



Unit 1 Environment Management

	Learning Outcome
After reading this unit, you will be able to:	
<ul style="list-style-type: none">• Explain succinctly the meaning of environment management• Elucidate on the fundamentals of sustainable development• Clarify the implications of human population growth• Describe how to limit the growth of population• Detail out the relationship between environment and business schools	

	Time Required to Complete the unit
<ol style="list-style-type: none">1. 1st Reading: It will need 3 Hrs for reading a unit2. 2nd Reading with understanding: It will need 4 Hrs for reading and understanding a unit3. Self Assessment: It will need 3 Hrs for reading and understanding a unit4. Assignment: It will need 2 Hrs for completing an assignment5. Revision and Further Reading: It is a continuous process	

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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 itself, 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 Environment Management

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, with population's a fraction of today's, 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 organize 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 utilization was incorporated in social as well as economic progress before the 1970s, e.g. integrated or comprehensive regional planning and management was put into practise 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 off-site 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. And 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 (1975: ix) 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.

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 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 variations of 'Laws of Ecology' (founded on four 'laws' published by Commoner (1971):

- 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 natural procedures and human actions to make sure no critical process is disturbed).

Since 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, recognize 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 two questions: (1) What type of planet do we desire? (2) 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: 175) identified two key segments: those who implement a horticultural implied comparison- Garden earth- and those who favor 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, 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 criticized (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:

- Working to secured 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. Following preventive measures is 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 programs 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)

- Serves as a tool to improve environmental performance
- Provides a systematic methodology for managing an organization's environmental behaviour
- Is that aspect of the organization's overall management structure that addresses immediate and future impacts of its products, services and processes on the environment
- Gives order and consistency for organizations to address environmental concerns through the allocation of resources, assignment of responsibility and consistent evaluation of practices, procedures and processes
- Focuses on continuous improvement of the system

What is the EMS Model?

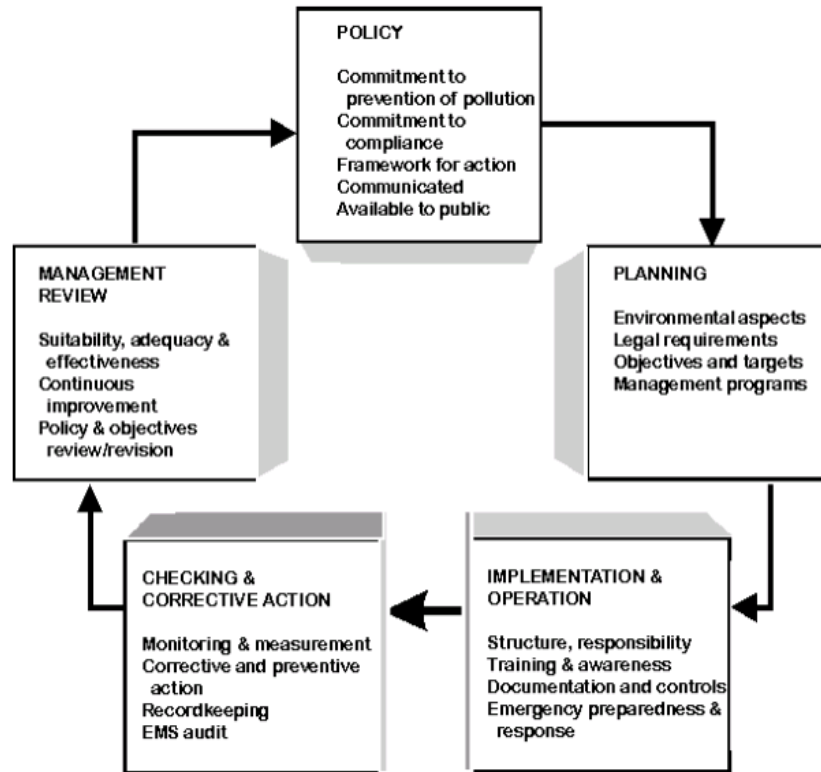


Fig. 1.1: EMS Continuous Improvement Cycle

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 organization is reviewing and revising the system on a continual basis.

This model can be employed by a wide range of organizations- right from manufacturing facilities to service industries to government agencies.

What are some key elements of an EMS?

- Policy Statement: a statement of the organization'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 organization
- Implementation: plans to meet objectives and targets

- Training: instructions to ensure employees are aware and capable of fulfilling their environmental responsibilities
- Management review


Common Queries:


1. Can existing environmental management activities be integrated into the EMS?


It is a matter of great comfort to many organisations that existent environmental management systems can be easily incorporated into the EMS. It is a flexible system and does not essentially require organizations 'retool' and 'reorganise' their existing activities. An EMS establishes a management framework by which an organization's impacts on the environment can be systematically identified and reduced. Many organisations have already been employing active and effective pollution prevention activities. Such ongoing activities can be assimilated into the overall EMS competently.

2. Can EMS be used to assist with maintaining compliance?

EMS can prove to be an efficacious tool to assist in maintaining and checking compliance, in fact. As an example, the Massachusetts Department of environmental protection (DEP) has opted to assist with the use of EMS in compliance cases. The Environmental Protection Agency (EPA) also produces a guidance on the use of EMS in Enforcement.

	Study Notes

	Assessment
<ol style="list-style-type: none"> 1. Define Environmental Management. 2. Explain nature and scope of Environment Management 	

	Discussion
<p>Being an individual, what and how much can you contribute for Environment Management? Discuss.</p>	

1.3 Fundamentals of Sustainable Development

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 the 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 are finding 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

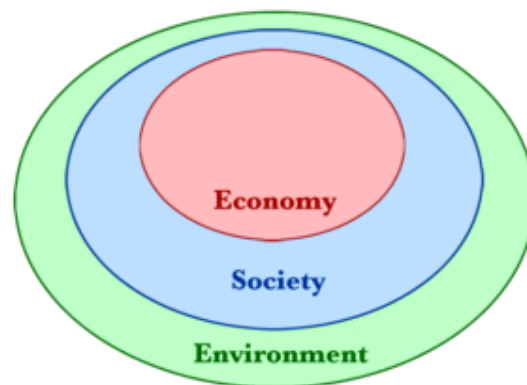


Fig. 1.2: A representation of sustainability

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.

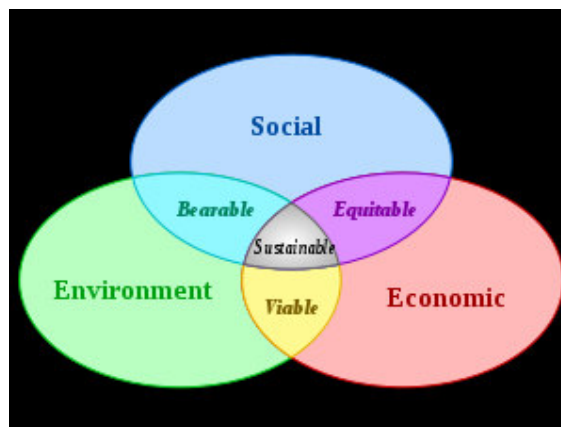


Fig. 1.3: Scheme of Sustainable Development

- 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".

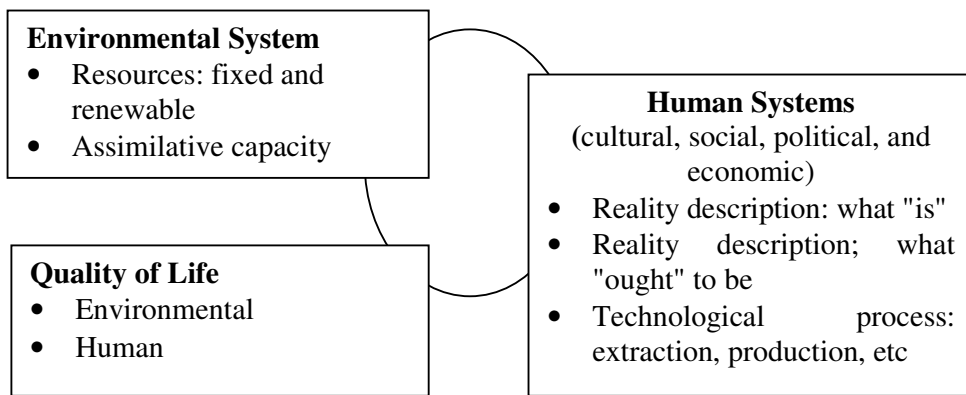


Fig. 1.4: Carrying Capacity and Quality of Life (adapted from Mabbutt 1985)

Consequently, carrying capacity, in terms of human systems, can be further defined as follows:

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 ecocentric, 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 nonhuman) 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.

- **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.

Example: 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.



Fig. 1.5: Members of a women's cooperative harvest their farmed trout in Lake Titicaca, Peru

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 utilization 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 recognizes 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



Fig. 1.6: Deforestation of native rain forest in Rio de Janeiro City (2009)

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 stabilizing 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**



Fig. 1.7: Air-polluting emissions from a power plant in New Mexico

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 four types of market failure as possible explanations:

First, while the benefits of natural or social capital depletion can usually be privatized, the costs are often externalized (i.e. they are borne not by the party responsible but by society in general).

Second, natural capital is often undervalued by society since we are not fully conversant with the real cost of depletion of natural capital.

Information asymmetry is a third reason- the link between a cause and its effect or effects is often obscured, making it difficult for actors to make informed choices.

Cohen and Winn close with the fourth realization that contrary to economic theory, many firms are not perfect optimizers. They postulate that firms often do not optimize 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 minimize 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 instrumentalize 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 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.

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 the 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 programs. 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**



Fig. 1.8: The retreat of Aletsch Glacier in the Swiss Alps (in 1979, 1991 and 2002 respectively)

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 criticize 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 idealized 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".



Study Notes

	Assessment
<ol style="list-style-type: none"> 1. What did you understand by Sustainable Environment? 2. Explain fundamentals and principles of Sustainable Environment. 	

	Discussion
<p>Conduct a debate on the topic "Sustainable Development". Write down 10 points each in favour and against the topic.</p>	

1.4 Implications of Human Population Growth

A research on the reserves and the natural resources of the world concluded that the increase observed in global average temperature over the last century "is unlikely to be entirely natural in origin" and that "the balance of evidence suggests that there is a discernible human influence on global climate". Human population has grown over the past 50 years. When there were fewer citizens to the world, the dominant factors in control of the ecosystem were natural, but now that the human population has grown far and wide, there is concern that humans are converting themselves into a significant influence on ecosystem dynamics. The quadrupling human population and tripling per capita carbon dioxide emissions in the 20th century now have a more significant effect on the earth's climate than in the past. Due to the inevitable and consistent human presence on earth, human behaviour and lifestyle will be major factors in deciding the dimensions of global warming. The industrialised world uses energy and resources, which contribute towards global warming because most of the energy generates from carbon-based fossil fuels like coal, oil and natural gas. Transportation or conveyance (the movement of people and goods) accounts for about one-third of the developed world's CO₂ emissions. There is a rapid swell in the energy consumed per capita as compared to the growth in the population. People must consider the sustainability of their lifestyles. Do we need so many cars? Do we need to burn fossil fuels to transport goods and people, manufacture products, heat and cool buildings, light spaces and cook food? Can we not practice moderation? Can we not compromise with alternative energy sources? Human behaviour's effect on global climate

reaches beyond mere energy consumption and the burning of fossil fuels. Due to industrialisation, nearly half of the world's green belt or forests, i.e. 16 million hectares of virgin forest, have been cut down or burnt, thereby leading to global warming. As a natural process, these forests absorb carbon dioxide and release oxygen and help in regulating the climate. Human activities resulting in deforestation include logging, farming, ranching, use of wood as fuel and lumber, mining, building of dams and urban expansion.

There are huge disparities in per capita emissions by different countries. Developed, industrialised countries are accountable for contributing most of the harmful gases into the atmosphere, therefore leading to a faster global warming as compared to the contribution of developing countries. In 1995, 20% of the world's population, resident of countries with the highest per capita emissions, contributed to 63% of the world's fossil fuel CO₂ emissions. The 20% of the world at the opposite end of the spectrum contributed only 2% of global fossil fuel CO₂. For example, the average person in the United States contributes five times as much carbon dioxide to the atmosphere as the average Mexican and 19 times as much as the average Indian. In addition, disparities in income lead to a small percentage of the population of a country to take the onus of the majority of greenhouse gas emissions. There is currently much debate about whether developing countries will continue to exploit resources and cause further pollution in order to develop their economies. In recent years, as scientists and policy makers have learned more about human population and its effect on climate change, there have been efforts to implement an international policy to avoid future problems. In 1992, the United Nations Framework Convention on Climate Change was submitted for signature at the Rio Earth Summit. It was signed and ratified by most low-lying island states and countries with an extensive coastal area. Unfortunately, the Convention was not obligatory and consequently, the countries were not compelled to adapt accordingly. They did not set targets or deadlines. The Kyoto Protocol was presented in 1997. If ratified, it would require the 38 developed countries to reduce their national emissions of greenhouse gases by five percent from 1990 levels by the year 2012. Due to objections by many nations and individuals, the Kyoto Protocol has not yet been ratified by all 38 developed nations. Some of them protest that developing nations should not face limitations on emissions as they are not responsible for contributing as much emissions as the industrial nations. Furthermore, industrialised nations have contributed most to the problem and therefore have an obligation to take the first steps. Dr. Manmohan Singh, on his part, has also stressed that the developing countries may change their habits and reduce their emissions if the developed countries bear the monetary aspect and extend monetary aid to the developing world to initiate this procedure.

