P.G. DIPLOMA IN ENVIRONMENTAL STUDIES

Course - 2
ENVIRONMENTAL AWARENESS AND HEALTH

BLOCK - 1 : ENVIRONMENTAL AWARENESS
BLOCK - 2 : ENVIRONMENTAL EDUCATION
BLOCK - 3 : HEALTH
BLOCK - 4 : DISASTER MANAGEMENT

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PREFACE

This book deals with Environmental Awareness and Health included in the syllabus of P.G. Diploma Programme in Environmental Studies offered by Dr. B.R. Ambedkar Open University. The topics included in this course generally cover the "core area" of the programme. The syllabus for the sake of convenience is divided into blocks each of which comprises a number of units. Each block generally covers a specific area of the subject. The units are written by the specialists in accordance with a format specially designed as to enable the student to read and understand them without much difficulty. Each unit begins with a statement of its contents followed by objectives. Each unit has at its end summary, model answers for the questions given in check your progress and also model examination questions. Three assignments are given at the end of the book and the student is expected to submit at least one to the Coordinator/ Asst. Director/Deputy Director of the concerned Study Centre.

This book deals with different aspects of environmental awareness, environmental education, various aspects of health such as water sanitation, vector control, epidemiology and disaster management issues like earthquakes and landslides, famines and floods, industrial accidents, toxic and chemical wastes etc.

The University hopes that this material will help the student to get acquainted with principal issues of Environment. Critical suggestions for improving the text are most welcome and they will be incorporated in the future edition.

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CONTENTS

BRAOU

BRAOU

BLOCK - 1 ENVIRONMENTAL AWARENESS

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UNIT - 1 : BALANCED VIEW OF DIVERSE ISSUES

Contents

BRAOU

1.1. OBJECTIVES

After going through this unit, you will be able to :

- describe the interdependency of environment and development,
- explain the need for a multi-disciplinary approach to development, and
- describe the alternative citizen's action.

1.2. INTRODUCTION

In the past, industrial and economic growth in Europe and North America was fuelled by abundant resources, obtained either domestically or from less developed countries in Asia and Africa. As a continuum, current attitudes were influenced by Western exploitative attitudes with roots in ancient history, rise of modern science, technology and industrial capitalism. Affluent consume a grossly disproportionate share of the worlds resources. The ratios differ for various resources, but it is estimated that overall the United States, with 5 percent of world population, accounts for 35 to 40 percent of the world's consumption of resources. Doubling of living standards in rich countries would increase the consumption of world resources six times as much as doubling of population in poor countries. On an international scale, the sway of Western science and economics has engendered not only world wide interdependence but increased the threat of a global confrontation between rich and poor nations. A number of recent authors discussed the biblical idea of dominion as the main historical root of environmentally destructive attitudes in the West. Lynn White points out that christianity has been so anthropocentric and arrogant towards Nature that it bears a huge burden of guilt for the environmental crisis.

It was usually assumed and continues to be so, that science and technology were inherently good and contributed to progress. The 1960s started with high confidence in technology. The United States set out to put a man on the Moon and the space program was a triumph of human ingenuity. Technology has developed in the industrial west as part of a system that had cumulative and pervasive impact on life and thought. But large-scale technologies also have accelerated the concentration of economic and social power and have proved difficult to control. By the late 1960s there was growing uneasiness about the social and environmental impacts of technology. It was clear that economic growth mainly had benefited a privileged minority and had done little to meet the basic needs of the vast majority. The disparities between rich and poor countries are enormous and continue to grow. Early in 1970s West became aware of environmental degradation though they were still confident that technology could overcome resource constraints. But by the end of the decade the escalating environmental and human costs of technological solutions were evident. Around the world there is an environment crisis, an energy crisis, a food crisis and a population crisis. Growing populations compete for limited resources. Expanding industries consume raw materials and generate wastes at unprecedented rates. Today we face difficult trade-offs among environmental preservations, economic growth, jobs and human health.

Presently, each and every nation is plagued by some form of environment pollution but issues differ. Gwyn Prins says, environment issues differ from development issues in their impact upon individual's lives. Environmental stresses may or may not touch people's lives in ways of which they are conscious and about which they can protest. But they always touch the sum total of living things, the biosphere. Environmental issues have been steadily occupying the international policy agenda for the past several years.

Issues of environment intertwined with those of economic growth, equity and welfare. These arise mostly out of the pattern of 'development' followed. Many present efforts to guard and maintain human progress, to meet human needs, and to realise human ambitions are simply unsustainable - in both the rich and poor nations. The results of the present profligacy are rapidly closing the options of future generations. Humanity has the ability to make development sustainable - to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs.

1.3. QUALITY OF ENVIRONMENT

After the Second World War, Western societies experienced rapid growth due to various reasons. The low cost of raw materials and rapid increases in productivity in both agriculture and industry made possible to achieve rapid growth in technological innovations. Progress has been made - child mortality is falling, more number of people can read and write, and quantity-wise world food production is increasing faster than the population. But this rapid growth, based on quantitative criteria and on the uncontrolled exploitation of natural resources caused widespread environmental degradation.

Every year 6 million hectares of productive dryland turns into worthless desert. This is the resultant effect of a combination of factors such as deforestation, soil erosion, modern agricultural practices and man's own empathy. More than 11 million hectares of forests are destroyed yearly which now equals an area about the size of India. Much of this land has been converted to low-grade farmland which consequently couldn't support the farmers who live on it for long. Between 1984 and 1987, the drought-triggered, environment-development crisis in Africa peaked causing chronic and extensive of shortages killing

nearly a million and putting 35 million at risk. Recent reports by the Food and Agriculture Organisation (FAO), and Oxfam, a London-based voluntary agency, say African countries like Angola, Mozambique, Sudan, Ethiopia and Liberia are again in the grip of drought and famine. According to FAO reports, drought has reduced harvests in all of the countries bordering the Sahelian zone, from Mauritania to the West to Ethiopia in the East. Situation is rapidly deteriorating in Sudan, and Northern Ethiopia is continuously facing a food emergency for the past five years. Brutal and continuous civil wars in these parts have been the cause and effect of such grim conditions. In South America, the vast expanse of forested Amazonia - approximately 6 million square kilometers - is in danger of extinction. The slash-and-burn policy with regard to these rain forests has devastated many species, plant and animal, and disrupted many ethnic cultures. Huge fires in these forests send enormous amounts of smoke into the air obliterating the sunlight with consequential effects on the global atmosphere. Cumulatively, all these factors are likely to affect the global climatic pattern, portending a grim scenario. In recent months dangerously high levels of ozone and acid rain has been discovered for the first time in central Africa.

Mounting costs of soil erosion and air and water pollution have forced China to concentrate its efforts on cleaning up the symptoms rather than doggedly pursue industrial growth. The National Environmental Protection Agency (NEPA), in its 1990 figures, placed waste gas emissions at 8.5 million standard cubic metres, forest cover at 12.78 percent (1988 figure) and industrial waste water 24.9 billion tonnes. While 15 percent of China is affected by erosion and siltation, desertification is growing at a rate of 1560 sq. km. a year. About 76 percent of China's energy is coal-based, which is low in quality and high in sulphur. Thus China joins the big four in the world which contribute to green house gases mainly due to burning coal - others are United States, Soviet Union and Brazil.

The main problem most people in Hongkong faced was air and noise pollution. Traffic noise is sometimes deafening and is exacerbated by the poorly designed flyovers right outside residential and office buildings with no noise barriers. Floating refuse is an endemic problem at beaches. Tolo harbour is notorious for its most polluted water.

Air pollution is a major health hazard on Taiwan's heavily populated and industrialised west coast. About 94,000 factories combine to emit five key pollutants - air borne particles, carbon monoxide, ozone, sulphur dioxide and nitrogen oxide. According to a survey commissioned by the Taiwan's Environmental Protection Administration (EPA), half the population of 20 millions are drinking water from heavily polluted sources; all surface and ground water sources are polluted. The most polluted area in Taiwan is the Lin yuan petro-chemical zone near Kaohsiung. Taiwan produces 30 million tonnes of waste annually. There is a 60-m-high mountain of garbage outside Taipei, capital of Taiwan, which symbolises its preferred method of solid waste disposal.

Air pollution in Seoul, Onsan, Yochan and many other industrial cities, of South Korea, have reached a critical level as a result of excessive sulphur dioxide, causing eye and skin infections. Added to this is automobile pollution, whose emissions have increased when the number of motor vehicles leaped from 53,000 in 1980 to 3.1 million in 1990. South Korea's coastal waters have been polluted by lead, mercury, cadmium and other toxic waste endangering the food chain and consequently human population. A large number of people became sick after a particular industry dumped 30 tonnes of phenol into the Naktong River, the water source for much of the southeastern part of the country, in February, 1991.

BRAOU

Over the past 20 years, Thailand's environment has been drastically deteriorating particularly between 1987-91 when it achieved double-digit growth largely due to foreign investment. A 1990 report, by the Thailand Development Research Institute (TDRI), says that air pollution in Bangkok, 70 percent by automobiles, is among the worst in Asia. In Thailand's Chaophya River, south of Bangkok, dissolved oxygen content is nearly zero and as a consequence many types of fish and prawn life have disappeared from the lower stretch of the river. Deforestation is extensive - at present forest cover is just about 18 percent. With present growth rates, in a few years time Thailand's per capita emission level is likely to surpass even some industrialised countries. Per capita emissions of carbon dioxide, methane and chlorofluorocarbons (CFC) usage in Thailand, though lower than more developed countries, is higher than other developed and undeveloped countries when compared on the basis of emission levels measured against GNP. Competition for natural resources intensified between industry, agriculture, housing and tourism after 1987 largely due to the boom in industrial growth.

Forests are considered as carbon-sinks of the world, particularly rainforests. However, Phillippine forests have depleted to an area of mere 6-7 million ha, necessitating the government to make export of rainforest timber illegal. Environmentalists are worried over denudation of forest cover in Malaysia - even European environmental groups have demonstrated their concern. Timber is Malaysia's second largest commodity export earning $3.1 billion in 1990. Sarawak, a province, alone exported some 14 million cu.m of logs in 1990, 45 percent of it to Japan. The highly urbanised Klang valley (which includes the capital Kuala Lumpur) has two to three times the pollution levels of major cities in the United States, and the Klang river system is heavily contaminated with agricultural and industrial effluents and sewage.

In Vietnam, which is still recuperating from the effects of some 13 megatons of bombs, plus 72 million litres of herbicide unleashed by the US in the 1960s, the current rate of deforestation is 200,000 ha per annum.

In South Asia, Bangladesh and Myanmar face different kind of problems. Bangladesh is under persistent threat of floods and cyclones, due to exte sive deforestation of trees on upper reaches, and of mangroves along the coast-line. Whether or not there is a link between this deluge of Bangladesh and a rise in the sea level, according to some scientists it could be a consequence of global warming. Rich mangrove forests along Myanmar's (formerly Burma) coast line have been continuously deforested, and the coast line is barren; open to pressures of ocean waves.

The European community, which is the most industrially advanced part of the world, produces 2200 million tons of garbage every year. Of this, 150 million tons are industrial waste out of which nearly 30 million tons is hazardous. In OECD (Organisation for Economic Cooperation and Development) member countries alone, there are thousands of waste disposal sites which require some form of treatment facilities. But the clean up is expensive. Estimates show that Federal Republic of Germany requires $10 billion and Denmark requires atleast $60 million to cleanup.

With ever tightening regulations, companies in the West are finding it cheaper to dump the wastes in the Third World. Green Peace identified more than 36 million tonnes of waste shipments from industrialised to underdeveloped countries between 1986 and 1988 alone. In 1988, a deal to import 15 million tons of US and European pharmaceutical and tannery wastes into Guinea Bissau, reached scandalous proportions. Under the deal, Guinea Bissau was to receive 600 million dollars, more than four times the country's GNP and

BRAOU

twice its national debt. Between 1982 and 1983 wastes transported in Western Europe for disposal in another country reached $425,000 tons.

Disposal of wastes within Europe is more haphazard and indiscriminate. At the Dutch border the chloride level in the Rhine is 400 milligrams a litre, whereas the natural level would be about 20 mg. Nearly 50,000 tonnes of salt (from factories and potassium mines) are crossing the German-Dutch border everyday. In Eastern Europe, four decades of communist rule has degraded the environment drastically. The West German Institute of Economic Research estimates that $200,000 millions would be needed over two decades just to clean up industrial pollution in Eastern Europe. In Europe, acid rains kill forests and lakes and acid precipitation may have acidified vast tracts of soil beyond hope of repair.

Elsewhere, in the United States, nearly 60 percent of the hazardous wastes are generated by the chemical industry and allied operations. Of 65,725 chemicals in common use, data required for complete health hazard evaluations were available for only 10 percent of pesticides and 18 percent of drugs, according to US National Research Council. The unsafe dumping of toxic wastes in the US has generated lot of heat and debate. One of the prominent examples is that of the Love canal. In Love canal district, New York, an abandoned canal was used as chemical dump, covered and sold to set up a school and resident colony upon it. The tragedy was finally exposed in 1978 after residents complained of abnormal numbers of miscarriages, cancers, birth defects and a wide range of other illnesses. According to a conservative estimate, there are 50,000 such known sites in the United States. After the Environmental Protection Agency (EPA) issued new regulations requiring companies generating toxic chemicals and industrial wastes to take responsibility for their proper disposal, a large number of US industries started looking overseas for dumping sites. In a controversial report, the Natural Resource Defense Council had predicted that some 6,000 American pre-schoolers might eventually get cancer from ingesting chemical residues on US produce - particularly apples treated with the ripening agent Alar. Some 50,000 pesticide products, in 600 chemical categories, are in use today, as farmers apply hundreds of chemicals every year to control weeds, fungi or insects on produce.

BRAOU

Mining as the first stage of industrial process has been another important aspect of industrial pollution. Thousands of miners have been affected through mining operation ever since the industrial revolution. Lands have been ravaged, landscapes have been polluted. In northern Saskatchewan, in Canada, extensive uranium mining has affected the ethnic Indian communities, and also lakes, birds, plants and animal species.

Industrial accidents is yet another problem of industrialisation. Accidents involving toxic chemicals and radioactive materials have occurred the world over. A survey carried out by the US Environmental Protection Agency, 6,928 accidents of varying severity occurred at US plants between 1980 and 1985; and average of five a day. In 1984, liquid gas storage tanks exploded in Mexico city, killing 1000 people and leaving thousands homeless. An accident at a Union Carbide plant in West Virginia resulted in emergency evacuation of residents and some health problems - only months after the Bhopal gas tragedy in India which killed over 3000 people and injured 200,000 more in 1984. The accidental release of the highly toxic and mutagenic chemical dioxin at Seveso, Italy, and the ensuing saga of drums of contaminated soil being passed around Europe demonstrated the need for strict environmental regulation and monitoring efforts. In 1986, a fire at a warehouse of a chemicals manufacturer in Basel, Switzerland, released toxic chemicals into the Rhine causing massive fish kills and affecting the vital water supply in countries downstream

all the way to Netherlands and sent toxic fumes into France and the Federal Republic of Germany. It could be years for the eco-systems to return to their former status. The Minamata tragedy in Japan is known for the mercury pollution of the seas through unscrupulous dumping which affected scores of fishermen through contamination of fish. Thousands of Iraqi's died and scores were debilitated after consuming chemical processed wheat, marked for seeds, which was imported from West.

The recent Gulf war has highlighted another environmental problem of massive proportions: sea pollution due to oil spills. Deliberate leakage of oil into the ocean by Iraq, during the war, which affected large number of species, is the largest ever spill. Coupled with this spill, which potentially could change the dynamics of ocean currents, was the black billowing smoke out of the 600 odd damaged oil wells in Kuwait, with probable effect on the world's hydro-meteorological cycle - consequences of which are yet to be understood. Already there are incidences of black rain up in the Himalayas as reported by a mountaineering expedition. In March 1989, a oil tanker belonging to Exxon company, Valdez, disgorged 10.8 million gallons of crude oil into the ocean at Prince William Sound in North Atlantic ocean. An estimated 28 million gallons of oil was ocean-spilled within the first ten months of the year 1990. Omitting mega-spills, the yearly average for the past decade was 34 million gallons. Most of the spills are caused by human error, pipelines bombed by guerillas or storage tanks struck by lightning.

1.3.1. Global Issues

At the global level, there is a debate over what constitute the most urgent problems. However, there are some priority areas or themes at the global level that need to be emphasized. These are :

i. Sustainable use and conservation of resources.

ii. Preservation of nature/environment.

iii. Prevention of pollution.

iv. Control of population growth.

Acid rain, desertification, global warming, ozone layer depletion, pollution of air, water and soil, radioactive contamination of large areas, species extinction are some of the most urgent environmental threats to be dealt with in the present and in the future, problems which are clearly serious, interdependent and characterised in most cases by a transboundary dimension in space and time. The late 1980s have seen an unprecedented growth of concern for the greenhouse effect, the global warming and other changes expected to occur as a result of the emission of various gases which trap heat in the earth's lower atmosphere. The atmospheric concentration of carbon dioxide in the 1980s has been 20 to 25 percent above the pre-industrial (or pre-1800) level. The greenhouse effect is extraordinarily complex. By 2030 A.D., the global average temperature is likely to be warmer than at any time in the last 12,000 years. This situation was possible with extensive burning of fossil fuels to run automobiles and industries. Other gases like CFCs threaten to deplete the planet's protective ozone shield to such an extent that the numbers of human and animal cancers would rise sharply and the ocean's food chain would be disrupted.

A report prepared by an Inter-Governmental Panel on Climate Changes (IPCC) warns of climate change due to global warming with devastating effect on millions of people, animals and plants as fertilized land turns to desert, and coasts are flooded.

BRAOU

1.3.2. Situation in India

In India, deforestation in the Himalayas resulted in soil erosion directly affecting the people of Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh. Rate of depletion of forest cover in Punjab and Haryana ranged from 120,000 ha to 49,000 ha between 1972-75 and 1980-82. Excessive doses of fertilizer has affected soil fertility considerably. According to a study by the Central Soil Salinity Research Institute, Karnal, nearly 10 to 20 percent has been damaged by different salts. The Yamuna, the biggest tributary of Ganga, flows are loaded with domestic and industrial sewage collected from Yamunanagar, Panipat and Sonepat. Activities such as brick-making, quarrying and mining denuded the earth of its rich top soil, a layer which is conducive for plant growth. There are 692 towns and cities in the eight states drained by the Ganga basin. Of these, as many as 100 are located along 2,525 kms., discharging large quantities of untreated sewage into the river. A rough estimate indicates that 27 major cities on the banks dump about 1200 million liters of waste water into the river every day. Out of 300 industrial units located along the river, 64 have been identified as gross polluters because of the volume of waste discharged (1,000 kilolitre or more per day) or the toxic characteristics. In 1986, under an ambitious Rs. 250 crore Ganga action plan, the entire stretch of the river flowing through Uttar Pradesh, Bihar and West Bengal was to be cleaned in phases.

Pollution problem is acute along the industrial metropolis of Kanpur due to large number of tanneries which have turned the Ganga into a mess. The River Gomti flowing by the State capital Lucknow is laden with sullage. Atmospheric pollution has already defaced the marble marvel of Taj Mahal caused by the emissions from a large number of foundries in Agra, and from the oil refinery at Mathura. This refinery was constructed over the protests of environmentalists. Recently, the Rajasthan Government has initiated plans to construct a thermal power station on the border area near to Agra.

Presently, a major controversy is raging over the multi-purpose Tehri dam project in Garhwal Himalayas regarding the choice of location (high seismic zone) and project-feasibility. From its planning stages in the 1970s, the project has drawn adverse comments from ecologists. When first prepared in 1967 the cost of the project was put at Rs. 126.80 crores, which escalated to Rs. 4,142 crores by March, 1990.

Mining operations have been the biggest threat to the desert environment in Rajasthan. Even reserve forests and wildlife sanctuaries have become susceptible to such exploitation contrary to specific laws governing these areas - status of the world-famous Sariska Tiger sanctuary is found to be no different.

Due to the abundance of mineral deposits in the Chotanagpur plateaus and south and central Bihar, where two steel plants and a number of chemical units are located, environmental pollution of the region has been extensive. As estimated 80,000 tons of ash from the Chandrapura thermal power station of the Damodar Valley Corporation flows into the river Damodar. Alarmingly, an analysis revealed that the water of the Subarnarekha river, in its lower reach, contains 6 mg. of cyanide per litre. The region of Chotanagpur, a tribal belt dotted with hills and covered by dense forests has a quiet climatic change with the establishment of giant industrial complexes - chiefly, the Heavy Engineering Complex, the Subarnalekha Hydel project, and the Patratu Thermal power project - besides extensive deforestation. Agitations in the region led to the dropping of the ambitious Koel-karo hydel project with a generation potential of 1000 mw. Apart from industrial pollution, Madhya Pradesh faces other environmental hazards such as rapid denudation of the forest cover, discharge of municipal sewage into the rivers, unscientific mining and

BRAOU

the fly-ash problem caused by the usage of poor-grade coal in thermal power plants. Bauxite mining was the causal factor for the rapid denudation of the Maikal ranges - the most important watershed in the country. In Madhya Pradesh, an Industrial Safety Audit in 1985 identified 12 units as hazardous as they use dangerous chemicals such as phosgene. Despite this knowledge, and the experience of Bhopal Gas tragedy in 1984 which left thousands killed or maimed, government is yet to formulate a consistent policy on environmental parameters before granting industrial licenses. In Ankleshwar (Gujarat), which is one of the largest chemical industrial estates in the country, the air is hazardous to breathe. The Sardar Sarovar project, which involves building a series of dams across River Narmada, will submerge about 1,30,482 hectares of which 55,681 ha is prime agricultural land and 36,066 ha of forests.

