the collection and disposal of both solid and liquid wastes. Every year the import of packaged consumer goods accentuates the amount of non-biodegradable waste. Pollution from industrial waste and sewage and disposal of toxic chemicals are significant contributors to marine pollution and coastal degradation. In spite of these laws, there are infinite instances where these laws are not followed and there is a degradation of the resources.

Manmade chemicals, many of them very toxic, can be difficult to recycle and expensive to destroy. Most wastes, hazardous or not are dumped together at the nearest available government-owned land. In Fiji, Tonga and Vanuatu, for example, the public dumps are in mangrove forests and the Department of Health dusts them regularly with pesticides and rat poison. The widespread use of toxic agricultural chemicals, that seeps in to in rivers and groundwater sources can pose as a health hazards to human population. The effect of such chemicals is long-term. Groundwater contamination is common in fresh water sources adjoining agricultural areas.

Pollution from wastes has serious implications for the small island states. These problems fall into the following three categories:

- Aesthetics
- Human health
- Environmental degradation

4.3.2 Costs of Pollution to the Tourism Industry

As tourism is a pivotal source of livelihood for the Pacific islands, its ambient beauty is of great economic importance. It forms a major revenue source for many countries like Maldives, the West Indies, etc. Yet in most of the Pacific islands and at other centres, tourists are confronted with litter; wrappers and aluminium cans line the roads, fast food plastic packaging is heaped on the edges of scenic overviews, disposable diapers drift through the clear waters or tangle in the branches of corals. Municipal dumps, often close to major urban centres, desecrate the otherwise beautiful environment.

4.3.3 Costs of Pollution to Human Health

Human health is endangered by litter indirectly. There are many diseases, which are a result of this litter. Mosquitoes that carry dengue fever breed in water trapped in cans, old tyres, jars and plastic containers. Dengue epidemics are common in the Pacific islands. A study in New Caledonia, for example, found the epicentre for a recent outbreak of dengue in a squatter city where litter was abundant. There are 23 different strains of dengue; most of them debilitate the victim for a period ranging from several weeks to several months. One variety causes internal haemorrhaging and can be deadly. In 1998, an epidemic of dengue spread across the South Pacific. Fiji spent millions of dollars combating the disease. More than 6,500 people required hospitalisation.

Improper disposal of waste is a leading cause of water contamination. Sewage contamination of water is common in all countries of the region and few streams and even many ground water supplies are safe for human consumption without treatment. Diarrhoea, often water borne was the third most common cause for hospitalisation in the world. In Kiribati, diarrhoea and other water-related diseases were the number one cause of death (WHO 1984). In Ebey Lagoon, in the Marshall Islands, where pollution levels have reached 25,000 times higher than WHO safe levels, epidemics of gastroenteritis were almost impossible to control (Keju and Johnson, 1982). Cholera, which caused diarrhoea and dehydration, killed 18 people in Kiribati in 1977 and initiated renewed efforts at improving sanitation and water supplies (Kiribati UNCED 1992).

Droughts and subsequent floods amplify water-related health problems. Many diseases spread, creating havoc in the lives of people. Leptospirosis and amoebic dysentery both increased following the prolonged droughts in 1987. Leptospirosis is transmitted by contamination of water supplies by rat or dog urine. Amoebic dysentery is transmitted by sewage-contaminated water. In New Caledonia and French Polynesia, leptospirosis increased from 9 cases in 1987 to 87 in 1988 and 158 in 1989. It fell again in 1991, parallel with the incidence of Amoeboensis. In French Polynesia, leptospirosis hospitalised 100 out of every 100,000 people in 1992. This compares to 0.4/100,000 cases in France.

4.3.4 Environmental Costs of Pollution

Environmental degradation from pollution indirectly affects human health through reduction of food security, loss of drinking water supplies and loss of economic opportunity. It entails loss of crops, food grains because of insects that are borne out of degradation.

Major industries flourishing in the small island states are agriculture, tourism, forestry, mining and fisheries. All of these generate waste, some a by-product of the activity, some a necessary part of the product stream. By-product wastes are generally the result of poorly managed operations and include siltation (from mining and land clearing during agricultural of forestry activities), oil pollution (used oil from machinery and from accidental spills), poisons (from pest control) and miscellaneous plastic trash (old fishing gear, plastic sheeting, drums and bags). Production wastes include organic wastes from food processing and chemical wastes (from oil palm refineries, mining processes, wood treatment, etc.)

Hazardous chemicals and nutrient pollution comprise the larger pollutants in the system. They are hazardous and may cause irreparable water pollution. Such pollutants enter the marine environment via effluents, dumps, storm runoff, sewage and wind-blown dust. These cause environmental degradation to inshore estuarine and marine environments. This is especially damaging to coastal marine nursery areas like sea grass beds, coral reefs and mangrove forests. While many of these effluents cause local environmental degradation, siltation, oil pollution, poisons and plastic trash contribute to extensive, damage to inshore marine environments.

Pollution in oceans is also possible through natural ways. Ocean currents form eddies around the mountains and it is in these oceanic vortices that many sea creatures proliferate in their planktonic stages. The lagoons of atolls and bays of high islands are also key areas for planktonic development. Air-blown dust, smoke and fresh water run-off from the islands carry oil-soluble manufactured toxins from gardens, food processing areas, kitchen sinks and municipal dumps onto the surface layer of the sea. The sea surface micro-layer is a vital nursery for the vast majority of all marine organisms and because of its special characteristics, is easily polluted by synthetic chemicals. Although these pollutants are not regular, it adds up to the total pollution creating a bigger problem, which is more relevant than ever before.

Almost all the multitudes of marine species of fish, plants and invertebrates shed their eggs into the seawater. These float and so almost all sea creatures spend the first few hours of life close to the micro-layer boundary at the sea surface. Under normal conditions, this layer is enriched by a very thin layer of natural oils, slowly digested by special marine bacteria. The nutrient-enriched surface layer of the sea is thus the largest single nursery environment of the planet. If this layer does not retain its natural form, it becomes difficult for these creatures to reproduce. Tests have demonstrated that this critical habitat is polluted by heavy metals, agricultural poisons and the breakdown of petroleum products. Bioassays demonstrate that these toxins can and do kill the eggs and larval stages of fish and invertebrates. Scientists are concerned that this problem may be contributing to the global decline in marine communities and fish populations.

4.3.5 Pollution from Mining

Mining is a non-renewable activity and environmental management is essentially a process of removing the minerals with minimal harm to the environment and maximum profit to society. The four kinds of mining are as follows:

- Mineral extraction (nickel, gold, silver, copper, iron, uranium and titanium)
- Coal mining
- Construction mining (for fill, building stone and cement)
- Oil and gas extraction

Each activity has its own environmental impact during extraction, processing and transport. There are many major mineral mining centres around the world and all of them engender various items including petroleum and natural gas, mostly from off-shore wells. Mining in these countries results in inevitable localised environmental damage. Regulations attempt, to mitigate damage from mine tailings, processing fumes and siltation of streams and rivers with varying degrees of success. In some areas, for example, minerals are taken by strip-mining in mountainous areas. As the terrain becomes rugged, the practical difficulties in preventing massive siltation of waterways also rocket. Therefore, it is increasingly important to make sure that there is minimal environmental damage through these mining activities. Prior to the 1980s, there were few, if any, environmental precautions taken with mining activities. Siltation of waterways and coastal areas as a result was common. Even after regulations were enacted, the practicalities of mine operation in rugged terrains often precluded effective environmental protection. This led to damage in the ecosystem in those areas. For example, siltation settlement ponds at the OK Tedi gold mine in Papua New Guinea were destroyed by an earthquake, but the mine was allowed to operate anyway. Sediments polluted the Fly River damaging coastal gardens and fisheries. Local land owners successfully sued mine owners and forced construction of new settlement ponds, but the success of these will be tested by future earthquakes and torrential rains.

4.4 The Air (Prevention and Control of Pollution) Act, 1981

The Air (Prevention & Control of Pollution) Act was enacted by Parliament in 1981with an objective to prevention, control and abatement of air pollution. Under Section 19 of this Act, the whole of National Capital Territory of Delhi has been declared as air pollution control area by the Central Government. Under this section, government approved fuels are to be used in the air pollution control area. The important provisions of the Air (Prevention & Control of Pollution) Act are discussed below.

Section 21(1)

This section deals with persons establishing or operating any industrial unit in National Capital Territory of Delhi without obtaining prior consent of the DPCC. The consent application will be disposed off within 4 months of receipt of the consent application. However, DPCC may either grant consent or reject the application within 4 months for reasons to be recorded in writing. It may also revoke previous, consent to the industry before expiry of the same after giving a reasonable opportunity of being heard. Any consent requires the compliance with the following conditions:

- Control equipment of such specification as the State Board may approve.
- Control equipment referred above shall be kept at all times in good running condition.
- Chimney, wherever necessary, of such specifications as state boards may approve.
- Any other such conditions as the state board may specify.

Section 22

No person operating any industrial plant, in any air pollution control area shall discharge or cause or permit to be discharged the emission of any air pollution in excess of the standards laid down by the state board.

Section 22(A)

State Board can also approach the court to stop any person from doing air pollution.

Sections 24(i) and 26(i)

DPCC officer has powers to inspect any premises in performance of their duties, take samples, examine records, documents, etc., or performing any other duty entrusted to him by the board. Every person operating any equipment is bound to provide all assistance to the person who is inspecting. When samples are taken, officials can collect the samples after informing the person of the industry. Any analysis of the samples done in the air lab can be produced as evidence in a court.

Section 31

Any person aggrieved by an order made by the state board under this act may, within 30 days from the date on which order is communicated to him, prefer an appeal to the authorised authority who in the case of Delhi is the Joint Secretary, Ministry of Environment & Forest. The state board can give directions to any person or office or authority in writing and such person or officer or authority is bound to comply with such directions, which includes the following:

- The closure, prohibition or regulation of any industry, operation or process.
- Stoppage or regulation of electricity, water or any other services.

Section 37

Any person failing to comply with the provisions of Section 21 or Section 22 or directions issued under Section 31(A) can be imprisoned from 1-1/2 years to 6 years, with fine or with a fine up to Rs.5000/- per day. If violation continues beyond one year imprisonment can be increased up to 7 years with fine.

Section 39
Whoever contravenes any of the provisions of this Act or any order or directions issued there under, for which no penalty has been elsewhere provided in this act, shall be punishable with imprisonment for a term which may extend to three months or with fine which may extend to ten thousand rupees or with both and in case of continuing contravention with an additional fine which may extend to Rs.5000/- for every day during which such contravention continues after conviction for the first such contravention.

Objectives of the Act
The Act is designed to prevent and control air pollution. It is applicable all over India. The Act gives powers to the boards for ensuring that there are proper systems for prevention of air pollution.

Air pollutant
Air Pollutant means any solid, liquid or gaseous substance, including noise, present in atmosphere in such concentration as may tend to be injurious to human beings, living creatures or plants or property or environment [Section 2(a)]. Air Pollution means presence of air pollutants in the air. [Section 2(b)] Thus, it covers noise pollution also. Emission has been defined as any solid, liquid or gaseous substance, coming out of chimney, duct or fuel or any other outlet [Section 2(j)]. Chimney is any structure with an opening or outlet from or through which any air pollutant may be emitted [Section 2(h)].

Control equipment
Control equipment means any apparatus, device, equipment or system to control the quality and manner of emission of any air pollutant. It includes any device used for securing the efficient operation of any industrial plant [Section 2(i)].

Industrial plant
Industrial plant means any plant used for any industrial or trade purpose and emitting any air pollutant into the atmosphere [Section 2(k)]. Thus, even equipment used for trade or business is covered, if it emits air pollutant.

Air pollution control area
State Government, after consultation with State Board, by notification, can declare any area as air pollution control area. Such areas can be added, deleted or altered by notification. State Government can prohibit burning of any material (other than fuel) in such area; if it is likely to cause air pollution. It can also order the following:

- Only approved fuel should be used in such area.
- Only approved appliance should be used for burning of any fuel or for generating or consuming any fume, gas or particulate matter. Such approval of fuel or appliance can be given by State Board [Section 19 of Air Act].

Standards regarding vehicles
State Government, after consulting State Board, may give necessary instructions to the registering authorities under Motor Vehicles Act in connection with maintenance of standards for emission of air pollutants. Such authority is bound to act on such instructions [Section 20].

Prior permission necessary for setting up of any industry
No person can establish any industry in air pollution control area without previous consent of the State Board. Application should be in a prescribed form, accompanied by necessary fees. A person already operating industry in the control area has to apply for the permission with the necessary fees to the state board within three months. After making necessary enquiries, the board may grant the consent subject to certain conditions or the consent may be refused. The consent can be subject to conditions. Such permission or refusal should be within four months. The State Board can cancel this consent, if the person fails to fulfil the conditions, only after giving the opportunity to the person of being heard.

Restraint on emitting air pollutants
Person operating any industrial plant shall not allow emission of air pollutants in excess of the standards laid down by State Board [Section 22 of Act]. State Board can apply to court (Judicial Magistrate or Metropolitan Magistrate)

for restraining persons from causing air pollution. The court can give the order as it deems fit. Court can order a person restraining him from discharging air pollutants. Court can authorise Board to implement the said direction [section 22A of Act].

Responsibility of occupier to inform, if there is excess pollution

Where in any area, the emission of air pollutants is in excess or the standards laid down by State Board (or is likely to increase), the person in charge of the premises, shall inform the fact to State Board or agencies or authorities necessary. The Board shall take necessary remedial measures to mitigate the emission of such air pollutants. The expenses incurred for mitigating the emission can be recovered from the person concerned [Section 23 of Act].

Approved laboratories

State Government can establish approved State Air Laboratories. It can also appoint persons with prescribed qualifications as Government Analysts. State Board can also appoint persons with prescribed qualifications as Board Analysts for analysis of samples.

Authorities

The Act envisages Central Board as well as State Pollution Control Boards in each State. [In Union Territories, Environment Control Committees have been formed, which also have Chairman and Secretary].

Composition of central board

It is the same board constituted under water (prevention and control) of pollution act 1974. A full-time chairman having knowledge relating to environment pollution (appointed by centre) up to 5 officials to represent central govt. Up to 5 officials as representing state boards with up to 2 to represent local authorities, up to 3 non-officials to represent fisheries, agriculture, industry, etc. Up to two persons to represent the corporate sector (by centre) are needed. A full time member secretary, who is equipped with qualifications and experience in science, engineering, management, etc., is also required.

The composition of board (detailed) is as follows:

- A Chairman, being a person, having special knowledge or practical experience in respect of matters relating to environmental protection, to be nominated by the State Government: Provided that the Chairman may be either whole-time or part-time as the State Government may think fit.
- Such number of officials, not exceeding five, as the State Government may think fit, to be nominated by the State Government to represent that government.
- Such number of persons, not exceeding five, as the State Government may think fit, to be nominated by the State Government from amongst the members of the local authorities functioning within the State.
- Such number of non-officials, not exceeding three, as the State Government may think fit, to be nominated by the State Government to represent the interest of agriculture, fishery or industry or trade or labour or any other interest, which in the opinion of that government, ought to be represented.
- Two persons to represent the companies or corporations owned, controlled or managed by the State Government, to be nominated by that Government
- A full-time member-secretary having such qualifications, knowledge and experience of scientific, engineering or management aspects of pollution control as may be prescribed, to be appointed by the State Governments; provided that the State Government shall ensure that not less than two of the members are persons having special knowledge or practical experience in, respect of matters relating to the improvement of the quality of air or the prevention, control or abatement of air pollution. Every State Board constituted under this Act shall be a body corporate with the name specified by the State Government in the notification issued under sub-section (1), having perpetual succession and a common seal with power, subject to the provisions of this Act, to acquire and dispose of property and to contract and may by the said name sue or be sued.

An occupier

Any person who has control over the affairs of the factory or the premises and includes in relation to any substance, the person in possession of the substance.

Chimney
Sec. 2 (h) includes any structure with an opening or outlet from or through which any air pollution may be emitted.

Approved fuel
Sec. 2 (d) includes any fuel approved by the state board for the purposes of this Act.

Approved appliance
Any equipment or gadget used for the burning of any combustible material or for generating or consuming any fume, gas or particular matter and approved by the state board for the purpose of this Act.

The following are the powers and functions of central board (sec. 16, part III):

- Advise the Central Government on any matter concerning the improvement of the quality of air and prevention, control or abatement of air pollution.
- Plan and cause to be executed a nation-wide programme for the prevention, control or abatement of air pollution.
- Coordinate the activities of the State Boards and resolve disputes among them.
- Provide technical assistance and guidance to the State Boards, carry out and sponsor investigations and research relating to problems of air pollution and prevention, control or abatement of air pollution.
- Perform such of the function of any State Board as may be specified in an order made under Sub-section (2) of Section 18.
- Plan and organise the training of persons engaged or to be engaged in programmes for the prevention, control and abatement of air pollution on such terms and conditions as the Central Board may specify.
- Organise through mass media a comprehensive programme regarding the prevention, control or abatement of air pollution.
- Collect, compile and publish technical and statistical data relating to air pollution and the measures devised for its effective prevention, control or abatement and prepare manuals, codes or guides relating to prevention, control or abatement of air pollution.
- Lay down standards for the quality of air, (i) collect and disseminate information in respect of matters relating to air pollution, other functions as necessary.

Powers to entry to collect information:
Any person empowered by a State Board in this behalf shall have a right to enter, at all reasonable times with such assistance as he considers necessary, any place:

- For the purpose of performing any of the functions of the State Board entrusted to him.
- For the purpose of determining whether and if so in what manner, any such functions are to be performed or whether any provisions of this Act or the rules made there under or any notice, order, direction or authorisation served, made, given or granted under this Act is being or has been complied with.

Penalties
If any factory violates provisions of Section 21(running a factory not permitted), Sec. 22(providing information required under the act), the offender shall be punishable with imprisonment for a term which shall not be less than two years but which may extend to seven years and with fine.

Powers to take samples
A State Board or any officer empowered by it in this behalf shall have power to take, for the purpose of analysis, samples of air or emission from any chimney, flue or duct or any other outlet in such manner as may be prescribed. The result of any analysis of a sample of emission taken under the above provision shall not be admissible in evidence in any legal proceeding unless the provisions regarding procedure of taking sample is followed.

The following is the procedure while taking sample (Sec. 26):

- Serve on the occupier or his agent, a notice, then and there, in such form as may be prescribed, of his intention to have it so analysed.
- In the presence of the occupier or his agent, collect a sample of emission for analysis.
- Cause the sample to be placed in a container or containers which shall be marked and sealed and shall also be signed both by the person taking the sample and the occupier or his agent.
- Send, without delay, the container to the laboratory established or recognised by the state board under Section 17 or if a request in that behalf is made by the occupier or his agent when the notice is served on him under clause (a), to the laboratory established or specified under sub-section (1) of Section 28.

Analysis of findings

Where a sample of emission has been sent for analysis to the laboratory established or recognised by the State Board, the Board Analyst appointed under sub-section (2) of Section 29 shall analyse the sample and submit a report in the prescribed form of such analysis in triplicate to the State Board. On receipt of the report under sub-section (1), one copy of the report shall be sent by the State Board to the occupier or his agent referred to in section 26, another copy shall be preserved for production before the court in case any legal proceedings are taken against him and the other copy shall be kept by the State Board.

Meetings of the board

For the purposes of this Act, a Board shall meet at least once in every three months and shall observe such rules of procedure in regard to the transaction of business at its meetings as may be prescribed provided that it, in the opinion of the Chairman, any business of an urgent nature is to be transacted, he may convene a meeting of the Board at such time as he thinks fit for the aforesaid purpose.

Board may constitute a committee

A Board may constitute as many committees consisting wholly of members or partly of members and partly of other persons and for such purpose or purposes as it may think fit. A committee constituted under this section shall meet at such time and at such place and shall observe such rules of procedure in regard to the transaction of business at its meetings, as may be prescribed.