There are also objections because the concept of population is addressed very vaguely. The Kyoto Protocol is based on national caps that will not be adjusted for increases or decreases in population. The United States population has risen 24% between 1990 and 2010. Since growth in population leads to more houses, cars, energy usage and consequently, emissions, countries with rising populations are evidently more disadvantaged under the Kyoto Protocol. In order to be successful, future policy should attend to national population growth and decline as well as emissions in developing countries. Developing countries such as South Korea, South Africa and especially China produce per capita emissions that already exceed those of some developed countries. China, with its enormous population, is presumed to have high amounts of greenhouse gases and will certainly surpass the United States in per capita emissions in the next few decades, according to experts. The common populace is uninformed about global climate change and numerous individual citizens of earth are unaware of how global warming could affect the human population.

Interestingly, there are many reasons for an average person to care about global climate change, which need to be brought to the forefront by way of publicity. The best estimate scenario projects a sea-level rise of about half a metre by the year 2100. This will affect the overall condition of the planet, creating havoc in the lives of the people. The repercussions of rising oceans would be tremendous- increased flooding, coastal erosion, salination of aquifers and loss of coastal cropland and living space, to mention a few. A warming climate will also affect public health. Higher average temperatures imply more intense heat waves, corresponding to potential for increase in the cases of severe heat stress. The geographic range of temperature-sensitive tropical diseases such as malaria and dengue fever would also expand. As temperatures increase, occurrence of droughts and floods will become more frequent. The incidents of water-borne diseases and a resurgence and spread of infectious diseases carried by mosquitoes and other disease vectors would also mount.

As against these horrifying pictures, there are important steps, which need to be taken in order to nullify the effects of increase in population around the world and the effect it will have on the climate of our planet. We must not rely solely on the guidance of environmental policy and law regarding climate and population to determine our actions because such guidelines and laws take time to develop. We must make critical lifestyle choices; we must engage in sustainable behaviours. The human population must be stabilized, i.e. we must curb population growth. In many countries of sub-Saharan Africa, the Near East and South Asia, the human population continues growing at an annual rate of at

least 2% and the average woman bears four to seven children. Funding of family planning and information services becomes an important aspect in this regard.

Energy efficiency must be enhanced. We should try to develop new and renewable energy resources, encourage the design and use of low-energy buildings, eliminate government subsidies for fossil fuels, encourage energy efficiency programmes in industry, invest in public transportation and introduce hypercars. Deforestation must be restrained. We should try to improve our technology and recycle as much as possible. Paper products should be replaced by more eco-friendly products wherever possible so as to decrease the amount of pulp needed to produce paper. We should encourage and insist on forest products certification (a way of identifying products that come from sustainable forestry) and provide incentives to developing countries for limiting deforestation. We must implement sustainable development in routine life by including wise public investment, effective natural resource management, cleaner agricultural and industrial technologies and less pollution. Reduction of and if possible, a ban on chlorofluorocarbons (CFCs), which is one of the biggest culprits in polluting the environment as it is often used as a coolant in appliances like refrigerators and as product propellants in spray cans, should be implemented because CFCs stay in the atmosphere for extended intervals of time and contribute to global warming. Finally, we need better intergovernmental response and action on a large scale and more efficient urban planning on a smaller scale. Internationally, we must attempt to ratify a plan on the lines of the Kyoto Protocol. Locally, we must plan our cities better with the help of strong local governments supported by active citizen groups.

1.4.1 OVERPOPULATION

Overpopulation is a condition where an organism's number exceeds the carrying capacity of its habitat. In other words, the term often refers to the relationship between the human population and its environment, the earth. India is one of many countries where managing this relationship is creating a major problem.

Overpopulation does not depend solely on the size or density of the population, but also on the ratio of population to available sustainable resources. It also depends on the way resources are used and distributed throughout the population. For example, in the USA, the population per square mile is not as high as it is in India but the consumption per person is very high and it creates tremendous pressure on the natural resources there. Overpopulation can be a result of an increase in births, a decline in mortality rates due to medical advances, an increase in immigration or from an unsustainable biome and depletion

of resources. Places like deserts are sparsely populated as the natural resources are negligent and cannot sustain a large human population.

The resources to be considered when evaluating whether an ecological niche is overpopulated include clean water, clean air, food, shelter, warmth and other resources necessary to sustain life. If the quality of human life is addressed, there may be additional resources considered, such as medical care, education, proper sewage treatment and waste disposal. Overpopulation creates havoc in the resources and inevitably ushers a lower standard of living that places competitive stress on the basic life-sustaining resources, leading to a diminished quality of life.

Rapid increase in human population over the past two centuries has raised concerns that humans are beginning to overpopulate the earth and that the planet may not be able to sustain even the existent or, worse, larger numbers of inhabitants.

POPULATION AS A FUNCTION OF FOOD AVAILABILITY

Thinkers propose that like all other animals, human populations predictably grow and shrink according to their available food supply- populations grow in an abundance of food and shrink in times of scarcity.

Supporters of this theory argue that every time food production is increased, the population grows. Some human populations throughout history support this theory. Populations of hunter-gatherers fluctuate in accordance with the amount of available food. Population increased after the Neolithic Revolution and an increased food supply. This was followed by later population growth after subsequent agricultural revolutions.

Critics of this idea, however, emphasise that birth rates are lowest in those developed nations that also have the highest access to food. Interestingly, some developed countries have both a diminishing population and an abundant food supply. The United Nations projects that the population of 51 countries or areas, including Germany, Italy, Japan and most of the states of the former Soviet Union, is expected to be lower in 2050 than it was in 2005. This shows that when one limits the scope to the population living within a given political boundary, human populations do not always grow to match the available food supply. Additionally, many of these countries are major exporters of food.

Nevertheless, on a global scale, the world population is increasing, as is the net quantity of human food produced- a pattern that has been established and proven for roughly 10,000 years, since the human development of agriculture. That some countries demonstrate negative population growth fails to discredit the theory. Food moves across borders from areas of surfeit to areas of scarcity. Additionally, this hypothesis is not so

simplistic as to be rejected by a single case study, as in Germany's recent population trends—clearly other factors are at work: contraceptive access, cultural norms and most importantly, economic realities, which differ from nation to nation.

PROJECTIONS TO 2050

According to projections, the world's population will continue to grow until at least 2050, with the population reaching 9 billion in 2040 (with some predictions putting the population in 2050 as high as 11 billion).

According to the United Nation's World Population Prospects report:

- The world's population is currently growing by approximately 74 million people per year. Current United Nations predictions estimate that the world's population will reach 9.2 billion around 2050, assuming a decrease in average fertility rate from 2.5 to 2.0.
- Almost all growth will occur in the underdeveloped regions, by which means, today's 5.3 billion population of underdeveloped countries is expected to increase to 7.8 billion in 2050. By contrast, the population of the more developed regions will remain mostly unchanged, at 1.2 billion. An exception is the United States population, which is expected to increase 44%—from 305 million in 2008 to 439 million in 2050.
- In 2000-2005, the average world fertility was 2.65 children per woman, about half of that in 1950-1955 (5 children per woman). In the medium variant, global fertility is projected to decline further to 2.05 children per woman.
- During 2005-2050, nine countries are expected to account for half of the world's projected population increase: India, Pakistan, Nigeria, Democratic Republic of the Congo, Bangladesh, Uganda, United States of America, Ethiopia and China, listed here according to the decreasing size of their contribution to population growth. China would have been higher still in this list, were it not for its One Child Policy.
- Global life expectancy at birth, which is estimated to have escalated from 46 years in 1950-1955 to 65 years in 2000-2005, is expected to continue to rise to 75 years in 2045-2050. In the more developed regions, the projected increase is from 75 years today to 82 years by mid-century. Among the least developed countries, where life expectancy today is just under 50 years, it is expected to be 66 years in 2045-2050.
- The population of 51 countries or areas, including Germany, Italy, Japan and most of the successor states of the former Soviet Union, is expected to be lower in 2050 than it was in 2005.

- During 2005-2050, the net number of international migrants to more developed regions is projected to be 98 million. Population growth in those regions will largely be due to international migration because deaths are projected to exceed births in the more developed regions by 73 million during this period.
- In 2000-2005, net migration in 28 countries prevented population decline or doubled at least the contribution of natural increase (births minus deaths) to population growth. These countries include Austria, Canada, Croatia, Denmark, Germany, Italy, Portugal, Qatar, Singapore, Spain, Sweden, United Arab Emirates and United Kingdom.
- Birth rates are now declining in a small percentage of developing countries, while the actual populations in many developed countries would decline without immigration.
- By 2050 (medium variant), India will have 1.6 billion population, China 1.4 billion, United States 439 million, Pakistan 309 million, Indonesia 280 million, Nigeria 259 million, Bangladesh 258 million, Brazil 245 million, Democratic Republic of the Congo 189 million, Ethiopia 185 million, Philippines 141 million, Mexico 132 million, Egypt 125 million, Vietnam 120 million, Russia 109 million, Japan 103 million, Iran 100 million, Turkey 99 million, Uganda 93 million, Tanzania 85 million, Kenya 85 million and the United Kingdom 80 million.

2050

- Africa- 1.9 billion
- Asia- 5.2 billion
- Europe- 674 million
- Latin America & Caribbean- 765 million
- North America- 448 million

1.4.2 ENVIRONMENT

Overpopulation has had a substantially adverse impact on the environment of the earth, commencing at least as early as the 20th century. There are also economic consequences of this environmental degradation in the form of ecosystem services attrition. Beyond the scientifically verifiable harm to the environment, some assert the moral right of other species to simply exist rather than become extinct. Environmental author Jeremy Rifkin says, "Our burgeoning population and urban way of life have been purchased at the expense of vast ecosystems and habitats. It's no accident that as we celebrate the

urbanisation of the world, we are quickly approaching another historic watershed: the disappearance of the wild".

The last fifty years have been the most traumatic in terms of environment degradation, as the collective impact of human numbers, affluence (consumption per individual) and our choices of technology continue to ceaselessly exploit an increasing proportion of the world's resources at an unsustainable rate. During a remarkably short period of time, we have lost a quarter of the world's topsoil and a fifth of its agricultural land, altered profoundly the composition of the atmosphere and destroyed a major proportion of our forests and other natural habitats without replacing them. The saddest part is that we have driven many species to extinction, which has hurt the ecosystems drastically. This loss is several hundred times beyond its historical levels and we are threatened with the loss of a majority of all species by the end of the 21st century.

Further, even in countries that have both large population growth and major ecological problems, it is not necessarily true that curbing the population growth will make a major contribution towards resolving all environmental problems. However, as developing countries with high populations become more industrialised, pollution and consumption will invariably increase.

1.4.3 EFFECTS OF HUMAN OVERPOPULATION

Some problems associated with or exacerbated by human overpopulation are given below:

- Inadequate fresh water for drinking as well as sewage treatment and effluent discharge: Some countries like Saudi Arabia use energy-expensive desalination to solve the problem of water shortage.
- Depletion of natural resources, especially fossil fuels
- In the industrialised countries air pollution, water pollution, soil pollution and noise pollution levels increase with increasing population.
- Deforestation and loss of ecosystems that sustain global atmospheric oxygen and carbon dioxide balance, owing to which about eight million hectares of forest are lost each year.
- Changes in atmospheric composition and consequent global warming
- Irreversible loss of arable land and an increase in desertification: Deforestation and desertification can be reversed by adopting property rights. This policy is successful even while the human population continues to grow.