In Maharashtra, molasses produced by more than 100 cooperative sugar factories has contaminated most drinking water sources, as it is dumped in pits wherever possible; Krishna basin has been affected extensively due to this pollutant. Thane region of this State is a revealing example of urban decay - due to factors like lack of proper planning, haphazard constructions, poor sanitation, large scale health problems, lack of proper financial structure within the civic bodies and gross mismanagement. Whole of the Marathwada region is under continuous drought conditions due to unscientific agricultural practices, lack of effective water sources, denudation of tree cover, etc. In parts of Kolhapur and Vidharbha, forests have been cleared completely.

The hill areas of West Bengal, like Darjeeling, are locations for many quarrying and mining operations denuding the area completely of any vegetation.

The greatest threat to environment in North-eastern region as a whole is deforestation. Mechanised open cast mining (Coal India) and oil pollution and flaring of gas (Oil and Natural Gas Commission) have devastated productive farms and lakes. Also, untreated effluents of Hindustan Paper Corporation have destroyed water bodies and agricultural land. The Loktak lake, in Manipur, the biggest in India, is sick due to heavy siltation and choking of feeder channels and soon it may dry up if preventive measures are not taken; all rivers of Manipur discharge into this lake. At present there is no fish in this lake which once used to supply the same for the entire area.

In Orissa, the Angul-Talcher area suffers from serious air pollution mainly due to fly ash, and water pollution from the two thermal units. Estimates show that more than 2500 tons of fly ash is generated daily which is expected to go up several times after the super thermal plants of the National Thermal Power Corporation are commissioned. In addition, the National Aluminium Company plans to add a sixth unit and a fertilizer plant is likely to be established. The Rourkela-Rajgangapur area in Sundergarh district is also the cause for some environmental concern.

Landscape of North Karnataka is severely eroded as a result of intensive and unscientific manganese mining. The Kaiga nuclear power project is nearing its completion in Uttara Kannada district of Karnataka. Led by Dr. Shivaram Karanth, a Jnanpith Award winner, environmentalists have opposed this project on ecological grounds. On the Western Ghats, tea plantation project covering a vast area of 1800 ha of grasslands, in villages of Galibeedy and Kaluru near Madikeri, had led to a ferment in the tiny district of Kodagu.

Environment in Goa is destabilized by iron-ore mining and 'throw-away' culture brought in by tourism. The second largest river in Kerala, the Periyar, considered as the life-line of the State has lost much of its importance because of various factors such as environmental

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degradation, pollution, scouring of the sides, encroachment and salinity. The 227 km. long river has a drainage area of about 5200 sq. km. of which 112 sq. km. extends into Tamilnadu. About 25 percent of the industrial units in the State are located along a 1 km. stretch on the Periyar bank at Udyogamandal. Their effluents were found to contain poisonous pollutants, mostly heavy metals, such as zinc, mercury and copper, and fluorides and phosphates - volume of discharge by 11 major units is to the tune of 1.3 lakh kilolitres.

Kerala has three major eco-systems - estuarine river systems flowing into Arabian sea which supported a large number of birds, animals and plants; rain forests; and the Shola forests of Idukki district. Many of Kerala's rivers originate in the sholas which holds the rainwater and releases it gradually. The destruction of the same now would mean drying up of these streams. The proposed Pooyamkutty Hydel project at Pindimedu, of Idukki district, is plagued by controversy on ecological considerations like the earlier Silent Valley project which was shelved due to widespread concern and protests. In Tamilnadu's North Arcot Ambedkar district, more than 200 tanning units are located along the Palar river from Ranipet to Vaniambadi flushing out enormous volume of effluents - due to which the river is now called Pazhar, river of waste. Both Eastern and Western Ghats are shorn or any vegetative cover after years of deforestation. The river Cauvery is polluted by effluents of different industrial units located along its course, both in Karnataka and Tamilnadu, particularly in Salem and Tiruchi districts. A 2000 MW nuclear power project is proposed to be constructed at Koodangulam in Nellai Kattabomman district which is opposed by the local fishermen.

Pondicherry is facing environmental pollution problems with the spread of urbanisation. Areas of Kalapeth and Krimambakkam have been identified for closer monitoring. Large tracts of farm land has been converted into residential and other projects. The tropical forests of Andaman and Nicobar islands, a towering and verdant canopy, are vanishing at an alarming rate - systematic denudation has resulted in soil erosion in many pockets. Wastes from saw mills, and sewage have reduced the marine life drastically. Pollution was added to the placid region, caused by fertilizers and pesticide run-off, with the increase in agricultural activity. Tourist influx had its own negative effects on the marine eco-system, particularly the coral reefs.

The idyllic islands of Lakshadweep face environmental threats in the form of coral reef destruction. According to the recent estimate by the Central Marine Fisheries Research Institute at Minicoy, the in situ percentage of dead corals at Minicoy is upto 90 percent of the surface coverage, and it is about 50 percent at Androtti, 80 percent at Kalpeni and 30 percent at Suheli Par.

1.3.3. Urbanization

In India, urbanization has become a phenomenon of this century. Many cities face problems such as deteriorating infrastructure, environmental degradation, inner city decay and neighborhood collapse. Yet, comparably, the physical environment in many cities of the industrial world has improved substantially over the past two decades. Garbage and auto emissions, including noise pollution, now greatly influence environmental conditions in these cities. In contrast, industrial growth and employment is the powerful stimuli for the rapid urbanisation of developing countries. Lack of planning, collapse of infrastructure due to rapid migration frayed the urban fabric putting enormous pressure for shelter and services. Air, water, noise and solid waste pollution problems have increased rapidly with consequential impacts on the life and health of city and suburb inhabitants and on

BRAOU

their economy. A growing number of the urban poor suffer from a high incidence of diseases - acute respiratory diseases, tuberculosis, intestinal parasites, and diseases linked to poor sanitation and contaminated drinking water (diarrhoea, dysentery, hepatitis and typhoid) are usually endemic.

Sixty percent of Calcutta's population suffer from pneumonia, bronchitis and other respiratory diseases related to pollution. The Hooghly estuary, near Calcutta, is choked with untreated industrial wastes from more than 150 major factories. In India, only 209 towns and cities had partial and only 8 had full sewage treatment facilities. Unguided industrial growth and uncontrolled physical expansion of cities are two factors which played havoc on the most productive agricultural land, and on the health and economy of the neighbouring villages of a urban area. Further, this increased inter-regional disparities creating social and economic imbalances.

Industrial effluents of a factory near Thanjavur, in Tamilnadu, affected the neighbouring villages like Gopalnagar, Kurungulam, Thuvalagiripatti and Nagappudaiyanpatti. Effluents, 200,000 litres per day, have degraded agricultural fields and water sources. Cattle die after consuming the effluent water. Health problems, due to effluents, are gradually surfacing. While in Rajasthan, five villages - Tamlao, Deeppura, Malpura, Bakshapura and Jharjhani - situated within ten km. of Rajasthan Atomic Power Station (RAPS) at Rawatbhata, are reportedly affected by radiation. Congenital deformities, lung and skin diseases, tuberculosis, infertility among women and impotency among men were some of the health problems identified in the area. In 1991, a team of doctors conducted a comprehensive health survey in order to verify any link between these problems and the RAPS-related radiation - information about their findings is not available.

Total urban population, in India, is 217 millions accounting for one-fourth of the country's population. And about 25 percent of total urban population lives in slums and under conditions of severe deprivation - illegal land tenure, deficient environment and services. The National Commission on Urbanisation had noted that urban land records are in 'hopeless disarray' and observed that the census of 1981 collected less information on urban issues than did the census of 1971. It suggested a modification in the course of urbanisation.

1.3.4. Andhra Pradesh

Andhra Pradesh is one of the five big States in India. With three distinct natural regions, it houses a large variety of natural resources. Prior to 1980s, its economy was considered to be predominantly agriculture based. In the past two decades, the State has continuously and deliberately tried to move away from the agricultural economy. From a modest beginning during independence with only 45 large and medium industries with an investment of Rs. 63 crores, this State has emerged as one of the major industrialized States in the country. At present, it has 828 large and medium industries with a total investment of Rs. 11,772 crores providing employment to nearly five lakh persons. This pace of industrialization was particularly rapid in the past decade. However, industrialization tended to be clustered in the capital city and one or two other centers, with concomitant socio-economic problems.

Natural Resources : According to data provided by the National Remote Sensing Agency, compared to 1967, when the forest cover in the State was 63,540 sq. km., i.e. 23 percent of the total area, it has depleted to 11 percent presently. Andhra Pradesh forests have been generally classified into five categories : Southern Tropical Thorn, Southern Tropical Moist Deciduous, Tropical Dry Deciduous, Littoral and Mangroves. The richest belt in forests is the northern stretch of the State, which includes districts of Visakhapatnam,

Srikakulam, East Godavari, Adilabad and Khammam. Certain areas in Cuddapah, Chittoor and Kurnool were known for exotic varieties of plants and dense forests. Thus, forests have been one of the important primary commodity upon which the net domestic product was sought to be increased. These forests served a variety of needs, like domestic energy needs, cattle grazing, industrial purposes, etc. But, the regenerative capacity of these forests couldn't copeup with the rapidity of forest clearance. The faster pace of forest clearance was mainly due to industries, especially forest-based - there are 8 major industries which are exclusively dependent on trees. Further, population explosion, and its subsequent land needs, made its own impact on the depletion. Thus, forest cover is getting lost both in quantitative and qualitative terms; some rare varieties like Red Sanders, Rose wood, Teak, etc., are almost extinct.

Effects of such denudation of forest cover are widespread, and indirect, which is generally less understood. Loss of tree cover exposes land to the rains leading to top soil run-offs, and subsequent siltation of water channels and reservoir. Further, this siltation creates uncontrollable situation like flash floods and droughts, as less water is stored to last until next monsoons. Also, with less storage capacity, depleting forest areas and unobstructed water run-offs into the oceans, there appears a break in the local hydro-meteorological cycle which most often leads to decrease in the rainfall. Thirdly, top soil loss means there is no medium for life regeneration, as it is the only source of genetic material for almost all the biological species.

According to some studies, most of the reservoirs built up across Godavari, Krishna and Tungabhadra are silted up to one-fourth of their original capacity. Apart from reservoirs, even rivers, streams and canals are choked up by silt. As a result of these far reaching changes in the ecological balance, economy of the state is gradually reaching a stage of peril. Agriculture has suffered the most in all the three regions of Andhra Pradesh despite different levels of impact; coastal Andhra is troubled by water logging and salinity while Telangana and Rayalaseema suffer with continuous drought conditions.

Water Pollution : In Andhra Pradesh most of the important lakes and streams are grossly polluted. Reportedly, at present, only 25 percent of our inland water sources contain clean water with 3 to 5 parts per million of BOD (Bio-chemical oxygen demand an indicator of pollution). Since most of the drinking water and other needs are met through by these inland sources, pollution of the same has the potential to cause damage to public health, industrial development, fisheries, agriculture and recreation.

Prominent industries in Andhra Pradesh which are causing serious water pollution problems belong to the categories of sugar, distillery, rice mills, paper mills, tanneries, textiles, jute, chemicals and fertilizers, oil refineries and pharmaceuticals. Effluents from these industries are improperly treated or not treated at all, thus contaminating a large number of neighbouring wells, lakes and streams.

Pollution of Sharada river by the sugar and distillery effluents from the Anakapalli co-operative sugar factory frequently forces closure of municipal water supply to Anakapalli town.

Toxic chemicals from local mining industry has seriously polluted Gattimadugu vagu of Vinukonda, poisoning plants, animals and human beings. Domestic sewage pollutes the drinking water source at Khammam, and, in Vizianagaram, River Champawati is contaminated by raw industrial effluents. River Nagavali receives sugar and paper mill effluents from Rayaguda.

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Godavari and Krishna rivers are polluted by sullage and sewage from towns situated along their banks. Further, Godavari is the ultimate sanctuary for partially treated effluents from paper, food and chemical fertiliser units. Peddavagu in Kagaznagar most of the time carries local paper and textile industrial effluents, while Pasupu vagu at Bodhan is polluted by Nizam sugar factory effluents. In Nellore, Velpur canal, Satyawada, Teki and Atreya drains receive domestic wastes and sugar and distillery effluents from local factories. Bulusuvagu at Bhimadole and the Bandirevukada at Challapalli are also polluted by local sugar factories. Factories at Amadalavalasa, Bobbili, Govada, Etikoppaka, Tuni, Pithapuram, Samarlakota, Miryalguda, Gadwal, Tirupati and other places are also causing local pollution problems. Handri river at Kurnool is polluted by oil - industry effluents. Distillery effluents at Chittoor are contaminating the drinking water sources. The famous Kolleru lake receives through its 16 drains, 15 irrigation channels and 2 rivers, many varieties of pollutants including the pesticidal and fertilizer residues from the farms, sullage and sewage from municipalities like Eluru and Gudivada, and industrial effluents from rice mills, sugar, distilleries and other industrial units in its catchment area. The adverse effects of pollution on the lake include eutrophication, depletion of prawn, fish, duck and pelican populations, prolific growth of weeds like water hyacinth and reduction in tourist traffic.

Pulicat lake, in Nellore district, with a spread of 600 sq. kms. is another victim of industrial pollution, from the industries established both in Andhra Pradesh and Tamilnadu. In addition, there is extensive deforestation of mangroves affecting the lake's biosphere depleting marine resources. Consequently, many fisherman families dependent on these are facing problems of survival.

Along a coastline of 974 km., extinction of mangrove forests, a natural barrier against sea erosion and cyclones, has exposed the land to devastation and degradation. Sea is also being increasingly used to dump municipal wastes, refuse and industrial wastage. Present trend of industrialization along the coastline has serious connotations for the survival of marine resources and coastal environment.

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Air Pollution : Intensive location of cement industries in Wadepalli, Kodad of Nalgonda district, and near Vijayawada has spread pollutant particles across surrounding areas. Villages like Ramapuram, Dosapeta, Malkapuram, Madhavapuram, Mellacheruvu, Bajinepalli, Mallareddy gudem, Kandi Banda, Lakshmipuram, Ganapavaram, Kuchipudi, Kapu gallu, Togari, Gudibanda, Yerravaram and Nallabandagudem, near Wadepalli are affected by the cement dust settling on their crops. People residing near cement industries, generally, are plagued by lung disorders, bronchitis and other bronchial ailments.

In other centres like Manchiryal, Jaggaiahpet, Cuddapah and Tandur, where there are cement industries and rock quarrying units, air is laden with cement dust and other tiny particles. Particle pollution is particularly serious considering its effect on the lungs of children, women and old people.

Thermal power plants produce lot of fly ash, and pollute the areas around Vijayawada and Ramagundam. Ash problem is also severe in areas wherever sugar factories have been established, like Bodhan, Hindupur, Zahirabad, Chagallu, etc. A recent phenomena is the flaring of natural gas in the Godavari basin at Narsapur which is regular source of carbon pollutants in the atmosphere. Also, gas pipeline from Narsapur to Kovvur, frequently spews out gas in the midst of fields and villages through leakages, and is often accompanied by fire. This 72 km long pipeline supplies natural gas to the Gas Turbo Power Station at Vijeswaram.

Limestone, which is used in steel plants and paper mills is quarried at the mines in Chinna Malkapuram, Jaladurgam, Peapully, Chandrapully and other sites within a radius of 20 km. from Dhone, near Kurnool. Also, burnt lime from these sites is used in the fertilizer, sugar, petrochemicals, steel and paper industries. But, the limestone kilns are the sources of air pollution, posing serious occupational hazards for the workers, most of whom are children, and also affects surrounding villages. Gases like methane, carbon monoxide and carbon dioxide emanate from a mixture of burning coal and limestone. Due to this, and particle pollution, the old and the young alike suffer from respiratory problems, skin rashes, cough, malarial fever, asthma tuberculosis and other diseases.

Pollution of atmosphere by the internal combustion engines is more widespread and rampant. Of them, automobiles have been the largest contributors. With the burning of diesel and petrol by motor vehicles, many air pollutants are entering the ambient atmosphere making it hazardous for human beings, and other biological life. Automobile pollution is one of the accompanying problems associated with unplanned urbanisation. Growth of cities has put tremendous pressure on urban transport services leading to proliferation of motor vehicles, and thus, air pollution. Total number of automobiles jumped from 8,67,074 in 1986-87 to 10,16,430 in 1987-88. It is estimated that the figure may reach 20 lakhs by the end of 2000 AD. Smoke from automobile exhausts includes carbon monoxide, nitrogen oxides, hydrocarbons, lead oxides, dust particles, etc. Exposure to such smoke induces such ailments as respiratory diseases, skin allergies, eye problems, etc. Inhalation of automobile exhaust, or more particularly carbon monoxide, affects oxygen supply capacity of the blood to various parts of the body. Apart from the commuters, the most vulnerable sections to automobile pollution are police, children, road-side vendors and residents alongside major traffic arteries. Increase in the ratio of nitrogen oxides and sulphur oxide in the atmosphere damage even buildings, monuments and concrete structures.

Major Cities - Their Existing Situation : Visakhapatnam is considered as one of the Asia's fast growing industrial cities. This city is surrounded by hills on three sides and a ocean on the other side. It houses several major industries including an oil refinery, two fertilizer units, one zinc smelter, two petrochemical industries, one cement factory, etc., and numerous small scale units. Apart from these, there are plans to establish 4 more industries, in the petrochemical sector, by the Central Government. Several ancillary industries are also on the anvil, Vizag Steel Plant is the biggest industry in this city.

Waste liquid and gaseous materials of industrial processes have made the lives of residents miserable - asthma, bronchitis, and lung - related problems are rampant. In areas of excessive pollution, there have been reports of miscarriages of pregnant women, and delivery of still - born children. Some time back, the National Environmental Engineering Research Institute (NEERI) Nagpur, conducted a study on pollution in Visakhapatnam. This study revealed that the presence of dust particles in the ambient air, near Townhall, ranges from 114 to 174 metric tons. Sulphur dioxide, a dangerous pollutant, is indiscriminately released into the atmosphere by industries like Hindustan Zinc and the oil refinery. In the areas of Chintala Agraharam, Porlupalem and Naval base, cement dust from Andhra Cement Factory is troubling the health of the residents. Ground water is polluted in various areas due to industries like BHPV and Hindustan Polymers which let out untreated effluents into the open. A major drinking water source to the city, Meghadrigadda reservoir is very near to these polluting sources. Parts of the North and Eastern side of the city are the worst affected. And, in general, due to the closed atmosphere within which the city is located, almost all the pollutants continue to stay in the ambient atmosphere for longer duration - winter season intensifies this condition.

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Among India's 3,119 towns and cities, Hyderabad is one of the fastest growing cities. Its population estimated at 2.2 million in 1981 has reached 6 million in 1992. Reasons for this are not hard to understand. Deliberate promotion of industrial development has gradually altered the socio-economic scenario. Although agriculture still continues to be the mainstay of the State's economy - nearly 41 percent of its net domestic product originates from this sector - more than three and half decades of development has transformed the State. In the past 8 - 9 years, Hyderabad has become the new boom city due to some of the factors which range from natural, social, economic to political. Annual phenomena of cyclones in coastal areas, continuous dry conditions in Rayalaseema and parts of Telangana, social upheavals in the Telangana region, planned economy in which centralisation is the key word, disparity in standards of living in rural & urban areas and decimation of local self governments are a few factors which led to rapid growth of Hyderabad. However, though Visakhapatnam and Vijayawada are also part of these phenomena, their growth rate is not on par with that of Hyderabad. Because, Hyderabad has several 'pull' factors. Firstly, it is the seat of the power structure. Secondly, it houses several industrial areas like Nacharam, Jeedimetla, Ramanthapur, Balanagar, Azamabad, Katedan, Moulali, Uppal, Cherlapalli, Patancheru, Bollarum and Saroornagar. Thirdly, it has become an important centre for national research organisation like Centre for Cellular and Molecular Biology (CCMB), Indian Institute of Chemical Technology (IICT), and some defense organizations, like Defense Metallurgical Research Laboratory (DMRL) etc. - there are nearly 15 to 20 of them. Also, there are several agricultural research organisations and Programmes. And, six universities are also part of the educational facilities available in this city. Thus, Hyderabad attracts all sections of the society due to the unlimited scope for employment, real or perceived.

The result is that there is enormous pressure for shelter and services fraying the infrastructure. Lack of a solid, diversified base to support the build up of housing, infrastructure and employment means haphazard growth.

Modern industrial development in Hyderabad, started with the establishment of the Bharat Heavy Electricals Limited at Ramachandrapuram on the outskirts of the city in 1961. This was followed by Hindustan Machine Tools and Indian Drugs and Pharmaceuticals Limited (IDPL) in the late sixties. In the early seventies, Hindustan Cables Limited, Electronics Corporation of India Limited, Nuclear Fuel Complex, Mishra Dhatu Nigam and Hindustan Aeronautics were established. All these industries belong to the public sector. Of all of them, IDPL triggered a proliferation of chemical & pharmaceutical industries, in the private sector, in Jeedimetla, Sanatnagar, Kukatpally, Patancheru and Bollarum. Belonging to large, medium and small scale categories, these industries, unfortunately, were established on the wrong side of the city of Hyderabad i.e., on the upstream towards the West. This wrong siting lies at the source of environmental degradation problems of Hyderabad.

Number of automobiles has increased tremendously in the past 5 years alongwith the unplanned growth of the city. Linear growth along the main roads, is one of the major factors for this exponential increase in automobiles. Estimates show that there are nearly 6 lakhs of vehicles, of different categories, out of which about 4 lakhs are two wheelers and one lakh cars.

Most industrial areas lack proper infrastructural facilities like water supply, roads and sewer line, which have not been developed properly. Much of the process water needs are met by individual borewells. Sewer lines are almost absent. Many units also depend on the tanker supply of water. Roads are improperly developed. Effluents of these

BRAOU

industries are released into the open, which collect in roadside drains and pits. As a result, ground water within the industrial area is polluted, and is unfit for process water. The best example is the Patancheru industrial area.