Board may associate persons/bodies for its work

A Board may associate with itself in such manner and for such purposes, as may be prescribed, any person whose assistance or advice it may desire to obtain in performing any of its functions under this Act. A person associated with the Board under sub-section (1) for any purpose shall have a right to take part in the discussions of the Board relevant to that purpose, but shall have a right to vote in a meeting of the Board and shall not be a member of the Board for any other purpose.

Appeals against the state board

Any person aggrieved by an order made by the State Board under this Act may, within thirty days from the date on which the order is communicated to him, prefer an appeal to such authority (hereinafter referred to as the Appellate Authority, 3-member body constituted) as the State government may think fit to constitute.

4.5 The Water (Prevention and Control of Pollution) Act, 1974

The Water Act was enacted by Parliament Act, 1974 to provide for the prevention of control of water pollution and the maintaining or restoring of wholesomeness of water. As on day, it is applicable in all the states of India. This act, unless the context otherwise requires, includes the following terms:

- Occupier
- Outlet
- Pollution
- Trade effluent

The relevant provisions of this are given as below:

- Section 19: The entire National Capital Territory of Delhi has been declared as water pollution prevention control area.
- Section 21: Officials of DPCC can take samples of the water effluent from any industry stream or well or sewage sample for the purpose of analysis.
- Section 23: Officials of the state boards can enter any premises for the purpose of examining any plant, record, register, etc., or any of the functions of the Board entrusted to him.
- Section 24: No person shall discharge any poisonous, noxious or any polluting matter into any stream, or well or sewer or on land.
- Section 25: No person shall without the previous consent to establish perform the following actions:
  - Establish or take any step to establish any industry, operation or process or any treatment and disposal system for any extension or addition thereto, which is likely to discharge sewage or trade effluent into a stream or well or sewer or on land.

    Or
  - Bring into use any new or altered outlet for the discharge of sewage.

    Or
  - Begin to make any new discharge of sewage.

Under this section, the state board may grant consent to the industry after satisfying itself on pollution control measures taken by the unit or refuse such consent for reasons to be recorded in writing.

- Section 27: A state board may from time to time review any condition imposed by it on the person under Sections 25 and 26 and may vary or revoke that condition.
- Section 28: Any person aggrieved by the order made by the State Board under Section 25, 26 or section 27 may within thirty days from the date on which the order is communicated to him, prefer an appeal to such authority (referred to as the appellate authority) as the State Government may think fit to constitute (in case of NCT of Delhi Appellate authority under this section is Financial Commissioner, Delhi Administration).
- Section 33: The State Board can direct any person who is likely to cause or has caused pollution of water in street or well to desist from taking such action as is likely to cause its pollution or to remove such matters as specified by the Board through court.
- Section 33A: DPCC can issue any directions to any person, officer or authority, and such person, officer or authority shall be bound to comply with such directions. The directions include the power to direct as follows:
  - The closure, prohibition of any industry.
  - Stoppage or regulations of supply of electricity, water or any other services.
- Section 43: Whoever contravenes the provisions of Section 24 shall be punishable with imprisonment for a term which shall not be less than one year and six months, but which may extend to six years with fine.
- Section 45: If any who has been convicted of any offence under Section 24 or Section 25 or Section 26 is again found guilty of an offence involving a contravention of the same proviso shall be on the second and on every subsequent conviction be punishable with imprisonment for a term which shall not less than two years, but which may extend to seven years with fine.
- Section 45A: Whoever contravenes any of the provisions of this act or fails to comply with any order or direction given under this Act for which no penalty has been elsewhere provided in this Act, shall be punishable with imprisonment which may extend to three months or with fine which may extend to ten thousand rupees or with both.

Summary

- Environmental law encompasses two major areas.
- Laws dealing with pollution are often media-limited, i.e., pertain only to a single environmental medium such as air, water (whether surface water, groundwater or oceans), soil, etc.
- In the Constitution of India, it is clearly stated that it is the duty of the state to "protect and improve the environment and to safeguard forests and wildlife of the country."
- The Department of Environment was established in India in 1980 to ensure a healthy environment for the country.
- The Environment Protection Act of 1986(EPA) came into force soon after the Bhopal Gas Tragedy and is considered an umbrella legislation as it fills many gaps in the existing laws.
- The patent system in India is administered under the superintendence of the Controller-General of Patents, Designs, Trademarks and Geographical Indications.
- Pacific island countries, like the rest of the world, face serious problems regarding disposal of wastes and pollution.
- Human health is endangered by litter indirectly.
- Improper disposal of waste is a leading cause of water contamination.
- The Air (Prevention & Control of Pollution) Act was enacted by Parliament in 1981with an objective to prevention, control and abatement of air pollution.
- Air Pollutant means any solid, liquid or gaseous substance, including noise, present in atmosphere in such concentration as may tend to be injurious to human beings, living creatures or plants or property or environment [Section 2(a)].
- A Board may constitute as many committees consisting wholly of members or partly of members and partly of other persons and for such purpose or purposes as it may think fit.
- The Water Act was enacted by Parliament Act, 1974 purpose to provide for the prevention of control of water pollution and the maintaining or restoring of wholesomeness of water.
- The entire National Capital Territory of Delhi has been declared as water pollution prevention control area.

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Self Assessment

1. _____dealing with pollution are often media-limited, i.e., pertain only to a single environmental medium, such as air, water (whether surface water, groundwater or oceans), soil, etc.
   a. Issues
   b. Laws
   c. Challenges
   d. Management

2. Which of the following act came into force soon after the Bhopal Gas Tragedy and is considered an umbrella legislation as it fills many gaps in the existing laws?
   a. The Environment Defence Act of 1966(EDA)
   b. The Environment Protection Act of 1986(EPA)
   c. The Environment Safety Act of 1978(ESA)
   d. The Environment Act of 1981(EA)

3. Match the following

1. Air pollution	A. It means any apparatus, device, equipment or system to control the quality and manner of emission of any air pollutant.
2. Control equipment	B. It has been defined under the Patents Act, 1970.
3. Industrial plant	C. It means presence of air pollutants in the air.
4. Invention	D. Means any plant used for any industrial or trade purpose and emitting any air pollutant into the atmosphere [section 2(k)].

   a. 1-D, 2-B, 3-A, 4-C
   b. 1-A, 2-C, 3-B, 4-D
   c. 1-B, 2-D, 3-C, 4-A
   d. 1-C, 2-A, 3-D, 4-B

4. Which of the following statement is true?
   a. Human health is endangered by litter indirectly.
   b. Human health is endangered by litter directly.
   c. Human health is endangered by confusion indirectly.
   d. Human health is protected by litter indirectly.

5. _____from industrial waste and sewage and disposal of toxic chemicals are significant contributors to marine pollution and coastal degradation.
   a. Population
   b. Recycling
   c. Pollution
   d. Chemicals

6. Which of the following statement is false?
   a. Leptospirosis is transmitted by contamination of water supplies by rat or dog urine.
   b. Amoebic dysentery is transmitted by sewage-contaminated water.
   c. Dengue epidemics are common in the Pacific islands.
   d. Proper disposal of waste is a leading cause of water contamination.

7. The Air (Prevention & Control of Pollution) Act was enacted by Parliament in _____with an objective to prevention, control and abatement of air pollution.
   a. 1981
   b. 1982
   c. 1980
   d. 1987

8. What means any solid, liquid or gaseous substance, including noise, present in atmosphere in such concentration as may tend to be injurious to human beings, living creatures or plants or property or environment [Section 2(a)]?
   a. Air pollutant
   b. Air pollution
   c. Control equipment
   d. Industrial plant

9. Which of the following is any structure with an opening or outlet form or through which any air pollutant may be emitted [section 2(h)]?
   a. Vent
   b. Chimney
   c. Pipe
   d. Open outlet

10. What of the following has been defined as any solid, liquid or gaseous substance, coming out of chimney, duct or fuel or any other outlet [section 2(j)]?
    a. Air
    b. Pollution
    c. Emission
    d. Gaseous substance

Chapter V

Water, Forest and Biodiversity Management

Aim

The aim of this chapter is to:

- introduce water, forest and biodiversity management
- explain water management
- explicate irrigation development and potential in India

Objectives

The objectives of this chapter are to:

- enlist types of dams
- elucidate dams and their roles
- explain forest management

Learning outcome

At the end of this chapter, you will be able to:

- identify forest products and their trade
- understand biodiversity management
- describe the role of biodiversity in international trade

5.1 Introduction

Water resources are sources of water that are useful or potentially useful to humans. Uses of water span agricultural, industrial, household, recreational and environmental activities. All these human activities require fresh water. Life would cease to exist without water. Salt water constitutes 97% of water on earth. Two-thirds of the remaining fresh 3% fresh water comprises frozen glaciers and polar ice caps. The residual share of unfrozen freshwater is mainly found as groundwater, with only a small fraction present above the ground or in the air.

5.2 Water Management

Though fresh water is a renewable resource, yet the world's supply of clean, fresh water is on a steady decline. With an incidental rise in population is there a greater demand for fresh water, which heightens the problem of shortage of fresh water. The demand for water already surpasses its supply in many parts of the world. The awareness of the global importance of preserving water for ecosystem services has only recently emerged. This awareness came only after more than half the world's wetlands were lost along with their valuable environmental services, with industrial development in the 20th century. Biodiversity-rich freshwater ecosystems are currently declining faster than marine or land ecosystems.

Importance of water management in crop production

Water is one of the most important inputs essential for the production of crops. Life cannot sustain without water. Plants need it in large quantities continuously during their life. It profoundly influences photosynthesis, respiration, absorption, translocation and utilisation of mineral nutrients and cell division besides some other processes. Both its shortage and excess affects the growth and development of plants directly and consequently, its yield and quality. Rainfall is the cheapest source of natural water supply for crop plants. In India, however, rainfall is notoriously capricious, causing floods and droughts alternately. The irrigation system also depends heavily on rainwater, thus creating more droughts and floods whenever rainfall is uneven. Its frequency distribution and amount are not in accordance with the needs of the crops. Artificial water supply through irrigation on one occasion and removal of excess water through drainage on another occasion, therefore, become imperative if the crops are to be raised successfully. Water management in India, thus, comprises irrigation, drainage or both, depending considerably on environmental conditions, soil, crops and climate. It is a situation-oriented entity. Thus, water conservation is very important in India.

Water affects the performance of crops not only directly, but also indirectly by influencing the availability of other nutrients, the timing of cultural operations, etc. Water and other production inputs interact with one another. In proper combinations, crop yields can be boosted manifold under irrigated agriculture. Water is a costly input when canals supply it. Moreover, very few canals actually supply water in India. The construction of dams and reservoirs, the conveyance of water from storage points to the fields, the operation and the maintenance of canal systems all involve huge expenses. The misuse of water leads to problems of water-logging, salt-imbalance, etc., thus rendering agricultural lands unproductive. Hence, a proper understanding (among people from myriad occupations) of the relationship among soils, crops, climate and water-resources for maximum crop production is very important in India.

Water resources

Taking the total geographical area of the country at 328 million hectares and the average annual rainfall at about 112 cm, the total annual precipitation in the country is estimated at about 3,700,000 million cubic metres. The southwesterly monsoon contributes over 80 per cent to the total precipitation in the country. The easterly winds can be attributed for most of the remaining amount. The Central Water and Power Commission, New Delhi, has estimated that of the total annual precipitation amounting to 8,00,000 million cubic metres, about 5,100,000 million cubic metres seeps into the ground, about 1,700,000 million cubic metres flows into the rivers and the remaining amount of about 1,200,000 million cubic metres evaporates back into the atmosphere. The water, flowing on the surface and that seeping into the ground, forms the following two major sources of water for irrigating crops.

Surface-water resources

India is a land where many rivers flow in abundance. A large number of rivers of distinct sizes and lengths form a network all over the country. The rivers in the north, which originate from the Himalayas, are snow-fed and thus, have less seasonal fluctuations in their flow than the rivers in the other parts of the country. Rivers of the central and southern parts of the country are entirely dependent on the monsoon. The rivers flow to their full capacity during the rainy season (July to September) and their flow dwindles with the approach of the summer. Post-monsoon river flow is heightened in the month of June.

This surface-flowing water needs to be trapped in ponds, tanks, lakes or artificial reservoirs when it is available in abundance, so that, it can be efficiently used for irrigation during dry periods to facilitate irrigation. Of the annual surface flow of 1,700,000 million cubic metres, only about 666,000 million cubic metres can be utilised for the purpose of irrigation, owing to the physiographical limitations.

Ground-water sources

Substantial supplies are also available from ground-water sources. Large amounts of rainwater seeps into the ground. Of the 800,000 million cubic metres of rainwater that seeps into the ground annually, about 430,000 million cubic meters of it is absorbed by the surface layers of the earth's crust and thus, can be utilised directly by vegetation in the process of evapo-transpiration and growth. The residual 370,000 million cubic metres of rainwater percolates deep into the porous strata of the earth's crust, representing the gross annual enrichment of the underground water. This ground water is tapped by digging or drilling wells and is lifted by using mechanical devices for irrigating the crops. This process is aided by the government to ensure that farmers have sufficient supply of water that meets their irrigation needs and accrue more harvests per year.

A precise quantitative inventory regarding ground water reserves is unavailable in India. Organisations, such as the Geographical Survey of India, the Central Ground Water Board and the State Tube-wells and the Ground Water Boards are engaged in this task. It has been estimated by the Central Ground Water Board that the total ground water reserves approximately amount to 55,000,000 million cubic metres out of which 425,740 million cubic metres have been assessed as the annual recharge from rain and canal seepage.

The task force on Ground-Water Reserves of the Planning Commission has also endorsed these estimates. All recharge to the ground water is not available for withdrawal, since part of it is lost as sub-surface flow. After accounting from these losses, the gross available ground-water recharge is about 269,960 million cubic metres per annum. A part of this recharge (2,460 million cubic metres) is in the saline regions of the country and is unsuitable for use in agriculture owing to its poor quality. The net recharge available for ground water development in India, therefore, is of the magnitude of about 267,500 million cubic metres per annum. The Working Group of the Planning Commission Task Force Ground-Water Reserves estimates that the usable ground-water potential would be only 75 to 80 per cent of the net ground-water recharge available and recommended a figure of 203,600 million cubic metres per annum as the long-term potential for ground-water development in India.

5.2.1 Irrigation Development and Potential in India

Irrigation has been practised in India since time immemorial. Wells and tanks, known today as 'minor irrigation works', were constructed in the past by several rulers for public welfare. Significant development irrigation, however, can be said to have commenced from 1850 onwards, with large-scale or major irrigation projects. These activities gained momentum after independence in 1947. Today, India has about 34 million hectares of land under irrigation, which amounts to about one-fifth of the total cultivated area. Major irrigation projects, irrigating more than 0.10 million hectares, have been constructed in India.

With utilisation of water resources, both from the surface flow and from the groundwater recharge, the Second Irrigation Commission has calculated that the ultimate area that can be irrigated is approximately 82 million hectares in the country. Until the end of the Fourth Plan, it was proposed that about 45 % of the surface utilisable flow and about 20 % of the usable ground will be utilised to irrigate about 34 million hectares. The commission will try to increase this amount as much as possible for the benefit of the country and to manage to have more agriculture in India.

The programmes for modifying weather, the desalinisation of seawater and the National Water Grid, if enforced, will further increase the potential for irrigation manifold. Surface water for irrigation is obtained from flowing rivers and from tanks, ponds, lakes or artificial reservoirs. The flow of rivers is directly diverted into canals or high dams are built across the river to form first large canals for irrigation. The future development of irrigation aims at impounding the surplus flows of rivers by constructing dams for use of water during the dry periods. There are many plans in place to build these dams for increasing the water supply.

Water from all these sources is conveyed to the fields through lined or unlined canals, distributaries and minor channels through the final structure called outlets. This entire conveyance system, up to the outlet, is built by the Irrigation Departments. From the outlet, water flows into small watercourses, which are constructed, owned and managed by a group of farmers. During its transport, there are considerable losses through seepage, percolation and evaporation. The commission is trying to construct closed canals to reduce this loss. From a typical water-distribution system, the losses in the main canal vary from 10 to 15 % and in the water-courses from 15 to 30 %. Thus, the total losses from the source till the water reaches the farmers' fields may amount to 40-60 %.

Ground water is tapped by digging shallow and large-diameter percolation wells or drilling deep tube-wells and lifting it to the surface. Shallow wells derive their water supply from the surrounding area through seepage, percolation, high-water table, etc. Deep wells depend for their water on aquifers, which may have their source at some distance. River valleys, canal-irrigated areas, low-lying places, natural vegetation and trees growing luxuriantly are indications of the presence of ground-water resources. The rate at which water can be pumped out from a well depends upon the recharging rate which, in turn, depends upon the permeability of the surrounding area in the case of shallow wells and on the thickness and the magnitude of aquifers.

Utilisation of water resources

The scientific utilisation of water resources for crop production involves consideration of the suitability of land and water for irrigation and then planning crops and water-management practices that commensurate with them. These factors are very important in managing the flow of water into the system and in taking maximum advantage from the available resources. Water-management practices include irrigation and drainage. Irrigation comprises three fundamentals as follows:

- How much water should be drained?
- How to drain water?
- How rapidly should the water be drained?

5.2.2 Soil-Water System

Soil-water system is explained in detail below.

Availability of water for crop plants

Soil is a heterogeneous mass and consists of three phases, viz., solid phase, liquid phase and gaseous phase. Mineral matter, consisting of sand, silt and clay and organic matter, forms the solid phase, which serves as a framework (matrix) with numerous pores of different shapes and sizes holding air and water in various proportions. Soil is a porous medium and serves as a water reservoir or bank. Water is deposited in this bank by rain or irrigation and plants withdraw it during their growth. The soil quality is important in retention of water. In desert areas, for example, there is no retention of water in the soil and therefore, plants cannot grow there easily. Some varieties of cacti may exist in these regions.

Water is retained by a soil particle in the form of a thin film around it and in the numerous small pores of the soil matrix with forces like surface tension capillarity, cohesion and adhesion. Salts present in soil water accentuate these forces by way of osmotic pressure. Plants, therefore, need to exert at least an equal amount of force for extracting water from the soil mass for their growth.

Immediately after rain or irrigation, water infiltrates into the soil and continues to move downwards into the soil mass to deeper layers. This downward movement is because of the gravitational force. The downward movement of water practically ceases after a certain time (normally after 48 to 72 hours). The water retained in the soil under this situation is termed 'field capacity' which forms the upper limit of the available soil moisture for crop plants. In other words, any further addition of water will not be retained by the soil, but will be lost through deep percolation beyond the roots of a crop, thus making it unavailable for the growth of its plants. After the wetting of the soil, as evaporation and transpiration continue, the soil water goes on diminishing till a point is reached when plants are unable to extract it. The moisture content at this stage is termed 'permanent wilting-point' and this sets the lower limit of the availability of soil water. In other words, any moisture below this point will not support plant growth. The range of soil water between the field capacity and the permanent wilting-point is termed 'available soil water for crop growth'. The available soil water-holding capacity increases mainly with the fineness of texture and the content of organic matter.

Availability of soil water for crop growth

Two classical hypotheses have been put forth for the relative availability of soil water in the available range:

- Water availability and consequently, the crop growth are equal and uniform over the entire range from the field capacity to the permanent wilting-point. This holds good generally, for perennial species, such as orchard and tree crops whose dense root mass permeates the soil matrix thoroughly.
- Water availability and crop growth proceed uniformly from the field capacity to a certain critical point beyond which crop growth decreases rapidly until the permanent wilting-point is reached. This view holds good for most of the seasonal field crops maturing up to the seed stage.

5.2.3 Water Management in Developing Countries

Water management in developing countries is explained in the paragraphs below.

The community's current water-related strategies and activities

The social sector has been identified as a priority for Community Development Policy. The management of water resources is an important element of this sector. The guidelines adopted in 1998 form the basis of Community activities. They have been used to define the orientations contained in this communication. They establish a holistic and strategic approach for water management and use. Water management is considered an inter-sectoral question as it has an important role to play in all areas of development: health, food security, transport, trade, etc. Regional cooperation is of particular importance since water is often a trans-boundary resource. Water management is therefore considered one of the most important aspects for the future of the world.