- Mass species extinctions from reduced habitat in tropical forests due to slash-and-burn techniques sometimes practiced by shifting cultivators, especially in countries with rapidly expanding rural populations: Present extinction rates may be as high as 140,000 species lost per year. As of 2008, the IUCN Red List enlists 717 animal species that have become extinct during recorded human history.
- High infant and child mortality: High rates of infant mortality are rooted in poverty. Rich countries with high population densities have low rates of infant mortality.
- Intensive factory farming to support large populations: It results in human threats including the evolution and spread of antibiotic resistant bacteria diseases, excessive air and water pollution and new viruses that infect humans.
- Bigger chance of the emergence of new epidemics and pandemics: For many environmental and social reasons, including overcrowded living conditions, malnutrition and inadequate, inaccessible or non-existent health care, the poor are more susceptible to infectious diseases.
- Starvation, malnutrition or poor diet with ill health and diet-deficiency diseases (e.g. rickets): However, rich countries with high population densities do not have famine.
- Poverty coupled with inflation in some regions and a resulting low level of capital formation: Poverty and inflation are aggravated by outrageous government and inadequate economic policies. Many countries with high population densities have eliminated absolute poverty and have managed to keep their inflation rates very low.
- Low life expectancy in countries with fastest growing populations
- Unhygienic living conditions for many, owing to water resource depletion, discharge of raw sewage and solid waste disposal: However, this problem can be reduced with the adoption of sewers. For example, after Karachi, Pakistan installed sewers, the city's infant mortality rate lowered substantially.
- Elevated crime rate due to drug cartels and rise in larceny by people stealing resources in order to survive
- Conflict over scarce resources and crowding, leading to increased levels of warfare

Social implications of rapid population growth in less developed countries

Social implications of population growth is a complex issue. Increased population in different developing countries is resultant of various aspects like poverty, hunger, high infant mortality, inadequacies in social services, health services and infrastructure

(transportation, communication etc). We would be grossly oversimplifying things if we innocently state that population growth leads to these problems. Population growth might just as easily be attributed to economic insecurity and poor health care. However, growth of population may be very rapid and consequently, may not yield the desired results of improving services meted out to the public and managing aspects like poverty and hunger management, because increasing numbers of people put enormous pressure on the economy and society of poor nations.

Poverty, for example, seems to be omnipresent; it existed long before the recent upsurge in population growth. Naturally, when one assesses poverty, there have to be reflections on the amount and kind of natural resources, including minerals and geographic features that a country possesses or lacks. It must also entail an examination of the country's political and social structure. In a few countries, a handful of people are in a position of strength- the haves- and the rest of the population does not have basic amenities like food and water- the have-nots. These people find it difficult to escape this vicious cycle of poverty often passed on from generation to generation. Rapid population growth makes this effort even more difficult.

Hunger has always been a soul mate to poverty. Most experts argue that the world could feed today's population and even a considerably larger number, if income were redistributed, if modern farming methods were used everywhere, if land reform policies were put into effect, if meat consumption were reduced, if non-nutritious crops were replaced by nutritious crops and if waste and corruption were controlled. Unfortunately, an escalating population may increase the problem of poverty and it may not help in managing to give the poor two meals per day. Population growth can reduce or eliminate food production gains resulting from the modernisation of farming. Population pressures may also promote practices such as over irrigation and overuse of croplands, which undermine the capacity to feed larger numbers.

In some cases, population growth is directly proportional to a social problem because it increases the absolute numbers whose needs must be fulfilled. For example, some poorer countries have accomplished the attainment of literacy for most of the newly born (new generation) children. Consequently, there is a boost in the percentage of children enrolled in school. On the other hand, the population growth during the same period also witnessed an upsurge in the number of children who were not enrolled in school owing to insufficient resources to meet the growing need. Similar observations could be made about jobs, housing, sanitation and other human needs. These problems are exacerbated when huge


flocks of people migrate from rural to urban areas and place an additional burden on an already inadequate system of supplies and services.

1.4.4 HUMAN POPULATION- ENVIRONMENTAL EFFECTS OF HUMAN POPULATION

The alarming increments in the size of the human population have resulted in a substantial degradation of environmental conditions. The changes are mainly leading to deforestation, unsustainable harvesting of potentially renewable resources (such as wild animals and plants of economic importance), rapid mining of non-renewable resources (such as metals and fossil fuels), pollution and other ecological damages.

On one side, there is an augmentation in population; on the other side, there is a per capita surge as well, leading to pressurising the environment. This has occurred through the direct and indirect consequences of increased resource use to sustain individual human beings and their social and technological infrastructure: meat production, fuel-burning, mining, air and water pollution, destruction of wild habitat and so forth.

In fact, the developed countries have increased their per capita economic productivity and energy consumption more rapidly during the twentieth century. This pattern is observed most significantly in industrialised countries. In 1980, the average citizen of an industrialised country utilised 199 gigajoules (GJ, billions of joules) of energy, compared with only 17 GJ/yr in less-developed countries. Although industrialised countries had only 25% of the human population, they accounted for 80% of the energy use by human beings in 1980. Another example exhibits that 20% of the world's richest people consume 86% of the goods and services delivered by the global economy, while the poorest 20% consume just 1.3%. More specifically, the United States- the world's richest country when appraised on a net and not on a per-capita basis- consumes approximately 25% of the world's natural resources and produces some 75% of its hazardous wastes and 22% of its greenhouse gas emissions, while consisting of only about 4.5% of the world's population.

	Study Notes

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Assessment

Write an essay (in 1000 words) on the implications of Human Population growth.



Discussion


Visit your nearby rural area for a survey and find out the causes and effects of population growth.


1.5 Limits to Growth


As long as we imagine humans retaining their present physical form, one obvious limit can be computed by dividing the cosmologists' estimated mass of the universe by the mass of a human. If you consider the human personality to be more important than its material embodiment, then you could get a larger number by embodying human personalities in smaller material forms. We will not discuss either possibility here.

Overreacting, if we imagine humans living on earth and refusing any new technology, we get much smaller limits and maybe these limits diminish with time as things are consumed. If you reject some important existing technologies or insist on allocating most of the planet to non-human life, you get still smaller limits. We will not discuss these possibilities either.

Neither of the above scenarios has much to do with present decisions- either personal or governmental. We assume continual use and enhancement of technology based on present science. This is conservative, since science will surely advance and offer more technological opportunities.

	Study Notes

	Assessment
"Are there any limits to growth?" Explain in your own words.	

	Discussion
Imaging What Would Happens If There Work No Limits To Growth	

1.6 Environment and Business Schools

Many business schools in the world have 'environment' as a subject in their curricula. This assists the students to appreciate the significance of environment in our life. When a school is committed to having all students in all core courses touching on social and environmental themes, it is a sign that the school is seriously committed to relevant issues. The basic idea is to make the students understand that environmental issues are ambiguous and long-standing in nature and need to be confronted head on. Such programmes on environment inculcate in the students a capability to manage the environment and its related aspects. Moreover, Environmental Education (EE) refers to organised efforts to impart education on how natural environments function and particularly, how human beings can manage their behaviour and ecosystems in order to live sustainably. The term is often used to imply education within the school system, from primary to post-secondary. However, it is sometimes used more broadly to include all efforts to educate the public and

other audiences, including print materials, websites, media campaigns etc. Related disciplines include outdoor education and experiential education.


Environmental education is of utmost significance in helping the students to learn how to manage the environment and its related aspects. It is a learning process that widens people's knowledge and awareness about the environment and associated challenges, cultivates the necessary skills and expertise to address the challenges and fosters attitudes, motivations and commitments to make informed decisions and take responsible action.


Environmental education in Business schools aims at the following:


- Inculcating an understanding of eco-systems and their interrelations
- Developing awareness regarding the utilisation and overexploitation of natural resources
- Perceiving the need for keeping pollution under control in order to uphold the quality of life
- Evolving the ability to identify, analyse and reflect upon different environmental concerns
- Acquiring skills to collect, analyse and interpret data and information relating to environmental problems
- Cultivating skills for effectively tackling problems related to the local environment.
- Adopting practices that help in promoting a balance in nature by making a judicious utilisation of resources and materials
- Acquiring leadership qualities through participation in specifically designed activities
- Developing love, affection, sensitivity and a sense of responsibility towards all living beings
- Participating in activities and programmes for protecting, preserving and conserving the environment and its resources
- Appreciating and respecting legal provisions for protection of animals and plants
- Imbibing the essence of environmental values and ethics in order to live in harmony with nature

Business Schools (B Schools) can integrate environmental education into their curricula with sufficient funding from EE policies. This funding can come from myriad agencies like government, semi government organisations, NGOs etc. This approach- known as using the “environment as an integrating context” for learning- incorporates environmental education into the core subjects and thus environmental education does not deprive students of attention to other important subjects such as art, gym or music. In addition to funding environmental curricula in the classroom, environmental education

policies apportion financial resources for hands-on, outdoor learning. These activities and lessons help address and mitigate "nature deficit disorder" as well as encourage healthier lifestyles.

	Study Notes

	Assessment
"Environment Management has become an important part of Business Education". Elucidate.	

	Discussion
Visit a nearby business school and discuss with the students how important do they feel Environment Education is.	

1.7 Summary

ENVIRONMENTAL MANAGEMENT

Environmental management is the process by which environmental health is regulated. Human beings cannot aspire to manage the environment itself, 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.

FUNDAMENTALS OF SUSTAINABLE DEVELOPMENT

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.

PRINCIPLES OF SUSTAINABLE DEVELOPMENT

There is a growing body of literature that agrees on a broad set of principles for sustainability to guide us towards the goals related to sustainable development. 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

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.

- Conserve life-support services
- Conserve biological diversity in genes, species and ecosystems
- Attempt to anticipate and prevent adverse environmental impacts
- Practice full cost accounting
- Recognise our responsibility to protect the global environment

- Respect the intrinsic value of nature

IMPLICATIONS OF HUMAN POPULATION GROWTH

Overpopulation is a condition where an organism's number exceeds the carrying capacity of its habitat. In other words, the term often refers to the relationship between the human population and its environment, the earth. India is one of many countries where managing this relationship is creating a major problem.

Overpopulation does not depend solely on the size or density of the population, but also on the ratio of population to available sustainable resources. It also depends on the way resources are used and distributed throughout the population.

PROJECTIONS TO 2050

According to projections, the world's population will continue to grow until at least 2050, with the population reaching 9 billion in 2040 (with some predictions putting the population in 2050 as high as 11 billion).

LIMITS TO GROWTH

As long as we imagine humans retaining their present physical form, one obvious limit can be computed by dividing the cosmologists' estimated mass of the universe by the mass of a human. If you consider the human personality to be more important than its material embodiment, then you could get a larger number by embodying human personalities in smaller material forms.

ENVIRONMENT AND BUSINESS SCHOOLS

Many business schools in the world have 'environment' as a subject in their curricula. This assists the students to appreciate the significance of environment in our life. When a school is committed to having all students in all core courses touching on social and environmental themes, it is a sign that the school is seriously committed to relevant issues. The basic idea is to make the students understand that environmental issues are ambiguous and long-standing in nature and need to be confronted head on. Such programmes on environment inculcate in the students a capability to manage the environment and its related aspects. Moreover, Environmental Education (EE) refers to organised efforts to impart education on how natural environments function and particularly, how human beings can manage their behaviour and ecosystems in order to live sustainably. The term is often used to imply education within the school system, from primary to post-secondary. However, it is sometimes used more broadly to include all efforts to educate the public and

other audiences, including print materials, websites, media campaigns etc. Related disciplines include outdoor education and experiential education.

1.8 Self Assessment Test

Broad Questions

1. Explain the fundamentals of sustainable development.
2. Why is limit in growth of population important? Give the implications of growth of population.
3. Explain overpopulation. Why is it important to control population?


Short Notes


- a. Environmental management
- b. Environment and business schools
- c. Principles of sustainable development
- d. Environmental effects of human population
- e. Sustainable economy


1.9 Further Reading

1. Environmental Management, Uberoi N K, Exzcel Books, 2000
2. Environmental Management, Pandey G N, Vikas Publishing House, 1997
3. Environmental Accounting, Gupta N Dass, Wheeler Publishing, 1997
4. Environment and Pollution Law Manual, Mohanty S K, Universal Law Publishing, 1996
5. Environmental Economics, Harley Nick, Mac Millen India Ltd, 1997
6. Environmental Economics, Kolstad Charles D, Oxford University, Press, 2000

Unit 2 Energy Management

	Learning Outcome
After reading this unit, you will be able to	
<ul style="list-style-type: none">• Discuss fundamentals of energy management• Describe uses of fossil fuels• Identify implications of energy production and trade• Outline energy balance ecosystem concepts• Discuss industrial ecology and recycling industry	

	Time Required to Complete the unit
<ol style="list-style-type: none">1. 1st Reading: It will need 3 Hrs for reading a unit2. 2nd Reading with understanding: It will need 4 Hrs for reading and understanding a unit3. Self Assessment: It will need 3 Hrs for reading and understanding a unit4. Assignment: It will need 2 Hrs for completing an assignment5. Revision and Further Reading: It is a continuous process	

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2.2.4 Best Ways to Manage Energy Consumption	
2.2.5 Managing Energy Consumption Effectively: An Ongoing Process	

- 2.3 Fossil Fuel Use**
 - 2.3.1 Characteristics, Origin, Applications and Effects
 - 2.3.2 Importance
- 2.4 Energy Production and Trade**
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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 equipment 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:

- 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 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 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, solar heaters conserve huge amounts of energy.