1.3.5. Global Policy Directions

Environmental policies are important for facing the ecological challenge. Local, national and international measures must be formulated and implemented; finding the most appropriate level of action necessary to cope with the various environmental threats. The Stockholm Conference in 1972 is considered as the first step towards facing this challenge - it dealt with environmental protection at the international cooperation level. This United Nations Conference on the Human Environment extended international consideration to the social, political and economic factors that influence man-environment relationships. The Conference accorded official recognition of the environment as a subject of general international concern and the institutionalisation of that concept in the United Nations Environment Programme (UNEP). Later on several bilateral and multilateral conventions have been established. Some of them are :

- Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, London, 29 December, 1972.
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Washington, D.C., 3 March, 1973.
- Convention on the Conservation of Antarctic Marine Living Resources, Canberra, Australia, 20 May, 1980.
- Vienna Convention for the Protection of the Ozone Layer, 1985.
- Montreal Protocol on Substances that Deplete the Ozone Layer, 1987.
- Convention on Control of Transboundary Movements of Hazardous Wastes and their Disposal, 1989.

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Yet management of the various commons - the oceans, outer space and Antarctica - is at different stages of evolution. The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Dumping Convention), which has a world-wide application was concluded in November, 1972 and entered into force on 30 August, 1975. In 1985, the London Dumping Convention extended indefinite moratorium on the dumping of low-level radioactive wastes. The Law of Sea Convention requires states to establish national laws and regulations to prevent, reduce and control pollution of the marine environment from dumping. The United Nations Conference on the Law of the Sea was the most ambitious attempt ever to provide an internationally agreed regime for the management of the oceans. By early 1987, the convention had been signed by 159 nations and 32 countries ratified it. Signed on 1 December, 1959, the Antarctic Treaty tries to ensure the conservation of its unique environment, preservation of its value for scientific research, and retaining its character as a demilitarized, non-nuclear zone of peace. The Montreal Protocol symbolizes the international response to control the emissions of the green house gases. Despite attempts, expectedly, most of them fall short of an enduring regime of controls due to different perceptions of individual countries. The recent World Conference on Environment and Development held in Brazil from 3-14 July, 1992, focused on the need to narrow this gap in defining the goals, strategies and policies to tackle environmental degradation, by every nation, individually and collectively - specifically, a

climate convention (dealing with country-wise carbon emissions), a biodiversity convention and a forest convention were put on the discussion table.

Check Your Progress - 1, 2 & 3

1. What are the parameters to establish a link between environmental issues and modern development?

2. Mention the global issues, and the positions of developed countries and developing countries in this regard.

3. Define Sustainable Development

Note : (a) Write the answers in the space given below.

(b) Compare your answers with those given at the end of this unit.

BRAOU

1.4. FRAMEWORK FOR ACTION - INSTITUTIONS, INDIVIDUALS AND COMMUNITIES

India's long history of culture and traditional belief ensured that Nature and its laws cannot be ignored by the humanity to prolong its own existence - its a different proposition if these aspects of Indian cultural evolvement remained only at the cognitive level in modern India. It is no surprise, this 'environmentalism' in Indian cultural ethos was reflected in the Indian constitution, in 1950, long before any other governing system in the world recognised the problem. The Directive Principles of State Policy, in Part IV of the Constitution, expansively deals with the improvement in the quality of life. The word 'environment' as used now means, at the abstract level, the quality of life in conjunction with the ecological balance. As such, Article 39 of the State Policy says : "The State shall, in particular, direct its policy towards securing -

(b) that the ownership and control of material resources of the community are so distributed as best to subserve the common good,

(c) that the operation of the economic system does not result in the concentration of wealth and means of production to the common detriment".

Here the reference to 'material resources' includes natural resources like air, water and land. Further, these provisions are strengthened by direct reference to the protection of environment in Article 48 A, which says, "The State shall endeavour to protect and improve the environment and to safeguard the forests and wildlife of the country".

And, in Part III of the Constitution, Article 21 confers the fundamental right to life, in these words : "No person shall be deprived of his life or personal liberty except according to procedure established by law". Pollution of basic resources like water and air, which subserve human needs, threatens this fundamental right.

Apart from constitutional provisions, there have been several Central enactments which deal with different aspects of social resources, public health and natural resources piece meal, like Mines and Minerals (Regulation and Development) Act, 1947, Industries (Development and Regulation) Act, 1952, Food Adulteration Act, 1954, River Boards Act, 1956, etc. Most of these Acts recognise the destructive effect of the respective

BRAOU

human action on nature and species, and proceeded to put limitations on such an activity. The main purpose of these Acts was regulation of development.

Governmental awareness about environmental aspects was significantly influenced by the U.N. Conference on Human Environment in 1972. Specifically, Mrs. Indira Gandhi, the then Prime Minister, who delivered the key-note address at the Stockholm meet, recognized the necessity of legal and organizational framework for environment protection. But, while the earlier enactments were meant only for individual acts, the post-1972 phase has to contend with the national and social directional systems. Because, now the overall stress is to sustain industrial growth through environment protection. Though the missing link between environment and development has been recognized, it did not reflect in different actions and policies, subsequently, due to social, economic, political and administrative reasons.

Apart from these Acts, a chapter on Fundamental duties was included in the Constitution, through 42nd Amendment, in 1976, in which Article 51 A(g) enunciates : "It shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures". Besides this, the entries dealing with "forests" and "wildlife" were dropped from the State list and inserted in the Concurrent list. This was done so as to give a national perspective to the protection of forest resources and wildlife.

1.4.1. Institutional Provisions

A National Committee on Environment Planning and Coordination (NCEPC) was appointed, in the 70s, with the aim of providing a central point for policy responses, wherein considerations of decision-making and management of environment can be focused upon comprehensively. Presently, a National Environment Council has been created to deliberate on various issues of environmental concern, with a broad based membership. Another important step taken in response to the growing environmental problem is the creation of a full fledged Department of Environment in November, 1980. In 1985, the Department of Environment was elevated to the level of a Ministry of Environment and Forests with the Department of Environment, Forests and Wildlife integrated into it. This Ministry was assigned the task of planning, promotion and coordination of environmental and forestry programmes. Conservation and survey of flora, fauna, forests and wildlife, prevention and control of pollution, afforestation and regeneration of degraded areas and protection of environment are some of its important activities.

The Water Act, 1974 envisaged creation of a Central Board and State Boards to deal with the issues of water pollution, which were formed gradually by all States. Though the Air Act, 1981, also, calls for creation of Air Pollution Control Boards, for administrative reasons, the mandate of Water Pollution Control Boards was extended to include this Act. Even the Environment (Protection) Act, 1986 was brought under their purview. Hierarchically, the State Boards are independent of the Central Board, and the Central Board was to function only as a supervisory and coordinating body. This was necessary, since with all forms of pollution there are likely to be issues concerning two or more States which could be contentious if extended into geo-political dimensions. The Central Pollution Control Board (CPCB), previously known as Central Board of the Prevention and Control of Water Pollution, is also charged with the responsibility of advising the government on all matters relating to pollution and environment protection.

BRAOU

1.4.2. Instruments for Institutional Interventions

With regard to operationalisation of the provisions, concerning industrial pollution, every new industry has to obtain a 'No Objection Certificate' (NOC) from the Pollution Control Board, which can be issued only after an assessment of the local environment. To reinforce this prescription, at the national level, Minimal National Standards (MINAS) have been evolved in the case of effluents and air emission standards for major categories of water and air polluting industries, respectively. National Ambient Air Quality Monitoring Programme and National Water Quality Monitoring Programme were launched as part of measures of pollution control. As all the above measures are 'curative', there was a felt need for a preventive environmental policy instrument. Environmental Impact Assessment (EIA) of development projects fulfills this need - the responsibility of project-appraisal through EIA has been entrusted to the Ministry of Environment & Forests. The purpose of EIA is to evaluate the beneficial and adverse effects of a development activity on the environmental system so that it could be integrated with economic analysis of the project costs and benefits - the development activity covers not only industries but every development project like irrigation projects, mining projects, etc. The project authorities are required to provide the relevant information as per prescribed questionnaires, or check lists, along with the feasibility, or detailed, project reports for scrutiny by various expert committees.

1.4.3. Environmental Laws and Courts

In consonance with the establishment of implementation mechanisms dealing with environmental issues, there has been no parallel effort in the judiciary. But legal redressal has been achieved in a few environmental-related cases largely through the instrument of Public Interest Litigation (PIL). Courts have a very important role in the protection of environment. Unfortunately, legal means have often been found inadequate. There are quite a few reasons for this sort of situation. Firstly, the courts are burdened with a plethora of cases. Public interest litigation has in no way been an unqualified success. Secondly, our judicial system suffers from inadequate understanding of the issues involved - its response has been obscurantist and obsolete. Thirdly, Indian problems are complex and defy any ready-made solutions. Many cases cannot be called environmental in the strict sense nor technology can be the ultimate solution, since it involves basic rights and survival of communities. Fourthly, political and administrative processes are discontinuous in their responses to judicial interventions, and often are captive of anti-environmental interests.

Knowledge is today a major source of power and control. Since environmental issues involve conflicts over natural resources between disparate interests, adjudication of these cases requires properly assessed scientific and technical data which is impartial and objective in approach. Recognizing this, the Supreme Court has recommended the setting up of environmental courts on a regional basis with one professional judge and two experts drawn from a Ecological Sciences Research Group (ESRG), keeping in view the nature of the case and the expertize required for its adjudication. The ESRG, as suggested, should consists of independent, professionally competent experts in different branches of science and technology who would act as an information bank for the court and the government departments. Consequently, a draft bill on environment courts was prepared by former Chief Justice, Sri. P.N. Bhagwati, upon the request of the government. However, this idea has not materialised so far.

With recognition of public interest litigation as an institutional obligation of the courts, a spate of environmental cases have been brought before the courts through this facility.

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Estimates show that 4,500 pollution related cases, and more, are pending in various courts in India with no significant success. But a few stand out for their path-breaking judgements.

1.4.4. Individual Action and Community Response

How are individuals in the real world to be persuaded or made to act in the common interest? The answer lies partly in education, institutional development and law enforcement.

There have been several initiatives at the individual and community level to protect and conserve the environment, the world over. In India, there are several which standout for their approach and successes. However, each movement has its genesis in different circumstances, but commonly linked by the concern for environment. The famous movements include Chipko movement in the Himalayas against deforestation and for the preservation of communal properties, movement against the Silent Valley project in Kerala, movements against dams (Tehri, Narmada, etc.), movements against industrial pollution in Karnataka, Tamilnadu, Orissa and Kerala, etc.

These movements have generated lot of debate on the rights of the local communities in the management of their natural resources like water, land and forests. This debate over years has encompassed in itself the traditional rights of certain traditional communities like tribals to preserve their culture and value systems, alongwith the natural ecosystems. It has also resulted in exposing the dichotomy between agriculture and industrialisation, people's participation and state control, laws and traditional practices, economic growth and ecological balance, inter state water disputes, leading to a fundamental change in the patterns of governance. These debates are now discussed in the domains of public policies, forest policy, agricultural policy, industrial policy, environmental policy, etc., and the linkages therein.

However, most laws do not recognise the right to information of citizens. Information on polluting industries and action taken by the governments, if any, against offenders, and about various development projects is inaccessible to citizens. This limits any independent citizen action.

But, in the recent past, certain changes have been proposed to make the law enforcement more effective. Government has decided to bring some amendments to the Environment Act. Under this proposal, individuals with prescribed experience and qualification may also collect samples against the present provision where only authorities have the right to do so. Also, there will be a provision for appeal against directions to a designated body. It has been proposed to reduce the notice period of 60 days, to be given by an individual to the government, to 30 days.

There is a proposal to label the environment friendly products to promote consumerism in consonance with sustainable development. This eco-label, it was desired, would encourage the industries to adopt processes and technologies which would enhance rather than degrade the environment.

Various eco-development schemes have been launched by the government and non-governmental organisations in the last decade or so. Different afforestation schemes tend to encourage individuals and communities to right the wrong committed through deforestation. Several rural development projects emphasise on people's participation. People's participation in planning and implementation of developmental projects has been the slogan of the non-governmental organisations and voluntary sector.

BRAOU

1.5. MOULDING PUBLIC OPINION

Education on environment is one of the tools for moulding public opinion on aspects of environment and development. Non-governmental organisations have taken the lead in this regard, and have been successful in legitimising the word, environment education. Several educational institutions and universities have also been offering courses on environment and environment education.

Environmental awareness was also sought to be spread through seminars, workshops, syposiums, and celebration of different days like world environment day, forest day, earth day, etc. However, it is widely agreed that our cultural systems, & age old beliefs contain much more wisdom and can in fact be better tools for moulding and mobilising public opinion. The most potential and benign method of moulding public opinion continues to be the information dissemination. Free information flow has helped in better planning of different projects and has helped in alround participation and has also acted as a check against exploitative tendencies. Thus, freedom of information has become the basic slogan for every environmental action and movement.

Check Your Progress - 4

4. Mention the role models necessary to solve environment and development issues.

Note : (a) Write the answer in the space given below.

(b) Compare your answer with the one given at the end of this unit.

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1.6. SUMMARY

The global environment is rapidly becoming the most demanding arena for debate, decision and action as the emergence of environmental problems pose stiff challenge for physical sciences as well as social sciences. The world over, Development resulted in disparities in terms of socio-economic conditions between rich and poor countries. Besides degrading the environment through pollution and deforestation, present economic trends had benefited a privileged minority and had done little to meet the basic needs of the vast majority.

Advanced industrial development, in Europe and North America, brought to the fore problems of overconsumption (of resources and goods), enormous amounts of garbage, acid rains, pollution, etc. with concomitant effects on living species survival and on environment. While poor regions like Africa and Latin America face resource depletion in the form of deforestation and mining leading to cycles of drought, famine and civil wars. These conditions have devastated human population killing nearly one million - other living species, plant and animal, are almost decimated.

At the global level, acid rain, desertification, global warming, ozone layer depletion, pollution, radiation, species extinction are some of the most urgent environmental problems. Increasingly, efforts are being concentrated to forge international cooperation in tackling these problems.

In India the scene is no different. Almost all the States have the common set of environment problems with variations in degree than kind. Given the socio-economic disparities, these problems mostly put the poorer sections of the society at disadvantage.

Andhra Pradesh is one of the major industrialised States in the country. More than three and half decades of development has changed the social scenario of Andhra Pradesh. Continuous near-drought conditions in Rayalaseema and Mahabubnagar district are some of the consequences observed. Increased devastation in coastal areas due to cyclones is largely because of depletion of natural barriers like mangrove forests. Land salinity in coastal areas is another effect of water logging. Clustered industrialisation near few cities like Hyderabad and Visakhapatnam, and in certain regions, was not conducive for the sustainability of resources in those cities or regions. Impact of industrial activity on the environment resulted in localised problems of air, water and land pollution.

Several environmental movements, with the initiative of individuals, communities and institutions have tried to respond to the crisis of environment and the perils of modern development in different ways. Government has also initiated certain steps to correct the situation.

1.7. CHECK YOUR PROGRESS : MODEL ANSWERS

1. The parameters to establish a link between environmental issues and modern development are :

   (i) Poverty and rate of economic growth. (ii) Extent of natural resource depletion and Gross National Product. (iii) People's participation in planning and implementation of development projects. (iv) Food security and export earnings. (v) Extent of industrialisation and urbanisation. (vi) Patterns of the growth of science and technology.

2. In all the global issues, developed countries want the developing countries to opt for alternative strategies of technology and development, blaming the present problems of environment on poverty and population in developing countries. Developing countries want the advanced countries to curb their overconsumption of resources, transfer of alternative technologies on easier terms, and more equity in global governance of global commons like oceans, rainforests, etc.

3. Sustainable development is a model which tries to meet the needs of the present without compromising the ability of future generations to meet their own needs.

4. The role models necessary to solve environment and development issues are : (a) Institutions, (b) Individuals, (c) Governments, (d) Non-Governmental Organisations.

1.8. MODEL EXAMINATION QUESTIONS

I. Answer the following questions in about 30 lines each.

1. Write a brief account on the quality of environment.
2. Write briefly about the problems to be attended immediately at the global and national level.

BRAOU

3. What are the problems arising due to urbanisation? Write briefly about them.
4. Write an account on water and air pollution.
5. Write a brief account on the existing situation in major cities in India.

II. Answer the following questions in about 10 lines each.

1. Write briefly about water pollution in Andhra Pradesh
2. What are the reasons for air pollution in A.P.
3. Write a brief account on environmental laws and the role of courts.
4. How are the individuals to be persuaded or made to act in the common interest?

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BRAOU

UNIT - 2 : VOLUNTARY AND OTHER AGENCIES

Contents

BRAOU

2.1. OBJECTIVES

After going through this unit, you will be able to :

- explain the importance of alternative institutions like NGOs and activists towards the protection of environment,
- explain the role and necessity of education for people's participation in the developmental programmes, and
- discuss the methods of improving the deliverance capacities of NGOs and activists in ensuring sustainable development.

2.2. INTRODUCTION

Society, and the nature of citizen initiatives in India in particular, and in different parts of the world in general is currently undergoing significant changes. A brief historical look will enable better understanding of this statement. The most clearly documented examples of citizen initiatives in modern history are the social reform movements in the 19th century. Raja Ram Mohan Roy and several others galvanized citizen action to challenge the then prevalent socio-cultural prejudices related to caste system, status of women, and children, etc. Support for such initiatives came from various sections in the society. Many examples of initiating schools, health facilities, orphanages, and widow homes are found in this period. Later on, and also initially during this period, foreign missionaries began to work with activities of education and health, especially in the rural and remote areas.

Freedom movement reflects the next phase of this tradition. Despite its political agenda, this movement could achieve mass participation through Mahatma Gandhi's appeal based on principles of voluntarism, 'satyagraha', sacrifice and struggle. Gandhi encouraged citizens to involve themselves in constructive social work, parallel to the determined political work against the British rule.

Another phase of development occurred in India after Independence, though it has its roots in the colonial governance by the British. With the government taking the dominant role in promoting socio-economic development, the role of citizens and various institutions which represent them gradually declined in the last four decades. Not only the State took over all resources, land, water and forests, etc., but it got equated with all that was considered as "public", i.e., common property. Thus, not only the natural resources, but also the system of social functioning, mutual support, education and governance got systematically decimated. In a way, the welfarist policies of the State have succeeded in making the citizens emotionally, intellectually and economically dependent on the State and its agencies, thereby creating passivity, dependence and apathy. The then existing material base and institutional capacity of the society was destroyed in the process. Traditional institutions like gram sabha, irrigation and natural resource management mechanisms have faded into oblivion. Alternately, a new system of governance, regulation and control emerged which was based on alien values, principles and structures.

India adopted a State-led model of development, after Independence. More than forty years after, this strategy has only increased inequality, misery and poverty. All systems of governance have lost their effectiveness and credibility. "Public control" over nation's resources was effectively diverted for individual gain during this period. Globalization added a stimulus to this process.

It is in this situation of declining role of the State, and increasing role of Market that reassertion of the civil society and citizen action needs to be understood.

BRAOU

2.3. VOLUNTARY ORGANISATIONS - CHANGING DIMENSIONS

A voluntary organisation is by definition a voluntary association of individuals, governed and guided by self-designed rules and regulations in accordance with the relevant statutes of the land, including the fundamental right to freedom of association. The distinctive motivation of voluntary social work derives from the intrinsic and natural human will to serve fellow beings, especially the weak, the deprived, the oppressed and the needy. This is the moral imperative and sine qua non of voluntarism. In India, voluntary association, not always formal or registered, is the key motif and mode in which social functioning takes place in all aspects of peoples lives and affairs. Social and community life with its element of self-help, mutual aid, self-management, cooperation as well as competition, social welfare and security, maintenance of social and religious assets, is still carried on the strength of voluntary service and association. These qualities and institutions are deeply ingrained in the cultural and dharmic traditions and tenets of various communities, occupations and ethnic groups as well as villages, towns and regions. Thus, voluntarism was a way of life, in India, especially in the village.

However, the dimensions of voluntary work changed in the pre-independence period with various social reforms, cultural and religious revival and constructive work movements and missionary work. In the later part of this period, most of these movements and

related organisations, identified themselves with the Independence struggle. Thus, voluntary movement was almost working in tandem with the government in the beginning stages of post-independence era.

But, by the mid-sixties, it was clear that neither the government through its planned development and avowedly socialist policies nor the voluntary social and political movements had been successful in tackling the problems of rural poverty. In fact, these had become aggravated by large scale displacement, alienation and impoverishment created by the development process.

The bulk of voluntary organisations in rural development belong to this genre of "professional" voluntary work whose patterns crystallized during the seventies. Though self-managed, these organisations were clearly located in main-stream development context. Their role as the voluntary sector became recognised in the National Seventh Five year plan and sizable budgetary allocations were made for specific poverty-alleviation activities to be carried out by this sector.

Historically speaking, work of voluntary organisations in India can be broadly categorised into four types. The first type offers services which address the important needs of deprived sections of the population in such diverse areas as education, health, drinking water etc. This type of organisations earlier played the role of charity and welfare for the poor and destitutes. The second type (can be seen throughout history) have been those whose role was to awaken and organise the poor and marginalised to struggle for their rights and for expression of their perspectives. These organisations, in recent years, are being called social action groups. The third type includes those which are promoting development interventions in the areas of environment, deforestation, income-generation, irrigation, agriculture, etc. In the last two decades, an increasingly large number of voluntary organisations have been involved in providing such development initiatives. Further, a new form of voluntary action has emerged in respect of networking and providing support to grass-roots. There are state or national level networks as well as research, training, documentation support organisations at various levels. Many of them are specialised in a sector (education, women, environment etc.) while some provide generalised support. Finally, and fifthly, activism of individuals, informal groups and institutions has been a new form of voluntary action based entirely on environmental issues. Concern for the consequences of one's action, concern for humans and generally life are the corner stones of this activism.