Future guidelines

It is essential to integrate water management into all development policies. With a view to achieving the goals in this field, the Commission has laid the foundation for a number of ideas, which are summarised below.

Raising the policy profile

More attention must be paid to the fragility of water resources and a more resolute political approach encompassing all the areas linked to water management, such as environmental sustainability, pollution, etc., must be adopted. If this is followed through, there will be a rise in scarcity of water and the problem will intensify. Six development priorities of the Community are the overarching framework for these activities. Within these priorities, the Commission identifies the following three objectives:

- Ensuring supply to every human being, especially the poorest, of sufficient drinking water of good quality and adequate means of waste disposal.
- Sustainable and equitable trans-boundary water resource management.
- Cross-sectoral coordination to ensure fair and appropriate distribution of water between users of different kinds.

Implementation of an integrated approach to water management

The commission identifies five activities required to achieve integrated management of water resources, namely:

- Awareness and participation: Users must be aware of the importance of water as a resource and their responsibilities in relation to sound management of this precious resource. Ownership is a key factor in the success of the policies and the participation of actors at all levels is thus essential.
- Institution capacity building: The success of activities is contingent upon capacity, resources and expertise of the institutions concerned. Support must be provided for the institutions responsible for water management.
- Demand-based management: It is not adequate to manage only water distribution; supply must also be managed. The challenge entails reduction of demand while increasing output through initiatives, such as reuse of water, protecting water resources, etc.
- Expanding knowledge-base: Necessary knowledge and information are essential for drawing up effective policies.
- Coordination: Coordination among donors (community, member states, the United Nations, NGOs, etc.) must be strengthened.

5.2.4 Water-related Action for its Different Uses

This approach must encompass all uses of water. The Commission highlights the priority actions in the following fields:

- Secure water supply and adequate sanitation for all: Emphasis is placed on the importance of sanitation.
- Use of water in agriculture for food and production to ensure food security: The Commission highlights the importance of saving water and promoting healthy agricultural practices to avoid contamination of water sources.
- Protecting and restoring water resources and ecosystems to contribute to the long-term sustainability of water use.
- Water as a source of energy and resource for industry: Rational water use must be ensured and pollution must be reduced and avoided.
- Management of water-related risks and of coastal areas: Risks relating to floods, droughts, etc., must be prevented through the establishment of warning systems and rapid response capacity systems.

All sources of public and private financing must be mobilised to implement these actions.

Key global challenges

The international community must tackle some significant questions that are becoming increasingly critical as water resources become scarce. The three major challenges are as follows:

- Trans-boundary water management for conflict prevention
- Implications of climate change
- The impact of the globalisation of trade on water management

Given that water resources are increasingly limited, the possibilities of conflicts over trans-boundary water management are on the rise. Support must be provided for measures aimed at improving regional cooperation on the management of trans-boundary water resources. Developing countries are particularly vulnerable to the problems linked to climate change, such as floods and droughts. Assistance in the form of research and capacity building that enables them to prevent and react to growing problems is necessary. The fact that they lack enough resources to manage with limited infrastructure hampers their efforts to conserve water more efficiently.

With regard to trade, the liberalisation of international trade could have a positive impact on developing countries. Imports of water-intensive food crops may prove to be a practical and cost-effective approach to ensuring food security. However, it is essential not to compromise a country's long-term prospects of overall food security or have a negative impact on farmers who grow food crops in developing countries. A strategic partnership must be established at the international level in order to achieve objectives and resolve problems. This process should be followed by developing countries and encompass civil society. This will ensure some stability in the system and lesser fights between countries over water.

5.2.5 Water Reservoirs

A reservoir is an artificial lake employed to store water. Reservoirs may be created in river valleys by the construction of a dam or may be built by excavation in the ground or by conventional construction techniques such as brickwork or cast concrete. The term 'reservoir' may also be used to describe underground reservoirs, such as an oil or water well. A dam is constructed mainly to preserve water for further usage. A dam constructed in a valley relies on the natural topography to afford the basin area of the reservoir.

Dams are typically located at a narrow part of a valley downstream of a natural basin. The valley sides act as natural walls with the dam located at the narrowest practical point to provide strength and the lowest practical cost of construction. Building a dam has its own ramifications though. In many reservoir construction projects, people have to be moved and re-located, historical artifacts have to be shifted or rare environments need to be relocated. Examples include the temples of Abu Simbel (which was moved before the construction of the Aswan Dam to create Lake Nasser from the Nile in Egypt) and the re-location of the village of Capel Celyn during the construction of Llyn Celyn. Construction of a reservoir in a valley will usually necessitate the diversion of the river during part of the construction often through a temporary tunnel or by-pass channel.

5.2.6 Uses

The uses of water reservoirs are dealt with in the paragraphs below.

Direct water supply

The water stored in dams is utilised for many purposes. Many dammed river reservoirs and most bank-side reservoirs are used to provide the raw water feed to a water treatment plant, which delivers drinking water through water mains. The reservoir does not simply hold water until it is needed; it can also be the first part of the water treatment process. The time the water is held for before it is released is known as the retention time. These design features allow particles, silt to settle down and makes time for natural biological treatment using algae, bacteria and zooplankton that naturally live within the water. The stored water essentially contains impurities, which cannot be cleaned naturally. Natural processes in temperate climate lakes produce temperature stratification in the water body which tends to partition some elements, such as manganese and phosphorus into deep, cold anoxic water during the summer months. In autumn and winter, the lake becomes fully mixed again. During drought conditions, it is sometimes necessary to draw down the cold bottom water and such elevated levels of manganese in particular can cause problems in water treatment plants.

Hydroelectricity

Water has many more benefits when it is stored in the dams. One huge benefit is its propensity to generate electricity. A reservoir generating hydroelectric power has turbines connected to the retained water body by large-diameter pipes. These generating sets may be at the base of the dam or some distance away. Some reservoirs generating hydro-electricity use pumped recharge in which a high-level reservoir is filled with water using high performance electric pumps at times when electricity demand is low. They then use this stored water to generate electricity by releasing the stored water into a low-level reservoir when electricity demand is high. Such systems are called pump storage schemes. This benefit is very important as electricity is one of the most important aspects in today's life and many Indian states are losing money as they lack enough electricity to meet their needs.

Controlling watercourses

Reservoirs can be used in a number of ways to control how water flows through downstream waterways.

Downstream water supply

Water may be released from an upland reservoir so that it can be utilised for drinking lower down the system, sometimes hundreds of miles further down downstream.

Irrigation
Water in an irrigation reservoir may be released into networks of canals for use in farmlands or secondary water systems. These canals can be open or closed. Irrigation may also be supported by reservoirs, which maintain river flows allowing water to be harvested for irrigation lower down the river.

Flood control
Flood control reservoirs collect water during times of very high rainfall and then release it slowly over the course of the following weeks or months. This is done with meticulous planning and experience. Some of these reservoirs are constructed across the river line with the onward flow controlled by an orifice plate. When river flow exceeds the capacity of the orifice plate, water collects behind the dam, but as soon as the flow rate reduces, the water behind the dam slowly releases until the reservoir is empty again.

In some cases, such reservoirs only function a few times in a decade and the land behind the reservoir may be developed as community or recreational land. This primarily transforms in to agricultural land. Such land cannot be employed for industrial use. New generations of balancing dams are being developed to combat the climatic consequences of climate change. They are called 'flood detention reservoirs'. However, they possess a risk of clay core drying out and reduction in structural stability, because these reservoirs remain dry for long periods. Recent developments include the use of composite core fill made from recycled materials as an alternative to clay. Thus, modern technology amplifies the efficiency of water management.

Canals
Where a natural watercourse's water is not available to be diverted into a canal, a reservoir may be built to guarantee the water level in the canal, for example, where a canal climbs to cross a range of hills through locks. The water may be stored here to maintain surplus supply and/or to ensure excess space in case of floods.

Recreation
Water may be released from a reservoir to artificially create or supplement white-water conditions for kayaking and other white-water sports. On salmonid rivers, special releases (in Britain called freshets) are made to encourage natural migration behaviours in fish and to provide a variety of fishing conditions for anglers.

5.2.7 Environmental Impact

Environmental impact has been explained in the paragraphs below.

Whole life environmental impact
All reservoirs will have a monetary cost/benefit assessment made before construction to see if the project is worth proceeding with. However, such analysis can often omit the environmental impacts of dams and the reservoirs that they contain. Often, the dam wrecks the ecosystem that has formed in that particular region. Some impacts, such as greenhouse gas production associated with concrete manufacture are relatively easy to estimate. Other impacts on the natural environment and social and cultural effects can be more difficult to assess and to weigh in the balance, but identification and quantification of these issues are now commonly required in major construction projects in the developed world.

Climate change
Depending upon the circumstances, a reservoir built for hydro-electricity generation can either reduce or increase the net production of greenhouse gases. An increase can occur, if plant material in the flooded areas decays in an anaerobic environment releasing methane and carbon dioxide. This apparently counter intuitive position arises because much carbon is released as methane, which is approximately eight times more potent as a greenhouse gas than carbon dioxide. This increase can be dangerous for the environment and hence it should be avoided as much as possible.

A study for the National Institute for Research in the Amazon evinced that hydroelectric reservoirs release a large pulse of carbon dioxide from above-water decay of trees left standing in the reservoirs, especially during the first decade after closing. This elevates the global warming impact of the dams to levels much higher than would occur by generating the same power from fossil fuels. According to the World Commission on Dams Report (Dams and

Development), when the reservoir is relatively large and no prior clearing of the forest in the flooded area was undertaken, greenhouse gas emissions from the reservoir could be higher than those of a conventional oil-fired thermal generation plant. For instance, in 1990, the impoundment behind the Balbina Dam in Brazil (closed in 1987) had over 20 times the impact on global warming than generating the same power from fossil fuels would, due to the large area flooded per unit of electricity generated.

A decrease can occur if the dam is employed in place of traditional power generation, since electricity produced from hydroelectric generation does not give rise to any fuel gas emissions from fossil fuel combustion (including sulfur dioxide, nitric oxide and carbon monoxide from coal). The Tucurui dam in Brazil (closed in 1984) had only 0.4 times the impact on global warming than would generate the same power from fossil fuels.

5.3 Dams and Their Roles

A dam is a barrier that impounds water or underground streams. Dams generally serve the primary purpose of retaining water, while other structures such as floodgates or levees (also known as dikes) are used to manage or prevent the water's flow into specific land regions.

5.3.1 Types of Dams

Based on the size , dams are classified in to five types. International standards define large dams as higher than 15–20 metres and major dams as over 150–250 metres in height. An auxiliary dam is constructed to confine the reservoir created by a primary dam either to permit a higher water elevation and storage or to limit the extent of a reservoir for increased efficiency.

- An auxiliary dam: It is constructed in a low area or saddle through which the reservoir water would otherwise escape. On occasion, a reservoir is contained by a similar structure called a dike to prevent inundation of nearby land. Dikes are commonly used for reclamation of arable land from a shallow lake. This is similar to a levee, which is a wall or embankment built along a river or stream to protect the adjacent land from flooding.
- An overflow dam: It is designed to be over-topped. A weir is a type of small overflow dam that is often used within a river channel to create an impoundment lake for water abstraction purposes and which can also be used for flow measurement.
- Check dam: It is a small dam designed to reduce flow velocity and control soil erosion. Conversely, a wing dam is a structure that only partly restricts a waterway, creating a faster channel that resists the accumulation of sediment.
- Dry dam: It is a dam designed to control flooding. It normally holds back no water and allows the channel to flow freely, except during periods of intense flow that would otherwise cause flooding downstream.
- Diversionary dam: It is a structure designed to divert all or a portion of the flow of a river from its natural course.

5.3.2 Based on Structure

Based on structure and material used, dams are classified as timber dams, arch dams, gravity dams, embankment dams or masonry dams, with several subtypes.

- Timber dams: Timber dams were widely used in the early part of the industrial revolution and in frontier areas due to ease and speed of construction. Rarely built in modern times by humans because of their relatively short lifespan and limited height, timber dams must be constantly kept wet in order to maintain their water retention properties and limit deterioration by rot, similar to a barrel. The locations where timber dams are most economical to build are those where either timber is plentiful and cement is costly or difficult to transport or where a low head diversion dam is required or longevity is not an issue.
- Arch dams: An arch dam is a type of dam that is curved and generally built with concrete. The arch dam is a structure that is designed to curve upstream so that the force of the water against it, known as hydrostatic pressure, presses against the arch, compressing and strengthening the structure as it pushes into its foundation or abutments. An arch dam is most suitable for narrow gorges or canyons with steep walls of stable rock to support the structure and stresses. As they are thinner than any other dam type, they require smaller amounts of construction material, thereby making them economical and practical in remote areas.

- Gravity dams: A gravity dam is constructed from concrete or masonry or sometimes both. It is called a gravity dam because gravity holds it down to the ground stopping the water in the reservoir pushing it over. Gravity dams use their own weight to resist opposing forces and as such require a hard bedrock foundation. A cross-section (or slice) through a gravity dam will usually look roughly triangular. Gravity dams are suited to sites with either wide or narrow valleys, but they do need to be built on sound rock formation.
- Embankment dams: These are made from compacted earth and are of two main types, rock-fill and earth-fill dams. Embankment dams rely on their weight to hold back the force of water, similar to gravity dams made from concrete. Rock-fill dams are embankments of compacted free-draining granular earth with an impervious zone. The earth utilised for this often contains a large percentage of large particles, hence we use the term rock-fill. Earth-fill dams, also called earthen, rolled-earth or simply earth dams, are constructed as a simple embankment of well-compacted earth.

5.3.3 Purposes of Dams

Purposes of dams are as follows:

Function	Example
Power generation	Hydroelectric power is a major source of electricity in the world. Many countries possess rivers with adequate water flow that can be dammed for power generation purposes. For example, the Itaipu on the Parana River in South America generated 14 GW and supplied 93% of the energy consumed by Paraguay and 20% of that consumed by Brazil as of 2005.
Water supply	Many urban areas of the world are supplied with water abstracted from rivers that are confined behind low dams. Examples include London with water from the River Thames and Chester with water taken from the River Dee. Other major sources include deep upland reservoirs contained by high dams across deep valleys such as the Claerwen series of dams and reservoirs.
Stabilise water flow/irrigation	Dams are often used to control and stabilise water flow, often for agricultural purposes and irrigation. Others such as the Berg Strait dam can help to stabilise or restore the water levels of inland lakes and seas, e.g., the Aral Sea.
Flood prevention	Dams such as the Blackwater dam of Webster, New Hampshire and the Delta Works are created for the purpose.
Land reclamation	Dams (often called dykes or levees in this context) are used to prevent ingress of water to an area that would otherwise be submerged, allowing its reclamation for human use. Example: Hoover Dam, Arizona, USA,etc.
Water diversion	A typically small dam is used to divert water for irrigation, power generation or other uses, with usually no other function. Occasionally, these are used to divert water to another drainage or reservoir to increase the flow there and improve water use in that particular area, e.g., the Imperial Dam diverts Colorado River in the southwestern United States.
Navigation	Dams create deep reservoirs and can vary the flow of water downstream. This can in return affect upstream and downstream navigation by altering the river's depth. Deeper water increases or creates freedom of movement for water vessels. Large dams can serve this purpose but most often weirs and locks are used. Example: Bonneville Lock and Dam comprise several run-of-the-river dam structures that together complete a span of the Columbia River between the US states of Oregon and Washington at River Mile.

Recreation and aquatic beauty	Dams built for any of the above purposes may find themselves displaced by time of their original uses. Nevertheless, the local community may have come to enjoy the reservoir for recreational and aesthetic reasons. Often the reservoir will be placid, surrounded by greenery and convey a natural sense of rest and relaxation to visitors. Example: KRS (Krishna Raja Sagara, India) dam is best example of a dam that is an ideal tourist destination.

Table 5.1 Purpose of dams

5.4 Forest Management

Forest management is the branch of forestry concerned with the overall administrative, economic, legal and social aspects and with the essentially scientific and technical aspects, especially silviculture, protection and forest regulation. This includes management for aesthetics, fish, recreation, urban values, water, wilderness, wildlife, wood products, forest-genetic resources and other forest resource values. Management can be based on conservation, economics or a mixture of the two. Techniques include timber-extraction, planting and replanting of various species, cutting roads and pathways through forests and preventing fire. Forests give hope of further life. If the forests are depleted, the world will not be able to survive.

Public input and awareness

There has been increased public awareness of natural resource policy, including forest management. Public concern regarding forest management may have shifted from the extraction of timber to the preservation of additional forest resources including wildlife and old growth forests, protecting biodiversity, watershed management and recreation. Increased environmental awareness may contribute to an increased public mistrust of forest management professionals and will lead to proper management of forests everywhere.

Wildlife considerations

The abundance and diversity of birds, mammals, amphibians and other wildlife is affected by strategies and the various types of forest management.

Forest management in India-bringing a network back to life

In India, forests are a main source of livelihood and income for some 315 million people, i.e., nearly one-third of the country's total population. The majority is very poor and for a long time they were deprived of their rights and fair access to these natural resources. As traders and the government heavily exploited forests, their situation increasingly degraded. Animosity between local communities and the nation's forestry department was constant. This was because the government did not allow local communities to cut trees for their consumption. Then, in 1988, a new policy made it possible for India's forests to be managed by the government and the people together. The result was the introduction of the Joint Forest Management programme in 1990.

Under the programme, villages organise committees that work with government foresters to prevent or halt forest degradation in exchange for rights to non-timber forest products and a share of revenues from timber harvesting. After its initial success in West Bengal, Joint Forest Management programme has spread to 27 of India's 29 states. It involves more than 63,600 village committees. This growth is a reflection of its resounding success.

The Ford Foundation initially supported Joint Forest Management in two states and later assisted the efforts of 25 non-governmental organisations to start a network for information exchange and policy advocacy. By the end of 1996, the network had grown to more than 150 members, ranging from nongovernmental, research and academic institutions to a few forestry agencies. This was a big achievement, considering the kind of people involved in the process. However, this Delhi-centred network faltered, when pressed to respond to the demands of new members from all over the country. In addition, the network had neither effective links to grass-root institutions nor regular channels to forestry policy-making processes.

5.5 Forest Products and Their Trade

The forest products sector is estimated to contribute about one percent of the world's gross domestic product and to account for three percent of international merchandise trade. The annual turnover of round wood, sawn wood, panels, pulp and paper exceeds US$200 billion. Although the values of non-wood forest products and the environmental services of forests are difficult to estimate in economic terms, they are critical to the livelihoods of an estimated 600 million people in the developing world alone.

This means that a large part of the Indian population depends on forests as a means of livelihood. The emerging markets for environmental services including the development of carbon trading under the Kyoto Protocol of the United Nations Framework Convention on Climate Change (UNFCCC) may have a considerable impact on patterns of trade in forest products and on forest management, making forestry more profitable as an environmentally sound and economically viable land-use option.

The total amount of round wood felled globally has declined slightly, since the beginning of the 1990s, as an outcome of decreased production in tropical areas and in the Commonwealth of Independent States (CIS). Approximately 80 percent of wood harvested from tropical forests is consumed as fuel-wood, while in temperate and boreal areas fuel-wood production has been declining. In Europe, bio-energy is gaining importance. On the other hand, wood is facing stiff competition in some of its key markets such as construction, decking, windows, mouldings or furniture from a wide range of other materials, such as steel, plastics or aluminium. International trade flows continue to be geared towards markets in the United States, Canada, Japan and Europe. However, major markets, such as China and India play an increasingly important role in the dynamics of world trade. There are huge imports to India of wood and allied products.

In the past, the international trade regime, primarily pursued by the World Trade Organisation (WTO) and regional trade agreements, focused its attention on tariffs and other formal trade measures. While those trade measures are generally decreasing in importance worldwide, trade and forest policy makers are increasingly concentrating on non-tariff measures to increase market access for forest products and services and to improve sustainable forest management. This move could backfire though, as it could actually increase the demand of wooden products. As steps to liberalise trade generally continue, the international debate in various regions for a mutually supportive relationship between trade in forest products and services and environment-related social issues will continue to influence patterns of forestry trade worldwide. Consequently, the international and regional trade policy debates, within and outside formal flora and institutions, are increasingly influenced by multilateral environmental agreements such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the Convention on Biological Diversity (CBD) and the UN Framework Convention on Climate Change (UNFCCC). These institutions help in maintaining forests around the globe.