WHY IS IT IMPORTANT?

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

- **Reduction in costs:** This is gaining importance as energy costs rise.
- **Reduction in 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 footprint to promote a green, sustainable and healthy environment
- **Reduce risk:** 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 that ensues owing to human activities. Earth had 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 risk:** 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.

1. 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-minutes 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.

2. 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 equipment 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 was the employer can 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:

- 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 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.

3. 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.

4. Tracking your progress at saving energy

Once you have taken action to save energy, it is important to take feedback 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 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.

	Study Notes

	Assessment
Conduct a survey on consumption of Energy in your neighbourhood. Prepare a report on the basis of the survey.	

	Discussion
On the basis of your survey, discuss with your neighbours about excessive consumption of energy and methods to conserve energy.	

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 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 prices 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.

- a. **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.
- b. **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 (CH_4). 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.

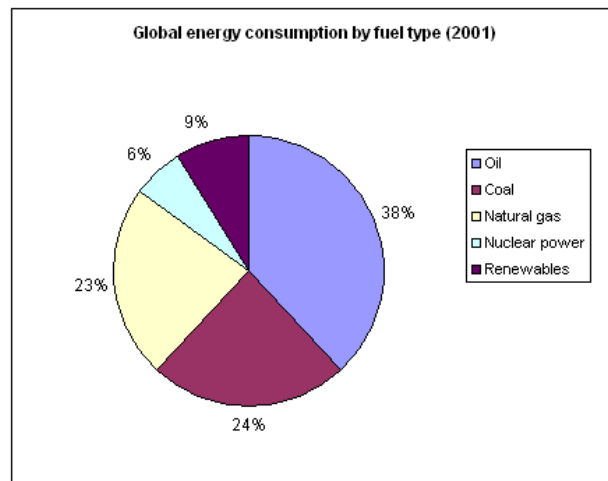


Fig.2.1: Global Energy Consumption by Fuel Type

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

Environment and Management

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 common for surplus electricity to be created. Electricity demands vary throughout the year and provision must meet the peak load 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, it 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.

1. 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 oils 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

A. 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.

B. 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.

C. 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.

2. Benefits

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.


3. Limitations


- **Nonrenewable Resource:** Fossil fuels are a nonrenewable resource. Fossil fuels take millions of years to develop under extreme conditions. Once they are used, they can no longer be 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 make 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 electric generation. The biggest supply of oil is not in the U.S. 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 majorly relied on is due to the simple economics- 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. Its overwhelming dependence on foreign oil means, as a nation, 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. Since then, their dependence on foreign oil has increased, not decreased.

	Study Notes

	Assessment
What steps can be taken to conserve fossil fuels (like petrol) at your end.	

	Discussion
Prepare a list of fossil fuels and find out the rate of their usage or consumption.	

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 Isaiah 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.

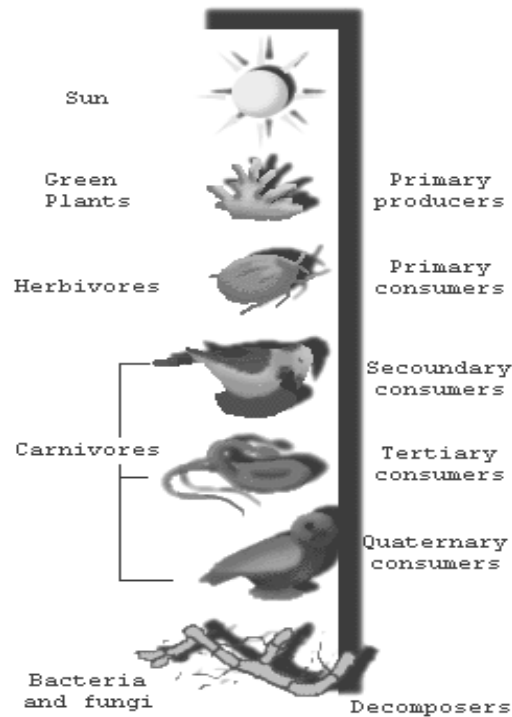


Fig.2.2: Formation of Fossil Fuel

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 production of autotrophs is propagated through the food web and all of the other trophic levels will respond to the increased availability of food (energy and materials will cycle faster).

The second theory, called top-down control, states that predation and grazing by higher trophic levels on lower trophic 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.

	Study Notes

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	Assessment
How long will it take for replenishment of fossil fuels like petrol, coal, etc. Find out and prepare a report on your survey.	

	Discussion
Draw a complete cycle of "Formation of Fossil fuels".	

2.5 Energy Balance Ecosystem Concepts

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 non-living 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:

1. Natural
 - a. Terrestrial ecosystem

b. Aquatic ecosystem

- Lentic, the ecosystem of a lake, pond or swamp
- Lotic, the ecosystem of a river, stream or spring

2. 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:

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

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, a grassland. 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.

2.5.2 COMPONENTS OF AN ECOSYSTEM

The components of the ecosystem can be categorised as 'abiotic' and 'biotic'.

Table 2.1: Components of an Ecosystem

ABIOTIC COMPONENTS	BIOTIC COMPONENTS
Sunlight	Primary producers
Temperature	Herbivores
Precipitation	Carnivores
Water or moisture	Omnivores
Soil or water chemistry (e.g., P, NH ₄ ⁺)	Detritivores
etc.	etc.
All of these vary over space/time	

Largely, this set of environmental factors is important almost everywhere, in all ecosystems.

Usually, biological communities include the 'functional groupings' shown above. A functional group is a biological category composed of organisms that perform mostly the same kind of function in the system, for example, all the photosynthetic plants or primary producers form a functional group. Membership in the functional group does not depend

very much on whom the actual players (species) happen to be, only on what function they perform in the ecosystem.

PROCESSES OF ECOSYSTEMS


Energy enters the system in the form of sunlight or photons, which is transformed into chemical energy in organic molecules by cellular processes including photosynthesis and respiration and ultimately is converted into heat energy. This energy is dissipated, meaning it is lost to the system as heat; once it is lost, it cannot be recycled. These ecosystems depend upon sunlight, as a source of energy, for their survival. Without this energy, everything would collapse and quickly shut down. Thus, the Earth is an open system in respect to energy.


Elements such as carbon, nitrogen or phosphorus enter living organisms in a variety of ways. Plants obtain elements from the surrounding environment through water or soil. Animals may also obtain elements directly from the physical environment, but usually they obtain these mainly because of consuming other organisms. Although these materials are transformed biochemically within the bodies of organisms, eventually due to excretion or decomposition, they are returned to an inorganic state. Bacteria become the last part of this process and they are involved in the process called decomposition or mineralisation.

During decomposition, these materials are not destroyed or lost. Thus, the earth is regarded as a closed system with respect to elements (with the exception of a meteorite entering the system now and then). The elements are cycled endlessly between their biotic and abiotic states within ecosystems. Those elements whose supply tends to limit biological activity are called nutrients.



Study Notes

	Assessment
<ol style="list-style-type: none"> 1. What did you understand by "Ecosystem"? 2. Explain various components of Ecosystem. 	

	Discussion
<p>Discuss and find out the components of Marine Ecosystem. After the discussion try to picturize it and draw on a chart paper.</p>	

2.6 Basic Concepts and their Applications in business

'Energy Management System' is becoming a widely accepted concept with a rise in energy costs, non-availability of quality power and increased awareness about energy management among consumers.

Creating awareness regarding the need for energy management, incentives for best energy-managed companies and power tariff structure suited to encourage energy saving can improve the existing power situation and will help formulate a better planned power supply system.

An integral energy management system for a building for controlling and monitoring of data, requires considerable investment. In addition, neither monitoring nor controlling is an end in itself, there has to be reasons and ultimate objectives in investing considerable amounts of money in this regard.

The investment is contingent upon the type of building, range of parameters to be monitored, utilities to be connected to the system and level of sophistication.

Hence, in opting for an energy management system, care should be taken to arrive at an appropriate system with the desired level and range of operation. The monitored parameters should be recorded and studied carefully, in order to evolve necessary steps and maintenance schedules for optimum use of energy.



Study Notes

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Assessment

How can energy management concept be applied to business or how can Energy Management be useful for business?



Discussion

Visit any office or a small business company nearby and find out what is their total energy consumption in a month and suggest some ways to conserve energy further.

2.7 Industrial Ecology and Recycling Industry

Industrial Ecology (IE) has been defined as a "systems-based, multidisciplinary discourse that seeks to understand emergent behaviour of complex integrated human/natural systems". This field approaches issues of sustainability by examining problems from multiple perspectives, usually involving aspects of sociology, the environment, economy and technology. The name germinates from the idea that we should use the analogy of natural systems as an aid in understanding how to design sustainable industrial systems.

Industrial ecology is the shifting of the industrial process from linear (open loop) systems, in which resource and capital investments move through the system to become Environment and Management

waste, to a closed loop system where wastes become inputs for new processes. The main criterion here is to manage wastes and improve efficiency.

2.7.1 RELATION TO EVOLUTION

Ecology and evolution are considered sister disciplines of the life sciences. Natural selection, life history, development, adaptation, population and inheritance are examples of concepts that thread equally into ecological and evolutionary theory. Morphological, behavioural and/or genetic traits, for example, can be mapped onto evolutionary trees to study the historical development of a species in relation to their functions and roles in different ecological circumstances. In this framework, analytical tools of ecologists and evolutionists overlap as they organise, classify and investigate life through common systematic principals, such as phylogenetics or the Linnaean system of taxonomy. No clear boundary that distinguishes ecology from evolution and both differ more in their areas of applied focus. Both disciplines discover and explain emergent and unique properties and processes operating across different spatial or temporal scales of the organisation. While the boundary between ecology and evolution is not always clear, it is understood that ecologists study abiotic and biotic factors that influence the evolutionary process.

2.7.2 RELATION TO THE ENVIRONMENT

"The environment of any organism is the class composed of the sum of those phenomena that enter a reaction system of the organism or otherwise directly impinge upon it to affect its mode of life at any time throughout its life cycle as ordered by the demands of the ontogeny of the organism or as ordered by any other condition of the organism that alters its environmental demands".

The environment is dynamically interlinked with ecology. Like the term ecology, the term environment also has different conceptual meanings. To many, these terms also overlap with the concept of nature. Environment includes the physical world, the social world of human relations and the built world of human creation. It describes the physical environmental attributes or parameters that are external to the level of biological organisation under investigation. It includes abiotic factors such as temperature, radiation, light, chemistry, climate and geology and biotic factors including genes, cells, organisms, members of the same species and other species that share a habitat. The physical environmental connection means that the laws of thermodynamics apply to ecology. Armed with an understanding of metabolic and thermodynamic principles, a complete account of energy and material flow can be traced through an ecosystem.

Environmental and ecological relations are studied through reference to conceptually manageable and isolated parts. However, once the effective environmental components are understood, they conceptually link back together as a holocoenoti system. In other words, the organism and the environment form a dynamic whole. Change in one ecological or environmental factor can concurrently affect the dynamic state of an entire ecosystem.

Ecological studies are necessarily holistic as opposed to reductionist. Holism has three scientific meanings or uses:

- The mechanistic complexity of ecosystems
- The practical description of patterns in quantitative reductionist terms where correlations may be identified but nothing is understood about the causal relations without reference to the whole system
- Owing to the above, a metaphysical hierarchy whereby the causal relations of larger systems are understood without reference to the smaller parts

An example of the metaphysical aspect to holism is the trend of increased exterior thickness in shells of different species. The reason for a thickness increase can be understood through reference to principles of natural selection via predation without any reference to the bio molecular properties of the exterior shells.

Ecosystems are primarily governed by stochastic (chance) events, the reactions these events provoke on non-living materials and the responses by organisms to the conditions surrounding them. Thus, an ecosystem results from the sum of individual responses of organisms to stimuli from elements in the environment. The presence or absence of population merely depends on reproductive and dispersal success and population levels fluctuate in response to stochastic events. As the number of species in an ecosystem is higher, the number of stimuli is also higher. Since the beginning of life, organisms have survived continuous change through natural selection of successful feeding, reproductive and dispersal behaviour. Through natural selection, the planet's species have continuously adapted to change through variation in their biological composition and distribution. Mathematically, it can be demonstrated that greater numbers of different interacting factors tend to dampen fluctuations in each of the individual factors.

- Ecosystems comprise abiotic (non-living, environmental) and biotic components and these basic components are important to nearly all types of ecosystems. Ecosystem ecology looks at energy transformations and biogeochemical cycling within ecosystems.