2.4. ENVIRONMENTAL NGOs

Over the past 30 years, environmental movement has grown dramatically and moved from strength to strength, the world over. However, in India, this movement despite a few shining examples is still in its initial stages, comparatively. Earlier, writers like Rachel Carson, Barry Commoner and Barbara Ward have taken the cause of environment. Over years, thousands of individuals, volunteers and local groups have become a part of this powerful movement. Scientific and NGO groups have played a major role in the environmental movement from its earlier beginnings. They were the first to point out evidence of significant environmental risks and changes resulting from the growing intensity of human activities. Other non-governmental organisations and citizen groups pioneered in the creation of public awareness and political pressures that stimulated the governments to act. Several international NGOs have produced reports on the status of and prospects for the global environment and natural resource base. A few national NGOs are publishing 'State of Environment' reports regularly, including India. Some others have produced regional reports

BRAOU

on similar lines - one such report in the vernacular language of Telugu was produced in Andhra Pradesh for the first time in India. These reports have played indispensable role since the Stockholm Conference in the 1970s in identifying risks, assessing environmental impacts and designing and implementing measures to deal with them.

In the West, the centrestage is today occupied by a select group of mass membership-based organisations which bring issues and campaigns to the fore. Well known among them are : Greenpeace, Friends of the Earth, the Sierra Club, the Environment Defence Fund and others. There are other equally powerful national NGOs like Bund (Germany), Society for Conservation of Nature (Denmark) and Society for Nature Conservation (Sweden). Study of these organisations will certainly reveal the ways of organising modern civil society to bring about social change. They have a grassroots base with mass membership which enables financial independence. Some US NGOs have an annual budget of $100 million a year. Some national environmental NGOs in Europe claim 1 to 2 percent of their country's adult population as their members. Their working methodology includes a variety of tools : from research, analysis, media attention, and countless battles, to a wide variety of lobbying and protest techniques. Environmental lobby represented mainly by the NGOs can no longer be ignored by the political agenda in many of these countries. Some organisations having acquired strength from the mobilisation of public opinion, are not only influencing the political system but also the economic system.

There are now at least 11 major environmental organisations in the US, ranging from National Wildlife Federation and the World Wide Fund for Nature on the right to the Friends of the Earth and Greenpeace on the left.

BRAOU

2.4.1. Greenpeace

This was founded in 1971. Presently, its membership is 5 million worldwide. Greenpeace concentrates its work in five areas : nuclear issues, atmosphere and energy, ocean ecology, toxics and tropical rainforests. It has offices in 30 countries, and support is strongest in Germany, Holland, the US and Britain. This organisation was started when a small group of people set out in fishing boat from Vancouver, Canada, to express their opposition to US nuclear weapons on a small Alaskan Island, in the 70s. Using simple message, non-violent, direct action and maximum impact, Greenpeace has grown from a small group of activists into an influential, international, environmental organisation with a multi-million dollar budget. In 1993, Greenpeace International employed about 85 people, including scientists, biologists, researchers and journalists. Greenpeace established a base in Antarctica, the last unspoilt continent, in 1987. And, subsequently, in 1991, fifty countries have signed a protocol not to dig for oil, gas or any other minerals at the South Pole in the next 50 years. Many view this as Greenpeace's crowning achievement in its 20 year history.

Greenpeace is well known for putting new issues on the agenda, such as the chloride industry as a major polluter or the huge transfer of toxic waste from the North to South. Greenpeace is increasingly trying to find solutions : promote safe alternative programmes and urging less industrial pollution. Its membership is wide. They are kept informed of the activities through bulletins, and a magazine. Many subscribers of this magazine send their reports, which serve as a useful feedback. Volunteers can inform schools and other groups about Greenpeace and its work for the environment.

2.4.2. Sierra Club

Sierra Club was founded in 1892 in United States by John Muir, a conservationist. Since its inception, Sierra Club was involved in several efforts to preserve park areas (or wildlife

sanctuaries) especially in expanding the area of the Yosemite National Park in California. However, under Muir its approach was entirely different from what it did in the mid-50s and 60s. It was confrontational in the latter period. From basically an organisation which had advocated preservation of wilderness, Sierra Club embraced the new approach of caring for the public health, after the success of Rachel Carson's Silent Spring.

The Club's statement of purpose is : to explore, enjoy and protect the wild places of the Earth; to practice and promote the responsible use of the Earth's ecosystems and resources; to educate and enlist humanity to protect and restore the quality of the natural and human environment; and to use all lawful means to carry out these objectives.

On all issues, the Club has coordinated its activities with other environmental groups working for common goals. Although its approach varies by issues, the Sierra Club leans more towards the militant and progressive side of the spectrum, among the organisations in the US. A 15 member volunteer-elected Board defines the broad policy of the Club. Although staff members exert a strong influence over the process, the organisational structure demands more accountability. Members of the Sierra Club, whose number reached 500,000 are actively involved in its campaigns, unlike in other groups whose members are mostly just donors. Individual chapters of the Club have a high degree of autonomy and participate actively in local, regional and sometimes national campaigns.

In contrast, developing countries have few NGOs with the same breadth and capture of social space. However, to an increasing extent, national NGOs draw strength from association with their counterparts in other countries and from participation in international programmes and consultations. Many international networks and coalitions of NGOs are active. They ensure that national NGOs have access to the support they require. These include regional groups providing networks linking together environment and development NGOs in Asia, Africa, Eastern and Western Europe, and North and South America. They also include a number of regional and global coalitions on critical issues such as pesticides, chemicals, grains, seeds, genetic resources, and development assistance. A global network of information exchange is provided through the Environment Liaison Centre (ELC) in Nairobi, Kenya. ELC has over 230 NGO member groups, with the majority from developing countries, and is in contact with 7,000 others.

BRAOU

Check Your Progress - 1 & 2

1. Name three environmental NGOs which have produced 'State of Environment' reports at international, national and regional levels.

2. Identify two important international events which are considered as historical in the field of environment.

Note : (a) Write the answers in the space given below.

(b) Compare your answers with those given at the end of this unit.

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2.5. ENVIRONMENTAL NGOs IN INDIA

The environmental movement is very new in India - about fifteen years old. Two important incidents, or moments, have enabled this : Chipko movement and Bhopal gas tragedy.

2.5.1. Chipko Movements

Chipko - "to hug" in Hindi - today evokes romantic images of poor, village women in the hills of northern India determinedly hugging trees to prevent them from being cut down by the very axes of forest contractors that were also a threat to their lives. However, Chipko's multi-faceted identity has meant different to different people. For some, it is the extraordinary movement of the poor for conservation of resources; for others it is local people's movement to regain control of their natural resources, snatched away by successive governments from the colonial periods; and finally, it is movement of women trying to save their environment. In fact, as a women's movement, it inspired eco-feminism in India and to some extent, throughout the world.

BRAOU

The people of Uttarakhand region, situated in the central Himalayas, raised their voice for the first time through the Chipko movement, to say that their life is mainly dependent on forests. In the last three decades, heavy destruction of forests degraded not only the environment but also the daily life of the villagers. There was discontentment among the people, but they received their biggest shock in the 1960s, when under a working plan, trees were cut on a largescale. This increased the intensity of the 1970 flood in the Alakananda river, which swept away six bridges, 16 footbridges and 25 buses. Hundreds of people and animals died. In 101 villages, 604 houses and 500 acres of crops were destroyed. Roads were blocked. Despite this, exploitation of forests for commercial purposes continued and no thought was given to stopping or reducing it. Between 1973 and 1977, the people of Gopeshwar, Mandal, Phata, Rampur, Reni and Bhyundar in the Chamoli district, situated in the watershed of Alakananda, had to protest at least half a dozen times against the Forest Department's working of forests.

Chipko's first battle took place in early 1973 in Chamoli district, when the villagers of Mandal, led by Chandiprasad Bhatt and Dasholi Gram Swarajya Mandal (DGSM), prevented the Allahabad - based sports company, Symonds from felling 14 ash trees. This act took place on 24th April. And, again on December, villagers stopped tree felling in Phata-Rampur forests, about 60 km from Gopeshwar. In 1974, more than 680 ha of forest was auctioned by the Forest department, in the area which was badly affected by

the massive Alakananda flood of 1970. But the women of Reni village drove out the contractor's labourers on 26 March, 1974. Meanwhile, other protests were staged in the Uttarakhand region. In 1974, a struggle was launched on July 25 by villagers from the Vyali forest area near Uttarkashi, seeking to halt tree-felling. In Kumaon, Chipko made its debut at the Nainadevi fair in Nainital in 1974, and activists proceeded to block forest auctions at several places, including Nainital, Ramnagar and Kotdwar. The movement in Kumaon gathered momentum following major landslides in Tawaghat. In Tehri-Garhwal, Chipko activist led by Sunderlal Bahuguna began organising villagers in May, 1977, to oppose tree-felling in the Henwal valley.

Irrespective of Chipko's grassroots achievement, it accomplished a great deal at the national and international levels. In its growth, Chipko contributed immensely to national and international ecological movements. International ecologists saw this movement as a cultural response of the people's love for their environment. Chipko was popularised by the feminist movement, who pointed out that village women have to walk long distances to collect fuel and fodder and they become the first victims of forest destruction.

Chipko's biggest contribution probably was the pro-poor environmentalism that it brought in its wake. Several environmental activists discerned in Chipko a powerful assertion by people of their rights over their environment. This was a true social justification of the protests, which defined a new morality in environmental concern. Chipko generated a volume of literature, but 20 years after its birth the questions remains what has been its impact locally, nationally and internationally. Did it achieve its objectives or were its gains only intellectual, with few benefits for the villagers?

2.5.2. Other Noteworthy Incidents

In the city of Bhopal in Madhya Pradesh, on December 3, 1984, the world witnessed one of the most tragic accidents in the history of the chemical industry. Some 40,000 kg. of deadly methyl isocyanate was released into the environment resulting in the loss of over 2,500 lives and affecting over 200,000 city residents for years to come. There was also damage to animal life and the environment of untold magnitude.

Though the Bhopal gas tragedy still continues through delayed effect on the life, the incident itself has had wider impact on people, governments, and industry, the world over. This incident has singularly jolted the institutions and the public alike from the complacency in protecting the environment. In the developed world, governments and industries responded promptly to the Bhopal disaster, taking a closer look at the installations handling hazardous material, checking the adequacy of operations, maintenance and safety controls, the availability of management measures for dealing with emergency situations and the awareness and preparedness of the industries and the neighbouring communities to deal with industrial accidents. The post-Bhopal situation in India followed a similar trail, with major strides being taken in formulating legislation to deal with accidents involving hazardous material. Awareness levels of the general populace was raised to new heights largely due to the media projection of the accidents, and related aspects.

Consequent to this, many action groups were formed in different parts of the country, to fight environmental deterioration, which later on graduated to become NGOs. Environmental awareness also spread due to certain initiatives taken by the government in the post-Bhopal scenario. Actions concerning the environmental legislation, River Ganga Cleanup Programme (popularly known as Ganga Action Plan), and National Environmental Awareness Campaign. The last mentioned campaign was directly linked with the NGOs and was

BRAOU

specifically aimed at raising the awareness levels of the people through voluntary agencies and NGO sector.

Movements against Tehri Project in Uttar Pradesh and Sardar Sarovar Projects across River Narmada exemplified the grit and tenor of environmental NGOs in India. Movement against projects across River Narmada is being led by Narmada Bachao Andolan. Other important movements are : Silent Valley Project in Kerala, Appiko movement (against deforestation) in Karnataka, and Baliapal movement in Orissa. In Andhra Pradesh, citizens against pollution has been instrumental in initiating movements against industrial pollution, nuclear power station, drought & desertification, and depletion of cattle resources. In Kerala, Kerala Shastra Sahitya Parishad is identified with people-oriented science education movement. International events like the World Commission on Environment and Development (1987), and the Earth Summit at Rio (1992) increased the pace of NGO activities in the sphere of environment.

2.6. STATE OF NGOs IN INDIA

The number of NGOs working on environment in India is estimated to be 1469, according to the 1991 WWF Directory on Environmental NGOs. Some of the salient points concerning the number and distribution of NGOs are :

- About 75% are societies formed under the Societies Registration Act and located in almost all the States and Union Territories with higher concentration in southern and western parts of the country and lesser in the north-eastern states.
- They are located in 217 districts i.e., nearly half the number of total districts in India.
- They are fewer in the districts of Assam, Haryana, Jammu & Kashmir, Karnataka, Madhya Pradesh and Manipur which are environmentally vulnerable states.
- About 2/3rds of all NGOs are in 51 districts.

These districts have not been selected on the basis of ecosystem degradation. Environment has come into play only recently in existing NGO' activities as part of a range of activities. Out of the total number only a few carry exclusively environment work.

In other words, most NGOs did not start rural development in the most environmentally degraded areas. They have selected the locations based on the low level of infrastructural development and poor delivery mechanisms of the government. As the popular perception of environmental degradation increases, it is possible that NGOs will be set up simply as a response to the most ecologically vulnerable areas of the country, as is happening already.

With regard to the level and area of operation, there are about 1287 working at the district level, 67 at the regional level and 118 at the national level. Again some of the salient features are that :

* regional and national organisations constitute about 15% of the total organisations.
* grassroots organisations working at the village or the district level are by far the most numerous.
* headquarters of grassroots organisations are primarily located in towns and villages. Not more than 50% are in the village.

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* number of villages covered by NGOs is about 30 to 40 thousand which means a ratio of one NGO covering 30-40 villages. This is approximately 5% of the villages in India.
* population coverage is about 1000 population in each village and assuming the NGO covers the whole population this is about 40 million people or 7% of the total Indian population.
* regional and national organisations are predominantly located in metropolitan cities like Bombay, Calcutta, Pune, Madras & Hyderabad.

Some of the important features to note here is that the NGO community is still small in its distribution clearly because environment is relatively a new phenomenon in India.

It is also important to note that there is not much variation of activity between national, regional and local NGOs. This raises a question as to their different roles. The difference in roles ought to be a functional one, with national and regional bodies acting as support agencies rather than undertaking direct field activities except in urban areas.

Concerning the environmental activities taken up by NGOs, majority of them have taken up :

* study, research and survey work
* seminar, workshops and symposiums
* documentation, publication and clearing house facilities
* formation of groups
* training and awareness creation
* protest action
* protection and conservative activities
* legal aid and counselling
* monitoring
* environmental development action

BRAOU

Of the activities above, the largest section of NGOs is doing education, awareness generation, training and research. A smaller number of NGOs is taking up campaigns against deforestation, pollution, construction of large dams, bio-diversity, etc. Environmental development is the smallest category of programmes. There are fewer NGOs which are working on local and regional issues, and much less when it comes to tackling national problems such as river drainage systems, population control, the impact of liberalisation policies on the environment, and so forth.

Even if the NGOs adopted a more integrated ecosystem-based perspective, there are many obstacles for them to carry out such a programme. Besides some of the internal organisational constraints (i.e., lack of trained manpower, paucity of resources, etc.), they are working under a situation in which there is :

* lack of scientific inputs
* general apathy and indifference among government officers, local politicians, people etc.
* interference and resistance from vested interest groups

* low participation of people
* funding that is often structured on technological or single interventionist approaches.

With the growing global consciousness on environment in India, there is going to be a change to multiple interventions with a more integrated perspective, within the NGO sector. At the same time, there needs to be a greater effort towards shifting environmental action from a project approach to one which promotes people's action and the formation of self-help groups.

NGO View Point : To maintain ecological balance, it is very important to keep the various components of nature in total harmony. The human race is being pushed towards rapid industrial growth by the growing pressures of population and the culture of increased consumption. Industrial development has not only led to an excessive exploitation of nature and the alienation of human beings with no other choice but to join the rat race by moving into industrial and consumption centres, namely, huge cities. The industrialisation policy in the Third World is city-oriented. The emphasis that has been placed on large and centralised industries is posing a serious challenge to administrators. On the other hand, villages continue to be neglected.

There is not just a physical distance between the towns and the villages but also psychological, social and economic distances. Because urban consumers are not aware of the real situation in the rural areas, they are not able to establish a harmonious relationship with the rural reality. Instead the consumer takes on the role of an exploiter, together with industrialists and traders. The exploiter has no regard for the sustainability of resources and, hence, makes unrestrained use of them. Nobody is paying attention to the warning of Mahatma Gandhi : "Nature has enough for everybody's need but not for everybody's greed".

NGOs consisting of those hardcore environmentalists and development philosophers and activists, have for a long time debated whatever industrial development has happened is it based on equity, justice, and on the important factor of sustainability?

BRAOU

2.7. INSTITUTIONS - GOVERNMENT, QUASI-GOVERNMENT AND NGOs

Environment and development challenges pose problems for institutions, national and international, that were established on narrow mandates and compartmentalised concerns. Governments' response, the world over, to the speed and scale of global changes has been a reluctance to recognize sufficiently the need to change themselves. However, the challenges are both interdependent and integrated, requiring comprehensive approaches to public participation. Yet most of the institutions facing these challenges tend to be isolated, divided, working to relatively narrow interests under the cloak of secrecy.

Governments pressurised by the citizens established environmental ministries and agencies to clean up the mess created by the rapid economic growth. But much of their work has been to control the damage : reforestation, cleaning polluted waters, etc. The existence of such departments gave a false impression that these bodies by themselves were able to protect and enhance the environmental resource base. Yet many countries still face huge economic burdens from inherited problems like air and water pollution, depletion of groundwater, deforestation, and the proliferation of toxics and hazardous wastes. Recent problems include : soil erosion, desertification and new forms of waste which are directly linked to agricultural, industrial, energy, forestry and transportation policies and practices.

A great institutional flaw in coping with the environmental challenges is the governments' failure to make the bodies whose policy actions degrade the environment responsible for ensuring that their policies prevent that degradation. Those departments responsible to protect environment are isolated from those which are managing the economy. The ability to anticipate and prevent environmental damage requires that the ecological dimensions of policy be considered at the same time as the economic, trade, energy, agricultural, and other dimensions. They need to be considered on the same agendas and in the same national and international institutions. This reorientation is one of the chief institutional challenges in the future. Meeting it requires major institutional development and reform.

NGOs and community groups often provide an efficient and effective alternative to public agencies in the delivery of programmes and projects.

2.7.1. Future Needs

There is a need for significant, sustained and continuous public education campaign to highlight the contributions of the NGOs in recent years and to impress upon their primacy and relevance. Also it has to be recognised that lobbying and advocacy is the primary and central role of NGOs especially in India. It is here that networks, associations and institutions become critical for effective and sustained advocacy on environmental issues. Likewise, it is important to look at the consumer movement and related citizen initiatives. Rapid economic growth necessitates comparable strengthening of such movement and institutions. Mobilisation of expertise, professional inputs, skills, new technology, etc., will become crucial for NGOs. This may entail cooperation with scientific and academic institutions. Finally, eventhough organised, formally structured voluntary organizations are more visible in the last two decades, it is important that individual citizen action is sustained.

2.7.2. Public Education

Public education on environment is needed to develop the ability to assess environmental situations and the causal chains of relationships leading to environmental damage; the interaction among social, economic and political factors as well as among biological, chemical and physical factors; mutually related and overlapping developments, networks and feedback; responsibility for future generations; economy and care in the use of all natural resources; respect for evolution, nature and life; recognition of limits of nature, human action and self-restriction; and acquiring the ability to perceive nature. There is an international consensus that environmental education within the existing school system can have an effect towards solving environmental problems.

Check Your Progress - 3, 4, 5 & 6

3. Which environmental NGO is opposing the Sardar Sarovar Project, across River Narmada?

4. Name a few other important people's movements against destruction and degradation of environment?

5. Which action group in Andhra Pradesh has been working on environmental issues and what were its significant activities?

6. Which organisation in India has made science education a people's movement?

BRAOU

Note : (a) Write the answers in the space given below.

(b) Compare your answers with those given at the end of this unit.

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2.8. SUMMARY

Society, and the nature of citizen initiatives in India in particular and in different parts of the world in general, are undergoing rapid changes. Voluntarism is assuming wider dimensions, necessitated by the fast changing modern economic growth, governance procedures and rapid environmental destruction. Dimensions of voluntary work has been changing ever since India has attained independence. Bulk of voluntary organisations are still working on aspects of rural development, though majority of them have now come to identify the environmental angle inherent in their programmes. However, a small tribe of environmental NGOs has come whose numbers are ever increasing working exclusively on issues of environment and development. Their work has been gained instant understanding through various platforms, and due to various factors. Important among them the support they have received internationally, and directly from the people.

In the present context of voluntarism, there is a strong need for institutional change, whether it is the government, quasi-government or non-governmental institution.

2.9. CHECK YOUR PROGRESS : MODEL ANSWERS

1. The three environmental NGOs are : (i) Worldwatch Institute, Washington D.C., United States. (ii) Centre for Science and Environment, New Delhi. (iii) Academy of Gandhian Studies, Hyderabad.

2. The two important international events are : (i) Stockholm Conference, 1970, and (ii) Earth Summit, Rio, Brazil, 1992.

3. Narmada Bachao Andolan is opposing the Sardar Sarovar Project across river Narmada.

4. Other important people's movements against destruction and degradation of environment are : (i) Silent Valley Project, in Kerala. (ii) Appiko Movement, against deforestation in Karnataka, and (iii) Baliapal, Orissa, against Balasore Missile Testing Range.

5. Citizens Against Pollution, an environmental action group, Hyderabad has been working on environmental issues. Its activities are : Struggles against industrial pollution in and around Hyderabad; opposition to the establishment of nuclear power plant in Nagarjuna sagar; agitation against mechanical slaughter houses; and for drought mitigation policies.

6. Kerala Shastra Sahitya Parishad, Kerala has made science education a peoples movement.

2.10. MODEL EXAMINATION QUESTIONS

I. Answer the following questions in about 30 lines each.

1. Study and analyse, comparatively, the working methodology of three NGOs at international, national and regional levels.
2. What is the role and relevance of a voluntary organisation in the modern context?
3. Can a NGO supplement or replace the welfare programmes of the government, and other institutions? Elaborate.
4. How participation of people can be ensured in the process of development?