Forest Management Certification and product labelling play an important role in accommodating environmental and social concerns in forestry. The increasing demand for certified forest products and the emerging markets for environmental services support further development of international certification schemes and national initiatives in this regard. While forest products certification is a market-based instrument, its relationship with national and international policy-making and policy implementation has become more prominent because of considerable political attention and promotion of this instrument by important institutions and constituencies in the government and civil society. The so-called 'phased approach to forest products certification', currently debated in the International Tropical Timber Council (ITTC) and other flora, shows the strong support of governments in the promotion of certification initiatives to achieve policy targets.

While the debate on international trade in forest products and services and the development and dynamics of the world market draw most of the international attention, domestic trade continues to play the most important role. A relatively small number of analyses focus on the impact and interaction between domestic trade and forest management. This is particularly true in developing countries and in countries with economies in transition. In order to support sustainable forest management, the rehabilitation of degraded forestland and the establishment of forest resources at the community level, environmental and social services of forests need careful consideration. It is the interface between trade and forest management that serves as the indicator for positive or negative influences and dynamics between them.

The contribution of forests towards poverty reduction is often under-estimated. Recent analyses of the contribution of forests to poverty reduction note their broader significance for local livelihoods and estimate that hundreds of millions of people depend on forests for subsistence production and environmental services like watersheds, soil erosion control, microclimate, biodiversity and cultural services.

It is estimated that 60 million highly forest-dependent people live in the rainforests of Latin America, Southeast Asia and Africa. An additional 350 million people are directly dependent on forest resources for subsistence or income and 1.2 billion people in developing countries use trees on farms to generate food and cash. Loss of forest resources is believed to affect 90 % of the 1.2 billion people who live in extreme poverty directly. Against this background, trade in forest products and services is vital for economic growth as well as for safeguarding sustainable livelihoods in rural areas throughout the developing world.

5.6 Biodiversity Management

The variety of life on earth or its biological diversity is commonly alluded to as biodiversity. The number of species of plants, animals and microorganisms, the enormous diversity of genes in these species, the different ecosystems on the planet, such as deserts, rainforests and coral reefs are all part of a biologically diverse Earth. Appropriate conservation and sustainable development strategies attempt to recognise this as being integral to any approach. Almost all cultures have in some way or form recognised the importance that nature and its biological diversity has had upon them and the need to maintain it. Yet, power, greed and politics have affected the precarious balance.

5.7 Role of Biodiversity in International Trade

Trade-related work under the Convention on Biological Diversity captures different aspects of the complex relationship between international trade and the objectives and provisions of the convention. The production of value-added goods and services derived from the biological diverse environment, which are traded in domestic and international markets (biotrade), may generate incentives for the conservation and sustainable use of biodiversity.

Accordingly, a number of thematic programmes of work under the convention call for increased marketing of products derived from sustainable use. As an outcome of these initiatives, The Secretariat of the Convention on Biological Diversity (SCBD) is cooperating closely with the Biotrade Initiative of the United Nations Conference on Trade and Development (UNCTAD) to advance biotrade promotion.

The Conference of the Parties (COP) is the Convention's governing body that meets every two years, or as needed, to review progress in the implementation of the Convention, to adopt programmes of work, to achieve its objectives, and provide policy guidance. It adopted a provisional framework of goals and targets to enhance the evaluation of achievements and progress in the implementation of the strategic plan of the convention. Target 4.3 of this framework calls for no species of wild flora and fauna to be endangered by international trade. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is the key partner in implementing this target and both conventions are cooperating closely to implement this target, including a liaison of biodiversity-related conventions.

While the Convention on Biological Diversity does not require measures that are directly related to international trade, there is an intricate relationship between many of its provisions as well as those of its Biosafety Protocol and the multilateral rules and provisions of the World Trade Organisation (WTO). For instance, the Parties to the Convention have emphasised the interrelationship between the convention and the provisions of the WTO's Agreement on Trade-related Aspects of Intellectual Property Rights (TRIPs) and the need to further explore this interrelationship. Similarly, the parties have underlined the relationship between the Biosafety Protocol and the provisions of the WTO Agreements on Technical Barriers to Trade (TBT) and Application of Sanitary and Phytosanitary Measures (SPS).

Summary

- Water resources are sources of water that are useful or potentially useful to humans.
- Life would cease to exist without water.
- Salt water constitutes 97% of water on Earth.
- Though fresh water is a renewable resource, yet the world's supply of clean, fresh water is on a steady decline.
- Rainfall is the cheapest source of natural water supply for crop plants.
- India is a land where many rivers flow in abundance.
- Substantial supplies are also available from ground-water sources.
- Irrigation has been practised in India since time immemorial.
- Soil is a heterogeneous mass and consists of three phases, viz., solid phase, liquid phase and gaseous phase.
- The social sector has been identified as a priority for Community Development Policy.
- Developing countries are particularly vulnerable to the problems linked to climate change such as floods and droughts.
- A reservoir is an artificial lake employed to store water.
- Flood control reservoirs collect water during times of very high rainfall and then release it slowly over the course of the following weeks or months.
- A dam is a barrier that impounds water or underground streams.
- Forest management is the branch of forestry concerned with the overall administrative, economic, legal and social aspects and with the essentially scientific and technical aspects, especially silviculture, protection and forest regulation.
- The forest products sector is estimated to contribute about one percent of the world's gross domestic product and to account for three percent of international merchandise trade.
- The variety of life on Earth or its biological diversity is commonly alluded to as biodiversity.

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Self Assessment

1. Water resources are _____ of water that are useful or potentially useful to humans.
   a. uses
   b. sources
   c. means
   d. supply

2. Though fresh water is a _____ resource, yet the world's supply of clean, fresh water is on a steady decline.
   a. renewable
   b. non-renewable
   c. main
   d. polluted

3. Match the following

1. Check dam	A. It is a dam designed to control flooding.
2. Dry dam	B. It is a small dam designed to reduce flow velocity and control soil erosion.
3. Timber dams	C. It is a type of dam that is curved and generally built with concrete.
4. Arch dams	D. These dams were widely used in the early part of the industrial revolution and in frontier areas due to ease and speed of construction.

   a. 1-C, 2-D, 3-A, 4-B
   b. 1-A, 2-C, 3-B, 4-D
   c. 1-B, 2-A, 3-D, 4-C
   d. 1-D, 2-B, 3-C, 4-A

4. What is an artificial lake employed to store water called?
   a. A dam
   b. A canal
   c. A reservoir
   d. Irrigation

5. _____has been practised in India since time immemorial.
   a. Erosion
   b. Irrigation
   c. Reservoir
   d. Utilisation

6. What is a heterogeneous mass and consists of three phases, viz. solid phase, liquid phase and gaseous phase?
   a. Soil
   b. Mineral
   c. Water
   d. Irrigation

7. Which of the following statement is false?
   a. Salt water constitutes 97% of water on earth.
   b. Life would originate to exist without water.
   c. Water is one of the most important inputs essential for the production of crops.
   d. Plants need it in large quantities continuously during their life.

8. A _____ is a barrier that impounds water or underground streams.
   a. dam
   b. reservoir
   c. hydroelectric
   d. orifice plate

9. Which of the following statement is true?
   a. Water has little benefits when it is stored in the dams.
   b. Water has hardly any benefits when it is stored in the dams.
   c. Water has many more losses when it is stored in the dams.
   d. Water has many more benefits when it is stored in the dams.

10. Forest Management Certification and product _____ play an important role in accommodating environmental and social concerns in forestry.
    a. management
    b. knowledge
    c. labelling
    d. value

Chapter VI

Disaster Management

Aim

The aim of this chapter is to:

- introduce disaster management
- explain typology disaster management
- explicate emergency management

Objectives

The objectives of this chapter are to:

- explain organisational structure and institutional arrangements for emergency management in the state
- elucidate planning process
- explicate trigger mechanism

Learning outcome

At the end of this chapter, you will be able to:

- identify the financial arrangements
- understand paradigm shift towards prevention and reduction
- recognise ushering in a new culture of disaster management

6.1 Introduction

Disasters have been visiting every part of the globe at one time or the other. The world is becoming increasingly vulnerable to various disasters. From earthquakes to floods and famines, mankind is even more threatened by the forces of nature. Disasters can strike at any time, at any place. The traditional perception has been limited to the idea of 'calamity relief', which is seen essentially as a non-plan item of expenditure. However, Disasters can have devastating effects on the economy they cause huge human and economic losses, and can significantly set back development efforts. Two recent disasters, the Orissa Cyclone and the Gujarat Earthquake are cases in point. With the kind of economic losses and developmental setbacks that the country has been suffering year-after-year, the development process needs to be sensitive towards disaster prevention and mitigation aspects. There is thus the need to look at disasters from a development perspective as well.

6.2 Disaster Management

The word Disaster is from a French word 'Desastre' meaning bad or evil star. However, this is a very narrow conception of disaster and in our context; any disaster means a situation in which there is a sudden disruption of normalcy within society causing widespread damage to life and property.

Typology of disaster

A disaster can be either natural [rain, flood, cyclone, storm, landslides, earthquake, volcanoes, etc.] or manmade [war including biological, arson, sabotage, riots, accident (train, air, ship, etc.), industrial accidents, fires (forest fires), bomb explosions, nuclear explosions and ecological disasters]. The discussion here is confined to the natural disasters. Pre-independence, droughts and famines were the biggest killers in India. The situation has changed due to a combination of factors like irrigation development and food security measures. Floods, cyclones, droughts, landslides, avalanches and earthquakes are some of the major natural disasters that repeatedly and increasingly affect the country.

Vulnerability

Vulnerability is defined as the extent to which a community, structure, service, or geographic area is likely to be damaged or disrupted by the impact of particular hazard, on account of their nature, construction and proximity to hazardous terrain or a disaster-prone area. In 1989, the General Assembly of the United Nations proclaimed the decade 1999-2000 as the International Decade for Natural Disaster Reduction (IDNDR). At the world conference on natural disaster reduction in the city of Yokohama, Japan in 1994, deep concern was expressed at the continuing human suffering and disruption of development due to natural disasters and a Yokohama Strategy and Plan of Action for a Safe World was developed. This was a definitive step in disaster mitigation and preparedness planning.

It is not possible to do away with the devastation due to natural hazards completely. However, destruction from natural hazards can be minimised by the presence of well-functioning warning systems, combined with preparedness on the part of the vulnerable community. Disaster management may be seen as a part of good governance.

6.3 Basic Concepts of Emergency Management

The basic concept suggests that the same management strategies can be applied to all emergencies. Emergencies do not just appear one day, rather they exist throughout time and have a life-cycle of occurrence, and hence the management strategy should match the phases of an emergency in order to mitigate, prepare, respond and recover from its effect. There are four phases in emergency management: mitigation, preparedness, response and recovery. The four phases are visualised as having a circular relationship to each other (Emergency Management Cycle). The activities in one phase may overlap those in the previous one.

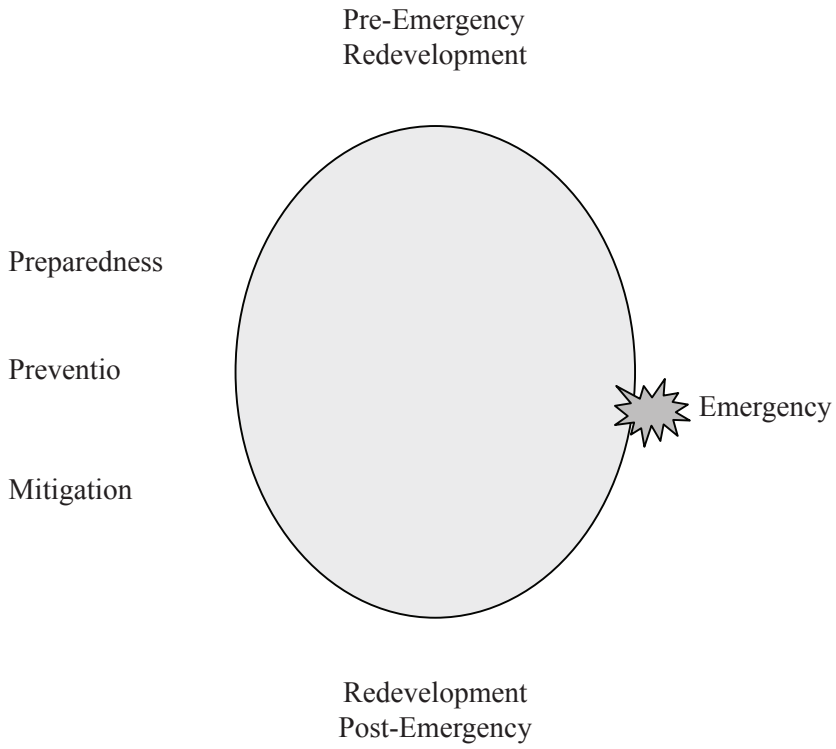

Fig. 6.1 Emergency management cycle
(Source: http://www.spc.tn.gov.in/tenthplan/CH_17.PDF)

6.3.1 Mitigation

Mitigation refers to activities which actually eliminate or reduce the vulnerability or chance of occurrence or the effects of a disaster. Mitigation phase begins with conducting hazard identification and vulnerability analysis which are essential to the planning of all other phases. Hazard identification and vulnerability analysis is a two-step process. First, the hazard is identified which has the potential of affecting the population. Secondly, how people, property and structures will be affected by the disastrous event.

6.3.2 Preparedness

Preparedness is a state of being ready to react promptly and effectively in the event of an emergency. Being prepared means that, a plan of action exists for an emergency, so that it is clear as to what to do before the emergency occurs. Preparedness measures to be undertaken depends upon the analysis of hazard severity and vulnerability, which is also the basis for deciding mitigation strategy. In some cases, such as a flood or hurricane, an early warning gives several hours to act. However, often no prior warning of an impending emergency, such as with earthquakes, tornadoes, explosions, or major fires is possible. Preparedness for any emergency, especially those, which strike without notice, requires a plan. It is essential to identify the resources available, and ways to utilise them. It must also be reasonably certain that the plan will work in an emergency situation.

Preparedness plan

The purpose of a plan is to provide a systematic way of responding to an emergency situation. The following aspects should be taken into consideration in the development of emergency preparedness plan:

- Identification of possible emergency situations which may occur in an area.
- Deployment of officer in charge in case of emergency.
- Developing a strategy for activities likely to be undertaken and resources which could be of use.
- Identifying government bodies responsible to respond in case of emergency.
- Establishment of Emergency Operation Centre (EOC) or Control Room to carry on emergency operations

6.3.3 Response

Response activities occur during and immediately following a disaster. They are designed to provide emergency assistance to victims of the event and reduce the likelihood of secondary damage. The five basic stages of response to an emergency or disaster are as follows:

- Notification/warning
- Immediate public safety
- Property security
- Public welfare
- Restoration

The length of each stage depends upon the emergency situation.

Notification/warning

Notification/warning is the first stage of response. Warning should be issued to two specific groups as follows:

- The general public
- Departments, individuals, or agencies who must respond to the emergency

In most emergency situations, the general public can be informed through radio and television; however, those in the immediate danger area should be informed by more direct means using public address systems.

Those departments, individuals or agencies, which must be alerted, should be informed according to the emergency preparedness plan. The alert could be done by two-way radio, telephone, messenger or local television and radio bulletins. The people who are expected to respond must be given enough information, so that they know what to do. Practically no warning can be given for an earthquake as there exists no scientific method to predict its occurrence. However, some of the conventional ways of earthquake prediction have been practised since ancient times, the most relevant being the erratic behaviour of animals just before an earthquake and it can be considered as an indicator of earthquake.

Immediate public safety

Immediate public safety deals primarily with providing emergency medical services, search and rescue and evacuation from the disaster area. The primary concern is for safety of the people and treatment of those who are injured.

Property security

This stage deals primarily with the protection of property in the community. Primarily local police carry out the actions in this stage. The police should see that property is safe and looting or vandalism does not occur. The fire department aids in prevention of further damage to surrounding property. The public works/highways department/ local urban or rural bodies may also play an important part by providing manpower, removing debris or providing street barricades.

Public welfare

Public welfare consists of two main operations, caring for the people after the emergency and assessing damage. This stage is where it is most important that all the service agencies work closely. During the public welfare stage the prime concern is about mass care for injured, shelter for the homeless, food and clothing for those in need. During this stage, assessment of the damage is necessary in order to obtain state or national support.

Restoration

Restoration involves actions that repair the necessities of life, which means restoring utility service and the removal of debris from the disaster scene.

6.3.4 Recovery

Recovery is the final phase of the emergency management cycle. Recovery continues until all systems return to normal, or near normal. Short-term recovery returns vital life support systems to minimum operating standards. It grows out of the response effort. During the response phase, emergency repairs to buildings are made as protective measures against further damage or injury. Short-term recovery is the restoration of vital services and facilities to minimum standards of operation and safety. Severely damaged buildings are scheduled to be replaced or removed, water and sewer repairs are made, electricity and telephone services returned to normal.

Long-term recovery

Long-term recovery may continue for a number of years, as the community slowly returns to pre-emergency or better conditions. Long-term recovery may include the complete redevelopment of damaged areas. During short-term recovery, buildings are repaired and people's immediate needs are taken care of and assistance programmes are put into effect. There is no clear-cut distinction when long-term recovery begins. They are not two distinctly different phases of recovery. Long-term recovery is simply those recovery efforts, which are still in operation long after the disaster and includes everything from complete redevelopment of the disaster area to mitigation efforts to prevent a similar disaster on an on-going basis for years after the emergency. The recovery phase of emergency management is just as vital as the mitigation, preparedness, and response phases. A key element in the recovery phase is to develop and implement ways to reduce community's vulnerability to a repeat of a similar emergency and also continued liaison with the State Headquarters and the Central Government for assistance.

Redevelopment as mitigation

After a major disaster, certain areas may be completely levelled and new buildings must be designed to take their place. Redevelopment refers to the complete replacement of structures, and not just structure repair. Redevelopment provides the opportunity to reduce the chances that similar structural damage will occur again. The redevelopment officials (public and private) must think of ways to rebuild the damaged structures, so that the next time the same hazard strikes, the impact is greatly reduced. Engineers should evaluate, if the building codes respond to a particular hazard. Planners should evaluate whether the damaged area should be re-zoned for lower density uses. Residents of a disaster-affected area should be asked for their preference for resettlement in the same area or other. The loss of human life and property from a disaster can be substantially reduced by timely issue of warning to the community likely to be affected from the disaster. Similarly, providing a quick response immediately after the disaster can substantially reduce the suffering of the affected people.

6.4 Organisational Structure and Institutional Arrangements for Emergency Management in the State

The organisational structure and institutional arrangements for emergency management in the state are discussed in the paragraphs below.

State Emergency Management Planning Committee (SEMPC)

A state emergency management plan must be prepared for each kind of disaster and the details of the organisational structure for emergency management activities should be made known. Responsibility of concerned agencies for the execution of rescue, relief and recovery operations and standard operating procedure for each should be made available. A state emergency management planning committee (SEMPC) should be constituted with all the stakeholders as members.