- Energy continuously enters an ecosystem in the form of light energy and some energy is lost with each transfer to a higher trophic level. Nutrients, on the other hand, are recycled within an ecosystem and their supply normally limits biological activity. Therefore, "energy flows, elements cycle".
- Energy is moved through an ecosystem via a food web, which comprises interlocking food chains. Energy is first captured by photosynthesis (primary production). The amount of primary production determines the amount of energy available to higher trophic levels.
- The study of how chemical elements cycle through an ecosystem is termed biogeochemistry. A biogeochemical cycle can be expressed as a set of stores (pools) and transfers and can be studied using the concepts of 'stoichiometry', 'mass balance' and 'residence time'.
- Ecosystem function is controlled mainly by two processes, the 'top-down' and 'bottom-up' controls.
- A biome is a major vegetation type extending over a large area. Biome distributions are determined largely by temperature and precipitation patterns on the Earth's surface.

2.7.3 RECYCLING

Recycling involves processing used and unwanted materials (waste) into new products in order to prevent wastage of potentially useful materials. It intends to reduce the consumption of fresh raw materials; reduce energy usage, air pollution (from incineration) and water pollution (from landfilling) by reducing the need for 'conventional' waste disposal and lowering greenhouse gas emissions as compared to fresh production. Recycling is a key component of modern waste reduction and is the third component of the 'Reduce, Reuse, Recycle' waste hierarchy.

Recyclable materials include many kinds of glass, paper, metal, plastic, textiles and electronics. These materials have to be managed differently. Although similar in effect, the composting or other reuse of biodegradable waste— such as food or garden waste – is not typically considered recycling. Materials to be recycled are brought to a collection centre or picked up from the curbside, then sorted, cleaned and reprocessed into new materials bound for manufacturing.



Study Notes

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Assessment

Differentiate between the terms Reduce, Reuse and Recycle. Give examples of each.



Discussion

Visit Municipal Corporation in your city and write an article on the complete process of recycling of different scrap materials (e.g. glass, paper, plastic, spoiled vegetable, fruits, leaves etc.)

2.8 Summary

ENERGY MANAGEMENT

FUNDAMENTALS OF ENERGY MANAGEMENT

'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. With respect to energy saving, energy management is the process of monitoring, controlling and conserving energy in a building or organisation.

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 equipment such as timer switches is often included in the definition as well.

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.

ECOSYSTEM

An ecosystem comprises the biological community that occurs in some locale and the physical and chemical factors that make up its non-living or abiotic environment.

PROCESSES OF ECOSYSTEMS

Energy enters the system in the form of sunlight or photons, which is transformed into chemical energy in organic molecules by cellular processes including photosynthesis and respiration and ultimately is converted into heat energy. This energy is dissipated, meaning it is lost to the system as heat; once it is lost, it cannot be recycled. These ecosystems depend upon sunlight, as a source of energy, for their survival. Without this energy, everything would collapse and quickly shut down.

ENERGY PRODUCTION AND TRADE

Four integral steps to the energy-management process are

1. Metering your energy consumption and collecting the data
2. Finding and quantifying opportunities to save energy
3. Targeting the opportunities to save energy
4. Tracking your progress at saving energy

BASIC CONCEPTS AND THEIR APPLICATIONS IN BUSINESS

'Energy Management System' is becoming a widely accepted concept with a rise in energy costs, non-availability of quality power and increased awareness about energy management among consumers.

Creating awareness regarding the need for energy management, incentives for best energy-managed companies and power tariff structure suited to encourage energy saving

can improve the existing power situation and will help formulate a better planned power supply system.

INDUSTRIAL ECOLOGY

Industrial Ecology (IE) has been defined as a "systems-based, multidisciplinary discourse that seeks to understand emergent behaviour of complex integrated human/natural systems". This field approaches issues of sustainability by examining problems from multiple perspectives, usually involving aspects of sociology, the environment, economy and technology. The name comes from the idea that we should use the analogy of natural systems as an aid in understanding how to design sustainable industrial systems.

2.9 Self-Assessment Test

Broad Questions

1. What is energy management? How it can be useful to humans? Give its short term and long-term effects.
2. How can we use fossil fuel? Share its advantages and disadvantages.
3. What is an ecosystem? Explain how the ecosystems are eroded in today's world.


Short Notes


- a. Ecosystem
- b. Recycling
- c. Components of an ecosystem
- d. Ecosystem services
- e. Effects of fossil fuels


2.10 Further Reading

1. Environmental Accounting, Gupta N Dass, Wheeler Publishing, 1997
2. Environmental Management, Uberoi N K, Excel Books, 2000
3. Environmental Management, Pandey G N, Vikas Publishing House, 1997
4. Environmental Economics, Harley Nick, Mac Millen India Ltd, 1997
5. Environmental Economics, Kolstad Charles D, Oxford University, Press, 2000
6. Environment and Pollution Law Manual, Mohanty S K, Universal Law Publishing, 1996

Unit 3 Environmental Management Systems

	Learning Outcome
<p>After reading this unit, you will be able to:</p> <ul style="list-style-type: none">• Outline fundamentals of environmental management systems• Discuss environmental auditing• Explain implications of environmental management and valuation• Describe green funding• Outline environmental trade shifts	

	Time Required to Complete the unit
<ol style="list-style-type: none">1. 1st Reading: It will need 3 Hrs for reading a unit2. 2nd Reading with understanding: It will need 4 Hrs for reading and understanding a unit3. Self Assessment: It will need 3 Hrs for reading and understanding a unit4. Assignment: It will need 2 Hrs for completing an assignment5. Revision and Further Reading: It is a continuous process	

	Content Map
<p>3.1 Introduction</p> <p>3.2 Environmental Management Systems</p> <p>3.3 ISO Standards</p> <p>3.4 The Environmental Management System</p> <ul style="list-style-type: none">3.4.1 PDCA (plan-do-check-act)3.4.2 Energy Efficiency3.4.3 EMAS3.4.4 Eco-Management and Audit Scheme	

3.5 Environmental Auditing

3.5.1 Impact Assessment and Environmental Auditing

3.6 Environmental Management and Valuation

3.6.1 Methods for Valuing the Environment

3.6.2 Conclusion

3.7 Environmental Accounting

3.8 Environmental Trade Shifts

3.8.1 Measuring the Effects

3.8.2 The Trade

3.9 Green Funding

3.10 Summary

3.11 Self-Assessment Test

3.12 Further Reading

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):

- 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 shows 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.


1. What are some key elements of an EMS?


- 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: Instruction to ensure employees are aware and capable of fulfilling their environmental responsibilities
- Management review

2. Can existing environmental management activities be integrated 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.

	Study Notes

	Assessment
<p>1. What is EMS?</p> <p>2. Complete the following:</p> <p style="padding-left: 40px;">An Environmental Management System (EMS):</p> <ul style="list-style-type: none"> • Serves as a tool to _____ • Provides a systematic way of managing _____ • Is the aspect of the organisation's overall management structure that addresses _____ 	

- Gives order and consistency for organisations to address _____ through _____, _____ and _____.



Discussion

Visit a nearby organisation and find out what EMS do they follow?

3.3 ISO Standards

1. 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 U.S. body that provides input into the standard's development is the U.S. 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 standard and may be found in the 'Clarification of Intent of ISO 14001'. These standards are maintained with the help of these avenues.

2. How are these standards developed?

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.

3. The 17 requirements of the ISO 14001:2004 standard

- 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

4. Legislation and standards

The Environmental Liability Directive [ELD] 2004/35/EC is an instrument of paramount importance that business need 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 on site by using any form of containment apparatus such as sealing the drains.

5. ISO 14000

a. 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 effect 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.

b. 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".

6. Three types

According to Mattsson and Olsson, there are three types of audit:

- 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.

7. 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 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.



Study Notes

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Assessment

1. What is ISO 14001?
2. What does PDCA stands for?



Discussion

Prepare a list of atleast 20 standards issued by ISO. Also mention their relevancy.

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

PLAN

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

Implement the new processes on a small scale, if possible.

CHECK

Measure the new processes and compare the results against the expected results to ascertain any differences.

ACT

Analyse 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 action 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, 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 iteration- once a hypothesis is confirmed (or negated), executing the cycle again 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 on-site 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

	Study Notes



Assessment

1. What is EMS?

2. Complete the following:

An Environmental Management System (EMS):

- Serves as a tool to _____
- Provides a systematic way of managing _____
- Is the aspect of the organisation's overall management structure that addresses _____
- Gives order and consistency for organisations to address _____ through _____, _____ and _____.



Discussion

Visit a nearby organisation and find out what EMS do they follow?

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) administers this designation.

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 and use this ambiguities to their own advantage. It is a fact that enforcement agencies are often not fully equipped in terms of labor and other infrastructure to identify violation of Pollution Control norms by industries. Since, 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 monitoring, norms and standards:


Table 3.1: Environmental Auditing 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	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

procedure of environmental monitoring shall be established by law		the environment
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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 judgment 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.

	Study Notes

	Assessment
<ol style="list-style-type: none"> 1. What is EMAS? 2. What are Environmental Monitoring, Environmental Norms and Environmental Standards? 	



Discussion

Visit a nearby organisation and find what EMAS they are operating with.

3.6 Environmental Management and Valuation

Environmental resources are a very important aspect in the global systems. From scenic beauty and recreational opportunities to direct inputs into the production process, environmental resources provide a complex set of values to individuals and benefits to society. Coastal areas, for example, endow scenic panoramas and radiant sunsets. Fish and other edible sea life caught in coastal areas afford a rich and nutritious source of food to consumers. Beaches are also excellent recreation areas that are used for relaxation, exercise or bird watching. These are only the direct benefits. The indirect benefits are also enormous if we start calculating. These values are not directly tied to use, such as climate modulation, physical protection and stewardship for future generations. All of these benefits are relevant in environmental valuation.



Fig. 3.1: Environmental Valuation

ENVIRONMENTAL VALUES

Fishing and hiking (that commonly fall under 'use value') are direct and quantifiable category of environmental values but they capture only a portion of the total economic value of an environmental asset. Indirect-use values, non-use values and intrinsic values are also associated with preserving environmental resources. Total economic value is represented by the following equation:

Total economic value = direct-use value + indirect-use value + non-use value + intrinsic value

The indirect values sometimes become more important than the direct values in the environment. Indirect-use values associated with coastal areas include biological support, physical protection, climate modulation and global life support. Non-use values are less direct, less tangible benefits to society and include option and existence values. The option value is the value an individual places on the potential future use of the resource, for example, benefits a beach would offer during future trips to the coastal area. There are many values, which form a part of the value system process. Existence values include bequest, stewardship and benevolence motives. Bequest value is the satisfaction gained through the ability to endow a natural resource on future generations. The stewardship motive is derived from an altruistic sense of responsibility toward the preservation of the environment and a desire to reduce environmental degradation. The benevolence motive reflects the desire to conserve an environmental resource for potential use by others. Finally, the intrinsic value of nature reflects the belief that all living organisms are valuable regardless of the monetary value placed on them by society.

It is important to note that there are certain environmental assets that are essential to support animal life and that the total value of these assets is not definable. Any changes in these assets may lead to a catastrophe in the system. Marginal changes, however, in the productivity and security of even irreplaceable environmental assets (e.g. the degradation of part of a large ecosystem or environmental resources essential to human life) can be captured in terms of total economic value. For example, the total economic value of air and water quality are immeasurably large because extreme degradation of either would result in irreversible and catastrophic damage to the capacity of this planet to support human and other life. It is important, therefore, to manage these assets diligently and permanently. However, we can observe the finite value that society places on small losses of even those assets that are essential for sustaining life. For instance, society has accepted some degradation of air quality in order to improve the efficiency and convenience of transportation. In this particular example, individual choices are not a good indicator of the

value of air quality since most of the costs of reduced air quality are externalised or passed on to others. Thus, we have to take the thinking of the society as a whole and try to make decisions accordingly.

3.6.1 METHODS FOR VALUING THE ENVIRONMENT

Environmental valuation is largely based on the assumption that individuals are willing to pay for environmental gains and conversely are willing to accept compensation for some environmental losses. The individual demonstrates preferences, which, in turn, places value on environmental resources. That society values environmental resources is certain; monetising the value placed on changes in environmental assets such as coastal areas and water quality is far more complex. Environmental economists have developed a number of market and non-market-based techniques to value the environment. The figure below presents some of these techniques and classifies them according to the basis of the monetary valuation, either market-based, surrogate market or non-market-based.