II. Answer the following questions in about 10 lines each.

1. What are voluntary organisations? Write briefly about them.
2. Write briefly about Greenpeace.
3. Write briefly about Sierra Club.
4. Briefly explain the Chipko movement.
5. What are the salient points concerning the number and distribution of NGO's in India?
6. Write briefly about the need for public education on environment.

Dr. Donthi Narasimha Reddy

BRAOU

UNIT - 3 : POPULATION DYNAMICS

Contents

3.1. OBJECTIVES

After going through this unit you will be able to :

- define the terms population growth, population dynamics, birth rates etc.,
- explain the interrelationship between population and development, and
- describe the determinants of population dynamics

3.2. INTRODUCTION

Study of population dates back to the 16th century when John Graunt, considered father of demography, collected and collated information on births and deaths from the records maintained by the Church. Scientific study of population and a study of its impact on society and human life made its beginning with the famous Malthusian theory of population. Thomas Malthus (1768 - 1834) an English economist and Clergyman warned us about the consequences of unchecked growth of population. Highlighting the disastrous consequences of explosion in population, Malthus wrote extensively on its implications on the availability of food and other essential goods. Malthus thus laid the path for the scientific and the methodical study of population.

Population growth is a manifestation of the three underlying factors - births, deaths and movement of people. These are referred to as fertility, mortality and migration. These are dealt in subject called demography a branch of knowledge, which focusses on the scientific study of population. The above three factors lead to the understanding of population dynamics and growth.

Population dynamics deals with the cause and effects of relationships of changes in number of individuals in populations from time to time. Some demographers explain the behaviour of populations as statistical aggregates. Study of population dynamics is necessitated to determine how much of the natural resource can be exploited without damaging the resource for future use.

Basic concepts are more or less similar to evaluating the growth of animal population including human populations because they are all limited by environmental resistance and the maximum sustainable level as determined by the capacity of ecosystem

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Assuming there are 'N' number of individuals in a population, 't' is time; 'b' is the instantaneous birth rate, 'd' is the instantaneous death rate, and r= (b-d) is the intrinsic rate of natural increase and the maximum number that can be supported by the environment is 'K'. Then;

$\frac{dN}{dt}$ -rN(K-N) according to which the maximum rate of growth when $d^2N/dt^2=0$, or when N=K/2.

Changes in (K-N) occur so slowly that (1.9.1.) can be treated as dN/dt=r KN....(1.9.2.)

on integrating (1.9.2.) we have Nt=Nc rKt.....(1.9.3.)

Owing to medical research the death rates are deteriorating faster than birth rates (r steadily rising). The relationship between r as a function of N is expressed as : $r=a. N^1/k$ which is particularly applicable to countries like India where a rapidly dropping death rate is concurrent with slowly dropping birth rate. Applying these basic concepts, Watt, an eminent scientist in an interesting book entitled **'Ecology and Resource Management'** predicted doom for the human population before 2026 A.D.

3.3. INTERRELATIONSHIP BETWEEN POPULATION & DEVELOPMENT

The interrelationship between population and development has been a subject matter of quite a few theories. Beginning with the slogan that "development is the best contraceptive". Dr. Karan Singh, former Union Minister of Health, believed that contraception provides the best path to development. John Caldwell in an important international report, stated that population remains the soft underbelly of development because its relationship to development has not been sustained by empirical testing. Diverse policy perspectives are co-existing on population and its relationship to development. A correlation between population and development was established in 1944 itself. According to Princeton University's Population Research Wing's report, development in general lowers the death rate faster than the birth rate, leading to population explosion.

Birth rates also fall after some time lag, causing population growth rates to slow down. Evolved in 1940s this theory further states that population transition begins and ends with zero rates. With the exception of Sub-Saharan Africa, the birth rates in-general declined with development. This general theory however does not explicitly state when the decline in birth rate would set in as development progresses. Further it does not tell us to when fertility comes down and the time span over which this can be explained. What are the indicators which can be identified as those which lead to decline in fertility? In what is known as population transition a UN study in 60s took into account 12 variables which cause it. These include : per capita income, urbanisation, female literacy and mortality rates. The results of this study were not encouraging as the 12 variables may differ between various countries with explanatory variables remaining the same. So development in general as measured by per capita income increases, demand for small family. However, the magnitude of the co-efficient is very small although it may be statistically significant. According to a study published by Pranab Banerji of *Indian Institute of Public Administration*, an increase of Rs. 100/- in per capita income is associated with only 0.78 percent increase in contraceptive prevalence rate. Hence he concluded that though development is a contraceptive it is not the best. Study of population dynamics therefore is relevant to gauge the impact of development on different population groups. The dynamics of it is much more important

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for policy planners. Infact some studies recently confirmed how important female literacy is for containing population growth. It is stated as the single most variable affecting contraceptive prevalence rate.

3.4. POPULATION DYNAMICS : DETERMINANTS

As pointed out earlier, population dynamics can be explained effectively through Fertility, Mortality and Migration.

Fertility : In the sub-field of population studies, fertility is a significant variable. Woman is an important agent in this as human reproduction is possible through her. Mostly every woman has an important event in her life which is known as *menarche* (that period which is marked by the commencement of menstrual function in women). From *menarche* onwords, women are capable of giving births till she attains *menopause* (final cessation of menses, change of life-opposite to menarche). In demography this period is known as child bearing age which is usually 13-15 to 45-49. In this life span of 30-35 years every woman has biological maximum capacity of giving births which is known as *fecundity* (productiveness; fruitfulness).

Fecundity however is different from fertility. Fertility (procreative capacity) is the actual capacity of child bearing of a woman. Population science or demography is more concerned with fertility than fecundity as the actual child bearing capacity is important in so far as births are concerned.

Then how is fertility measured? The measurement of fertility is expressed in quantitative terms i.e., at certain rates. The most common measurement of fertility is as follows :

$$\text{Birth rate CBR*} = \frac{\text{No. of CBs in an year} \times 1000}{\text{Mid year population of that year}}$$

(CBR : Crude Birth Rate; CBs : Crude Births)

Most of the calculations in demography are based on per 1000 population or per 1000 women for better understanding. The birth rate therefore tells us the number of births per 1000 population in an year in a locality/area/country. There are three distinct advantages in following this method. (1) These are simple to calculate; (2) easy to understand and (3) Comparison across the countries is possible. There are disadvantages too. The major limitations to the Crude Birth Rate (CBR) is that in the denominator of the mid year in which total population is taken is likely to be misleading. Because population includes males and females of all ages. Men and women belonging to those age groups other than the one's in the reproductive ages are irrelevant for counting the births in the numerator.

Check Your Progress - 1

What is the difference between Fecundity and fertility?

Note : (a) Write the answer in the space provided below.

(b) Compare your answer with the one given at the end of this unit.

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Fertility Differentials : Differences in fertility levels are quite striking which are ofcourse natural in a vast country with diverse cultures. Several studies accounted for the differential fertility by Religion, Caste, Residence status, Literacy levels, Occupational structures and other important variables.

Religion : In our country, studies pointed out that, Muslim Women have higher number of living children than the Hindu women.

Caste : Among Hindus, forward castes have lower fertility than backward and scheduled castes.

Residential status : Fertility levels are higher in rural areas than in urban areas. Urbanisation is generally held to be a good explanatory variable for low fertility.

Literacy : As pointed out earlier, several studies clearly stated that fertility reduction and high female literacy are strongly correlated. Illiterate women have higher fertility than literates. Education of the husband also affects fertility.

Occupational Status : Population in non-agricultural occupations have lower fertility than those engaged in agricultural occupations.

According to the National Family Health Survey conducted in May 1995 by the *Population Research Centre*, Andhra University and the *International Institute for Population Science* current fertility rate in the rural areas of AP is 13 percent higher than in the urban areas. Fertility differences exist between different population subgroups. Fertility of illiterate women is substantially higher (3.0 children per women) than the fertility of women with atleast high school education (1.8 child per women). Scheduled Tribe Women have higher Total Fertility Rate (TFR) than Scheduled Caste. Marriages at very young ages although have been reported to be declining, the median age at marriage is still low at 15.9 years, despite the existence of Child Marriage Restraint Act, 1978, the minimum legal age at marriage in India is 18 years for women and 21 years for men. 78 percent in rural and 44 percent in urban are getting married much before the stipulated age.

Check Your Progress - 2

Is there any difference in the fertility rate between rural and urban areas of A.P.?

Note : (a) Write the answer with the space provided below.

(b) Compare your answer with the one given at the end of the unit.

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The crude birth rate per 1000 population is 24.1 percent while the crude death rate is 9.1 percent. According to the same study the Total Fertility Rate (TFR) in AP is 2.6.

According to the World Development Report more than 1 billion people live in abject poverty. The next generation will see the world's population rise by 3.7 billion even if progress in population growth decelerates. Most of these people will be born into poor families. From 2.1 percent a year in 1965-70, population growth now slowed to 1.7% as more countries have begun a transition toward lower fertility. The population of World is more than 5.3 billion and is increasing by 93 million a year. From 1.7 percent in 1990, the World Bank predicts the decline in population growth to about 1 percent a year by 2030. World population would be more than double from current levels and would stabilise at about 12.5 billion around middle of the twenty second century. Two thirds of population growth would occur by the year 2050 and 95 percent of population growth would take place in developing countries. The above projections are based on fertility differentiations.

TABLE 1 : Statewise Distribution Of Major Demographic Indicators In India

Sl. No.	State	Crude Birth Rate (in 1990)	Infant Mortality Rate (in 1990)	Female Literacy Rate (1991 Census)
	Major States			
1.	Andhra Pradesh	26.3	70	33.7
2.	Assam	29.7	76	43.7
3.	Bihar	29.7	75	23.1
4.	Gujarat	29.6	72	48.5
5.	Haryana	31.9	69	40.9
6.	Karnataka	28.0	70	44.3
7.	Kerala	19.6	17	86.9
8.	Madhya Pradesh	37.1	111	28.4
9.	Maharashtra	27.5	58	50.5
10.	Orissa	30.0	122	34.4
11.	Punjab	27.6	61	49.7
12.	Rajasthan	33.6	84	20.8
13.	Tamil Nadu	21.6	59	52.3
14.	Uttar Pradesh	35.6	99	26.0
15.	West Bengal	28.2	63	47.1
	Smaller States & Union Territories			
16.	Himachal Pradesh	27.4	69	52.5
17.	Jammu & Kashmir	31.4	70	NA
18.	Manipur	21.1	-	48.6
19.	Meghalaya	31.8	-	44.8
20.	Nagaland	16.2	-	55.7

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21.	Sikkim	26.3	-	47.2
22.	Tripura	24.9	-	50.0
23.	A & N Islands	21.6	-	66.2
24.	Arunachal Pradesh	30.1	-	29.4
25.	Chandigarh	17.8	-	73.6
26.	D & N Haveli	35.9	-	26.1
27.	Delhi	23.9	-	68.0
28.	Goa	15.8	-	68.2
29.	Daman & Diu	27.4	-	61.4
30.	Lakshadweep	25.6	-	70.9
31.	Mizoram	NA	-	78.1
32.	Pondicherry	20.4	-	65.8
	All India	30.2	80	39.4

NA : Figures are not available

The following illustration helps us in understanding the issue of population dynamics.

Crude Birth Rate (CBR)	Crude Death Rate (CDR)	Crude Growth Rate (CGR)
31	11	20
31	13	18

What can easily be inferred from the above is that we seem to have reasonably done well in mortality front and not much in the fertility front. That is because of advances in science and technological fronts we could contain the death rate. However, our success in fertility is not that encouraging because of superstitions and traditional modes of living. The argument can be rounded off with the observation already made i.e., an increased female literacy holds the key to the control of fertility rate. Again control of fertility by rapid expansion of educational opportunities paves the way for general development.

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3.5. SUMMARY

A broader understanding of the population dynamics comprising of three major features i.e., Fertility, Mortality and Migration helps us in appreciating the rates of the growth or fall of the three indicators through which planning process is initiated. A macro analysis of the three indicators constitutes only a part of the population policy. Programmes of action are evolved to control population and models are developed based on them.

3.6. CHECK YOUR PROGRESS : MODEL ANSWERS

1. The child bearing age of woman is 13-15 to 45-49. In this life span of 30-35 years every woman has biological maximum capacity of giving births and it is known as fecundity where as fertility is the actual capacity of child bearing of a woman.

2. The current fertility rate in rural areas of A.P. is 13% higher in urban areas according to the National family health survey conducted in May, 1995 by the *Population Research Centre*, Andhra University and the International Institute for population science.

3.7. MODEL EXAMINATION QUESTIONS

I. Answer the following questions in about 30 lines each.

1. Explain briefly the interrelationship between population and development.
2. Write briefly about the determinants of population dynamics.

II. Answer the following questions in about 10 lines each.

1. What is fertility ?
2. Differentiate between fertility and fecundity.
3. What is birth rate ?

Dr. I. Ramabrahamam

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UNIT - 4 : IMPACT ANALYSIS STUDIES

Contents

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4.1. OBJECTIVES

After going through this unit, you will be able to :

- explain the environmental impact assessment,
- describe the prediction of impacts and carry out EIAs,
- explain the legal and policy position with regard to impact assessment.

4.2. INTRODUCTION

There is an increasing disharmony between man and nature as seen in phenomena such as malnutrition, soil erosion, pollution, deforestation and material for every resource. This is in contrast to the 'nature worshiping' cultures found mostly in the South and Eastern countries of the world. Due to the destruction of environment, modern development has become uneven. Availability of relatively cheap energy encouraged moves towards energy intensive economies (rather than labour intensive ones) in industrial nations i.e., depending more on machines and automation. A great environmental impact has been felt from the use of these energy sources in the mining, smelting and use of minerals and other materials of the Earth's crust. Also, the steady improvement of technology has meant the recovery of progressively little mineral deposits. With the result, today every industrial region is marked with a million holes and heaps. The environmental effects of this 'industrial revolution' have been massive and are well recorded.

In the context of the debate over these and several other
world, in the past two decades, attempts are now being made
process through sustenance of resources. A feature of the res
in recent years has been to try to minimise the impact
ecosystems. One of the major concerns is that enviro
through resource exploitation, but also through the
utilisation processes. Thus, not only resources are bei
capability of the environment and its ability to absor

Increasing population, galloping technology and economic
of environmental crisis and the need for achieving a bal
today, higher production and consumption of profit-oriente
of progress. Very often these pursuits have resulted in the
free dumping grounds. The experience of the last few dec
into sharp focus the fact that man must start to think of livin
The old concept of progress which has prevailed for the last 20
account the means to safeguard air, water and land which sus
environmental protection was not included in the cost of basic production
now it is hoped that development of new technologies will balance be
against the existing benefits of ecology.

Environmental management is now accepted in India as a major guid
development. It is realised that environmental issues arise in virtua
economy and that each sector should evolve its own solutions. Th
environmental considerations into development activities is pro
environment impact assessment before projects are cleared
projects in the sectors of irrigation, hydroelectric power, the
ports and harbours, new townships, etc., have to asses
and prepare environmental management plans before th
Before approval, it is ensured that the adverse eff
are minimal.

4.3. IMPACTS ON ENVIR

India is a country of physical, n
based on utilisation of th
technology was essen
India is no ex

a threat to water quality through effluents discharged from for most old industries is essentially borrowed from outdated loped world. Municipal wastes from the towns and cities treated. These discharges affect the quality of surface tal areas. Almost all the rivers go dry during summer lution of wastes discharged in them. With the constant ndustrial effluents, most rivers and water bodies have ter quality of these rivers and other water bodies such environmental challenges facing India.

y mining has been regarded as an acceptable price to pay for litary might. It is the world's third biggest economic activity after sm. While mines have customarily provided people evicted from mployment, the recent trend of high degree of mechanisation, has few

e major environmental impacts that cannot be mitigated. Impacts of dams bitat, loss of fertile lands, destruction of forests, and sediment trapping, l impacts of displacement of large numbers of people from their homes cement has brought to the fore the issue of natural resource rights and s. Multipurpose projects entail local people to lose their lands and the benefits of power and water are usurped by the far-off urban in salinity in the lands irrigated by the waters of these dams is one There is another as yet not clearly established concern : inducement n where these huge reservoirs have been constructed. Koyna ally cited as one of the examples for such an eventuality. versy due to its location in the seismic zone. Environmentalists a huge reservoir in an area prone to earthquake is fraught to earthquake can wipe out entire civilisation in the ancient towns like Kashi and Varanasi. Irrigation the disease of schistosomiasis into the surrounding n purposes, have made downstream stretches e flows totally.

deforestation and habitat destruction covering household, agriculture, economic development. iomass based energy

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shortage in housing, potable water and sanitation are
further unless timely remedial action is taken. Of the 4
only about 2,500 are provided with water supply an
system. The task of providing essential facilities to hal
challenge for India.

Green Revolution in agriculture which utilises high yielding varieti
modern techniques of monoculture, fertilisation, irrigation and
started in India in 1964. The rise in the use of pesticide
to the growth of the Green Revolution and export-o
thirds of the pesticide used in agriculture and cons
400 districts of India. Green Revolution r
farmers had been using for centuries wi
scientists. The natural genetic b
monocultures are more thre
on pesticides a

ONMENT

tural, climatic, cultural and linguistic diversity.
e natural resources of the country with the aid of
ually carried out for the past four decades, after Independen
ception to the global phenomenon of environmental degradation.
gy, based on the old models of the developed countries, provided pro
also polluted water and air. Roads provided better communication facilities but a
access to forests which were cut to meet the demands of the people. Medical f
improved the health of the people but increased the population dramatically, rais
demand for the products of nature. Vast majority of people are directly dependent
natural resources of the country for their basic needs of food, fuel, shelter and of f
for their cattle. While the annual per capita income in India has been rising ove
years, about 40 percent of people are still below the poverty line. Environmental degrada
has adversely affected the poor who depend upon the natural resources in their immedi
surroundings. Thus poverty and environmental degradation are nothing but two facets
one challenge.

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the coun
through fish and cro
farmers, but also their livelihoo
in the Third World countries. In Indian env
is the rehabilitation of people ousted by the developm
industrial projects. In the past four decades, several thousands o
their traditional homeland, and villages. These displaced, mostly tribals, h
in their life, and had degenerated into destitutes. Extensive deforesta
tribals in a no win situation, as their source of sustenance got eroc
people deteriorated with paucity of resources like water and frequent
a combination of factors like deforestation, soil erosion, and cash crop sy
movement of the country towards modern industrial development has
of urbanisation putting at disadvantage millions who could not be p
due to their illiteracy, and poverty.

Environmental changes wrought by industrial growth have brought w
human health. Not only are there the occupational illnesses and h
groups but also a more general suite of diseases which are associated

ries : heart disease, cancer, diabetes, obesity, dental caries, AIDS, etc. Lack of se and a diet high in animal fats and processed, fibre free foods seem obvious factors for many of these illnesses, generally in the urban and metropolitan cultures.

4.3.2. Social Consequences of Urbanisation

Economic growth is largely industrial growth, and industrial growth is largely carried out in cities and towns. Therefore, the role of the city and its lifestyles cannot be overlooked in any consideration of environmental impact. On the face of it, man appears to be a very adaptable species, for the overall health and survival rates of the inhabitants of the cities, especially in the Western countries, are very good enough though the people are isolated from nature. According to Dubos (1967), the price of such successful biological adaptability is paid in social terms : people no longer mind ugliness, exhaust fumes and other contaminants, and even regard such conditions as normal. A good deal of research has been done over whether modern city is a good habitat for humans. Urbanisation, which entails crowding and overload on physical senses, is expected to produce social pathologies like stress, mental health breakdown, and crime. However, there are certain very large cities with very low crime rates, as in Japan. Influence of culture can be one way or the other. One major drawback of the cities is that they are dependent on inputs of food, water and power, and waste dispersal. Therefore, the city is ecologically difficult because it includes heavy demands for all types of resources, and generates wastes, the disposal of which may create high levels of contamination of ecosystems. However, there are distinct advantages of urban life, since socially cities are ambivalent. Presently, a lot of discussion is centered around making cities sustainable i.e., producing, and consuming its own resources, and also assimilating its wastes.

4.4. ENVIRONMENTAL IMPACT ASSESSMENT

Rachel Carson's "Silent Spring" can be considered as the first ever formal study of impact on environment, of essentially a development activity. This book deals with the effect of DDT spraying on agricultural crops, on the human health. Starting with this, impact assessment has grown into a major subject of study. However, impact is defined as collision. But the connotation in the present context of impact is much broader. Here it is understood as related to the effect of a particular action on the surroundings, namely the environment. Thus, the effect of all human actions on the nature and environment is termed as impact. Impact as a word herein is generally associated with either assessment or analysis. But, impact analysis or assessment does not mean that it is an exercise of assessing only the consequences of an impact i.e., after the action. Environmental Impact Assessment includes the predictive analysis, identifying the side effects of a action or process, and also analysing the consequences of an action. It has also been broadened to include the search for alternatives and optimal solutions.

EIA is intended to explore the possible implications of the particular action, process or project on future trends of natural resource management. EIA explores the expected outcome of divergent pressures on the consumption patterns of resources. It establishes the starting conditions against which the scope, intensity and directions of future changes in environment and ecology can be gauged. It identifies those factors that will shape the resource consumption patterns under the present environmental crisis. Based on a series of assumptions consistent with the concept of sustainable development, EIA offers quantitative projections of resource exploitation and consumption.

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The technique of EIA - comprehensive inter-disciplinary analysis of the environment impact to understand the physical, chemical and biological effects and their influence on social, cultural and aesthetic concerns - is a useful tool for environmental planning and management for planners for proper site selection, cost effective technology and overall harmony with environment and user community. It is essential that the main areas of potential impact are quickly identified and irrelevant issues discarded at the outset. The methodologies used for impact identification are categorised as adhoc, checklist and impact matrix. It is claimed that a systematic EIA at the planning stage would avoid the extra financial outlay to be spent at later stages in solving environmental and social problems.