State Crisis Group (SCG)

The setting up of a State Crisis Group (SCG) will enable quick decision-making, operational direction and coordination of the issue of warning and execution of rescue, relief and recovery operations. The responsibilities of the SCG would include the following:

- On spot decision-making
- Control and coordination of response and recovery activities
- Resource mobilisation and replenishment
- Monitoring of overall response and recovery activities
- Preparation of reports for submission to State Government through Relief Commissioner

State Emergency Manager (SEM)

Different government agencies and the NGOs are supposed to operate within the overall direction and coordination of the Commissioner of Revenue Administration/Relief Commissioner, who may be designated as the State Emergency Manager (SEM). The individual government agencies and the NGOs will perform the assigned jobs, but the State Emergency Manager will appropriately augment their resources by drawing upon resources from other government agencies and the local communities. The chief secretary or commissioner of revenue administration can also assign additional responsibilities and functions to different government agencies to meet the requirements of the situation. During the time of emergency, the chief secretary or the commissioner of revenue administration who is the State Emergency Manager (SEM) would act as the focal point for control and coordination of all activities. His responsibilities would be as follows:

- Get in touch with the local Army/Navy/Air force units for assistance in rescue, evacuation and relief.
- Requisition resources, materials and equipment from all departments/organisations of the government and also from private sector.
- Direct industry to activate their onsite and offsite disaster management plan.
- Set up site operations centre in the affected area with desk arrangements.
- Arrange establishment of transit and/or relief camps, feeding centres and cattle camps.
- Send Preliminary Information Report and Action Taken Report to the Government.
- Arrange immediate evacuation whenever necessary.

State Emergency Control Room (SECR)

The need for directing the operations at the affected site, the need for coordination at the district headquarters and the need for interaction with the State Government to meet the conflicting demands at the time of disaster is the responsibility of the Relief Commissioner and his team. A well-equipped State Emergency Control Room (SECR) in terms of manpower and equipment should be established to help the Relief Commissioner and his team and to perform the following functions:

- Collection and compilation of information from the affected area
- Documenting information flow
- Decision-making regarding resource management
- Allocation of task to different resource organisation
- Supply of information to State Government

The SECR may have senior representatives in the capacity of Desk Officers from the following key resource agencies:

- Search, Rescue & Evacuation desk-Police and Fire Services
- Logistics & Welfare desk
- Medical desk
- Infrastructure desk

The Desk Officers should maintain constant contact with the State Crisis Group members and the other district heads to ensure quick decision-making.

Activities of State Emergency Control Room (SECR)

The activities of state emergency control room are discussed in the paragraphs given below.

Normal times

The responsibilities during the normal times will include:

- Ensure all warning and communication systems, instruments are in working condition.
- Collect information on a routine-basis from the State departments on the vulnerability of areas to disasters.
- Liaise with SEMPC.

- Develop status reports of preparedness and mitigation activities in the State.
- Ensure appropriate implementation of State Emergency Management Plan.
- Maintain data bank with regular updating.

Evaluation and updation of State Emergency Management Plan is the responsibility of SEMPC. However, SEMPC would keep an account of the amendments and accordingly review its response strategy. SECR will be responsible for activating the trigger mechanism in the event of receipt of a warning or occurrence of a disaster.

Activities on occurrence of emergency

Issue warning/alert: On the basis of message received from the forecasting agencies, warning has to be issued for the general public and the departments which play a vital role during emergencies. Issue of correct and timely warning would be one of the prime responsibilities of SECR. For effective dissemination of warning SECR should have a well planned line of communication. The relief commissioner would be the authoritative body to issue warning. Formulation of warning message should consider the target group for which it is issued.

Post-emergency activities

After an emergency the main responsibility of a SECR would be:

- Evaluation of relief and rehabilitation activities in order to assess the nature of state intervention and support, suitability of the organisation structure, institutional arrangements, adequacy of operating procedures, monitoring mechanisms, information tools, equipment and communication system.
- Post-emergency impact studies for long-term preventive and mitigation efforts to be taken.

Communication room (main message room)

The police wireless system should continue to be in contact with the SECR. In every district the police have a well-established wireless communication system; therefore, under any emergency the communication resources available with the police may be utilised. During disaster, SECR would be connected to Site Operations Centre and the facilities at various Desks.

Emergency Support Functions (ESFs)

Emergency Support Functions (ESFs) are how emergency management accomplishes many of the tasks of responding to an emergency.

List of emergency support functions

The main emergency support functions are as follows:

- ESF No. 1 – Communication
- ESF No. 2 – Public Health and Sanitation
- ESF No. 3 – Power
- ESF No. 4 – Transport
- ESF No. 5 – Donation
- ESF No. 6 – Search and Rescue
- ESF No. 7 – Public Works and Engineering
- ESF No. 8 – Food
- ESF No. 9 – Information and Planning
- ESF No. 10 – Relief Supplies
- ESF No. 11 – Drinking water
- ESF No. 12 – Shelter
- ESF No. 13 – Media
- ESF No. 14 – Help lines

6.5 Planning Process

The Planning process for disaster management is based on the principle that response and level of preparedness required are dependent on the extent of vulnerability and the level of capacity to deal with situations. Disasters may be graded at four-levels as follows:

- L1: District-level disasters within the capabilities of the district administration to deal with.
- L2: State-level disasters within the capabilities of State Government to deal with.
- L3: National-level disasters requiring major intervention of the Central Government.
- L0: No disaster situations. This is the level at which surveillance, preparedness and mitigation activities must be focussed on.

6.6 Trigger Mechanism

Trigger mechanism is a quick response mechanism, which would spontaneously set the vehicle of management into motion on the road to disaster mitigation process. The trigger mechanism has been envisaged as a preparedness plan, whereby the receipt of a single of an impending disaster would simultaneously energise and activate the mechanism for response and mitigation without loss of crucial time. This would entail all the participating managers to know in advance the task assigned to them and the manner of response. Identification of available resources, including manpower, material and equipment and adequate delegation of financial and administrative powers are prerequisites to successful operation of the trigger mechanism.

As and when a disaster takes place, be it natural or man-made, the managers struggle to mitigate its effects on human lives and material losses. The immediate response in all disasters has more or less the same parameters. These are to provide rescue and relief and save the precious human life. Thus, the emergency response of the disaster managers is a factor independent of the types of intensity of the disasters.

As and when the disasters strike or take place, the managers are required to swing in action without losing time. Generally, in such situations, the managers start organising, planning and activating the mitigation process. On the other hand, the event had already taken place and the need of that hour is to start the mitigation process and virtually no time can be spared at that stage for the activities like organising and planning. Time is the essence of the immediate relief and rescue operations to save human lives and mitigate human miseries for the next 48 to 72 hours. Thereafter, actually what is required to be done is a part of long-term rehabilitation and reconstruction programmes.

The trigger mechanism in fact is a preparedness plan in which all the participating managers, and actors know in advance the task assigned to them and the manner in which they have to be prepared themselves to respond. In fact the trigger mechanism is in essence the Standard Operating Procedure (SOP) in which the implementation of the efforts on ground is well laid down. Generally, the activities which include evacuation, search and rescue, temporary shelter, food, drinking water, clothing, health and sanitation, communications, accessibility, and public information which are very important components of disaster management, would follow on the activation of the Trigger Mechanism.

All these major activities which are common in all types of disasters will require sub-division and preparation of sub-action plans by each specified authority. They will be required to list all requirements and their availability within the prescribed response-time. Separate SOPs need to be in place for each frontline agency like Police, Fire-Service, PWD, Highways, Health Departments, etc.

The Trigger Mechanism requires the disaster managers to achieve the following:

- Evolve an effective signal/warning mechanism.
- Identify activities and their levels.
- Identify sub-activities under each activity/level of activity.
- Specify authorities for each level of activity and sub-activity.
- Determine the response time for each activity.

- Work out individual plans of each specified authority to achieve the activation as per the response time.
- Have quick response teams for each specified authority.
- Have alternative plans and contingency measures.
- Provide appropriate administrative and financial delegations to make the response mechanism functionally viable.
- Undergo preparedness drills.

6.7 Paradigm Shift Towards Prevention and Reduction

Recognising the rapidly rising worldwide toll of human and economic losses due to natural disasters, the UN General Assembly in 1989 took a decision to launch a far-reaching global undertaking during the nineties to save human lives and reduce the impact of natural disasters. With this aim in mind, the decade 1990-2000 was declared as the International Decade for Natural Disaster Reduction (IDNDR).

The objective of the IDNDR was to reduce, through concerted international action, especially in developing countries, the loss of life, property damage and social and economic disruption caused by natural disasters, such as earthquakes, floods, cyclones, landslides, locust infestations, drought and desertification and other calamities of natural origin.

By the year 2000, as per the plan of the IDNDR, all countries should have the following:

- Comprehensive national assessments of risks from natural hazards, with these assessments taking into account their impact on developmental plans.
- Mitigation plans at national and/or local levels, involving long-term prevention and preparedness and community awareness.
- Ready access to global, regional, national and local warning systems and widespread dissemination of such warnings.

Prevention, mitigation and preparedness strategy

The prevention, mitigation and preparedness strategy can be achieved as follows:

- Development of a culture of prevention as an essential component of an integrated approach to disaster-reduction.
- Prepare and maintain in a state of readiness 'Preparedness and Response Plans' at National, State and District levels.
- Adoption of a policy of self reliance in each vulnerable area.
- Education and training in disaster prevention, mitigation and preparedness for enhancement of capabilities at all levels.
- Identification and strengthening of existing centres of excellence in order to improve disaster prevention, reduction and mitigation capabilities.

6.8 Ushering in a New Culture of Disaster Management

A new culture of disaster management can be ushered in through the approaches which are described in the following paragraphs.

Culture of preparedness

Hitherto, the approach towards coping with the effects of natural disasters has been post-disaster management involving many problems, such as law and order, evacuation and warnings, communications, search and rescue, fire-fighting, medical and psychiatric assistance, provision of relief and sheltering, etc. After the initial trauma of the occurrence of the natural disaster is over within the first few days or weeks, the phase of reconstruction and economic, social and psychological rehabilitation is taken up by the people themselves and by the government authorities. Soon thereafter, the occurrence of the disaster is relegated to historic memory till the next one occurs either in the same area or in some other part of the country.

It is not possible to do away with the devastation of natural hazards completely. However, experience has shown that destruction from natural hazards can be minimised by the presence of a well-functioning warning system, combined with preparedness on the part of the vulnerable community. Warning systems and preparedness measures reduce and modify the scale of disasters. A community that is prepared to face disasters receives and understands warnings of impending hazards and has taken precautionary and mitigatory measures will be able to cope better and resume their normal life sooner.

Culture of prevention

One of the many lessons learnt by victims of various natural disasters is that the aftermath of a disaster can be even worse than the disaster event itself. Thus, there is a need to acknowledge the necessity for efforts towards disaster prevention. However, people are often surprised by the concept of reducing disasters. How, it is often asked, can a natural disaster such as an earthquake or a cyclone be reduced or prevented?

Natural occurrences such as floods, earthquakes, cyclones, etc., simply cannot be avoided altogether, they are a part of the environment we live in. What can be done, however, is to take preventive measures at various levels of society in order to make the impact of such natural hazards as harmless as possible for people and people's properties. The impact of a natural hazard can be reduced; its worst effects can be prevented.

Early warning

Building codes do not exist against storm surge inundation. Prescribed means today to save life and properties against storm surge inundation is to evacuate people to safer places as quickly as possible on receipt of warnings. Coordinated early warning systems against tropical cyclone are now in existence around the globe and it is possible to warn the affected population at least 24 to 36 hours in advance about the danger from a tropical cyclone. By taking advantage of early warning systems, it is now possible by prepared and knowledgeable communities to minimise the loss of lives and properties.

Development planning

There is a need to integrate development plans and regulations with disaster-mitigation. The construction of roads, railways lines, bridges, etc., should be according to the topography and geology of that area in terms of risk and vulnerability. All development projects (engineering and non-engineering) including irrigation and industrial projects should be targeted towards disaster-mitigation.

Environmental protection, afforestation programmes, pollution control, construction of earthquake-resistance structures should have priority for implementation. What is important is to introduce a culture of prevention in disaster managers and all communities, at all levels: action to save lives must be taken before disaster strikes. For instance, most of the deaths and casualties in an earthquake are caused not by the earthquake itself, but due to the collapse of buildings and concrete structures. Hence, earthquake proof features need to be planned and incorporated at the structural design itself. Retrofitting of existing structures will also mitigate the effects of an earthquake. Such preventive measures are essential also in a state like Tamil Nadu considering that much of the state has been upgraded to Zone III in the revised seismic Zonation map of India, on par with Latur in Maharashtra. The building control regulations need to be revised accordingly.

6.9 Financial Arrangements

The policy arrangements for meeting relief expenditure related to natural disasters are, by and large, based on the recommendations of successive Finance Commissions. The two main windows presently open for meeting such expenditures are the Calamity Relief Fund (CRF) and National Calamity Contingency Fund (NCCF). The Calamity Relief Fund is used for meeting the expenditure for providing immediate relief to the victims of cyclone, drought, earthquake, fire, flood and hailstorm. Expenditure on restoration of damaged capital works should ordinarily be met from the normal budgetary heads, except when it is to be incurred as part of providing immediate relief, such as restoration of drinking water sources or provision of shelters, etc., or restoration of communication links for facilitating relief operations. The amount of annual contribution to the CRF of each State for each of the financial years 2000-01 to 2004-05 is as indicated by the Finance Commission. Of the total contribution indicated, the Government of India contributes 75 percent of the total yearly allocation in the form of a non-plan grant, and the balance amount is contributed by the State Government concerned. A total of Rs.11, 007.59 crores was provided for the Calamity Relief Fund from 2000-05.

Pursuant to the recommendations of the Eleventh Finance Commission, apart from the CRF, a National Calamity Contingency Fund (NCCF) Scheme came into force with effect from the financial year 2000-01 and would be operative till the end of the financial year 2004-05. NCCF is intended to cover natural calamities like cyclone, drought, earthquake, fire, flood and hailstorm, which are considered to be of severe nature requiring expenditure by the State Government in excess of the balances available in its own Calamity Relief Fund. The assistance from NCCF is available only for immediate relief and rehabilitation. Any reconstruction of assets or restoration of damaged capital should be financed through re-allocation of plan funds.

The initial corpus of the National Fund is Rs.500 crores, provided by the Government of India. This fund is required to be recouped by levy of special surcharge for a limited period on central taxes. Assistance provided by the Centre to the States from the National Fund is to be financed by the levy of a special surcharge on the central taxes for a limited period. A list of items and norms of expenditure for assistance chargeable to CRF/NCCF in the wake of natural calamities is prescribed in detail from time-to-time.

There are a number of important ongoing schemes that specifically help reduce disaster vulnerability. Some of these are Integrated Wasteland Development Programme (IWDP), Drought Prone Area Programme (DPAP), Desert Development Programme (DDP), Flood Control Programmes, National Afforestation & Eco-development Programme (NA&ED), Accelerated Rural Water Supply Programme (ARWSP), Crop Insurance, Sampurn Grameen Rozgar Yojana (SGRY), Food for Work, etc.

The High Power Committee (HPC) constituted by GOI on Disaster Management which submitted its report in October 2001 recommended that at least 10 percent of plan funds at the national, state and district levels be earmarked and apportioned for schemes which specifically address areas, such as prevention, reduction, preparedness and mitigation of disasters.

The Eleventh Finance Commission too paid detailed attention to the issue of disaster management and, in its chapter on calamity relief, came out with a number of recommendations, of which the following have a direct bearing on the Plan:

- Expenditure on restoration of infrastructure and other capital assets, except those that are intrinsically connected with relief operations and connectivity with the affected area and population, should be met from the plan funds on priority basis.
- Medium and long-term measures should be devised by the concerned Ministries of the Government of India, the State Governments and the Planning Commission to reduce, and if possible, eliminate, the occurrences of these calamities by undertaking developmental works.
- The Planning Commission, in consultation with the State Governments and concerned Ministries, should be able to identify works of a capital nature to prevent the recurrence of specific calamities. These works may be funded under the Plan.

In order to move towards safer development, development projects should be sensitive towards disaster mitigation. With the kind of economic losses and developmental setbacks that the country has been suffering year-after-year, it makes good economic sense to spend a little extra today in a planned way on steps and components that can help in prevention and mitigation of disasters, than be forced to spend many multiples more later on restoration and rehabilitation. The design of development projects and the process of development should take the aspect of disaster reduction and mitigation within its ambit; otherwise, the development ceases to be sustainable and eventually causes more hardship and loss to the nation.

Summary

- Disasters have been visiting every part of the globe at one time or the other.
- Disasters can strike at any time, at any place.
- The word Disaster is from a French word 'Desastre' meaning bad or evil star.
- Any disaster means a situation in which there is a sudden disruption of normalcy within society causing widespread damage to life and property.
- Vulnerability is defined as the extent to which a community, structure, service, or geographic area is likely to be damaged or disrupted by the impact of particular hazard, on account of their nature, construction and proximity to hazardous terrain or a disaster-prone area.
- In 1989, the General Assembly of the United Nations proclaimed the decade 1999-2000 as the International Decade for Natural Disaster Reduction (IDNDR).
- Emergencies do not just appear one day, rather they exist throughout time and have a life-cycle of occurrence, and hence the management strategy should match the phases of an emergency in order to mitigate, prepare, respond and recover from its effect.
- There are four phases in Emergency Management, mitigation, preparedness, response and recovery.
- After a major disaster, certain areas may be completely levelled and new buildings must be designed to take their place.
- The relief commissioner would be the authoritative body to issue warning.
- The planning process for disaster management is based on the principle that response and level of preparedness required are dependent on the extent of vulnerability and the level of capacity to deal with situations.
- Trigger mechanism is a quick response mechanism, which would spontaneously set the vehicle of management into motion on the road to disaster mitigation process.
- One of the many lessons learnt by victims of various natural disasters is that the aftermath of a disaster can be even worse than the disaster event itself.
- The policy arrangements for meeting relief expenditure related to natural disasters are, by and large, based on the recommendations of successive Finance Commissions.
- The Calamity Relief Fund is used for meeting the expenditure for providing immediate relief to the victims of cyclone, drought, earthquake, fire, flood and hailstorm.

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Self Assessment

1. The word Disaster is from a French word '_____' meaning bad or evil star.
   a. Desastre
   b. Disaster
   c. Desast
   d. Disast

2. When did the General Assembly of the United Nations proclaimed the decade 1999-2000 as the International Decade for Natural Disaster Reduction (IDNDR)?
   a. 1999
   b. 1978
   c. 1989
   d. 1969

3. Match the following

1. Mitigation	A. It is a state of being ready to react promptly and effectively in the event of an emergency.
2. Preparedness	B. It is the final phase of the emergency management cycle.
3. Response	C. It refers to activities which actually eliminate or reduce the vulnerability or chance of occurrence or the effects of a disaster.
4. Recovery	D. These activities occur during and immediately following a disaster.

   a. 1-A, 2-D, 3-B, 4-C
   b. 1-D, 2-B, 3-C, 4-A
   c. 1-B, 2-C, 3-A, 4-D
   d. 1-C, 2-A, 3-D, 4-B

4. _____involves actions that repair the necessities of life, which means restoring utility service and the removal of debris from the disaster scene.
   a. Public welfare
   b. Notification/warning
   c. Immediate public safety
   d. Restoration

5. What is the first stage of response?
   a. Immediate public safety
   b. Notification/warning
   c. Property security
   d. Public welfare

6. _____ and updation of State Emergency Management Plan is the responsibility of SEMPC.
   a. Trigger
   b. Emergency
   c. Planning
   d. Evaluation

7. What refers to the complete replacement of structures, and not just structure repair?
   a. Planners
   b. Recovery
   c. Redevelopment
   d. Restoration

8. _____ is a quick response mechanism, which would spontaneously set the vehicle of management into motion on the road to disaster mitigation process.
   a. Planning process
   b. Trigger Mechanism
   c. Emergency Support Functions
   d. Evaluation

9. Which of the following statement is true?
   a. The police wireless system should continue to be in contact with the SECR.
   b. The police system should stop to be in contact with the SECR.
   c. The police wireless system should discontinue being in contact with the SECR.
   d. The police should continue to be in contact with the people.

10. Which of the following statement is false?
    a. Disasters have been visiting every part of the globe at one time or the other.
    b. Disasters can't strike at any time, at any place.
    c. A disaster can be either natural or manmade.
    d. Pre-Independence, droughts and famines were the biggest killers in India.