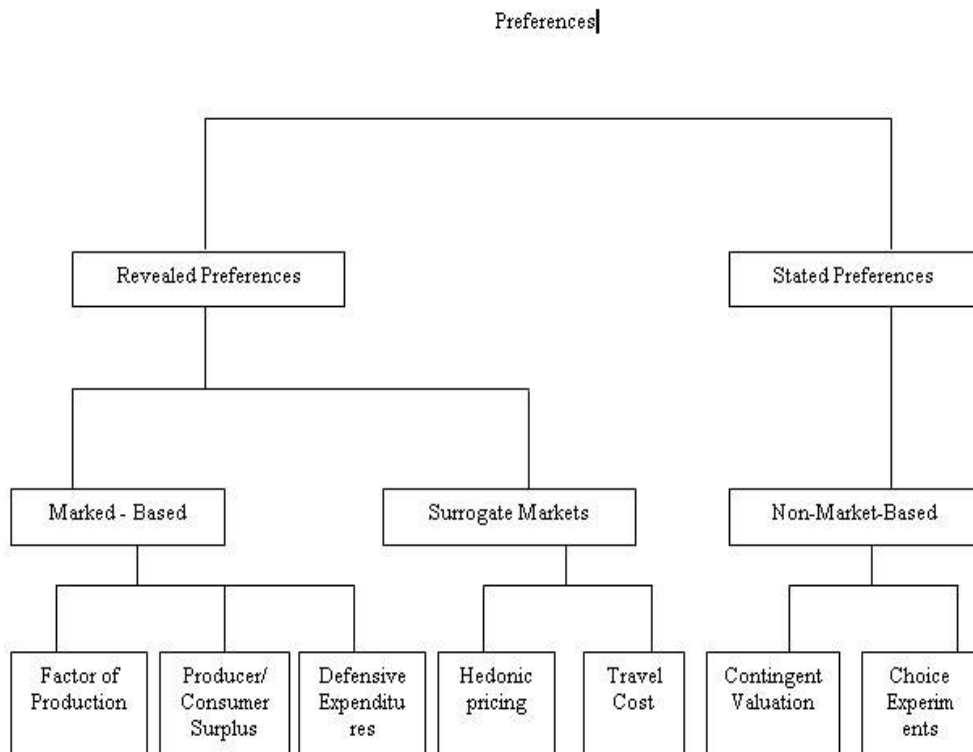


Fig. 3.2: Environmental Valuation Methods

- **Market-based methods:**

Economists generally prefer to rely on direct, observable market interactions to place monetary values on goods and services. Markets enable economists to measure an individual's willingness to pay in order to acquire or preserve environmental services. In turn, consumers reveal their preferences through the choices they make in allocating scarce resources among competing alternatives. There are a number of market-based methods of environmental valuation. There are three market-based techniques: a) factor of production approach, b) change in producer/consumer surplus and c) examination of defensive expenditures.

The value of a natural resource can be monetised based on its value as a factor of production. *An Economic View of the Environment* notes that the output of any firm is a function of several important inputs, e.g. land, capital, natural resources, which are collectively known as 'factors of production'. In their role as factors of production, raw materials and environmental inputs are used in the production of other goods. When a natural resource has direct value as a factor of production and the impact of environmental degradation on future output of that resource can be accurately measured, the resultant monetary value of the decline in production or higher cost of production can be measured. For example, a decline in water quality could have a direct and detrimental impact on the productivity and health of shellfish beds. This technique is methodologically straightforward; however, it is limited to those resources that are used in the production process of goods and services sold in markets. Because many goods and services produced by the environment are not sold in markets, the factor of production method generally fails to capture the total value of the resource to society.

- **Surrogate market methods:**

Due to the absence of clearly defined markets, the value of environmental resources can be assessed from information from surrogate markets. The most common markets used as surrogates are those for property and labour. Two common surrogate market methods discussed below are the hedonic price method and the travel cost method.

The hedonic price method employs surrogate markets for placing value on environmental quality. The real estate market is the most commonly used surrogate in this price method. Water, air and noise pollution have a direct impact on property values. By comparing properties with similar characteristics or by examining the price of a property over time as environmental conditions change and correcting for all non-environmental

factors, information about the housing market can be used to estimate people's willingness to pay for environmental quality.


Travel cost method is used to measure the value of a recreational site by surveying travellers' economic costs incurred (e.g. time and out-of-pocket travel expenses) when visiting the site from some distance away. These expenditures are indicators of society's willingness to pay for access to the recreational benefits provided by the site.


3.6.2 CONCLUSION


Environmental valuation techniques are primarily driven by the principle that individuals are self-interested and demonstrate preferences that form the basis of market interactions. These market interactions demonstrate how individuals value environmental goods and services. The market-based nature of economic theory emphasises the maximisation of human welfare. The market, in turn, determines resource-allocation based on the forces of supply and demand.

The environment, thus, is used as an instrument to achieve human satisfaction. In turn, the environment can be treated like any other commodity and its associated value can be broken down into many elements. For example, the value of coastal areas could be theoretically quantified based on the value of the products it offers (e.g. fish, crabs, clams, recreation and bird watching). In this manner, environmental valuation can be viewed as a mechanistic approach in which the total value of an environmental system is assessed in terms of the value of its individual parts.

Existence values are not demonstrated in the marketplace and are somewhat based on unselfish motives, thus making them problematic to environmental analysts. To quantify existence values accurately within the framework of environmental valuation is difficult. Revealed preference methods (e.g. travel cost method and hedonic pricing methods) measure the demand for the environmental resource by measuring the demand for associated market goods. Existence values are not adequately captured using these methods. Existence values are only revealed through surveys of individual willingness to pay for the environmental resource or willingness to accept compensation for environmental losses.

	Study Notes

	Assessment
Explain methods to evaluate the Environment.	

	Discussion
On the basis of above mentioned methods try to evaluate a nearby site or a tourist location. You can take help from local tourist guide and prepare a report on that.	

3.7 Environmental Accounting

Every business has an overriding responsibility to make the fullest possible use of its resources, both human and material. An enterprise is a corporate citizen. Like a citizen, it is esteemed and judged by its actions in relation to the community of which it is a member as well as by its economic performance. As far as the Indian corporate sector is concerned, it is sad but true that it has not been performing as a good citizen. Keeping this in view, many laws have been laid down and further amended as per requirement, in order to bind the corporate sector to fulfill their social responsibility for better development of Indian economy. Responsibility towards the environment has become one of the most crucial areas of social responsibility. Recent years have witnessed rising concern for environmental degradation, which is taking place mainly in the form of pollution of various types, viz. air, water, sound, soil erosion, deforestation etc. It is a worldwide phenomenon. It spoils human health, reduces economic productivity and leads to loss of amenities. Developing countries

like India are faced with the twin problem of protecting the environment and promoting economic development. A trade-off between environmental protection and development is required. A careful assessment of the benefits and costs of environmental damages is necessary to uncover the safe limits of environmental degradation and the required level of development.

Forms of Environmental Accounting

1. Environmental Management Accounting (EMA): This refers to management accounting with a particular focus on material and energy flow information and environmental cost information. This type of accounting can be further classified into the following subsystems:

a. Segment Environmental Accounting: This is an internal environmental accounting tool to select an investment activity or a project, related to environmental conservation from among all processes of operations and to evaluate environmental effects for a certain period.

b. Eco Balance Environmental Accounting: This is an internal environmental accounting tool to support PDCA for sustainable environmental management activities.

c. Corporate Environmental Accounting: This is a tool to inform the public about relevant information compiled in accordance with Environmental Accounting. It should be called Corporate Environmental Reporting. For this purpose, the cost and effect (in quantity and monetary value) of its environmental conservation activities are used.


2. Environmental Financial Accounting (EFA): This refers to financial accounting with a particular focus on reporting environmental liability costs and other significant environmental costs.


3. Environmental National Accounting (ENA): This refers to national level accounting with a particular focus on natural resources stocks and flows, environmental costs and externality costs etc.


Need of Environmental Accounting at Corporate Level: It helps to know whether an organisation has been discharging its responsibilities towards the environment. A company is expected to fulfill the following environmental responsibilities.

- Meeting regulatory requirements or exceeding that expectation.
- Cleaning up pollution that already exists and properly disposing off the hazardous material.

- Disclosing, the amount and nature of the preventative measures taken by the management (disclosure required if the estimated liability is greater than a certain percent of the companies net worth), to both potential and current investors.
- Operating in a way that those environmental damages do not occur
- Promoting a company having wide environmental attitude
- Control over operational and material efficiency gains driven by the competitive global market
- Control over increases in costs for raw materials, waste management and potential liability of political environment in which they occur

	Study Notes

	Assessment
Write full forms of the following: EMA, SEA, EBEA, CEA, EFA, ENA.	

	Discussion
Discuss with your classmates and faculty, the usefulness of Environmental Accounting.	

3.8 Environmental Trade Shifts

International trade may affect sustainable agricultural and rural development and the environment in a number of ways. First, trade may encourage production activities to shift from places where the environment is less sustainable to places where it is more sustainable or vice versa. Second, increased trade liberalisation changes the pattern and level of world consumption, production and income and these changes can affect the environment in ways that go beyond the shifting of consumption and production among countries. Third, trade influences the process of economic development, creating fresh opportunities for the profitable use of productive resources. For instance, international trade in agricultural products is large and an important source of foreign exchange earnings for many countries.

As incomes rise, demands on resources increase but, at the same time, income growth can also lead to more demands for better environmental quality. In addition, increased incomes make investment in resource-conserving strategies both more affordable and more attractive. Moreover, higher incomes are associated with lower population growth rates, reducing the pressure on environmental resources. Higher incomes and better employment opportunities widen the range of choices, thus leaving fewer rural people dependent on environmentally fragile areas like steep hillsides for subsistence.

Trade shifts the incidence of environmental effects. Trade geographically separates production from consumption. When environmental effects are national and not trans-border in their incidence and are mainly associated with production, trade may shift the environmental effects from one country to another. In addition, where consumption produces waste that has become an important part of the ecological cycle (for example, when nutrients are returned to the farmers' fields), separation of production and consumption in trade may put stable ecosystems out of balance. In some cases, production in one country may have environmental effects on neighbouring countries. For instance, water used for irrigation that then drains back into the river system raises the salt content for users in other countries downstream. In other cases, the act of production has beneficial global environmental effects e.g. planting trees that absorb and store carbon.

Although shifting the location of environmental damage may not affect the total world environmental damage, it often poses problems of international concern. Where the negative effects are purely national, the unilateral action of one country to alleviate its own environmental problems may well raise costs to producers and hence cause a competitive handicap for its exports of affected products. If the country is big enough, the effect may be an increase in world trade prices, with consequences for all countries. In other cases, such as

when an importer raises food safety standards, environmental protection measures may adversely affect exports from other countries.

Trade affects world production and consumption. Trade shapes global production and consumption. If there were no trade in coffee, for example, world consumption and production would be far less because coffee cannot be produced everywhere. The argument also applies to commodities that are produced in a far wider spectrum of countries than tropical beverages. By exploiting comparative advantages, a country can enjoy higher levels of consumption and production, which influence the ways in which natural and environmental resources are used and protected.

This basic interrelationship between trade and the environment implies that trade policy has an impact on the environment. Conversely, because environmental policy affects the supply and demand situation of commodities, it affects trade too. It is in recognition of this two-way relationship that UNCED called for mutually supportive environmental and trade policies.

3.8.1 MEASURING THE EFFECTS

The impact of trade on the environment depends on the volume of trade, the share of trade in production and consumption and the environmental impact of production and consumption. Large volumes of forestry and fishery products are traded along with several agricultural commodities including cereals, sugar, fats and oils, oil meals, meat, bananas, fresh citrus, cotton, pulses, dairy products, wine, coffee and rubber. At the global level, for trade of agricultural commodities: production ratio is usually low, while for commodities such as tropical beverages and rubber world trade is the main stimulus to production. Trade in cereals accounts for little more than 12 percent of world production.

3.8.2 THE TRADE

Production ratio in some commodities is often significant for individual countries even when it is not significant globally. For example, while only 3 to 4 % of the world's rice production is traded, exports account for more than 20 % of production in Australia, the EC, Guyana, Pakistan, Thailand, Uruguay and the United States. At the same time, imports of rice account for more than 80 % of consumption in as many as 43 countries.

The production and processing of commodities result in varying degrees of environmental effects. These effects depend on numerous factors including technology, soils, topography, water quality and the ecosystem. There is no overall measure of pollution produced or consumed per tonne of a given product that can be applied to all countries and ecosystems.



Study Notes

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Assessment

"International trade can effect agricultural and rural development as well as the environment in a lot of manners". Comment.



Discussion


Write down the effects of International Trade on Environment. Discuss these points with your classmates and find out what points have they mentioned.


3.9 Green Funding

Environmental management practices are directed towards the welfare of the community and economy as a whole. The major problem affecting the development of the environmental framework in various countries is the lack of knowledge, support and monetary funding. To support environmental sustainability, governments of various countries are funding environmental projects and green ventures. The funding is made available through government bodies such as central government, regional government, local government, government offices and regional local development agencies. Government funding for environmental management practices are usually allotted as a percentage of the 'economic stimulus package', which is bailout money allotted by the government to boost the economic growth of the country. The stimulus package consists of government funding for various economic and social activities and includes tax rebates. The Environment and Management

focused areas for funding are energy efficient infrastructure, usage expansion of renewable source of energy, reduction in greenhouse gases and carbon emissions, development of low carbon vehicles, clean technologies and green infrastructure for waterways, roadways and railways and conservation of water resources.