Though the industrial projects are not site-specific, but practically are not always site-independent considering their infrastructural needs for power, water, raw material, land, skilled labour, proximity to market, waste disposal, etc. However, the government had adopted a policy to disperse industries to backward and underdeveloped areas giving several financial and other incentives. Industrial siting, especially of large projects, in many countries, is not always free from political and other environmental considerations. In these circumstances, EIA is essential to know whether the location of the industry in a particular place is beneficial for everybody's interests.

Any development project has both negative and positive environmental impacts. Negative impacts cause environmental degradation. It is the responsibility of planners, scientists and environmentalists to document these impacts separately so that these can be identified, quantified and attempts may be made to maximize positive impacts and minimise negative impacts for better development with least environmental degradation. Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) have been considered as important documents which can be utilised by scientists, planners, government agencies and public to clearly understand the environmental implications of the proposed project with respect to overall development plan and take decisions in the interest of environment and national economy. It also helps to analyse the techno-environmental feasibility of the proposed project.

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The terms of environmental impact assessment and environmental impact statement were first used officially in the National Environmental Policy Act (NEPA) of the United States, enacted on January 1, 1970. It has now been accepted by many countries with minor modifications to suit the local needs. In India, the Ministry of Environment and Forests, Department of Environment, Government of India, appointed a working group and published a report in August, 1985, containing "Environmental Guidelines for Siting of Industries". The guideline briefly discusses the salient features which must be considered for setting up an industry and also discusses the importance of an EIA and EMP report.

4.4.1. Socio-economic Impact Assessment

Socio-economic impact assessment developed in the 1970s and 1980s mainly in relation to the assessments of the impacts of major resource development projects, such as nuclear power station, hydroelectric schemes and oil - and gas-related developments. Wolf (1974), one of the pioneers of SIA, adopted the wideranging definition of SIA as the "estimating and appraising of the conditions of a society organised and changed by the large scale application of high technology". A socio-economic impact assessment includes questions regarding the type, duration, area and distribution of impacts; that is, the analyst needs to ask the questions what to include, over what period of time, over what area and who will be affected? Direct employment on a project will generate expenditure on local services

(e.g., for petrol, tea stalls, and hotels). The ratio of local to non-local labour on a project is often a key determinant of many subsequent impacts. Socio-economic impacts should be considered for all stages of the life of a development project.

There are ofcourse many other dimensions to impacts besides the areas discussed here, including adverse and beneficial, reversible and irreversible, quantitative and qualitative, and actual and perceived impacts.

4.4.2. Environment Monitoring

As a basic step towards study and management of pollution, introduction of man-made pollutants and their interference with the natural processes (and the resultant imbalance/ risk) are sought to be determined. Considerable progress has been made in recent years in respect of monitoring of chemical pollutants in air, water and land as well as their complex, inter-relationships. The complexity of this gigantic task requires sustained efforts and commitments. Determination of diverse chemical pollutants before and after the remedial measures is a major part of environmental monitoring. This helps in evaluating the risks involved and success achieved. This data is also necessary as basic input for policy decisions and statutory laws for environmental protection.

The need for sensitive and selective analytical techniques gradually came into focus as very low concentrations of pollutants were required to be accurately monitored. The present need for unattended continuous chemical monitoring is an important requirement when larger multi-pollutant surveys in far flung areas are to be conducted over extended periods. Sophisticated instruments for analysis are expensive to buy and more difficult to maintain in developing countries. Older monitoring methods are still continuing though a gradual change is also visible. Increasing use is also being made of mobile environment monitoring laboratories which have speeded up generation of requisite data at site, covering air pollution, meteorological and other data. Nearly 70,000 chemicals are at present in general use and 500 - 1000 are being added yearly with no limit in sight. In fact, quadrupling of global economic activity since 1950 has lead to increasing chemical wastes, not to mention the application of fertilisers, pesticides, detergents, food additives, etc. Chemical and toxicological monitoring of contaminants belonging to diverse chemical groups has become integral part of extensive national and international programmes to safeguard man and his environment. Monitoring of hazardous wastes deposited on land (sanitary landfills) and their disposal by incineration are other areas which have received intensive attention during the last two decades. The problem is acute in the case of industrialised nations but the Third World countries are also catching up with increase in their population and industrial development.

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4.4.3. Major Chemical Accidents and Impact Assessment

The direct and indirect effects of major chemical accidents (like Bhopal gas tragedy which occurred on 3rd December, 1984, releasing Methyl Isocyanate or Valdez oilspill) are amongst the greatest concerns facing the industry, governments, environmentalists and the public in almost every country in the world today. Major industrial disasters are occurring at more frequent intervals than the rate at which humanity and the environment can recover from one. Effects of chemical accidents on the environment range from a temporary change of manageable proportion through serious, acute, temporary actions of high magnitude to drastic, long term impairment.

An analysis of major chemical accidents around the period of 1974 - 1988 highlights the following general causes or causative factors :

(i) Runaway reactions, explosions or fire;

(ii) Design faults leading to accidental mixing of chemicals;

(iii) Storage of unacceptably large quantities of hazardous and vulnerable chemicals;

(iv) Accidents during transportation by rail, road or sea;

(v) Inventory control failure;

(vi) Improper waste disposal practices; and

(vii) Human failure.

Tanker accidents involving trucks carrying chemicals, petroleum products, and other hazardous material have caused loss of life, and serious impact on local environment. In the recent years, a spate of accidents near Bombay and other places forced the government to think about formulating certain guidelines to prevent accidents. However, serious efforts at disaster management, or studying impact of such accidents on the environment is yet to be done.

Modern Hazard Assessment techniques involve identification and analysis. Six methods are followed today :

(i) Failure Mode and Effect Analysis;

(ii) Hazard Analysis;

(iii) Hazard and Operability Study;

(iv) Fault Tree Analysis;

(v) Consequential Analysis;

(vi) Risk Rating.

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Traditionally, the location and siting of hazardous industries are determined by economics, market, labour, transportation, water, energy and associated factors. For installations that process hazardous, flammable and toxic materials, hazard analysis is a convenient tool in ensuring the safety of the surrounding settlements and that of the employees. Applying hazard analysis in the early planning stage of a project may provide a useful quantitative assessment of alternative layouts for hazardous plants.

4.4.4. Environmental Audit and Impact Statements

Environmental audits are defined as a basic management tool comprising a systematic, periodic and objective evaluation of how well environmental management systems and equipment are performing, at the individual industry level. The aim of the audit is to facilitate management control of environmental practices, and to enable the company to assess compliance with legal and regulatory requirements. Environmental auditing is seen as a internal process that should become necessary and routine part of most industries.

The concept of environmental auditing came into being during the early 1970s, but under the guise of a number of different approaches and names; depending on the industry concerned environmental audits have been called environmental reviews, survey assessments

and quality controls. Although there is no set way in which an environmental audit is performed, the procedures have become more formalised with time.

In order to prevent or reduce waste generation it is necessary first to examine the production processes involved in industrial operations and to identify the origins of the wastes. Next, it is necessary to examine whether the raw material conversion can be maximised, and whether in-plant practices can be improved upon. Thirdly, whether raw material substitution or process change needs to be considered. Fourthly, after having exhausted the possibilities of reduction in waste generation, it should be examined whether recycle, recovery or re-use is possible. Then, lastly, comes the consideration : how to treat the unavoidable waste in order to minimize its adverse impact on the environment. The preparation of the Environmental Statement is a systematic method to carry out these activities by plant managers.

Check Your Progress - 1 & 2

1. What mechanisms are available to you to help in environmental monitoring of pollution in your area?

2. Write briefly about the biggest chemical accident in India.

Note : (a) Write the answers in the space given below.

(b) Compare your answers with those given at the end of this Unit.

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4.5. VALUING NATURAL RESOURCES

The socio-economic costs of natural resource degradation are real and hard felt, especially in the developing countries of Asia. The objectives of achieving higher income in most projects often excludes the consequences such as uneven distribution of such income and positive & negative off-site impacts. There is a continuing search for ways to expand economic analysis to include more off-site and environmental effects, as also the challenge

of assessing environmental impacts in economic terms. Many valuation techniques are available, including market value or productivity approaches (those that use market prices to calculate costs), other indirect market approaches, and survey-based techniques.

However, specific problems are encountered in valuing natural resources. These problems include selection of discount rate, intertemporal and intergenerational issues, uncertainty, and issues of resource irreversibility; costs of the extinction of a particular species (leading to the decimation of an entire ecosystem), depletion of a particular resource or mineral, and preserving hazardous wastes like nuclear waste for generations to come. Qualitative factors such as quality of life, social, and political concerns are also important, but difficult to value. Further, there has been the problem of standardizing valuation procedures for natural resources and environmental effects, notwithstanding its usefulness as a methodology and guide in project and program decision making. The other problem is the absence of systematic criteria for analysing the tradeoffs between present and future generations.

Natural resource valuation systems can be useful in improving the balance between development and conservation. The techniques and methods for resource evaluation are being developed so that they can be used for evaluating development alternatives and actions. Generally, analysis of environmental effects is done in a step by step procedure :

* impact identification
* impact measurement
* valuation and
* economic analysis.

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4.5.1. Defining Values

Values are individual and collective concepts with emotional, judgemental and symbolic components that are used to determine what is important, worthwhile and desirable. Thus values contain and at the same time evolve from judgements and beliefs about what is "good" or "bad" and "right" or "wrong". Values therefore can significantly influence human behaviour regarding the conservation or destruction of environment. Values must also be considered regarding the consequences, or impact, of both the conservation and the destruction of environment.

By their very nature, values are complex in both interpretation and influence. This is particularly true in regard to environment which involves anthropocentric (man-centred) and biocentric (ecology-centred) values. The tangible as well as intangible values of environment are difficult and are sometimes impossible to define, formulate and quantify. Tangible values may be more readily recognised like timber production and industrial use of materials. Intangible values, such as conservation of water and education, are less discernible in terms of economic and other material benefits. In nature, even tangible values can often become impossible to calculate, depending on the objectives. For example, timber production can be assessed based on the market values, but the cost of cutting trees might be more in terms of loss of top soil, soil erosion, etc.

There are, however, a number of high value interrelationships within natural environment which are as yet not disturbed much by development. In addition to these varied and complex natural interrelationships themselves, some of these values manifest as the very ecosystems like tropical forests. These dynamically interrelated values cannot be listed here in any particular order of importance because each is so interdependent on all others.

4.5.2. Economic Analysis - Emerging Approaches

Sustainable production is both an ecological and an economic concept. As an ecological concept, one area of concern is the maintenance of resource stock at a sustainable level to attain maximum sustainable yield and provide a sufficient resource base for future generations. Economic analysis of environmental effects is done because of concern for :

* a better use of scarce resources;
* higher social returns from these resources;
* fewer social costs arising from the use or misuse of these resources; and
* the need for anticipatory planning.

Analytical techniques that deal with resource management problems include the following :

* natural resource assessment - rapid appraisal of resources, identifying trends of resource use and key areas suitable for funding and development;
* natural resource accounting - system of bookkeeping that parallels the national accounts, involving a physical account of stocks and flows;
* extended cost-benefit analysis - incorporating environmental effects (externalities) in a microanalysis of each individual project; and
* macroeconomic policy analysis - taking natural resource management and deriving policy implications (For example, an export policy like food processing that has major impact on natural resources use; price policies; incentives).

However, there are limits to economic analysis. Different resource systems lead to different kinds of approach, thus the application will depend on individual projects and individual countries. Application of cost-benefit analysis in developing countries is constrained by limited manpower and institutional capabilities. It is easy to say that the 'benefits must exceed the costs', but how to measure benefits and costs is the big question. Especially that of resources like forests, water, air and land. Benefits of forests, as an exercise by James Lovelock over the Amazon forests suggests, might run into billions of units of any currency, making the whole exercise of cost-benefit analysis redundant. However, this analytical technique is being used more and more in assessment of development projects.

Changing project costs also need to be considered periodically as there is a need to balance different factors in the analysis. Generally, social dimensions are not given the primary consideration. The role of economic analysis is to provide alternatives, with their merits and demerits, and not to make decisions. Thus, the role of the technocrat is limited to evaluating policy options.

4.6. LEGISLATION OF EIA

A gazette notification on environmental audit has been issued by the Ministry of Environment and Forests on 13th March, 1992, which was amended in 1993. This notification applies to every person carrying on an industry, operation or process requiring consent to operate under Section 25 of the Water (Prevention and Control of Pollution) Act, 1974, or under Section 21 of the Air Act, 1981, or both authorisation under the Hazardous Wastes (Management and Handling) Rules, 1989, issued under the Environment (Protection) Act, 1986. The notification requires that an Environmental Statement for the financial year ending the

PRAOU

31st March to be submitted to the concerned State Pollution Control Board, on or before the 30th September of the same year. In the Environmental Statement, every industry will provide information on the water and raw material consumption, pollution generated, information on hazardous wastes and solid waste alongwith the disposal practices. The industries are also required to specify the impact of pollution control measures on conservation of natural resources.

4.7. SUMMARY

Technological disasters are becoming a source of concern to all countries, developed or developing. Though a great number of people agree that all is not well with relationship between humans and environment, however, there are considerable differences in views as to what should be the first priorities and significantly, the long term purpose of different directions. Broadly, there are two directions : one would suggest that problems can be solved through application of technology and change in institutions. The other one sees biological and physical limitations of the ecosystems, and argue for a fundamental change in the human-ecology relationship. However, both the directions require information on patterns of natural resource management possible only through an assessment of the impact, i.e., Environmental Impact Assessment.

EIA can be a powerful tool for controlling the processes, social and technical, from riding roughshod over the local ecology and ecosystems. It can be a source of information for better planning and design of developmental activities. EIAs and EMPs can help people in asserting their rights and choice over the management of environment. Formal research institutions like universities in India have not yet recognised the need for impact assessment studies for the society, and as such research in this area is still in its nascent stages.

BRAOU

4.8. CHECK YOUR PROGRESS : MODEL ANSWERS

1. A portable pollution monitoring kit is available. Some NGOs like World Wide Fund for Nature provide these kits.

2. The leakage of poisonous methyl isocyanate (MIC) gas on 3rd December, 1984, from the chemical plant of Union Carbide at Bhopal left in its wake over 2,500 dead and over one hundred thousand injured, with irreparable damage to a high percentage of them.

4.9. MODEL EXAMINATION QUESTIONS

I. Answer the following questions in about 30 lines each.

1. How can the EIA help in achieving sustainable development.
2. Write in detail about the individuals and institutions needed for conducting EIAs and EMPs.
3. Write in detail about major chemical accidents and Impact Assessment.
4. Write briefly about emerging approaches for economic analysis.

II. Answer the following questions in about 10 lines each.

1. What are the social consequences of urbanisation?
2. Write briefly about socio-economic impact assessment.
3. Briefly write about environmental auditing.
4. Write briefly about Legislation of EIA.

Dr. Donthi Narasimha Reddy

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BLOCK - 2 ENVIRONMENTAL EDUCATION

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UNIT - 5 : MEANING AND SCOPE

Contents

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5.1. OBJECTIVES

After going through this unit, you will be able to :

- list out the objectives of environmental education,
- describe the school and college level environmental education and educating the public,
- describe various movements of people to preserve the forests.

5.2. INTRODUCTION

Environment, in biology, comprises the whole range of external influences acting on an organism, of both physical and biological forces of nature surrounding the human individual. All living organisms are a part of a balanced and interacting ecosystem; they draw substrate from the solid, liquid and aerial resources of mother earth.

Environment has been defined as "the aggregate of all the external conditions and influences affecting the life and development of an organism". There are a number of environmental problems in India. There is urgent need to educate the masses and make them aware of the problems which are concerned with day-to-day life. The awareness and education

must be acquired by the society from programmes that fall outside the formal education system, since majority of the population still do not have adequate access to formal education

5.3. OBJECTIVES OF ENVIRONMENTAL EDUCATION

The objectives of environmental education are :

- ★ to improve the quality of life,
- ★ to create an awareness among people on environmental problems,
- ★ to develop necessary skills,
- ★ to solve environmental problems,
- ★ to make it possible for people to participate in decision making concerning the environment, and
- ★ to provide an awareness of economic, political, social and ecological interdependence.

5.4. TARGET GROUP

Most people recognise the urgent need for environmental education, but only some have clear ideas about what needs to be done and very few have either the actual experience or the knowledge about the courses that need to be taught. The chief objective of environmental education is that individual and social groups should acquire awareness and knowledge, develop attitudes, skills and abilities and participate in solving real life environmental problems. The perspective should be integrated, inter-disciplinary and holistic in character. The lay public in rural, tribal, slum and urban areas, women and students and teachers in schools, colleges and universities as well as planners and decision and policy makers, programme implementors and Research and Development workers need to be educated about environment.

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5.5. NATURAL, PHYSICAL AND SOCIAL FACTORS

Many of the environmental problems in India are due to under-development and ignorance. The general public are not aware of the environmental problems and their occurrence. Millions of people are poor, hungry and without the basic needs of adequate food, cloth, shelter, health and education. This is not only an intolerable situation in terms of humanity, but it has various environmental consequences. Poverty, illiteracy and ignorance together contribute to environmental decay. The urge to improve neighbourhood condition is lost.

The process of development aggravates the environmental problems. The process of agricultural growth and transformation, for example, involves construction of reservoirs and irrigation system, clearing of forests, use of fertilizers and pesticides etc. These processes and urbanisation certainly have environmental implications.

The increase in population has had its impact on the rural and urban environment. Both urban and rural areas share the same problem. Only 4.3 percent of the population in rural areas is provided with safe drinking water. About 25 per cent of the population in cities live in slums and settlements.

Check Your Progress - 1

What are the objectives of environmental education?

Note : (a) Write the answer in the space given below.

(b) Compare your answer with the one given at the end of this unit.

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5.6. CURRICULUM DEVELOPMENT

Based on different disciplines environmental education programmes have been classified into 3 fold.

a. **Environmental studies** : This is concerned with the environmental disturbance and minimisation of their impacts through changes in the society (Social Sciences)

b. **Environmental Sciences** : Its deals with the study of processes in water, air, soil and organisms which lead to population or environmental damage and to know a scientific basis for establishing a standard which can be considered acceptably clean, safe and healthy for human and the natural ecosystem (Physical and Natural Sciences).

c. **Environmental Engineering** : This is the study of technical processes which are used to minimise the pollution and the assessment of impact of these on environment (Engineering Sciences).

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5.7. SCHOOLS AND COLLEGES

5.7.1. Primary School Stage

Here the emphasis should be mostly (75%) on building up awareness, followed by real life situations (20%) and conservation (5%). Thus attempt should be to only sensitise the child about environment. The content to be used are surroundings from home to school to outdoor situations. Teaching strategy includes audio-visual and field visits.

5.7.2. Lower Secondary School Stage

From the lower secondary stage onwards, the quantum of awarnesses must decrease and there should be increased knowledge of rural life situations, conservation and sustainable development. At lower secondary level, objective must be real life experience, awarnesses and problem identification. The contents to be used are those primary school level supplemented with general sciences. Teaching, practicals and field visits are to be done.

5.7.3. Higher Secondary School Stage

Here the emphasis must be on conservation, assimilation of knowledge, problem identification and action skills. The content used may be science based and action oriented work. There should be proper teaching, practicals and field work. Many developing countries like India face problems of lack of resource materials, funds and trained instructors and teachers at secondary school stage. In the school education, National Council for Teacher Education (NCERT) has been playing vital role in designing syllabi, text books, help books, charts, kits, teaching materials and aids both for students and teachers.

5.7.4. Tertiary (College) Stage

At this level, the picture would be almost reverse of the primary level, as maximum emphasis would be on knowledge regarding sustainable development based on experience with conservation followed in a descending order by conservation, real life situations and awareness. The content must be college or university based on Science and Technology, Teaching, practicals and action-oriented field work.

5.7.5. University Education

Environmental education at this level is being worked after the University Grants Commission (UGC). There is a high powered committee to suggest areas of environmental education at post-graduate level. There are about ten universities teaching course in environmental areas. Besides, there are also research institutes and professional institutions as Indian Institute of Technology, Engineering colleges, Schools of Planning and Architecture, which offer courses in environmental engineering. The university education has three major components : teaching, research and extension. At post-graduate level four major areas are recognised.

(a) **Environmental Engineering** : It includes subjects like architecture, civil engineering, town and country planning, including human settlement, slum improvement, landscape architecture, industrial design, regional science and urban ecosystem studies.

(b) **Conservation and Management** : It includes fields like land use, forestry, agriculture, energy, waste management, wild life management, national parks, biosphere reserves, biological diversity, water management, mining management, non-polluting renewable energy development, etc.

(c) **Environment Health** : This deals with public health and hygiene, sanitary and chemical engineering, occupational health, toxicology, nutrition, drug use etc.

(d) **Social Ecology** : It includes subjects like human ecology, sociology, social planning, cost benefit, community organisation and services, psychology and counselling environmental ethics and related areas of humanities.

There are some institutes and centres assisted by Department of Environment, which provide formal education/training in environmental areas. For instance, Centre for Environmental Education, Ahmedabad, Indian Institute of Forest Management, Bhopal and Indira Gandhi National Forest Academy, Dehra Dun.

BRAOU

5.8. EDUCATING THE PUBLIC

The non-formal environmental education is designed for any age group participating in social, economic and cultural development of the community. They form groups or clubs and arrange exhibitions, public lectures, meetings and environmental compaigns. The following constitute the main content of educating the public.

(a) **Adult Education** : Adults may influence other members for better ways of life. In local language information packs, posters, slides, audio, audio-visuals etc., may be generated.

(b) **Rural Youth and Non-student Youth** : They may organise into groups.