Chapter VII

The Legal and Regulatory Framework for Environmental Protection in India

Aim

The aim of this chapter is to:

- introduce legal and regulatory framework for environmental protection
- explain legislations for environmental protection in India
- explicate water (prevention and control of pollution) act

Objectives

The objectives of this chapter are to:

- enlist environment (protection) act, 1986 (EPA)
- elucidate hazardous wastes
- explicate international agreements on environmental issues

Learning outcome

At the end of this chapter, you will be able to:

- identify convention on biological diversity, 1992 and UN convention on desertification, 1994
- understand an assessment of the legal and regulatory framework for environmental protection in India
- describe UN framework convention on climate change (UNFCCC), 1992

7.1 Introduction

Over the years, together with spreading of environmental consciousness, there has been a change in the traditionally-held perception that there is a trade-off between environmental quality and economic growth as people have come to believe that the two are necessarily complementary. The current focus on environment is not new. Environmental considerations have been an integral part of the Indian culture. The need for conservation and sustainable use of natural resources has been expressed in Indian scriptures, more than three thousand years old and is reflected in the constitutional, legislative and policy framework as also in the international commitments of the country.

Even before India's independence in 1947, several environmental legislations existed, but the real impetus for bringing about a well-developed framework came only after the UN Conference on the Human Environment (Stockholm, 1972). Under the influence of this declaration, the National Council for Environmental Policy and Planning within the Department of Science and Technology was set up in 1972. This Council later evolved into a full-fledged Ministry of Environment and Forests (MoEF) in 1985 which today is the apex administrative body in the country for regulating and ensuring environmental protection. After the Stockholm Conference, in 1976, constitutional sanction was given to environmental concerns through the 42nd Amendment, which incorporated them into the Directive Principles of State Policy and Fundamental Rights and Duties.

An extensive network of environmental legislation has grown in the country, since the 1970s. The MoEF and the pollution control boards (CPCB, i.e., Central Pollution Control Board and SPCBs, i.e., State Pollution Control Boards) together form the regulatory and administrative core of the sector.

A policy framework has also been developed to complement the legislative provisions. The Policy Statement for Abatement of Pollution and the National Conservation Strategy and Policy Statement on Environment and Development were brought out by the MoEF in 1992, to develop and promote initiatives for the protection and improvement of the environment. The EAP (Environmental Action Programme) was formulated in 1993 with the objective of improving environmental services and integrating environmental considerations in to development programmes. Other measures have also been taken by the government to protect and preserve the environment. This chapter attempts to highlight only legislative initiatives towards the protection of the environment.

7.2 Legislation for Environmental Protection in India

The legislations for environmental protection in India are explained in the paragraphs given below.

7.2.1 Water

Water quality standards especially those for drinking water are set by the Indian Council of Medical Research. These bear close resemblance to WHO standards. The discharge of industrial effluents is regulated by the Indian Standard Codes and recently, water quality standards for coastal water marine outfalls have also been specified. In addition to the general standards, certain specific standards have been developed for effluent discharges from industries, such as iron and steel, aluminium, pulp and paper, oil refineries, petrochemicals and thermal power plants. Legislations to control water pollution are listed below.

Water (prevention and control of pollution) Act, 1974

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

Water (prevention and control of pollution) Act, 1977

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

7.2.2 Air

Legislations to control air pollution are listed below.

Air (prevention and control of pollution) Act, 1981

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

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

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

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

Complementing the above Acts is the Atomic Energy Act of 1982, which was introduced to deal with radioactive waste. In 1988, the Motor Vehicles Act was enacted to regulate vehicular traffic, besides ensuring proper packaging, labelling and transportation of the hazardous wastes. Various aspects of vehicular pollution have also been notified under the EPA of 1986. Mass emission standards were notified in 1990, which were made more stringent in 1996. In 2000, these standards were revised yet again and for the first time separate obligations for vehicle owners, manufacturers and enforcing agencies were stipulated. In addition, fairly stringent Euro I and II emission norms were notified by the Supreme Court on April 29, 1999 for the city of Delhi. The notification made it mandatory for car manufacturers to conform to the Euro I and Euro II norms by May 1999 and April 2000, respectively, for new noncommercial vehicle sold in Delhi.

7.2.3 Forests and Wildlife

The legislations to protect forests and wildlife are listed below.

The wildlife (protection) Act, 1972, amendment 1991

The WPA (Wildlife Protection Act), 1972, provides for protection to listed species of flora and fauna and establishes a network of ecologically-important protected areas. The WPA empowers the central and state governments to declare any area a wildlife sanctuary, national park or closed area. There is a blanket ban on carrying out any industrial activity inside these protected areas. It provides for authorities to administer and implement the Act; regulate the hunting of wild animals; protect specified plants, sanctuaries, national parks and closed areas; restrict trade or commerce in wild animals or animal articles; and miscellaneous matters. The Act prohibits hunting of animals except with permission of authorised officer when an animal has become dangerous to human life or property or disabled or diseased as to be beyond recovery (WWF-India, 1999). The near-total prohibition on hunting was made more effective by the Amendment Act of 1991.

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

7.2.4 General

The legislations to protect environment in general are listed below.

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

From time to time, the central government issues notifications under the EPA for the protection of ecologically-sensitive areas or issues guidelines for matters under the EPA. Some notifications issued under this Act are:

- Doon Valley Notification (1989), which prohibits the setting up of an industry in which the daily consumption of coal/fuel is more than 24 MT (million tonnes) per day in the Doon Valley.
- Coastal Regulation Zone Notification (1991), which regulates activities along coastal stretches. As per this notification, dumping ash or any other waste in the CRZ is prohibited. The thermal power plants (only foreshore facilities for transport of raw materials, facilities for intake of cooling water and outfall for discharge of treated waste water/cooling water) require clearance from the MoEF.
- Dhanu Taluka Notification (1991), under which the district of Dhanu Taluka has been declared an ecologically fragile region and setting up power plants in its vicinity is prohibited.
- Revdanda Creek Notification (1989), which prohibits setting up industries in the belt around the Revdanda Creek as per the rules laid down in the notification.
- The Environmental Impact Assessment of Development Projects Notification, (1994 and as amended in 1997). As per this notification:
  - All projects listed under Schedule I require environmental clearance from the MoEF.
  - Projects under the delicenced category of the New Industrial Policy also require clearance from the MoEF.
  - All developmental projects whether or not under the Schedule I, if located in fragile regions must obtain MoEF clearance.
  - Industrial projects with investments above Rs 500 million must obtain MoEF clearance and are further required to obtain a LOI (Letter Of Intent) from the Ministry of Industry, and an NOC (No Objection Certificate) from the SPCB and the State Forest Department if the location involves forestland. Once the NOC is obtained, the LOI is converted into an industrial licence by the state authority.
  - The notification also stipulated procedural requirements for the establishment and operation of new power plants. As per this notification, two-stage clearance for site-specific projects, such as pithead thermal power plants and valley projects is required. Site clearance is given in the first stage and final environmental clearance in the second. A public hearing has been made mandatory for projects covered by this notification. This is an important step in providing transparency and a greater role to local communities.
- Ash Content Notification (1997), required the use of beneficiated coal with ash content not exceeding 34% with effect from June 2001, (the date later was extended to June 2002). This applies to all thermal plants located beyond one thousand kilometres from the pithead and any thermal plant located in an urban area or, sensitive area irrespective of the distance from the pithead except any pithead power plant.
- Taj Trapezium Notification (1998), provided that no power plant could be set up within the geographical limit of the Taj Trapezium assigned by the Taj Trapezium Zone Pollution (Prevention and Control) Authority.

- Disposal of Fly Ash Notification (1999), the main objective of which is to conserve the topsoil, protect the environment and prevent the dumping and disposal of fly ash discharged from lignite-based power plants. The salient feature of this notification is that no person within a radius of 50 km from a coal-or lignite-based power plant shall manufacture clay bricks or tiles without mixing at least 25% of ash with soil on a weight-to-weight basis. For the thermal power plants, the utilisation of the fly ash would be as follows:
  - Every coal or lignite-based power plant shall make available ash for at least ten years from the date of publication of the above notification without any payment or any other consideration, for the purpose of manufacturing ash-based products, such as cement, concrete blocks, bricks, panels or any other material or for construction of roads, embankments, dams, dykes or for any other construction activity.
  - Every coal or lignite based thermal power plant commissioned subject to environmental clearance conditions stipulating the submission of an action plan for full-utilisation of fly ash shall, within a period of nine years from the publication of this notification, phase out the dumping and disposal of fly ash on land in accordance with the plan.

Rules for the manufacture, use, import, export and storage of hazardous microorganisms/genetically engineered organisms or cell

Rules for the manufacture, use, import, export and storage of hazardous microorganisms/genetically engineered organisms or cell were introduced in 1989 with the view to protect the environment, nature and health in connection with gene technology and micro-organisms, under the Environmental Protection Act, 1986. The government in 1991 further decided to institute a national label scheme for environmentally-friendly products called the 'ECOMARK'. The scheme attempts to provide incentives to manufactures and importers to reduce adverse environmental impacts, reward genuine initiatives by companies, and improve the quality of the environment and sustainability of available resources. Besides the above attempts, notifications pertaining to Recycled Plastics Manufacture and Usage Rules, 1999 were also incorporated under the Environment (Protection) Act of 1986.

The environment (protection) rules, 1986

These rules lay down the procedures for setting standards of emission or discharge of environmental pollutants. The rules prescribe the parameters for the Central Government, under which it can issue orders of prohibition and restrictions on the location and operation of industries in different areas. The rules lay down the procedure for taking samples, serving notice, submitting samples for analysis and laboratory reports. The functions of the laboratories are also described under the rules along with the qualifications of the concerned analysts.

The national environment appellate authority Act, 1997

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

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

7.2.5 Hazardous Wastes

There are several legislations that directly or indirectly deal with hazardous waste. The relevant legislation is the Factories Act, 1948, the Public Liability Insurance Act, 1991, the National Environment Tribunal Act, 1995 and some notifications under the Environmental Protection Act of 1986. A brief description of each of these is given below. Under the EPA 1986, the MoEF has issued several notifications to tackle the problem of hazardous waste management. These include the following:

- Hazardous Wastes (Management and Handling) Rules, 1989, which brought out a guide for manufacture, storage and import of hazardous chemicals and for management of hazardous wastes.

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

Factories Act, 1948 and its amendment in 1987

The Factories Act, 1948 was a post-independence statute that explicitly showed concern for the environment. The primary aim of the 1948 Act has been to ensure the welfare of workers not only in their working conditions in the factories, but also their employment benefits. While ensuring the safety and health of the workers, the Act contributes to environmental protection. The Act contains a comprehensive list of 29 categories of industries involving hazardous processes, which are defined as a process or activity where unless special care is taken, raw materials used therein or the intermediate or the finished products, by-products, wastes or effluents would result in the following:

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

Public liability insurance Act (PLIA), 1991

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

National Environment Tribunal Act, 1995

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

7.3 International Agreements on Environmental Issues

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

Convention on international trade in endangered species of wild fauna and flora (CITES), 1973

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

Montreal protocol on substances that deplete the ozone layer (to the Vienna convention for the protection of the ozone layer), 1987

The Montreal protocol to the Vienna convention on substances that deplete the ozone layer came into force in 1989. The protocol set targets for reducing the consumption and production of a range of ozone depleting substances (ODS). In a major innovation the Protocol recognised that all nations should not be treated equally. The agreement acknowledges that certain countries have contributed to ozone depletion more than others. It also recognises that a nation's obligation to reduce current emissions should reflect its technological and financial ability to do so. Due to this, the agreement sets more stringent standards and accelerated phase-out timetables to countries that have contributed most to ozone depletion (Divan and Rosencranz, 2001).

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

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

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

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

Basel convention on transboundary movement of hazardous wastes, 1989

Basel Convention, which entered into force in 1992, has the following three key objectives:

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

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

UN framework convention on climate change (UNFCCC), 1992

The primary goals of the UNFCCC were to stabilise greenhouse gas emissions at levels that would prevent dangerous anthropogenic interference with the global climate. The convention embraced the principle of common, but differentiated responsibilities which has guided the adoption of a regulatory structure.

India signed the agreement in June 1992, which was ratified in November 1993. As per the convention, the reduction/ limitation requirements apply only to developed countries. The only reporting obligation for developing countries relates to the construction of a GHG inventory. India has initiated the preparation of its First National Communication (base year 1994) that includes an inventory of GHG sources and sinks, potential vulnerability to climate change, adaptation measures and other steps being taken in the country to address climate change. Further details on UNFCC and the Kyoto Protocol are provided in Atmosphere and climate chapter.

Convention on biological diversity, 1992

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

The Convention on Biological Diversity came into force in 1993. Many biodiversity issues are addressed in the convention, including habitat preservation, intellectual property rights, biosafety, and indigenous peoples' rights. India's initiatives under the Convention are detailed in the chapter on Biodiversity. These include the promulgation of the Wildlife (Protection) Act of 1972, amended in 1991 and participation in several international conventions, such as CITES.

UN Convention on desertification, 1994

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

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

International tropical timber agreement and the international tropical timber organisation (ITTO), 1983, 1994

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

7.4 An Assessment of the Legal and Regulatory Framework for Environmental Protection in India

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

Some initiatives have addressed these issues in the recent past. The Government of India came out with a Policy Statement for Abatement of Pollution in 1992, before the Rio conference, which declared that market-based approaches would be considered in controlling pollution. It stated that economic instruments will be investigated to encourage the shift from curative to preventive measures, internalise the costs of pollution and conserve resources, particularly water. In 1995, the Ministry of Environment and Forest (MoEF) constituted a task force to evaluate market-based instruments, which strongly advocated their use for the abatement of industrial pollution. Various economic incentives have been used to supplement the command-and-control policies. Depreciation allowances, exemptions from excise or customs duty payment, and arrangement of soft loans for the adoption of clean technologies are instances of such incentives. Another aspect that is evident is the shift in the focus from end-of-pipe treatment of pollution to treatment at source. The role of remote sensing and geographical information systems in natural resource management and environmental protection has also gained importance over time.

An important recent development is the rise of judicial activism in the enforcement of environmental legislation. This is reflected in the growth of environment-related public litigation cases that have led the courts to take major steps such as ordering the shut-down of polluting factories. Agenda 21 highlights the need for integration of environmental concerns at all stages of policy, planning and decision-making processes including the use of an effective legal and regulatory framework, economic instruments and other incentives. These very principles were fundamental to guiding environmental protection in the country well before Rio and will be reinforced, drawing on India's own experiences and those of other countries.

Use of remote sensing in integrating environment and development at the policy planning and management levels

The country has an extensive and integrated institutional infrastructure and focused programme elements to enable integration of environmental concerns in decision-making. The main initiatives include:

- National natural resource management systems: An integrated resource management system aimed at optimal utilisation of the country's natural resources through a systematic inventory of resource availability using remote sensing in conjunction with other techniques
- Remote sensing for sound environmental management: Remote sensing is playing an important role in providing information on physical environmental parameters, such as land and climate, vegetation, soils, water, terrain and slope, land use, air and water pollution, etc. Through the use of Geographical Information Systems, this information is integrated with relevant collateral information to evolve solutions to many environment issues. Notable achievements have been made in the area of regular forest cover mapping and monitoring as well as detection and monitoring of natural disasters along with assessment of the associated damages.

Role of remote-sensing in strengthening the legal and regulatory framework for environmental protection

Remote-sensing has established itself as an operational means to provide reliable information and bench mark survey mechanisms in the context of the following :

- Make laws and regulations more effective.
- Establish judicial and administrative procedures.
- Provide legal reference and support services.
- Develop effective national programmes for reviewing and enforcing compliance with national, state and local laws on environment and development.

A number of case studies in the country demonstrate the application of remote-sensing in this context. These cover forest encroachment studies, mapping of coastal regulation zones, enforcement of environmental legislation, environmental impact assessments, vegetation change detection studies and land-use planning studies

Generation of natural resources information towards strengthening the national accounting system

Endeavors include the setting up of a National Spatial Data Infrastructure (to build a repository of natural resource information), National (Natural) Resources Information System (to provide integrated information on natural resources, socio-economic factors, etc.), Groundwater Prospects Zone Mapping, Bio-resource Data Base, Wasteland Mapping, and the Integrated Mission for Sustainable Development. The IMSD project aimed at generating action plans to enhance the productivity and quality of natural resources. The project covered 85 million hectares of problem lands falling in 175 districts in the country and has been successful in evolving action plans with community participation to address several issues including enriching groundwater potential and increasing cropping intensity.

Summary

- The current focus on environment is not new. Environmental considerations have been an integral part of the Indian culture.
- Even before India's independence in 1947, several environmental legislations existed, but the real impetus for bringing about a well-developed framework came only after the UN Conference on the Human Environment (Stockholm, 1972).
- An extensive network of environmental legislation has grown in the country, since the 1970s.
- Water quality standards especially those for drinking water are set by the Indian Council of Medical Research.
- At the State level, the SPCBs (State Pollution Control Board) function under the direction of the CPCB and the state government.
- To counter the problems associated with air pollution, ambient air quality standards were established, under the 1981 Act.
- National Ambient Air Quality Standards (NAAQS) for major pollutants were notified by the CPCB in April 1994.
- The WPA (Wildlife Protection Act), 1972, provides for protection to listed species of flora and fauna and establishes a network of ecologically-important protected areas.
- The government in 1991 further decided to institute a national label scheme for environmentally-friendly products called the 'ECOMARK'.
- The Factories Act, 1948 was a post-independence statute that explicitly showed concern for the environment.
- The Montreal protocol to the Vienna convention on substances that deplete the ozone layer came into force in 1989.
- India acceded to the Montreal Protocol along with its London Amendment in September 1992.
- The Convention on Biological Diversity (CBD) is a legally binding, framework treaty that has been ratified until now by 180 countries.
- The ITTO established by the International Tropical Timber Agreement (ITTA), 1983, came into force in 1985 and became operational in 1987.
- The extent of the environmental legislation network is evident from the above discussion, but the enforcement of the laws has been a matter of concern.
- An important recent development is the rise of judicial activism in the enforcement of environmental legislation.

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Self Assessment

1. When was the National Council for Environmental Policy and Planning within the Department of Science and Technology set up?
   a. 1912
   b. 1972
   c. 1962
   d. 1947

2. What was formulated in 1993 with the objective of improving environmental services and integrating environmental considerations in to development programmes?
   a. The EAP (Environmental Action Programme)
   b. Central Pollution Control Board (CPCB)
   c. Ministry of Environment and Forests (MoEF)
   d. National Council for Environmental Policy

3. Match the following

1. Water (prevention and control of pollution) Act, 1974	A. This Act provides for protection to listed species of flora and fauna and establishes a network of ecologically-important protected areas.
2. Water (prevention and control of pollution) cess Act, 1977	B. This Act represented India's first attempts to comprehensively deal with environmental issues.
3. The wildlife (protection) Act, 1972, amendment 1991	C. This Act was a post-independence statute that explicitly showed concern for the environment.
4. Factories act, 1948 and its amendment in 1987	D. This Act provides for a levy and collection of a cess on water consumed by industries and local authorities.

   a. 1-D, 2-B, 3-C, 4-A
   b. 1-A, 2-C, 3-B, 4-D
   c. 1-B, 2-D, 3-A, 4-C
   d. 1-C, 2-A, 3-D, 4-B

4. Which of the following sets the water quality standards especially those for drinking water?
   a. Central Pollution Control Board
   b. Water (prevention and control of pollution)
   c. Indian Council of Medical Research
   d. Indian Medical Centre

5. The government in 1991 further decided to institute a national label scheme for environmentally-friendly products called the '_____'.
   a. ECOMARK
   b. ECOFRIENDLY
   c. ECOPROD
   d. ECOACT

6. _____Waste (Management and Handling) Rules, 1998, were formulated along parallel lines, for proper disposal, segregation, transport, etc., of infectious wastes.
   a. Municipal
   b. Hazardous
   c. Chemical
   d. Biomedical

7. Which of the following statement is true?
   a. India became a party to the CITES in 1976.
   b. India became a party to the CITES in 1956.
   c. India became a party to the CITES in 1967.
   d. India became a party to the CITES in 1957.