	Study Notes

	Assessment
What do you understand by Green Fund and Green Funding? Write in your own words.	

	Discussion
List at least 10 Green Funds and mention risks involved and benefits provided by them.	

3.10 Summary

ENVIRONMENTAL MANAGEMENT SYSTEM

An Environmental Management System (EMS):

- 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 on-going evaluation of practices, procedures and processes
- Focuses on continual improvement of the system

ISO STANDARDS

ISO 14001

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.

ECO-MANAGEMENT AND AUDIT SCHEME

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

ENVIRONMENTAL AUDITING

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

ENVIRONMENTAL MANAGEMENT AND VALUATION

Environmental resources are a very important aspect in the global systems. From scenic beauty and recreational opportunities to direct inputs into the production process, environmental resources provide a complex set of values to individuals and benefits to society.

ENVIRONMENTAL ACCOUNTING

Every business has an overriding responsibility to make the fullest possible use of its resources, both human and material. An enterprise is a corporate citizen. Like a citizen, it is esteemed and judged by its actions in relation to the community of which it is a member as well as by its economic performance. As far as the Indian corporate sector is concerned, it is sad but true that it has not been performing as a good citizen. Keeping this in view, many

laws have been laid down and further amended as per requirement, in order to bind the corporate sector to fulfill their social responsibility for better development of Indian economy. Responsibility towards the environment has become one of the most crucial areas of social responsibility.

ENVIRONMENTAL TRADE SHIFTS

International trade may affect sustainable agricultural and rural development and the environment in a number of ways. First, trade may encourage production activities to shift from places where the environment is less sustainable to places where it is more sustainable or vice versa. Second, increased trade liberalisation changes the pattern and level of world consumption, production and income and these changes can affect the environment in ways that go beyond the shifting of consumption and production among countries. Third, trade influences the process of economic development, creating fresh opportunities for the profitable use of productive resources.

GREEN FUNDING

Environmental management practices are directed towards the welfare of the community and economy as a whole. The major problem affecting the development of the environmental framework in various countries is the lack of knowledge, support and monetary funding. To support environmental sustainability, governments of various countries are funding environmental projects and green ventures.

3.11 Self-Assessment Test

Broad Questions

1. What is environmental auditing? Explain impact assessment and environmental auditing.
2. What are the applications of environmental valuation? State the different ways to value the environment.


Short Notes


- a. Environmental trade shifts
- b. Green Funding
- c. EMAS
- d. PDCA
- e. ISO 14000


3.12 Further Reading

1. Environmental Management, Uberoi N K, Excel Books, 2000
2. Environmental Management, Pandey G N, Vikas Publishing House, 1997
3. Environmental Accounting, Gupta N Dass, Wheeler Publishing, 1997
4. Environmental Economics, Harley Nick, Mac Millen India Ltd, 1997
5. Environmental Economics, Kolstad Charles D, Oxford University, Press, 2000
6. Environment and Pollution Law Manual, Mohanty S K, Universal Law Publishing, 1996

Unit 4 Environmental Laws

	Learning Outcome
After reading this unit, you will be able to:	
<ul style="list-style-type: none">• Distinguish fundamentals of environmental laws• Outline patent laws• Identify implications of pollution and waste management• List air and water pollution acts• Explain environment cost due to pollution	

	Time Required to Complete the unit
<ol style="list-style-type: none">1. 1st Reading: It will need 3 Hrs for reading a unit2. 2nd Reading with understanding: It will need 4 Hrs for reading and understanding a unit3. Self Assessment: It will need 3 Hrs for reading and understanding a unit4. Assignment: It will need 2 Hrs for completing an assignment5. Revision and Further Reading: It is a continuous process	

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4.3.5 Pollution from Mining	

- 4.4 The Air (Prevention and Control of Pollution) Act, 1981**
- 4.5 The Water (Prevention and Control of Pollution) Act, 1974**
- 4.6 Summary**
- 4.7 Self-Assessment Test**
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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 indispensable and would have damaging repercussions if broken. Environmental law encompasses two major areas: (1) pollution control and remediation (2) 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 such as forests, mineral deposits or animal species or more intangible resources such as especially scenic areas or sites of high archeological 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 Environment and Management

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

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; Where, 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,

- An invention must be novel

- Has an inventive step and
- 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.



Study Notes



Assessment

Complete the sentences by filling appropriate words in the blanks:

1. The history of patents and patent laws is generally considered to have started in _____ with a _____ of _____ which was issued by the _____.
2. A patent is a set of _____ granted by a state (national government) to an _____ or their assignee for a limited period of time in exchange for a _____ of an _____.
3. The patent system in India is administered under the superintendence of the _____.

4. The Head Office (in India) is located at _____ and other Patent Offices are located at _____, _____ and _____.

5. A patent can be granted for a _____ which may be related to any _____ or _____.



Discussion

Prepare a list of at least 10 inventions or discoveries which are patent or copyrighted.

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:

- Ensure efficient and effective provision of staff for the new structure and development of personnel
- Collect, analyse and disseminate relevant and current information regarding pollution and waste management
- Promote programmes on pollution and waste management that give effect to integrated pollution and waste management
- Promote public participation in environmental governance and decision-making with respect to integrated pollution and waste management
- Provide efficient and effective support to all clients and ensure co-operative governance to achieve integrated pollution and waste management
 - Develop and implement pollution and waste management legislation, policies, norms, standards and guidelines and ensure 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 practiced 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 hazard to human population. The effects 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 TOURIST INDUSTRY

Since 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 tires, 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 hemorrhaging 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. Diarrhea - often water borne- was the third most common cause for hospitalisation in the world. In Kiribati, diarrhea 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 diarrhea 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 Amoebosis. 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 or 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).

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. There are four kinds of mining mostly:

- Mineral extraction (nickel, gold, silver, copper, iron, uranium, 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 1980's, 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.



Study Notes

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Assessment

Write short notes on:

- a. Air Pollution
- b. Water Pollution
- c. Land Pollution
- d. Noise Pollution



Discussion

Discuss the advantages and disadvantages of plastic and write an article concluding the discussion. (not more than 500 words)

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

The Air (Prevention & Control of Pollution) Act was enacted by Parliament in 1981 with 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.

Following are the important provisions of the Air (Prevention & Control of Pollution) Act:

Under Section 21(1)

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

Under 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.

Under Section 22(A)

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

Under Sections 24(i), 26(i)

DPCC office have 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.

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

Under 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 upto Rs.5000/- per day.

If violation continues beyond one year imprisonment can be increased upto 7 years with fine.

Under 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.

WHAT IS 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 form or through which any air pollutant may be emitted [section 2(h)]

WHAT IS 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)].

WHAT IS 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.

WHAT IS 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 that (a) only approved fuel should be used in such area (b) only approved appliance 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 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 fulfill 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 center) 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.

Composition of board (detailed):

- 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; 9[
- 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.

Who is 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

What is a chimney?

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

What is approved fuel?

Sec. 2 (d): any fuel approved by the state board for the purposes of this act

What is 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.

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. (dd) 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 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, which is mentioned in next slide.

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 at a meetings 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 day 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.

	Study Notes

	Assessment
<ol style="list-style-type: none"> 1. What are the causes of Air Pollution? 2. What is "The Air (Prevention and Control of Pollution) Act, 1981"? 3. State Important Provisions under the Air Pollution Act, 1981 4. What are the objectives of the Act 	

	Discussion
<p>What are the Preventive Measures to check Air Pollution? Discuss.</p>	

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

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. As on day, it is applicable in all the states of India. In this act, unless the context, otherwise requires

- Occupier
- Outlet
- Pollution

- Trade effluent

The relevant provisions of this and are given as below:

Under Section 19:

The entire National Capital Territory of Delhi has been declared as water pollution prevention control area.

Under 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.

Under 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.

Under Section 24:

No person shall discharge any poisonous, noxious or any polluting matter into any stream, or well or sewer or on land.

Under Section 25:

No person shall without the previous consent to establish shall

- 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.

Under Section 27:

A state board may from time to time review any condition imposed by it on the person under section 25 and 26 and may vary or revoke that condition.

Under 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).

Under 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.

Under 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:-

- The closure, prohibition of any industry.
- Stoppage or regulations of supply of electricity, water or any other services.

Under 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 & six months but which may extend to six years with fine.

Under 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.

Under 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.



Study Notes



Assessment

Write a note on "The Water (Prevention and Control of Pollution) Act, 1974".



Discussion

Collect pictures depicting "Hazards of Water Pollution"

4.6 Summary

ENVIRONMENTAL LAW

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.

PATENT LAWS

The patent system in India is administered under the superintendence of the Controller General of Patents, Designs, Trademarks and Geographical Indications.

POLLUTION AND WASTE MANAGEMENT

Pollution and waste management aims to facilitate and develop programmes, projects, cooperative management and policy mechanisms, measures and decision-support systems to ensure integrated pollution and waste management.

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 practiced 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.

COSTS OF POLLUTION TO HUMAN HEALTH

Human health is, endangered by litter indirectly. There are many diseases, which are a result of this litter. The mosquito that carries the dengue fever virus breeds in water trapped in cans, old tires, jars and plastic containers.

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 also means losing crops, food grains directly and because of the insects that are borne out of the degradation.

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

The Air (Prevention & Control of Pollution) Act was enacted by Parliament in 1981 with 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

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

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. As on day, it is applicable in all the states of India.

4.7 Self-Assessment Test

Broad Questions

1. Write a note on environmental law. What is the importance of environment law in our lives?
2. Write a note on pollution. State and explain the different kinds of pollution in detail.


Short Notes


- a. Waste management
- b. Air pollution act
- c. Water pollution act
- d. Hazards of Water Pollution
- e. Pollution and Human health


4.8 Further Reading

1. Environmental Management, Uberoi N K, Excel Books, 2000
2. Environmental Management, Pandey G N, Vikas Publishing House, 1997
3. Environmental Accounting, Gupta N Dass, Wheeler Publishing, 1997
4. Environmental Economics, Harley Nick, Mac Millen India Ltd, 1997
5. Environmental Economics, Kolstad Charles D, Oxford University, Press, 2000
6. Environment and Pollution Law Manual, Mohanty S K, Universal Law Publishing, 1996

Unit 5 Water, Forest and Biodiversity Management

	Learning Outcome
<p>After reading this unit, you will be able to:</p> <ul style="list-style-type: none">• Outline fundamentals of water, forest and biodiversity management• Discuss roles of dams• Identify implications of environmental management and valuation• Explain role of biodiversity in international trade	

	Time Required to Complete the unit
1.	1 st Reading: It will need 3 Hrs for reading a unit
2.	2 nd Reading with understanding: It will need 4 Hrs for reading and understanding a unit
3.	Self Assessment: It will need 3 Hrs for reading and understanding a unit
4.	Assignment: It will need 2 Hrs for completing an assignment
5.	Revision and Further Reading: It is a continuous process

	Content Map
5.1	Introduction
5.2	Water Management
5.2.1	Irrigation Development and Potential in India
5.2.2	Soil-Water System
5.2.3	Water Management in Developing Countries
5.2.4	Water-Related Action for its Different Uses
5.2.5	Water Reservoirs
5.2.6	Uses
5.2.7	Environmental Impact

- 5.3 Dams and their Role**
 - 5.3.1 Types of Dams
 - 5.3.2 Classification by Structure
 - 5.3.3 Purposes of Dams
- 5.4 Forest Management**
- 5.5 Forest Products and their Trade**
- 5.6 Biodiversity Management**
- 5.7 Role of Biodiversity in International Trade**
- 5.8 Summary**
- 5.9 Self-Assessment Test**
- 5.10 Further Reading**

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 there is 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.

1. 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 draughts 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 800,000 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 the 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 meters 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 practiced 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 ground-water 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 a) how much water should be drained? b) how to drain water? c) and how rapidly should the water be drained? under a given situation of soil, water and crops.

5.2.2 SOIL -WATER SYSTEM

1. 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.

2. Availability of soil water for crop growth

Three 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

1. 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.

2. 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.

3. 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 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

4. 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:

- 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 transboundary water management are on the rise. Support must be provided for measures aimed at improving regional cooperation on the management of transboundary 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

- 1. 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 produces 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.
- 2. 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 re-charge 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.
- 3. Controlling watercourses:** Reservoirs can be used in a number of ways to control how water flows through downstream waterways.
- 4. Downstream water supply:** Water may be released from an upland reservoir so that it can be utilised for drinking lower down the system, sometimes hundred of miles further down downstream

- 5. 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.
- 6. 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.
- 7. 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.
- 8. 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

- 1. 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.

2. 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 Tucuruí 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.