(c) **Tribals / Forest dwellers** : The programme of education can be taken up by involving their community leaders, women and youth. They are an important content of our forest wealth.

(d) **Children Activities** : This can be ensured through essay competitions of different age groups. Department of Environment with the help of United School Organisation of India organised such activities. On the spot painting, modelling and poster design contests are conducted for children by the National Museum of Natural History.

(e) **Eco-development Camps** : They help in sound rural development involving youth. A set of guidelines has been prepared by the Department of Environment. The main objectives are : to create awareness in student and non student youth about basic ecological principles; to identify root cause of ecological problems as related to human activities; to take steps to solve local ecological / environmental problems, and to develop a spirit of national integration.

(f) **Non-governmental Organisations** : There are over 200 NGOs, of which most are involved in employmental education and awareness, others in nature conservation, pollution control, afforestation and social forestry, floristic and faunal studies, rural development, wild life conservation and waste utilisation and eco-development. The environmental education and awareness by the non-governmental organisations is very important. The 'Chipko movement' in the Himalayan region to save the forest cover from felling, the Bombay Bachao Committee to highlight the problems of Bombay city, Taj Mahal Protection Movements, Silent Valley Protection Committee and several others, are sufficient to mention.

(g) **Public Representatives** : India has environmental forums for M.Ps and M.L.As to discuss environmental problems facing the country. They may build up public opinion and stimulate public interest.

(h) **Training Senior Executives/Administrators** : Regular courses should be arranged for various institutes imparting such training. These are general environmental management, industry-specific environmental management etc.

(i) **Foundation Courses** : The courses for the probationers selected for the I.A.S., I.F.S., I.P.S., and cadets of three wings or Armed Forces need to be supplemented with foundation courses on environment relevent to their area of work.

(j) **Centres of excellence** : Department of Environment has established two centres of excellence in the country. They generate knowledge and methodology and training in areas of Tropical Ecology (Bangalore) and Environmental Education (Ahmedabad).

BRAOU

(k) **Development of educational material and teaching aids** : Audio, audio-visual materials, materials of media (TV, Radio, Films, News papers etc.), mobile exhibitions etc., must be designed by competent man power. One such centre is Centre for Environmental Education, Ahamadabad.

(l) **World Environment Day** : All governments in the states, academic institutions, universities, colleges, schools and voluntary organisations organise suitable activities on this day (June, 5) to generate awareness in the public.

(m) **National Environmental Awareness Compaign (NEAC) / National Environment Month (NEM)** : Commencing from 1986, Department of Environment conducts NEAC. From November 19th to December 18th every year NEM is observed to create awareness among public.

5.9. CASE STUDIES

5.9.1. Chipko Movement

Women were the first to react to cutting of trees in Himalayas. As a result, the famous Chipko (Hug the trees) movement was started. When the contractors' axe men came to chop the trees with armed police to help them, the women hugged the trees saying 'chop us! not the trees. These trees give us water we drink and fertile soil to grow food. These are our life and soul'. The voice came from their hearts. The Chipko women continued their struggle against tree-felling for eight years till Uttar Pradesh state government put a ban on felling of the green trees for commercial purposes in this area. The message was taken to remote Himalayan villages, as the conditions all over Himalaya were similar to Uttar Pradesh hills, even worse in some areas through 4870 km. long Kashmir,Kohima and Chipko foot march.

Like a migratory bird, Chipko flew from North to far South. It was in the Southern State of Karnataka that the people of Sirs Taluka in the Western Ghats, launched Appiko (Kannada word for Chipko) movement on September 8, 1983. The farmers opposed the felling of natural forest as they felt this will adversely affect their farms. In the hilly district Kodagu the coffee growers took up the cause of protecting the natural forest. Now the Chipko movement is popular throughout India.

5.9.2. Silent Valley Movement

In the state of Kerala, a group of scientists and Kerala Sasthra Sahitya Parishad launched the Silent Valley movement to save the natural forests as it was the last remaining of virgin forest. The farmers of Wyanad the adjoining hill districts were worried to see the raising of mass scale eucalyptus plantations after clear felling of the natural forests. The water ponds dried up and growing paddy became difficult. They knew the value of natural-shola-forests and grasslands which keep the flow of the rivers regular. Hence they also joined the movement. It was not only the opposition of felling of trees for commercial purposes, but people also opposed other activities which destroyed the forests.

5.9.3. Dharati Mata-Dharam Mata

In the tribal belt of Sambalpur district in Orissa - Gandhmaran area - Bharat Aluminium Company, a Government of India public sector undertaking - decided to mine bauxite. The constructions of roads, ropeways, railway line and the mine itself threatened the

BRAOU

natural forest over the hill slopes. These hills are the sources of streams, which irrigate the agricultural lands in the foot hills, provide employment to the tribals through the collection of medical herbs, bamboo to make mats and baskets and edible wild fruits, roots and tubers. When all their efforts to stop the mighty Bauxite Company failed, men and women offered satyagraha. They lay down on the road, obstructing the entry of vehicles. Their slogan was "Dharati Mata Dharam Mata" (Earth is the mother of righteousness). All repressions failed to suppress the voice of people. A committee of the Department of Environment justified the demand of the tribals and bauxite mining was stopped.

5.9.4. Thanrao Struggle

The villagers in Thanrao, Dehra Dun prevented the entry of lime-stone quarry lessee, who had been operating for twenty four years. The government machinery was in his favour. The police, the administration, the mining inspector and other officials, all looked over his illegal activities. He was virtually the ruler of the area. In September, 1986 the villagers launched the direct action. Men, women, children, young and old - all came forward to join the non-violent resistance movement. They squatted on the road and prevented entry of quarry owner's vehicles into the mining area. All methods, terror and allurement - failed to dissate the villagers, who were determined to save their forest, the water sources and the soil. The Supreme Court decided the case in their favour and after two year's of struggle they won.

Check Your Progress - 2

What is Chipko movement?

Note : (a) Write your answer in the space given below.

(b) Compare your answer with the one given at the end of this unit.

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5.10. SUMMARY

There is an urgent need to educate the masses on environmental problems. There are mainly objectives for environmental education. The people of all categories should be educated on environmental aspects. Schools, colleges and university level education on environment is necessary. Educating the public through various ways will be possible. Chipko movement, Silent Valley, Dharati Mata - Dharam Mata and Thanrao struggle are some of the peoples' movements to save the forests.

5.11. CHECK YOUR PROGRESS : MODEL ANSWERS

1. The objectives of the environmental education are to improve the quality of life, to create awareness among the people an environmental problems, develop skills to solve environmental problems and make them participate in decision making.

BRAOU

2. Hugging of trees to save them from felling, there by saving the forests, is known as Chipko movement.

5.12. MODEL EXAMINATION QUESTIONS

I. Answer the following questions in about 30 lines each.

1. What are the ways to educate the public on environmental problems?
2. How can we create awareness on environment in schools, colleges and universities?

II. Answer the following questions in about 10 lines each.

1. Write briefly on Chipko movement.
2. What are the objectives of environmental education?
3. Write about the different disciplines of environmental educational programmes.
4. What is Thanrao struggle?
5. Who are the target groups for environmental education?
6. What is Dharati Mata - Dharam Mata?

Dr. N. Raman

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UNIT - 6 : INFORMATION AND COMMUNICATION

Contents

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6.1. OBJECTIVES

After going through this unit, you will be able to :

- explain the importance of information and communication,
- describe the role of media,
- list out the resources, and
- describe the alternative approaches.

6.2. INTRODUCTION

Information has always played an important role in human life and it has always been difficult to obtain adequate information in the past. The invention of transistor brought about a revolutionary change in the field of communication and information processes. Now, with telecommunications, satellite cable TV, Videotapes, compact discs, network computers, newspapers, periodicals and direct mail, we are flooded with information. Information today is an economic resource on par with resources like capital and labour, because its possession, manipulation and use can increase the cost effectiveness of many physical and cognitive processes. Information processings are playing a major role in manufacturing as well as in solving human problems. Information is also being treated as an economic commodity which has stimulated the growth of a new segment of national economics-the information service sector. This sector provides a broad range of information products and services.

Through the coupling of computers of the telephone communication network, the video terminal has provided access to the vast resources of the digital information world. To facilitate this linkage, the telecom network has been adapted to carry digital information, particularly with the use of lasers and optical fibres. Common communication protocols permit computers of different makes to communicate with each other in networks. Moreover, the networks are themselves interconnected by hardware devices and software called gateways that convert one protocol format to another. These technological advances have led to the state of the art information systems that have very rapid processing and retrieval of information, can handle large volumes of data reliabily. The overall performance is highly cost effective.

Other important dimensions of advances in information systems technology include :

(a) The shift in the user community of information systems to the 'end users' has had a major impact on their design.

(b) The universal trend is towards teleprocessing information systems in which processors and data repositories are geographically dispersed, a change which is conducive to data sharing whether within a single building or factory or more globally.

(c) Constant expansion of functions of information systems as they become more easy manipulating the systems being gradually transformed from data processing to cognition aiding system.

6.3. DATA BASE

Todays electronic information systems are linked with progress in four information technologies digital processors, digital storage, communication and software. Digital storage technologies are now very advanced with optical discs able to consolidate digital representation of text, image, video and sound on a single medium. Optical circuits are much faster than electronic circuits. Development of integrated optics is an attempt to employ film technology in optical circuits and devices. This will have far-reaching impact on the advancement of communication, information processing and control systems. Software advances have also allowed this technology to be used by persons other than computer experts. Easy-to-use software products for creation, maintenance, manipulation and querying

BRAOU

of files and records, have made many interactive applications in offices and other professional environments possible. The database has become a central organising framework for information systems, taking advantage that allows data sharing among diverse applications. Many of today's information systems are tantamount to data base systems, organised collections of data maintained and used with the aid of data base management system (DBMS) software.

Computers are now to be found in every walk of life. Meteorologists use them to make reliable weather forecasts. A weather computer illustrates another strength of the computer-as a data processor. Meteorologists feed into it weather information (data) in the form of figures giving rainfall, temperature, humidity wind speed and direction from sites all over the world. The computer stores all the information and can sort it out to show any patterns in the way the weather is developing. It can then make predictions about the future weather. Computers are playing an ever-increasing role in the process of improving the flow and machines. This is a field now becoming known as information technology.

Data processing systems may be electronic, electro-mechanical machines for transforming information into suitable forms in accordance with procedures planned in advance. The term data-processing system is also applied to the scheme or procedure that prescribes the sequence of operations to be performed in processing the information. Virtually every data-processing system, regardless of the degree of automation, consists of six basic functions: recording, transmission, manipulation, reporting, storage and retrievel - collectively termed the data processing cycle.

Management Information Systems (MIS) focus primarily on resource administration and provide top management with aggregate reports to support their functions. They generally consist of a number of modules, each supporting a particular function. The modules share a common data-base whose contents-however-may be distributed. National Informatics Centre Network (NICNET) is one of the most important applications of MIS in India.

The National Informatics centre was set up by the Govt. of India with the main objective of accessing district level data quickly. NIC has now set up a national network (NICNET) which links Delhi with all state capitals and district headquarters using INSAT-ID. A proposal was also made for an exclusive satellite NICSAT, for tele-and data communications for NICNET.

New types of teleprocessing systems have become available for use by the public. These are electronic data bases made available via-on-linedata base search systems. In many countries on-line data base services are being coordinated in the form of planned national information systems, generally in conjunction with public data networks and international telecommunication facilities. Such efforts are being made in India too, along with attempts to formulate a national information policy for management and better exploitation of information resources and technologies.

INDONET is an "Integrated information management and distributed data processing facility, spanning the entire country. It aims at revolutionary data processing within the country. Under this project, a computer network has been set up in Bombay, Delhi, Calcutta which provides local computing facilities to small and medium scale sectors.

Over 6000 regional of local networks worldwide are already interconnected by a super highway known as INTERNET set up by the National Science Foundation of the United

BRAOU

States. Internet connects universities, federal and state government agencies, professional associations, commercial firms, unclassified military systems, colleges and secondary and even elementary schools.

6.4. INFORMATION DISSEMINATION

This can be studied under two subheadings, i.e., (a) Postal Communications and (b) Telecommunications

6.4.1. Postal Communications

India's postal service is among the world's largest one. The history of modern postal system in India may be traced back to 1837 when postal services were thrown open to public. The Postal department was set up in 1854. The Railways mail Service was started in 1907 and the airmail Service in 1911. The Posts and Telegraph Board has now been bifurcated and deals with the two separate Departments namely the Department of Telecommunications with effect from 31st December, 1984. The Ministry of communications through the Department of posts also discharges certain agency functions, such as running Post Office Saving Bank, issuing National Savings Certificate and Postal Life Insurance Policies and selling units of Unit Trust of India. On an average each post office serves 5,206 persons and covers an area of 22.16 sq. km. More than 99% of the villages had been provided daily mail delivery service.

The mail is carried both by surface and air. Under the All up scheme, all inland letters, letter cards, post cards, registered letters and money orders are normally carried by air without surcharge. A scheme called Quick Mail Service (QMS) was introduced in 1975.

India is a member of the Universal Postal Union (UPU) and the Asian Pacific Postal Union (APPO) - a restricted postal union constituted within the framework of the UPU. Reduced postage rates are applied to letters and post-cards exchanged by surface between the members of the Conference of Commonwealth Postal Administration (CCPA). Currently, India is the Chairman of the Technical Committee on Postal Service of the SAARC countries. India has direct postal communications with almost all countries in the world. Mails for some countries are exchanged through a third country. An expedited mail service, also known as the International Speed Post Service, was introduced on 1st August 1986 to selected destinations abroad. Now speed post service is also available to major cities.

6.4.2. Telecommunications

One of the key factors which sustain the pace of modern life style is telecommunication. It plays a very vital role in the commercial, industrial and economic activities of mankind and has helped to shrink the world into a global village. Past couple of decades have witnessed breathtaking progress marking the rapid developments in the field of telecommunications. Exchange of information, data and facts and figures including live pictures from one part of the world to any other part of the earth is now routinely possible.

Telegraph was the earliest means of communication between two points separated by distance. In 1876 Bell discovered the telephone which made possible the transmission of human voice over long distances. Telecommunication services were introduced in India soon after the invention of telegraphy and telephone. The first telegraph line between

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Calcutta and Diamond Harbour was opened for traffic in 1851. By March 1854, telegraph messages could be sent from Agra to Calcutta. As in the case of telegraph, the telephone service was introduced in Calcutta in 1881-82 barely 6 years after the invention of telephone. By 1900, telegraph and telephones had started serving the needs of Indian Railways. The first automatic exchange was commissioned at Shimla in 1913-14 with a capacity of 700 lines. Now all the cities and towns besides 7000 large villages have access to telephone network. All the state capitals are connected to Delhi on subscriber dialled long distance network. The network comprises 31 trunk automatic exchanges with 398 stations connected to it. There are 176 point to point STD routes. The performance of subscriber dialled network has considerably improved with the introduction of Stored Programme Controlled (SPC) electronic trunk automatic exchanges at Delhi, Bombay, Calcutta and Madras. Demand Trunk Service was introduced for the first time on Bombay-Bangalore route in 1971, now linking major cities.

In cities, towns and other centres of population, the telephones in the individual houses, offices and other places are interconnected by overhead lines and/or underground multicore cables through a central exchange which provides the switching between the various instruments either automatically or manually. The cities themselves are linked by trunk telephone lines. Coaxial cables and microwave links are usually employed for this purpose, as these arrangements have the added advantage that they can provide a large number of Channels, so that a number of two-way telephone conversations can take place simultaneously. Such communication links also provide telex facilities in which electric typewriters may be interconnected to transmit and receive printed (typed) messages.

In a facsimile process, printed image on a whole page can be transferred faithfully from one place to another using fax machines. Introduction of electronic telex exchanges at Delhi, Bombay, Calcutta and Madras has brought about qualitative improvement in telex services. Direct international telex service is operated to 46 countries.

In both telegraph and telephone, the transmitting and receiving points have to be connected by metal wires through which electrical signals travel in the form of current variations.

The discovery of wireless at the turn of the centuary by Marconi was a revolution in the history of communication technology. It was no longer necessary to connect the transmitter and the receiver by wires. Instead, electromagnetic waves could be used to carry information and message from one point to another. The early half of this century witnessed a spectacular growth of wireless communication. Wireless telegraphy and wireless telephones linked nations and countries. Ships and airplanes could communicate to their bases and between themselves with ease using wireless. Telecommunication become an integral part of military operations. Regular broadcast of news, features and music over radio become so common place that became part of modern life. This was supplemented by television in which live images could be telecast to a large number of individual viewers. Under, modernisation programme, microprocessor based Store and Forward Telegraph (SFT) systems have been introduced in major telegraph offices to speed up transmission of telegrams by curtailing transitional delays.

Direct international point-to-point trunk circuits are available to 47 countries in the world on 1026 channels for 45 countries via satellite. India's first intercontinental telephone exchange was commissioned in November, 1973. International Direct Dialled telephone service was first introduced from Bombay to U.K. This facility was progressively extended to the other three metropolitan cities during the next four years. The Videsh Sanchar Nigam Ltd. (VSNL), formed on 1 April, 1986 after the conversion of the Overseas

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Communication Service, is responsible for India's international telecommunication services. VSNL operates from four regional gateways : Bombay, New Delhi, Calcutta and Madras, bringing international circuits as close as possible to the traffic load centres. The services are provided by a modern wide band submarine telephone cable between Madras in India and Penang in Malaysia and by the INTELSAT satellite positioned over the Indian Ocean which is linked to the two earth stations, one at Arvi near Pune and the other at Dehra Dun. A troposcatter communication link also connects India and USSR. VSNL provides live relay of international TV broadcast programmes via satellite. This facility is available from Bombay and New Delhi. Conference facility of International Telephone (INCOTEL) has also been introduced. This facility is presently available at Bombay, it enables a customer in India to have a conference with up to four international parties on telephones. The equipment for INCOTEL facility manufactured by the research and development sections of VSNL.

The wireless Planning and Co-ordination Wing which was established in 1952, is a radio regulatory authority responsible for co-ordination and regulation of radio spectrum usages in the country and is the model agency for all matters concerning the International Telecommunication union telecommunication matters and Asia Pacific Telecommunity (APT) - an inter-governmental organisation of the region.

Communication Satellites

The Indian National Satellite (INSAT) programme has been designed with the objective of strengthening long distance telecommunication (radio, telegraph, television) links with various cities and remote areas by means of a communication satellite to which are linked the earth stations sited at locations desired to be linked. Till INSAT was in position, the 7 earth stations (2 main and 5 small stations) that were commissioned in November, 1980 were connected to INTELSAT (International telecommunication satellite), the communication facilities of which had been leased in part for the purpose. While, INSAT IA failed, INSAT IB was put into orbit in 1983 and has proved successful. INSAT IC has been put into orbit though its functioning is impaired. INSAT-I is a multipurpose operational satellite system for domestic long distance telecommunications, meteorological earth observations and data relays, nation wide direct satellite TV broadcasting to augment community TV receivers in rural areas and nationwide radio and TV programme distribution for rebroadcasting through terrestrial transmitters.

Satellite communication employing Very Small Aperture Terminal (VSAT) technology offer an attractive solution to the problems related with transit inventory, pricing, maintenance and invoice information and process control data. Because of these, many large companies abroad have turned to VSAT networks for forming the backbone of their corporate communications. VSAT networks can provide voice, data and video communications at varying information rates, ranging from tens of kilobytes to thousands of kilobytes per second, with acceptable propagation delays and that too between widely separated often remote locations.

A typical VSAT consists of an antenna, 'rf-unit', a modern and a multiplexer. On the receiver side, the radio equipment contains a low noise amplifier, a mixer (down converter). VSAT networks offer a very high degree of availability typically more than 99.5%. The response time does not exceed three seconds. VSAT costs are same, whether the sites are separated by 15 kms. or 1500 kms. and quality of transmission is independent of distances involved.

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International Maritime Satellite (INMARSAT) organisation is an internationally owned co-operative which provides worldwide mobile satellite communications for maritime, aeronautical and land mobile users. The INMARSAT organisation is headquartered in London and as on June 1992 has 65 member countries. INMARSAT is able to support services including direct dial telephone, telex, fascimile, electronic mail and data communications between mobile users and subscribers around the world connected to the International Public Switched Network (IPSN). There are three essential components of the INMARSAT systems - the Inmarsat space segment, the land earth station and the mobile earth stations.

Telecommunication and Human Development

The immense good that telecommunications do to individuals and countries, the crucial role that they play in the economic development and the contribution they make to human welfare and convenience are so widely realised that conscious and concerted efforts are being made at the global level to promote them and make them accessible universally. The rapid application of Science and Technology discoveries and inventions like transistors, digital micro-electronics, microprocessors, communication satellites optical fibre light wave transmission, cellular reuse of radio frequencies and so on, are leading to the convergence in one universal information transport system of telecommunications, computers and broadcasting. The resulting mass markets and myriads of uses to which a telecommunications connection can be put are breaking down the traditional monopolies, government restrictions are driving down cost prices, so that general humanity and not a few previliged groups only benefit.

Education and information are the greatest equipment and the most powerful resource for individual and community development. The route to full literacy and excellence through the traditional system of class-rooms, indifferent and ill-equipped teachers is costly, time consuming, wasteful and intellective. We have 3 electronic alternatives.

a) Connect the village school through a telephone using radio-tech, have excellent study.

b) Reading material in the electronic computer memories which are coupled to the telecommunication network. The village teacher dials the computer electronic library and calls for any information/text he wants for display on the Personnel Computer (PC). Whatever he wanted, could be printed;

c) Putting a VSAT education network : a community place of the village has a roof-top VSAT which through a communication satellite in sky, links it to central electronic school (ES). The ES can deliver information to the village school. Lectures/talks including pictures could be received.