8. The Montreal protocol to the Vienna convention on substances that deplete the ozone layer came into force in _____.
   a. 1990
   b. 1979
   c. 1981
   d. 1989

9. Which of the following statement is false?
   a. India acceded to the Montreal Protocol along with its London Amendment in September 1992.
   b. India became a party to the CITES in 1967.
   c. India ratified the Basel Convention in 1992, shortly after it came into force.
   d. The Convention on Biological Diversity came into force in 1993.

10. The _____ established by the International Tropical Timber Agreement (ITTA), 1983, came into force in 1985 and became operational in 1987.
   a. ITTO
   b. TPN
   c. UNCED
   d. CBD

Chapter VIII

Environmental Management Plan

Aim

The aim of this chapter is to:

- introduce environmental management plan
- explain purposes of environmental management plan
- explicate details of environmental management plan

Objectives

The objectives of this chapter are to:

- enlist environmental management cell
- elucidate monitoring of environment
- explicate proposed budgetary provisions for EMP

Learning outcome

At the end of this chapter, you will be able to:

- identify the concept of waste-minimisation, recycle/reuse/recover techniques, energy conservation and natural resource conservation
- understand the operation phase
- describe environment management plan

8.1 Introduction

Industrial development is associated with a few positive impacts and a few negative impacts on the environment. The negative impacts should not hinder industrial development, but they should be properly mitigated. An Environmental Management Plan (EMP) has been prepared for the proposed cement plant of M/s. Rudradev Cement Pvt. Ltd. to minimise negative impacts and is formed on the basis of prevailing environmental conditions and likely impacts of this project on various environmental parameters. This plan will also facilitate monitoring of environmental parameters. EMP includes scheme for proper and scientific treatment and disposal mechanism for air, liquid and solid hazardous pollutants. Apart from this, green belt development, safety aspect of the workers, noise control, fire protection, etc., are also included in it.

8.2 Purpose of Environmental Management Plan

Various purposes of the environmental management plan are as follows:

- To treat and dispose of all the pollutants, viz., liquid, gaseous and solid wastes so as to meet statutory requirements (Relevant Pollution Control Acts) with appropriate technology.
- To support and implement development work to achieve environmental standards and to improve the methods of environmental management.
- To promote green-belt development.
- To encourage good working conditions for employees.
- To reduce fire and accident hazards.
- Budgeting and allocation of funds for environment management system.
- To adopt cleaner production technology and waste minimisation programme.

8.3 Details of Environmental Management Plan

The environmental management plan includes the following phases which are explained in the paragraphs below.

8.3.1 Construction and Commissioning Phase

The construction and commissioning phases of various environments are dealt in detail in the paragraphs below**.**

Air environment

The construction phase will be for a short period and hence the impacts will also be for a short and temporary period. During construction activities, mainly emission of dust and gases from movement of vehicles and construction activity is expected. However, following measures will be taken to reduce/contain such emissions:

- Preparation of paved internal movement roads will be taken up at the initial stage of civil construction work.
- Water will be sprinkled on loose top soil to prevent re-suspension of dust into ambient air due to movement of vehicles, etc.
- Separate civil construction material storage yard will be created within the site and it will be enclosed.
- Cement bags will be separately stored under cover in bales. Sand will be stacked under tarpaulin cover.
- Possibility of raising green belt along with construction activity will also be explored.
- Transport vehicles and construction equipments/machineries will be properly maintained to reduce air emissions.
- Vehicles and equipments will be periodically checked for pollutant emissions against stipulated norms.
- Idle running of vehicles will be minimised during material loading/unloading operations.
- Exhaust vent of DG set will be kept at proper height to ensure quick dispersal of gaseous emissions.
- All construction workers will be provided appropriate PPEs like dust mask, ear plug, helmet, safety belt, etc., and made to wear them during working hours.

Water environment

Maximum water requirement for construction purpose is estimated to be approximately 10 cu. mt. per day and water requirement for domestic purpose of construction work force is estimated to be approximately 3 cu. mt. per day. Thus, total water requirement during construction period will be approximately 13 cu. mt. per day. Water requirement during construction phase will be fulfilled by ground water using the bore-well located within premises. Water quantity being small, no major impact on existing water resources of the study area is envisaged. Further, there will be no housing facility at site for construction workers and hence a major source of impact on water environment will be avoided. Proper and sufficient sanitary facility will be provided to construction workers to maintain hygienic conditions at site. Storm water drain compatible with the local hydrological pattern of the area is provided to carry off any run-off or storm water from the premises and this water will be harvested through ground water recharge or storage. Care will be taken during construction work not to create any obstruction/dips in the topography which can lead to accumulation of water within premises leading to undesirable consequences like health and hygiene problems, etc.

Solid waste

Main solid waste generation during construction phase will be construction debris like rubble, brick bats, debris, steel scrap, wooden scrap, sand, gravel, etc. However, these materials are inert in nature and will not result into leaching of any substance or constituent. These materials will be properly sorted and will be used within premises for filling of low-lying areas. Wooden scrap, steel scrap will be given to scrap dealers. On completion of civil work, all debris, etc., will be completely removed from site to avoid any incompatibility with future use.

Noise environment

The following measures are proposed during construction period to mitigate adverse impacts:

- Construction machinery and vehicles will undergo periodic maintenance to keep them in good working condition.
- All machineries to be used for construction purpose will be of highest standard of reputed make and compliance of noise pollution control norms by these equipments will be emphasised by the company.
- Acoustic laggings and silencers will be used in equipments wherever possible.
- Feasibility of putting up acoustic enclosures/temporary barriers around areas with high noise levels will also be explored.
- All construction workers working in high noise areas will be provided appropriate Personal Protective Equipments (PPEs) like ear muffs and made to wear them during working hours.
- Possibility of raising green belt along with construction activity will also be explored so as to serve as a noise barrier.

Land environment

The following steps are proposed to take care of impact of construction activity on project land area:

- On completion of civil work, all debris, etc., will be completely removed from site to avoid any incompatibility with future use.
- Other materials like paints, diesel, etc., will be properly stored and handled to prevent any spillage on land.
- All the wastes will be stored at a designated site within the premises to prevent scattered discharge on land.

Ecology

As the proposed expansion will be within premises, no major tree cutting exercise will be there and no major impact on ecology is anticipated. However, possibility of rising of green belt along with construction activity will be explored, so that greening of area can be started at the beginning of proposed expansion project.

Socio-economic

As there will be no temporary housing colony for construction workers, no socioeconomic impact due to the same is envisaged. Overall socioeconomic effect of construction phase will be positive due to direct and indirect employment opportunity for the local population.

8.3.2 Operation Phase

Operation phase of any industry being longer in duration and because of its potential to create continuous impacts is much more important from the environmental impact point of view and a comprehensive and effective EMP has to be prepared and implemented to safeguard environmental concerns during the operation phase of any unit.

Air environment

The incremental Ground Level Concentrations (GLCs) of pollutants, i.e., Particulate Matter (PM) due to the proposed project have been predicted to be within the CPCB norms. The following measures are proposed to mitigate negative impact of operation phase of the project on the surrounding air environment:

- All transfer points will have bag filter attached to them to control and capture dust emission.
- Height of all the stacks will be as per statutory requirements. All the stacks will have Stack Monitoring Facility (SMF) consisting of sampling port-hole, platform and access ladder.
- Adequate spares of critical components of dust collection systems will be kept to ensure trouble free operations and continuous compliance to emission norms.
- A comprehensive plan for fugitive emission control based on CPCB guidelines is prepared and its details are given following section.
- All stacks will be provided with online CPM (Continuous Particulate Measurement) analysers and interlocking system with production plant will be provided which will automatically shutoff production activities when the emission concentration exceeds the set limit.
- Possibility of use of vehicles using cleaner fuel like Compressed Natural Gas (CNG) will be explored and if found feasible will be implemented on a large-scale.
- Transport vehicles will be properly maintained to reduce air emissions.
- Vehicles will be periodically checked for pollutant emissions against stipulated norms.
- Idle running of vehicles will be minimised during material loading/unloading operations.

Action plan to control secondary fugitive emissions as per CPCB guidelines is explained in the paragraphs given below.

Unloading section

The action plans to control secondary fugitive emissions at unloading section as per CPCB guidelines are as follows:

- Enclosure (of flexible material) will be provided towards unloading side up to suitable height.
- Bag filter will be provided to effectively capture dust emission.

Material handling section and transfer points

The action plans to control secondary fugitive emissions at material handling section and transfer points as per CPCB guidelines are as follows:

- All transfer point locations will be fully enclosed but will have access doors. Doors will be kept closed during operation.
- All transfer points will have bag filters.

Storage of clinker, gypsum and fly ash

The action plans to control secondary fugitive emissions regarding storage of clinker, gypsum and fly ash as per CPCB guidelines are as follows:

- Gypsum storage will be done under covered shed and side walls will be provided on minimum two sides up to roof level.
- Clinker and fly ash will be stored in concrete silos.
- Fly ash will be transported in closed trucks/tankers and will be mechanically transported into silos.
- All silo tops will be equipped with bag filters.

Cement packing section

The action plans to control secondary fugitive emissions at cement packing section as per CPCB guidelines are as follows:

- Packing machines will be provided dust extraction system in the form of bag filters.
- Adequate ventilation will be provided in packing hall to provide dust-free work environment.
- Spilled cement from the packing machine will be collected properly and sent for recycling. Arrangement for vacuum sweeping will also be provided.

Roads

The action plan to control secondary fugitive emissions at roads as per CPCB guidelines is as follows:

- All internal roads will be of concrete and will be well maintained. Repairing work required, if any, will be carried out immediately.
- Speed limit inside the plant premises will be fixed to prevent dust emissions.

Other measures

The other measures adopted to control secondary fugitive emissions as per CPCB guidelines are as follows:

- Company will also designate Environment Manager, who will look after fugitive dust emission control including emergency situations. He will be adequately trained to handle the responsibility of control of fugitive emissions.
- All personnel working on fugitive emission control systems will be given regular training on operation and maintenance of the system.
- A proper record and documentation of fugitive dust control system will be kept.
- All other guidelines of CPCB too will be complied.

Water environment

Total water requirement for operation phase will be 23 KLD and full filled by ground water using bore-well located within premises. To compensate and mitigate impact on ground water availability in the area due to continuous withdrawal of ground water by the project to the tune, a comprehensive rain water recharge scheme will be developed. Proper and sufficient sanitary facility will be provided to construction workers to maintain hygienic conditions at site. The sewage is treated in a common sewage treatment plant. While the purified water will be reused for the cement manufacturing process, the sewage sludge, which is an excellent fertilizer, shall be set out in the areas where reforestation is anticipated.

Action plan for rainwater harvesting

Rain water harvesting is a way to capture the rain water when it rains, store that water above ground or charge the underground and use it later.

Rainwater harvesting system

Rooftop rainwater from the admin area, store area and plant area is flown down to the ground and then taken to storm water drains. The storm water drains are intercepted at strategic locations and rainwater is diverted into recharge wells. The recharge wells are provided with recharge bores to facilitate the recharge. Layers of filtering material like boulders, pebbles and coarse sand inside the recharge will ensure efficient filtration.

Solid wastes

The following precautionary measures will be adopted for the effective disposal of solid wastes:

- All the solid wastes will be stored separately in a ‘Solid Waste Storage Area’ within the factory premises. It will have non-percolating R.C.C. floor and covered roof. The storage area will have proper illumination and ventilation and equipped with fire extinguisher device wherever required. A signboard will be put out-side the storage area marked ‘Solid Waste Storage Area’ and ‘Danger’.

- Non-hazardous dried bio-sludge from septic tank will be rich in nutrients and hence will be used as fertilizer and nutrient within premises for gardening.
- Hazardous waste, i.e., used lubricating oil will be given to CPCB registered recycler/re-processor of oil.

Noise environment

The following precautionary measures will be adopted to control the noise level:

- Roof of buildings will be constructed of reinforced concrete or of lightweight concrete
- Walls and ceilings of building will be lined with sound absorbing materials, wherever required
- Sheet metal casting and housing will be insulated with sound absorbing materials
- Noise generating sources and their platforms will be maintained properly to minimise noise vibrations generated by them
- Personnel working near the noisy machines in different plant locations, will be provided with well designed ear muffs/plugs (effective noise reduction 10-15 dBA)
- Cement mill premises will have proper ventilation.
- Green belt will be developed to act as a noise barrier.
- Noise barriers/shields in the form of walls, beams will be provided around the units, wherever found feasible
- Training to personnel will be imparted to generate awareness about effects of noise and importance of using PPEs.

Land environment

There will be no major generation of hazardous waste from the project. A small quantity of used lubricating oil will be generated which will be properly stored and disposed off. There will be no disposal of industrial effluent on land as small quantity of treated industrial effluent will be re-used. Only treated sewage will be used on land for gardening purpose. Thus, no impact on land is envisaged due to discharge of gaseous emission, solid waste or liquid effluents from the proposed unit.

Biological environment

Green belt development: Tree plantation is one of the effective remedial measures to control the air pollution and noise pollution. It also causes aesthetics and improvement of area climatologically as well as sustains and supports the biosphere. It is an established fact that trees and vegetation acts as a vast natural sink for the gaseous as well as particulate air pollutants due to enormous surface area of leaves. It also helps to attenuate the ambient noise level. Plantation around the pollution sources control the air pollution by filtering the air particulate and interacting with gaseous pollutants before it reaches to the ground. Tree plantation also acts as buffer and absorber against accidental release of pollutants.

In Green belt area about 1000 tree per acre of land shall be planted, the selection of tree species suitable for plantation at the industry shall be governed by guiding factors as stated below:

- The trees should be tolerant to air pollutants present in the area
- The trees should be able to grow and thrive on soil of the area, be evergreen, inhabitant, having minimum of leaf fall.
- The trees should be tall in peripheral curtain plantation and with large and spreading canopy in primary and secondary attenuation zone.
- The trees should possess extensive foliar area to provide maximum impinging surface for continued efficient adsorption and absorption of pollutants.
- The trees should be fast growing and indigenous and should maintain ecological, land and hydrological balance of the region.
- It is also recommended to plant few trees, which are sensitive to air pollution, as air pollution indicator.
- It is also recommended to carry out extensive plantation within premises.

- Some portion of rooftops/terraces area of the building will be covered with plantation.
- Keeping in view the climatic conditions, status of soils and vegetation types in and around the project area the species shall be selected for the proposed green belt development.

Health and safety

The following health and safety measures will be adopted:

- Regular inspection and maintenance of pollution control systems. All measures related to safety such as safety appliances, training, safety awards, posters, slogans will be undertaken.
- The workers exposed to noisy sources will be provided with ear muffs/plugs.
- Adequate facilities for drinking water and toilets will be provided to the employees.
- The fire and safety equipment will be properly utilised and maintained regularly.
- The health of the workers will be regularly checked by a well qualified doctor and proper records will be kept for each worker.

General considerations

For good housekeeping of the proposed project, following measures will be planned:

- Maintaining cleanliness of roads to prevent accumulation of dust and waste material.
- Inculcating positive attitude among employees for good housekeeping.
- Maintaining hygienic conditions in canteens, near drinking water source and toilets.

Concept of waste-minimisation, recycle/reuse/recover techniques, energy conservation, and natural resource conservation

Waste-minimisation, recycle/reuse/recover techniques, energy conservation, and natural resource conservation will involve the following concepts:

- Waste-minimisation: Process optimisation by using latest technology equipment.
- Recycle/reuse/recover: Close circuit process water cooling system for plant. Dust collected from air pollution control equipment will be 100% recycled in the in cement manufacturing process. Other solid wastes, i.e., used/ spent oil shall be reused in plant for lubrication or sold to authorise recyclers. However, no waste is generated by plant operation.
- Energy Conservation Measures: Latest technology has been selected for grinding of clinker and slag which have minimum specific power consumption. In order to conserve energy, the following measures have been taken right at the time of selection of equipments and technology:
  - Control of fans with frequency converters instead of dampers.
  - To go for highly energy efficient pulse jet bag filters for the cement mill.
  - To install highly efficient, high efficiency air separators in the mill.
  - Minimise use of compressed air, by use of proper compressed air pipe line design in the plant.
  - The lighting of the complete plant will be controlled with light intensity controllers.
  - Air leakages will be to a bare minimum with proper design of air ductings and casings for cement mill.
  - False air leakages in the plant will be arrested by carrying out regular checks.
- Natural resource conservation: By using slag and fly ash, natural resource, such as limestone is conserved. To conserve ground water, rain water harvesting will be carried out to store rain for future use and also to recharge ground water.

8.4 Environmental Management Cell

In addition to preparing an EMP, it is also necessary to have a permanent organisational set up to ensure its effective implementation. Hence, M/s. Rudradev Cement Pvt. Ltd. will create a team consisting of officers from various departments to co-ordinate the activities concerned with management and implementation of the environmental control measures. This team will undertake the activity of monitoring the stack emissions, ambient air quality, noise

level, etc., either departmentally or by appointing external agencies wherever necessary. Regular monitoring of environmental parameters will be carried out to find out any deterioration in environmental quality and also to take corrective steps, if required, through respective internal departments. The Environmental Management Cell will also collect data about health of workers, green belt development, etc. Organogram of the Environmental Management Cell is presented in Fig. 8.1.

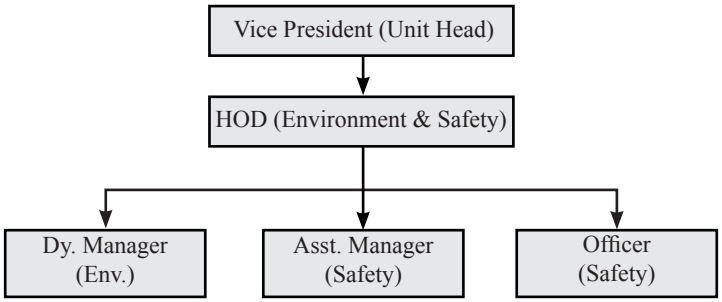

Fig. 8.1 An organogram of environment management cell

The cell will also be responsible for monitoring of the plant safety and safety related systems which include the following:

- Checking of safety related operating conditions.
- Visual inspection of safety equipments.
- Preparation of a maintenance plan and documentation of maintenance work specifying different maintenance intervals and the type of work to be performed.
- Conduct and submit annual environmental audit. A SPCB registered agency will be retained to generate the data in respect of air, water, noise, soil and meteorological data and prepare the environmental audit report. This report will be submitted to the SPCB every year before 30th September. Timely renewal of Consolidated Consents & Authorisation (CC & A) will also be taken care of.
- Submitting environmental monitoring report to SPCB. Data monitored by the cell will be submitted to the Board regularly and as per the requirement of SPCB. The cell will also take mitigative or corrective measures as required or suggested by the Board.
- Keeping the management updated on regular basis about the conclusions/results of monitoring activities and proposes measures to improve environment preservation and protection.
- Conducting regular safety drills and training programmes to educate employees on safety practices. A qualified and experienced safety officer will be responsible for the identification of the hazardous conditions and unsafe acts of workers and advise on corrective actions, organise training programmes and provide professional expert advice on various issues related to occupational safety and health.
- Conducting safety and health audits to ensure that recommended safety and health measures are followed.

8.5 Monitoring of Environment

A regular monitoring of environmental parameters like air, water, noise and soil as well as performance of pollution control facilities and safety measures in the plant are important for proper environmental management of any project. Therefore, the environment and safety cell will handle monitoring of air and water pollutants as well as the solid wastes generation as per the requirements of State Pollution Control Board and Central Pollution Control Board. Proposed monitoring schedule for environmental parameters is given in following table 8.1.

Advantages of monitoring

Monitoring of various parameters will be carried out regularly to administer the following:

- Find out pollution level inside the plant and in nearby area.
- Compile pollution related data for remedial measures.
- Find out efficiency level of pollution control measures adopted.