	Study Notes



Assessment

Write short notes on the following:

- a) Water Management in India
- b) Various uses of Fresh Water
- c) Actions taken in respect of Water Management



Discussion

Prepare a project report on "Sources and Utilisation of Fresh Water in India". Report should not be of more than 20 pages.

5.3 Dams and their Role

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

- a. **By size:** International standards define large dams as higher than 15–20 meters and major dams as over 150–250 meters 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 BY 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. Since they are thinner than any other dam type, they require smaller amounts of construction material, thereby making them economical and practical in remote areas.



Fig. 5.1: Arch-Gravity Hoover Dam

- **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.



Fig 5.2 Gravity dam - Dworshak Dam

- **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

Table 5.1 Purpose of dams

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 Paraná 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 or weirs. 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 of
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
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 comprises several run-of-the-river dam structures that together complete a span of the Columbia River between the U.S. 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



Study Notes



Assessment

1. Complete the following sentences:

- a) A reservoir is an _____ that is used to _____. Reservoirs may be created in _____ by the construction of a _____ or may be built by

excavation in the ground or by conventional construction techniques such as brickwork or cast concrete.

- b) A _____ is a barrier that impounds water or underground streams. They generally serve the primary purpose of _____, while other structures such as floodgates or levees (also known as dikes) are used to manage or prevent _____.

2. Write short notes on:

- a) Types of Dams
- b) Uses of Dams



Discussion

How many Dams are there in India and what purpose do they solve? Discuss with your faculty and prepare a report on it.

5.4 Forest Management

1. **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.
2. **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.

- 3. Wildlife considerations:** The abundance and diversity of birds, mammals, amphibians and other wildlife is affected by strategies and the various types of forest management.
- 4. 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. Since 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 policymaking processes.



Study Notes

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	Assessment
Explain in not more than two sentences:	
a) Forest management	
b) Forestry	
c) Forest Management Plans	

	Discussion
Find out complete details of Joint Forest Management Programme.	

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 fuelwood, while in temperate and boreal areas fuelwood 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 fora 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.

	Study Notes



Assessment

Choose the correct word from the words given below and fill in the blanks:

- forest product
 - non-timber forest products
 - Deforestation
 - global warming
- a) A _____ is any material derived from a forest for commercial use, such as lumber, paper, or forage for livestock.
- b) All other non-wood products derived from forest resources, comprising a broad variety of other forest products, are collectively described as _____.
- c) _____, _____ and other environmental concerns have increasingly affected the availability and sustainability of forest products, as well as the economies of regions dependent upon forestry around the world.





Discussion


Study about forest products and their trade in India and prepare a list of such products which are produced and traded off near your area.

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.

	Study Notes

	Assessment
Give a detailed description on Biodiversity Management.	

	Discussion
<p><i>"India ratified the World Heritage Convention in 1977 and since then five natural sites have been inscribed as areas of 'outstanding universal value'. These sites are: (1) Kaziranga National Park, (2) Keoladeo National Park, (3) Manas National Park, (4) Sundarbans National Park, (5) Nanda Devi National Park."</i></p> <p>Study the main features and attractions of these National Parks and prepare a report on the basis of your study.</p>	

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).

	Study Notes

	Assessment
What is the role of Biodiversity in International Trade?	

	Discussion
Discuss what kind of value-added commodities as well as services are developed from biodiversity, for local market.	

5.8 Summary

WATER MANAGEMENT

Water resources are sources of water that are useful or potentially useful to humans. Uses of water include agricultural, industrial, household, recreational and environmental activities. Most human activities require fresh water.

A reservoir is an artificial lake used to store water. Reservoirs may be created in river valleys by the construction of a dam or may be built by excavating in the ground or by conventional construction techniques.

DAMS AND THEIR ROLE

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 water flow into specific land regions. Hydropower and pumped storage hydroelectricity are often used in conjunction with dams to provide clean electricity for millions of consumers. It can also be used to collect water or for storage of water, which can be evenly distributed between locations.

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.

BIODIVERSITY MANAGEMENT

Biodiversity is the variation of life forms within a given ecosystem, biome or on the entire Earth. Biodiversity is often used as a measure of the health of biological systems. The biodiversity found on Earth today consists of many millions of distinct biological species.

ROLE OF BIODIVERSITY IN INTERNATIONAL TRADE

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.

5.9 Self- Assessment Test

Broad Questions

1. Why is water management important? Explain in detail.
2. Write a note on water management in developing countries.

Short Notes

- a. Biodiversity
- b. Dams
- c. Reservoirs
- d. Trade of forest products
- e. Biodiversity and international trade

5.10 Further Reading

1. Environmental Management, Uberoi N K, Excel Books, 2000
2. Environmental Management, Pandey G N, Vikas Publishing House, 1997
3. Environmental Accounting, Gupta N Dass, Wheeler Publishing, 1997
4. Environmental Economics, Harley Nick, Mac Millen India Ltd, 1997

5. Environmental Economics, Kolstad Charles D, Oxford University, Press, 2000
6. Environment and Pollution Law Manual, Mohanty S K, Universal Law Publishing, 1996

Glossary

Abiotic Resources	These are resources, which are considered abiotic and therefore not renewable. Zinc ore and crude oil are examples of abiotic resources.
Ancillary Material	Material that is not used directly in the formation of a product or service
Auditing	Environmental auditing is a management tool to objectively and systematically evaluate environment management systems with the following objectives: (i) Waste prevention and reduction, (ii) Assessing compliance with regulatory requirements and (iii) Placing environmental information in the public domain.
Biotic Resources	These are resources, which are considered biotic and therefore renewable. Rainforests and tigers are examples of biotic resources.
By-product	A useful and marketable product or service that is not the primary product or service being produced
Certification	The procedure by which third party gives written assurance that a product, process, or service conforms to specific requirements
Characterisation	Characterisation aggregates classified environmental interventions/aspects within an environmental impact category. This step results in environmental performance indicators.
Classification	Classification attributes are environmental interventions/aspects listed in an environmental inventory/environmental effects register according to environmental impact categories.

Close-loop Recycling	A recycling system in which a product made from one type of material is recycled into a different type of product (e.g. used newspapers into toilet paper). The product receiving recycled material itself may or may not be recycled.
Co-product	This is a marketable by-product from a process that can technically not be avoided. This includes materials that may be traditionally defined as waste such as industrial scrap that is subsequently used as a raw material in a different manufacturing process.
Continuous Improvement	The process of enhancing an environmental management system to achieve improvements in overall environmental performance in line with an organisation's environmental policy
Damage	Deterioration in the quality of the environment not directly attributable to depletion or pollution
Depletion	The result of the extraction of abiotic resources (non-renewable) from the environment or the extraction of biotic resources (renewable) faster than they can be renewed
Downcycling	It is the process of re-using material for the production of new goods or services on the same quality level. If the quality of the goods and services produced with recycled material is lower, then the process is known as downcycling.
Eco-Efficiency	The relationship between economic output (product, service, activity) and environmental impact added caused by production, consumption and disposal
Emission	One or more substances released to the water, air or soil in the natural environment.
Environment	Surroundings in which an organisation operates, including air, water, land, natural resources, flora, fauna, humans, and their interrelations is the

environment. This definition extends the view from a company focus to the global system.

Environmental Aspects

These are elements of an organisation's activities, products or services which can interact with the environment (ISO 14004). A significant environmental aspect is an environmental aspect, which has or can have a significant environmental impact.

Environmental Effect

Any direct or indirect impingement of activities, products and services of an organisation upon the environment, whether adverse or beneficial constitute environmental effect. An environmental effect is the consequence of an environmental intervention in an environmental system.

Environmental Effects Evaluation

A documented evaluation of the environmental significance of the effect of an organisation's activities, products and services (existing and planned) upon the environment

Environmental Effects Register

A list of significant environmental effects, known or suspected, of an organisation's activities, products and services upon the environment

Environmental Impact

Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's activities, products or services constitutes environmental impact. An environmental impact addresses an environmental problem.

Environmental Impact Added

The total of all environmental interventions of a product or production system evaluated (weighted) according to the harmfulness of each intervention to the environment

Environmental Intervention	Exchange between the economy and the environment including resource extraction, emissions to the air, water, or soil, and aspects of land use is called environmental intervention. If resource extraction is excluded, the term used in this case is environmental release.
Environmental Inventory	An environmental inventory identifies and quantifies - where appropriate - all environmental aspects of an organisation's activities, products and services.
Environmental Issue	A point or matter of discussion, debate or dispute of an organisation's environmental aspects
Environmental Management	Those aspects of an overall management function (including planning) that determine and lead to implementation of an environmental policy
Environmental Management Audit	A systematic evaluation to determine whether an environmental management system and environmental performance comply with planned arrangements, and whether a system is implemented effectively, and is suitable to fulfill an organisation's environmental policy
Environmental Management Manual	The documentation describing the procedures for implementing an organisation's environmental management program
Environmental Management Program	A description of the means of achieving environmental objectives and targets
Environmental Management Review	A formal evaluation by management of the status and adequacy of systems and procedures in relation to environmental issues, policy and regulations as well as new objectives resulting from changing circumstances
Environmental Management System	The part of an overall management system, which includes structure, planning activities, responsibilities, practices, procurements, processes and resources for developing, implementing, achieving, reviewing and maintaining an environmental policy

Environmental Management System Audit	A systematic and documented verification process to objectively obtain and evaluate evidence to determine whether an organisation's environmental management system conforms to the environmental management system audit criteria set by the organisation and communication of the results of this process to management.
Environmental Objectives	The overall environmental goal, arising from an environmental policy that an organisation sets itself to achieve and which is quantified where practical
Environmental Performance	Measurable results of an environmental management system, related to the control of its environmental aspects. Assessment of environmental performance is based on environmental policy, environmental objectives and environmental targets
Environmental Performance Index	This is a parameter describing environmental impact with a single figure. An index is usually calculated by weighting the actual impact level against a target level.
Environmental Performance Indicators	These comprise different parameters describing the potential impact of activities, products or services on the environment. These parameters are the result of characterising classified environmental interventions/environmental aspects
Environmental Policy	This is a statement by an organisation of its intentions and principles in relation to its overall environmental performance. Environmental policy provides a framework for action and for the setting of its environmental objectives and target.
Environmental Problem	An environmental problem is a description of a known process within the environment or a state of the environment, which has adverse effects on the sustainability of the environment including society. They include resource consumption and environmental impacts.

Environmental Regulation Register	This is a list of regulations regarding environmental aspects of an organisation.
Environmental Release	Same as environmental interventions
Environmental Target	A detailed performance requirement, quantified where practical, applicable to the organisation or parts or combination thereof, that arises from environmental objectives and that must be set and met in order to achieve those environmental objectives
Environmental Strategy	A plan of action intended to accomplish a specific environmental objective
Interested Party	Individuals or groups concerned with or affected by the environmental performance of an organisation. Interested groups include those exercising statutory environmental control over an organisation, local residents, an organisation's investors, insurers, employees, customers and consumers, environmental interest groups and the public
Open-loop Recycling	A recycling system in which a particular mass of material (possible after upgrading) is remanufactured into the same product (e.g. glass bottles into glass bottles)
Organisation	A company, corporation, firm, enterprise or institution, or part or combination thereof, whether incorporated or not, public or private, that has its own functions and administration is called an organisation. For organisations with more than one operating unit, a single operating unit may be defined as an organisation.
Pollution	Residual discharges of emissions to the air or water following application of emission control devices (EPA 1993b)
Primary Product	The product or service, which is the strategic focus of an organisation

Prevention of Pollution	This entails use of processes, practices, methods or products that avoid, reduce or control pollution. These may include recycling, treatment, process changes, control mechanisms, efficient use of resources and material substitution.
Recycling	The process of re-using material for the production of new goods or services on the same quality level is called recycling. If the quality of the goods and services produced with recycled material is lower, then the process is known as downcycling.
Registration	This is the procedure by which an organisation indicates relevant characteristics of a product, process or service, or particulars of an organisation or person, and then includes or registers the product, process or service in an appropriate publicly available list.
Resources	This includes materials found in the environment that can be extracted from the environment in an economic process. There are abiotic resources (non-renewable) and biotic resources (renewable).
Reuse	The additional use of a component, part or product after it has been removed from a clearly defined service cycle. Reuse does not include reformation. However, cleaning, repair or refurbishing may be done between uses
Solid Waste	Solid products or materials disposed of in landfills, incinerated or composted
System	A collection of operations that perform a desired function
Valuation	The process of weighting characterised environmental interventions against each other in a quantitative and/or qualitative way. This process results in an environmental performance index

Verification Activities	All inspection, test and monitoring work related to environmental management
Waste	This refers to an output with no marketable value that is discharged to the environment. Normally the term 'waste' refers to solid or liquid materials.
Waterborne Waste	Discharge of pollutants into water