Sr. No.	Attribute	Parameters	Frequency of Monitoring
1.	Stack Monitoring	SPM, SO2, NOx	Every Month or as specified by State pollution Control Board
2.	Ambient air quality within premises	PM, SO2, NOx, CO	Every Month or as specified by State pollution Control Board
3.	Ambient air quality outside premises	PM, SO2, NOx, CO	Once in a year or as specified by State pollution Control Board
4.	Water monitoring	Ph, Temp., TDS, TSS, Hardness, BOD, COD, heavy metals, etc.	Once in a year or as specified by State pollution Control Board
5.	Noise monitoring within premises	Noise levels	Every Month or as specified by State pollution Control Board
6.	Noise monitoring outside premises	Noise levels	Every Month or as specified by State pollution Control Board

Table 8.1 Monitoring schedule for environmental parameters

Laboratory facilities

Laboratory facilities to analyse the above stated parameters will be provided to cater to the needs of all environmental control activities, all necessary equipments for the monitoring and analysis of environmental parameters shall be made available. List of laboratory equipments required for environmental monitoring is given in following table 8.2.

Sr. No.	Name of Equipments	Description	Make	Model	Qty.
1.	High volume sampler(RDS)	For ambient air quality monitoring	Envirotech	APM-460BL	3
2.	Stack sampler	Stack monitoring	Vayubodhan Upkaran	VSS1	1
3.	Sound level meter	Sound level monitoring	Lutron	SL4010	1
4.	Digital anemometer	Wind speed measurement	Lutron	AM4201	1
5.	Water testing kit	Water quality testing	Scientific	Portable	1
6.	Rain gauge	Rain fall measurement	Scientific	-	1
7.	TDS meter (Digital)	TDS test	ESICO	651E	1
8.	PH meter (Digital)	TDS test	ESICO	111E	1

9.	Hygrometer	Humidity measurement	BARIGO	-	2
10.	Incubator for BOD test	BOD	Scientific	-	1
11.	Max-Min. thermometer	Temperature measurement	G.H.Zeal Ltd.	-	1
12.	Mercury thermometer	Temperature measurement	Labequip Inst.	-	1

Table 8.2 Laboratory equipments for environmental monitoring

8.6 Proposed Budgetary Provisions for EMP

Adequate budgetary provisions have been made by management for execution of environmental management plans. The details of total capital and recurring (per annum) for environmental pollution control measures are given in following table 8.3.

Sr. No.	Item	Rs. In lakhs
Capital expenditure:		
1.	Air Pollution control equipment	320.00
2.	Water treatment	10.00
3.	Emission monitoring equipments	8.00
4.	Green belt development	10.00
	Total capital expenditure	**348.00**
Recurring expenditure per annum:		
6.	Recurring expenditure on environmental management cell and on pollution control systems	120.00

Table 8.3 Total capital and recurring cost for EPCM

Summary

- Industrial development is associated with few positive impacts and few negative impacts on the environment.
- EMP includes scheme for proper and scientific treatment and disposal mechanism for air, liquid and solid hazardous pollutants.
- During construction activities, mainly emission of dust and gases from movement of vehicles and construction activity is expected.
- Maximum water requirement for construction purpose is estimated to be approximately 10 cu. mt. per day and water requirement for domestic purpose of construction work force is estimated to be approximately 3 cu. mt. per day.
- Main solid waste generation during construction phase will be construction debris like rubble, brick bats, debris, steel scrap, wooden scrap, sand, gravel, etc.
- Total water requirement for operation phase will be 23 KLD and fulfilled by ground water using bore-well located within premises.
- Rain water harvesting is a way to capture the rain water when it rains, store that water above ground or charge the underground and use it later.
- Rooftop rainwater from the admin area, store area and plant area is flown down to the ground and then taken to storm water drains.
- A small quantity of used lubricating oil will be generated which will be properly stored and disposed off.
- Tree plantation is one of the effective remedial measures to control the air pollution and noise pollution.
- Tree plantation also acts as buffer and absorber against accidental release of pollutants.
- Adequate budgetary provisions have been made by management for execution of environmental management plans.

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Self Assessment

1. _____ development is associated with few positive impacts and few negative impacts on the environment.
   a. Environment
   b. Industrial
   c. Positive
   d. Negative

2. _____ includes scheme for proper and scientific treatment and disposal mechanism for air, liquid and solid hazardous pollutants.
   a. EMP-Environmental Management Plan
   b. Relevant Pollution Control Acts
   c. Appropriate technology
   d. Industrial development

3. Match the following

1. Waste minimisation	A. By using slag and fly ash, limestone is conserved.
2. Recycle/reuse/recover	B. Process optimisation by using latest technology equipment.
3. Energy conservation measures	C. Close circuit process water cooling system for plant.
4. Natural resource conservation	D. Control of fans with frequency converters instead of dampers.

   a. 1-D, 2-A, 3-C, 4-B
   b. 1-A, 2-D, 3-B, 4-C
   c. 1-B, 2-C, 3-D, 4-A
   d. 1-C, 2-B, 3-A, 4-D

4. Which phase will be for a short period and hence the impacts will also be for a short and temporary period?
   a. Operational phase
   b. Construction phase
   c. Management phase
   d. General phase

5. Maximum water requirement for construction purpose is estimated to be approximately _____ cu. mt. per day and water requirement for domestic purpose of construction work force is estimated to be approximately 3 cu. mt. per day.
   a. 1 cu. mt.
   b. 8cu. mt.
   c. 6 cu. mt.
   d. 10 cu. mt.

6. Which of the following statement is true?
   a. Total water requirement during construction period will be approximately 13 cu. mt. per day.
   b. Total water requirement during construction period will be approximately 11 cu. mt. per day.
   c. Total water requirement during construction period will be approximately 9 cu. mt. per day.
   d. Total water requirement during construction period will be approximately 4 cu. mt. per day.

7. What is one of the effective remedial measures to control the air pollution and noise pollution?
   a. Deforestation
   b. Tree plantation
   c. Rain water harvesting
   d. Rooftop rainwater harvesting

8. In addition to preparing an EMP, it is also necessary to have a permanent organisational set up to ensure its _____ implementation.
   a. effective
   b. ineffective
   c. minor
   d. organised

9. Which of the following statement is false?
   a. Purposes of the environmental management plan are to encourage good working conditions for employees.
   b. Purposes of the environmental management plan are to reduce fire and accident hazards.
   c. Purposes of the environmental management plan are to adopt cleaner production technology and waste minimisation programme.
   d. Purposes of the environmental management plan are to achieve environmental hazardous pollutants.

10. The Environmental Management Cell will also collect data about health of workers, _____ belt development, etc.
   a. green
   b. red
   c. brown
   d. blue

Case Study I

Fujitsu Environmental Management System

Fujitsu and sustainability

As a leader in ICT sustainability Fujitsu has a long commitment to reducing the environmental impact of our operations. Here in Australia, our most significant impact is from our data centre operations and the consumption of electricity. However, our sustainability strategy is much broader than this and covers all aspects of our operations across Australia and New Zealand including greenhouse gas (GHG) emissions, water and waste.

The challenges

While many organisations accept that they have a duty or moral obligation to be environmentally responsible, there are also other key drivers that should be acknowledged. These can include legal requirements, customer or stakeholder demands and expectations from present and potential future employees. These drivers require organisations to not only pursue profit, but seek to do so in a manner that is considerate to the environment, if not actively beneficial to the environment.

While many organisations have acknowledged these drivers, the leading organisations have gone a step further and are harnessing the societal shift towards greater sustainability to deliver innovation and new forms of value.

Fujitsu's Sustainability Team is dedicated to the development and execution of the company's ambitious sustainability vision. As part of this transformation process they need to connect to all parts of the organisation and integrate into all layers of the company, from the fundamental underpinning processes all the way through to the culture, company brand and identity.

Any sustainability transformation programme is dependent on its integrity. The company must be genuine in its intentions and its actions. It is fundamental to understand what impact the company's operations are having on the environment, what action is being taken to reduce these impacts and how successful these actions are in their implementation.

The Environmental Management System underpins the company's objectives which in turn supports our goals and ultimately our sustainability vision. The EMS is the framework to move from strategy to realisation.

The solution

Fujitsu has a global Environmental Management System certified under 14001. However, as with other management systems we opted to seek a local certification for our operations. Our primary reasons for doing this was to enable closer integration with the existing management systems such as ISO 9001; that the EMS would benefit from greater integrity from closer management attention; and also a higher audit frequency.

The Fujitsu EMS provides a framework for a systematic approach to meeting our environmental objectives. This enhances the likelihood of meeting them through a rigorous plan-do-check-act approach that is independently verified.

SAI Global's Damian James General Manager, Assurance Services Australia said, "During SAI Global's EMS certification audits conducted during August 2012, we found evidence of an exceptional level of commitment, input and support from top management and staff alike with a focus on sustainability. This has ensured that the Environmental Management System provides Fujitsu ANZ with the intended controls, prevention and reduction of pollution as well as customer focus and system improvement opportunities through effective implementation."

The health and performance of the system is monitored via a comprehensive set of goals, KPIs and related targets along with a well implemented internal audit programme."

Fujitsu's operations in Australia and New Zealand include office locations, warehouse and distribution centres and of course our data centres. Each of these types of locations has been included in our EMS. Of these facilities it is our data centres which have the greatest environmental impact, so naturally these were the focus of our EMS roll out. Today all of Fujitsu's data centres are managed under our local ISO 14001 certified Environmental Management System. This is something above and beyond our competition and is something that Fujitsu is rightfully proud of.

Building a virtual team from across the organisation and working closely with our Business Management Systems team, we developed an extremely robust environmental management framework. We have clear and measureable objectives with associated measurement and controls. As part of our EMS we have trained more than 1,100 staff, so that participation and understanding of our obligations and impacts are known and understood by our staff.

The benefits

At Fujitsu Australia and New Zealand we have reduced operating expenses and injected additional impetus into our path to sustainability. From a 2008 baseline, the emissions generated by our offices have been cut by more than 18%, travel related GHG emissions have been reduced by more than 50% and our data centre facilities run a PUE that is best practice for tier III data centres.

Our environmental management system is integrated into both our local and global management systems. Our approach is robust and includes the following principles:

- Transparency: We share our environment related results to critique for continuous improvement
- Broad based: We encourage employees to keep the impact of their business activities front of mind
- Customer-focused: We work with our clients on improving environmental efficiency
- Responsible: We are conserving resources as we create best of breed, eco-friendly products and services

"I firmly believe that business has a crucial role to play in addressing the challenges we face in terms of achieving a sustainable future and that part of this role is a responsibility to minimise the environmental impact from our operations. An Environmental Management System is a comprehensive framework that promotes good practice for achieving this.

Fujitsu is seeing better performance against our sustainability targets, real cost saving and a greater degree of staff understanding and engagement in sustainability at all levels as a result of our programme." Chris Seale, Director of Sustainability, Fujitsu Australia & New Zealand

Our Environmental Management System is well-documented and successful. We have in place top level management support and a very comprehensive set of goals underpinning our strategy. The strategy itself is understood by our employees and progress is monitored effectively. These aspects combine into a highly effective sustainability program which has been recognised in a number of external audits. Fujitsu Australia and New Zealand has embraced the challenge of global sustainability and seeks ongoing, continuous improvement in our environmental performance.

(Source: *Fujitsu Environmental Management System.* [Pdf] Available at: <http://www.fujitsu.com/downloads/AU/Fujitsu-Environmental-Management-System-Case-Study.pdf)> [Accessed 17 December 2013]).

Questions

1. What is the challenge?

   Answer

   Fujitsu's ambitious sustainability vision spans the entire operation of the company. To underpin and support our long-term strategy robust processes and practices are needed to continuously reduce the environmental impact of our operations, and embed sustainability into everything that we do.

2. What is the solution?

   Answer

   The solutions are as follows:

   - Implementation and ISO 14001 certification of an Environmental Management System (EMS) across all facility portfolio types
   - Locally managed and resourced with strong management support
   - Aligned to existing local management systems and to global EMS
   - All regional data centres included in our certification programme

3. What is the benefit?

   Answer

   The benefits are as follows:

   - Continuous improvement and monitoring of environmental goals, objectives and targets
   - Reduced operating expenses
   - Integration of sustainability across the entire organisation both locally and globally

Case Study II

How Autani can Save Your School Money?
A case study on implementing the Autani integrated energy management solution in schools.

Executive Summary
Autani provides school administrators an effective means of saving money and energy. After implementing Autani's integrated energy management solution, the school studied herein reported an average savings of over 70%.

The Autani Solution
Autani has developed an integrated energy management system that enables school administrators to save money by cost effectively managing their lighting, HVAC, computers, and plug loads from a single, easy to use, wireless platform. Wireless technology and user-friendly, intuitive energy management software makes the solution easy to install and easy to maintain for both new and retrofit construction.

Autani's integrated approach to energy management yields numerous benefits over manual control. The Autani solution simplifies energy management by integrating multiple energy consuming systems, which eliminates redundant equipment costs and interoperability issues, as well as streamlines operating processes. There is no need to deploy dedicated personnel to verify the status of the building or make changes for special events or seasonal adjustments. In short, Autani solutions make energy management easy by reducing waste and saving money automatically.

The Autani Solution Implemented
The Autani solution was implemented in a California private school. This implementation included HVAC, lighting, computer energy management and plug load control, and it was performed in three phases.

- Metering devices were installed to baseline the school's average daily consumption. In the baseline, the school continued to use it's previously installed programmable thermostats and the cleaning crews continued to turn off lights at night.
- HVAC and lighting management were implemented, which involved installing wirelessly communicating thermostats, light controllers, and occupancy sensors. HVAC was controlled based on schedule and occupancy, and lighting was controlled based on occupancy.
- Plug load control and computer management were added. User-defined energy saving rules for temperature setback, lighting control, and computer and plug device operation were optimised. The optimisation rules included changing the temperature set point schedules, activating rules for doors and contacts, and activating occupancy rules.

The Results
Fig. 1, below, details the energy consumption at the school during each phase of the Autani implementation as a function of the type of day: school day, non-school day, or school closed.

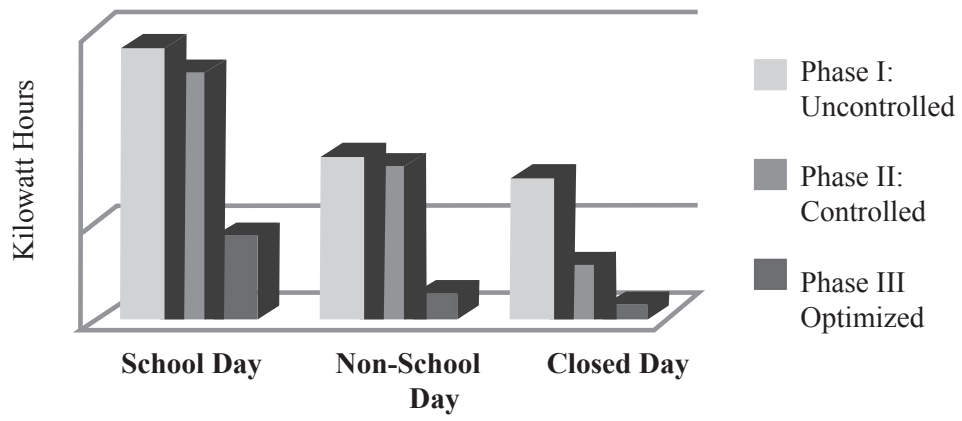

Fig. 1 Energy consumption comparison

The full implementation of the Autani solution resulted in a significant decrease in energy usage for all types of days. The significant energy savings achieved using the Autani solution results from the Autani system being designed specifically to manage the variable usage patterns prevalent in schools.

Fig. 2 shows the savings in lighting, HVAC, and computers/other office equipment resulting after the implementation of the Autani solution.

Figure 2: Energy Savings

	Lighting	HVAC	Computers & Plug devices
Percentage Reduction	**48%**	**31%**	**85%**

Fig. 2 Energy savings

The Autani solution was able to achieve substantial energy savings across all major consumption groups and across all three daily usage patterns. Within the individual consumption groups, it was notable that:

- Significant reductions in HVAC and lighting energy consumption were achieved over and above the savings achieved with programmable thermostats and manual control of lighting.
- Automated control of computer and plug devices can substantially reduce the energy consumed by those devices, presumably due in part to the lack of an effective manual procedure to control those devices as a group.

The Added Benefit – Utility Rebate Opportunities

In addition to lower utility costs, the amount of energy saved on campus qualified the school for a rebate from their utility provider, providing further monetary savings and reducing system payback time.

A Word from Our Customer

The headmaster of the school summarised his experience with Autani by saying, "We carefully monitored and recorded our energy use prior to implementing the system. Our energy savings to date are impressive, with an overall average savings of 71%. Thanks to the Autani system, we are finally able to monitor and control our energy use, while still providing a comfortable and non-disruptive environment for our students, faculty and staff."

(Source: *How Autani Can Save Your School Money*. [Pdf] Available at: <http://www.autani.com/wp-content/uploads/file/White_Paper_School_Case_Study.pdf)> [Accessed 17 December 2013]).

Questions

1. What did the Autani solution implemented in a California private school?
2. What did the Autani solution able to achieve?
3. How much energy was saved?

Case Study III

United Nations Environment Programme

Background
Conduct a green buildings review of renovation designs for the United Nations complex in New York.

Our Approach
The United Nations (UN) headquarters complex in New York City has changed little since it was designed in the 1940's. In response to changes in building codes, security concerns, and the desire for improved energy efficiency and environmental performance, the UN has budgeted over US$1.5 billion to completely renovate the campus. While the design, size, and shape of the buildings will remain unchanged, the renovation's main goal is to replace outdated and deteriorated building systems, to improve security and the environmental performance of the buildings, including indoor environment, energy and other items.

The UN also aims to improve its environmental performance by benchmarking its improvements against the standards established by the United Stated Green Building Council (USGBC) called Leadership in Energy & Environmental Design (LEED).

The UN retained ERM to review the current design of the campus renovation to evaluate its improvements in energy efficiency and environmental performance to determine its potential status against a LEED benchmark. In addition, the UN requested that ERM provide potential 'blue sky' design features that while not necessarily cost-effective, can be used to make the campus unique and provide a unique 'signature' for stakeholders.

ERM first assembled a truly global team of diverse professionals for this project, including experts in green building design, environmental assessments, energy efficiency, and climate change. The team reviewed current design information and evaluated the features against other programmes. The team then identified additional improvements in energy efficiency, water conservation, landscaping and materials usage. ERM estimated approximate costs of the additional design features where appropriate. ERM also researched and evaluated the application to the UN renovation of unique 'blue sky' design features.

Benefits and Value
ERM issued a report to the UN containing the review of the current design of its major renovation of the Headquarters campus as applied to green building standards. The report confirmed in detail that the current design was highly advanced in environmental performance. The report provided a list of additional features that could be incorporated. ERM provided a number of more innovative, 'blue sky' design features to make the renovation unique.

The client is currently reviewing the recommendations for possible inclusion in the final design and construction documents, and will likely incorporate many of ERM's recommendations in the final design.

(Source: *United Nations Environment Program.* [online] Available at: <http://www.erm.com/en/Analysis-and-Insight/Case-Studies/Case-Study_United_Nations/)> [Accessed 17 December 2013]).

Questions
1. When was the United Nations (UN) headquarters complex in New York City designed?
2. What is the aim of U.N?
3. What is blue sky and its benefits?

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Self Assessment Answers

Chapter I

1. b
2. c
3. d
4. a
5. c
6. b
7. a
8. d
9. b
10. d

Chapter II

1. a
2. c
3. d
4. c
5. a
6. b
7. c
8. c
9. b
10. c

Chapter III

1. b
2. d
3. c
4. a
5. c
6. d
7. b
8. a
9. b
10. d

Chapter IV

1. b
2. b
3. d
4. a
5. c
6. d
7. a
8. a
9. b
10. c

Chapter V

1. b
2. a
3. c
4. c
5. b
6. a
7. b
8. a
9. d
10. c

Chapter VI

1. a
2. c
3. d
4. d
5. b
6. d
7. c
8. b
9. a
10. b

Chapter VII

1. b
2. a
3. c
4. c
5. a
6. d
7. a
8. d
9. b
10. a

Chapter VIII

1. b
2. a
3. c
4. b
5. d
6. a
7. b
8. a
9. d
10. a