Avonic refer to advance airborne electronics system of the type used in the Airbus, A-320. These cover the control of the aircraft, display of information in the cockpit. The extensive use of electronics enabled the design and operation of newlines.

Lasers (light amplication by stimulated emission of radiation) are devices that produce an intense, coherent and highly directional beam of a single frequency. Several laboratories and organisations in India have been working on development of lasers, their components and support system etc., the important areas of applications of lasers in India are :

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a) **Optical communication** : Laser beams have fibre optic compatability and can carry very complex signals because of the high frequency. Experiments are underway on atmospheric propagation of laser beams and their use for underwater communications.

b) Indian Space Research Organisation (ISRO) has developed a LIDAR (light radar) system for satellite tracking.

c) Laser computer printers are widely used including as part of Desk Top Printers (DTPs).

d) The Laser Data Communicator developed at Trombay was successfully tested. Improved model of the communicator with new receiver optics is undergoing tests for a range of more than 4 km.

Check Your Progress - 1

Write briefly about Communication satellites.

Note : a) Write you answer in the space given below.

b) Compare your answer with the one given at the end of this unit.

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6.5. ROLE OF MEDIA

6.5.1. Radio

Radio broadcasts started in India in 1927 with two privately - owned transmitters at Bombay and Calcutta. The government took them over in 1930 and operated them under the name of Indian Broadcasting service. Subsequently its name was changed to All India Radio in 1936 and since 1957 it is known as Akashvani. The present network of All India Radio comprises over 160 stations excluding the national Channel as compared to only 6 radio stations in 1947. As now All India Radio covers 96.2% of India's population. The Vividh Bharati service of Akashvani which has been broadcasting popular music and entertainment programmes was started in 1957. Commercial broadcasts on the radio was introduced on 1967. The national channel was started in 1988 to broadcast quality music, features, plays, sports and economic reviews from evening till late in the night.

6.5.2. Television

Television in India was started in Delhi on September 15, 1959. The facilities were gradually extended to other cities of the country. In 1976, Doordarshan was separated from all India Radio and organised into a full-fledged department. Introduction of satellite technology came into operation in 1975. Colour television was introduced in 1982. Doordarshan

witnessed an unprecedented growth with installation of almost one transmitter a day in 1984 and immediately thereafter. Its programmes reach over 82.4% of country's population through a network of 542 transmitters. The national programme on Doordarshan was introduced on August 15, 1984. School TV programme was started in October 1961. Programme of higher education for college students was started in August, 1984.

Vivek Darpan : Project 'Vivek Darpan' as an experiment for use of electronic media for improving the quality of life in the rural areas, was designed to demonstrate and propagate the use of electronics media as most cost-effective method for disseminations of socio-economic information knowledge in rural areas as compared to traditional method/media. Presently the project is initiated in more than 200 villages of the states of Rajasthan, U.P., Bihar, Punjab, Gujarat, Tripura, WB, Arunachal Pradesh and proposed to be implemented in the 10 villages of Haryana.

This medium is a powerful tool, if properly facilitated and used as an aid for communication, in programmes of rural development, family welfare, rural education and women's upliftment.

6.5.3. Films and Publicity

Feature films were produced in India since 1912-13, while R.G.Torney along with N.G.Chitre made Pundalik in 1912, D.G.Phalke produced Raja Harischandra in 1913. The era of silent movie was overtaken by the talkie era in 1913 when Ardeshir Irani produced Alam Ara. India now leads the world in the annual output of feature films.

The Films Division is the largest national agency devoted to the production and distribution of documentation and news magazines. The National Film Development Corporation (NFDC) was set up in April, 1980, as a Central Agency to promote good cinema in the country. The primary aim of the Corporation is to plan, promote and organise the integral development of the film industry.

The Directorate of Film Festivals was transferred to NFDC in July 1981 and is entrusted to organise : (a) international film festivals, (b) national film festivals, (c) film weeks under cultural exchange programmes in India and abroad and (d) to participate in international film festivals.

The National Film Archives of India was established in February 1964 to acquire and preserve the heritage of National and International cinema, film classification, documentation, research encouraging film study and dissemination of film culture.

The Children's Film Society of India (CFSI) was established in 1955 as an autonomous body with the objectives off promoting and encouraging the children's film movement in the country.

6.5.4. Directorate of Advertising and Visual Publicity (DAVP)

This is the central agency of the Government for publishing the policies, programmes and performances of various ministries (except Railways), departments and autonomous bodies through the widest range of communication media. DAVP bring out publicity literature in English, Hindi and 11 regional languages. The Directorate organises competition every year for the National Awards for Excellence in Printing and Designing the Books and other publications in order to generate healthy competitive endeavour for higher standards in printing and designing.

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The Directorate of Field Publicity (DEP) is the largest medium of interpersonal communication in the country. Its main objective is to enthuse people with the sense of confidence and to actively involve them in national building activities.

The Song and Drama Division is the live media wing of the ministry of Information and Broadcasting. It utilizes the traditional, folk and contemporary stage forms for purposes of social communication projecting the developmental activities in the country.

The Indian institute of Mass Communication (IIMC) is the national centre for advance training and research in mass communication in India.

The Film and TV Institute of India (FTII) was set up in 1960 for training in the art and craft of film making.

Photo Division is the largest photographic unit of its kind in the country.. The Division has a valuable collection of photographic negatives of archival value relating to the major news events as well as collection of photographs showing socio-economic development in the country.

6.6. NEWS PAPERS

The office of the Registrar of Newspaper for India, known as Press Registrar, came into being on 1 July, 1956. Indian Press consists of 36 centenaries. The Gujarati daily, Bombay Samachar, published from Bombay is the oldest existing newspaper. It came into existence in the year 1822. Uttar Pradesh claimed the top position of being the largest publisher of newspapers. The highest number of newspapers were published in Hindi (over 6000) followed by English (nearly 4000).

The Press Information Bureau (PIB) is the central agency of the Government for putting out information on its policies, programmes and activities. The information goes to dailies, as well as news periodicals, news agencies and radio and television organisations, both Indian and foreign. India has 4 news agencies, Press Trust of India (PTI), United News of India (UNI), Samachar Bharati and Hindustan Samachar. The Non-Aligned News Pool was set up on 13 July, 1976. The News Agencies Pool of the Non-Aligned Countries is a system of news exchange based on professional co-operation, equality and co-ordination among the pool partners. India, which played a leading role in the formation of the pool was elected the first chairman of the co-ordinating committee. The Press Council of India which was set up in 1979 safeguards freedom of press, maintains and improves the standard of newspaper and news agencies. The Research and Reference Division performs a basic and pivotal function as an information servicing agency to the Ministry of Information and Broadcasting, its media units and their field offices. The National Documentation Centre on Mass Communications was set up as part of the Research and Reference Division in 1976 with the broad objective of collecting, interpreting and disseminating information relating to agencies, events and trends in the field of mass communication, including press and different media units of the Central and State Governments. The Publications Division is responsible for the production and sale of books and journals on all subjects of national importance with a view to providing up-to-date and authentic information to the public at home and abroad.

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6.7. VOLUNTARY AGENCIES

In all societies and at all times, people have been giving something, either in cash or in kind or services for the welfare of the needy, the destitute and the victims of natural calamities. No complete or reliable data are available about the total number of Voluntary Agencies in the country but about 5000 are known to be receiving grants from the Central Social Welfare Board and a much larger number is probably functioning with their own resources derived from religious and charitable organisations, private donations and gifts, etc. In their aims and ideals, quality of personnel and standard of services, voluntary agencies are known to show wide variations from some old-well established organisations with a distinguished record of dedicated service at the one end to a few new agencies which have sprung up to take advantage of government grants available for specific welfare activities at the other. Organizationally, the Bharatiya Agro-Industrial Foundation (BAIF) at Pune has been able to pioneer joint sector co-operations in rural development in which the funding is largely official whereas the management is vested in private agencies. The Self Employed Women's Association (SEWA), Ahmedabad is an inspiring prototype; it is indictive of the power of awareness and collective organization in creating a community and mobilising it for action through self-improvement.

Funds are now available especially through foreign funding agencies, some of which operate annual budget of up to 4 crores. The major problem of the agencies is not funds but ideas, people and organisations. The entry of industrial houses into the field of rural development should open up opportunity for fruitful collaboration between these agencies which are in a position to offer funds, technology and management support and voluntary agencies which can provide motivation, grass root expertise and social leadership. There could be a similar partnership between voluntary agencies and institutions like schools, colleges and research establishments in developing programmes of voluntary youth services and work experiences.

A preponderance of active voluntary agencies are either Gandian or Church-related. Voluntary action outside the Gandian/Church orbit has also tended to radiate onwards from socially conscious urban centres, head offices being in Delhi, Bombay, Poona, Hyderabad, Madras, Bangalore and so on. In the field of health, the Voluntary Health Association of India does provide an advisory service over a limited area.

6.8. RESOURCES AND CONSERVATION

6.8.1. Resources

Natural resources have a vital role on economic life. Knowledge about their occurrence and utilization enables us to undertake best use of these resources. Natural resources are available in varying varieties and different quantities. Development in science and technology has enlarged out resource base. A natural resource is anything found by man in his natural environment that he may in some way utilize for his own benefit. In this broad sense, the resources include minerals, energy sources (oil, coal, uranium, gas) and soils. They include all the elements of land which provide sites for buildings, roads, railways etc. They include surface and underground water indispensable for human, animal and plant life and also a means of transport. Natural resources include air and everything that constitutes the atmosphere or reaches man by way of atmosphere such as solar radiation, which in the ultimate analysis is essential to life.

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There is now a great awareness about the role of natural resources and there is greater concern about their proper utilization and conservation. This interest has been further heightened by pollution of water, air etc., due to indiscriminate and improper use of available natural resources. Initial economic activity involves man working upon natural resources making fire, cultivation, domestication of animals, making of pottery development tools etc., all are directly the result of man working upon nature. These resources provide them with food and raw materials. Some like minerals are sources of foreign exchange earnings.

Land Resources

Land is a renewable resource. The geographical area and the type of soil determines the very existence and development of society. Land is put to various uses like production of food, fibre and fodder. Besides non-agricultural uses like construction of buildings, railways, roads etc., are also undertaken. Hence the area available to the country as also the pattern of its use are of immense importance. India's land area is 1/7th of that of U.S.S.R. and 1/3rd of U.S.A. and Canada. Forests occupy 22.7% of the total land which is much less than the national target of 33%. About 1.75 crores of acres are under non-agricultural uses like roads, buildings and waste lands.

Forest Resources

Forests are another important renewable resource. Among the advantages of forests the principal ones are ecological improvements, influence on climate and moderation of temperature, conservation of soil and regulation of moisture and stream flow. Forests cause perennial flow in hill streams and rivers. The major forest based industries are pulp-paper, newsprint, rayon, saw-milling, wood-panel products, matches, resins, medicinal herbs, wild-life and tourism. Forests provide a variety of minor products like tanning material, honey, dyes, essential oils, grasses, fodder etc.

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Water Resources

Water is basic to all natural resources as it sustains all human, animal and plant life. We have adequate water resources but are a long way from using it properly. Water resources include sources of fresh water and surface water. It consists of tangible resources like lakes, rivers etc., and ground water and potential resources such as saline waters, ground water from saline springs, as also water obtainable from snow and cloud formation by seedling etc. The main source for irrigation is rain. Rivers and under ground water also provide irrigation but only to a small extent. Hydel power continues to be the cheapest source of energy. Water transport is of special importance.

Mineral Resources

Modern industrial civilization is based on minerals. India possesses a wide variety of minerals and these are exploited efficiently. The Indian economy depends on minerals as they are essential for rapid industrial development and modernization of agriculture. The vital ones are coal, petroleum and iron ore because these are used in most of the products. Manganese, chromite, aluminium, copper, lead, zinc, phosphate, potash etc., are also important minerals.

Energy Resources

Energy is a basic requirement for modernisation. Energy is the key to raising labour productivity and transforming the structure of an economy. In general sources of energy are varied : coal, oil, electricity, human power and animal power. Coal is a fossil fuel needed for power generation and satisfying energy requirements by railways, thermal power stations, steel plants and for production of chemicals. Another fossil source of energy is oil, which has become very expensive since 1973.

6.8.2. Conservation

The land is largely a potential asset. To realise its full capacity planned utilization is a must. Obviously, the total requirement for land cannot be met. The remedy is in making more efficient use of land and by changing the land use pattern. Barren area should be used optimally. Better graded lands should be kept for agricultural purposes. Suitable technology and farm practices will help in higher yield rates. Available technology needs to be modified to suit the requirements of small scale and dry area farming.

The total area under forests is only 23% of the geographical area which is inadequate. Forest should be increased to 33% of the total land area. Prevention of deforestation will involve development of alternative energy like biogas, preventing reckless felling of trees by people who misuse administrative and legal loopholes etc. The forests that stand degraded should be rehabitated. There is great scope for agro-forestry projects. It means integration of silviculture with horticulture, agriculture, animal husbandary etc.

Besides the assessment of water resources, care and prudence is required in utilization of water. Conservation is necessary to ensure economy and efficiency. To achieve this, one has to redesign irrigation projects. National water grids are required to ensure interconnection of one water shed with another. The surplus of one water shed can compensate for the deficit of the other system. Conservation should also include uses of saline water for irrigation. Again there is the need to provide for the reuse of effluents from urban and industrial areas which otherwise cause pollution.

Attention must be given to conservation of mineral wealth as it is a non-renewable asset. We should not export processed and semiprocessed minerals indiscriminately. If used locally the economy will generate additional income and employment. Our internal requirement for these minerals is bound to grow with industrialization.

There is a need for regulating demand for energy, as supplies are limited and cannot grow very fast. To control demand 3 types of measures are necessary.

1. the overall energy intensity of protective process be reduced,
2. energy efficiency should be stepped up,
3. a desirable pattern of energy-use should be promoted, for example in respect to households, biogas use should be encouraged and use of kerosene discouraged.

At the current rate of production, India's coal reserves are likely to last over a thousand years. So the government should reorganise and retionalise production and restructure the overall management pattern. In view of limited reserves of oil, the need is to curtail oil consumption and to (i) convert power stations to coal based ones and (ii) appropriate pricing policies to curb the use of oil products. There is a need for further exploration and to develop existing reserves.

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6.9. NEED VERSUS GREED

The natural resources should be treated together looking at the social need. The resource policy has to be government's responsibility as the government can keep the social objective constantly in view. Private enterprises working on the basis of market forces cannot give appropriate weight to externalities like the pollution in the development of natural resources. For example the ecological make up of any region cannot be assigned a price in the open market. The government can look both at social benefit and social costs and come to an effective compromise. Thus, the government should have plan of the use, conservation and augumentation of the country's resources. Such plans are inconceivable at microlevel as it is too idealistic to expect individuals to think of social needs. Plans with greed will certainly ruin the progress of the country.

6.10. ALTERNATIVE APPROACHES

The resources so far developed are not being efficiently used. Nor do we look at alternative ways of using the same resources. To overcome this, (1) research and development efforts should be substantially stepped up to develop less resource intensive methods of production, and (2) exploration should be to discover new resources.

6.10.1. Nuclear Energy

Coal has the drawback that it can only be economically used near its place of origin. Generation of hydel electricity depends upon the availability of falling water. Atomic power may the most advantagious solution to problems of the country. Atomic power plants can be located anywhere and are cheaper to install than other comparable systems. However, environmental hazards like disposal of nuclear wastes associated with nuclear plant should be looked into properly before further development is undertaken.

6.10.2. Wind Power

The potential wind energy capacity is estimated at 5000 MW. Also the technology can be made available in remote areas. These power units are ideal as they can be set up to cater to the needs of small number of users. They involve no transmission lines hence no transmission costs. At present wind power projects have been setup in Gujarat, Maharashtra, Tamil Nadu and Orissa.

6.10.3. Solar Energy

Sun is a perennial and almost inexhaustable source of power. A solar energy station with a capacity of 10 KW. has already been constructed. The retionale of the project is simple; sun-shine stations producing 4 to 10 KW of power are ideal for our numerous scattered villages under the solar water heaters, solar stills, solar cookers and set up nearly 20000 street light systems based on solar system.

6.10.4. Other Sources of Energy

Other sources of energy are plant residues and dried cow-dung. The former is derived from crop residue and is a renewable resource. Cow-dung, together with other natural wastes, is a valuable potential resource in remote areas. It could be utilized much more effectively by a simple small scale gasification process (biogas), the technology

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being available for decades. The government has set up 10 MW power plants based on rice husk at Patiala.

6.11. COMMUNITY ACTION

To help farmers, co-operatives in India play a significant role in the production and distribution of agricultural output. As economic development takes place, co-operation is expected to become progressively the principal basis of organisation in agriculture, small scale industries environmental studies etc. Conditions in rural areas did not promote co-operation and the farmers did not understand the significance and utility of co-operation. A major National Environmental Awareness Campaign (NEAC) has been launched since July 1986 to create environmental awareness at all levels of the Indian public. The aim of the campaign was to create environmental awareness at national level. The department of environment constituted a national award, entitled, "Indira Gandhi Paryavaran Puraskar" to be awarded annually from 1987 onwards to any citizen of India or organization for significant contribution in the field of environment. In 1985, a new Ministry of Environment and Forests with department of environment and forest and wildlife was set up. It serves as the focal point in the administrative structure of the central government for planning, promotion and wild life programmes. The department decides monitoring the protection of environment also looks after the environmental protection of coastal waters, mangrooves, coral reefs and wetlands, survey and conservation of biotic and abiotic resources; environmental research, education awareness and information. The Central Board for the Prevention and control of water pollution is the national apex body for the assessment, monitoring and control of water and air pollution. An action plan has been framed for the prevention and control of pollution of water bodies such as Ganga, Damodar, Krishna etc.

Check Your Progress - 2

Write briefly about national resources.

Note : (a) Write your answer in the space given below.

(b) Compare your answer with the one given at the end of this unit.

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6.12. SUMMARY

Information has always played an important role in human life. Today's electronic information systems are linked with progress in four information technologies one of the key factors which sustain the pace of modern life style is telecommunications. Radio and Televisions have reached almost every house in the country. Feature films and newspapers are contributing

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a lot in the information dissemination. Voluntary agencies are also helping in creating awareness in the public. Natural resources have a vital role on economic life and we should conserve them. The natural resources should be treated together looking at the social need and we should develop alternative resources. By co-operation we can implement many actions.

6.13. CHECK YOUR PROGRESS : MODEL ANSWERS

1. Communication satellites are used to strenghten long distance telecommunication links with various cities and remote areas by linking the satellite and cities by the earth stations sited at the remote locations.

2. Natural resources have a vital role on economic life. The resources include land, forest, water, mineral and energy. A natural resource is anything found by man in his natural environment that he may in some way utilize for his own benefit.

6.14. MODEL EXAMINATION QUESTIONS

I. Answer the following questions in about 30 lines each.

1. Write briefly about telecommunications.
2. What are the major natural resources? Write briefly about their conservation.

II. Answer the following questions in about 10 lines each.

1. What is the role of television in community uplift?
2. Write briefly about postal communication.
3. What is the role played by voluntary agencies?
4. Explain the alternative sources of energy.
5. Write briefly about films and publicity.
6. Describe data base.

Dr. N. Raman

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UNIT - 7 : ENVIRONMENTAL MANAGEMENT

Contents

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7.1. OBJECTIVES

After going through this unit you will be able to :

- explain the principles of environmental management,
- describe various strategies, and
- describe the utilization of resources and recycling.

7.2. INTRODUCTION

Environmental degradation as a result of man's activities started when man, the hunter settled down as an agriculturist. With increase in population, his requirements for food and needs have further increased but with the application of science and technology man's standard of living was improved and he was able to control his environment. The industrialisation and technological advances set in process the deterioration of quality of life. The unwise use of resources, raw material and energy has led to their consumption at a faster rate. The situation became more adverse with the introduction of non-biodegradable

materials in the environment. If environmental quality is to be assured, measures must be taken before damage occurs, not after. The environmental dimension must be built into all policies, plans, programmes, projects and decisions. Impacts can be mitigated by the correct location of the project, placing it near similar projects, remote from sensitive populations. Careful zoning and land-use planning can help here. Environmental management is the most talked of subject all over the globe.

7.3. PRINCIPLES OF MANAGEMENT

The real objectives of environmental management are to focus specifically on those environmental areas which should be preserved or enhanced for the use of this and future generations. Environmental management has three objectives (i) to protect people from pathogenic organisms, toxic chemicals and from excesses of physical energies; (ii) to spare humans annoyance, irrigation and discomfort from offensive conditions in water, in air and on the land, (iii) to safeguard the balances of the earth's ecosystems and to conserve natural resources. To keep the balance, the alternatives are : eliminate the waste; treat the waste to reduce the deleterious load on the open environment; or augment the environmental capacity to assimilate the waste. All of these are applied in one way or another to manage liquid, solid and air borne wastes. Above all, what is required is a preventative tool for environment.

7.4. STRATEGIES

Today there is a growing tendency for protection and preservation of environment all over the world. Due to rapid growth of population, industrialization, urbanization and motorisaton especially since 1960s, pollution problems have become very serious in many countries. Efficient management has therefore become an absolute necessity to avoid the over-use and abuse of the natural resources of environment. Environmental management is also essential for the minimization of the impact of human activities on the ecological environment. At present, various strategies are being adopted by the countries of the world to manage and utilize the resources optimally and at the same time unduly degrading the environment.

7.4.1. Role of Government in Environmental Management

The government is the supreme manager of environment and it is the duty of the government to manage the security and sovereignty of air, water and land. Today, the magnitude of the pollution problems are so serious that they require to be tackled only through public policies. The reason being that the private market system fails to allocate environmental resources efficiently due to the pervasiveness of pollution costs external to private decision makers. Environmental equality is a 'public good' and the economic efficiency in environmental resource allocation necessitates the intervention of government.

Generally, there are two approaches available for pollution abatement policy. They are :

(i) Discouraging pollution through altering the market incentives.

(ii) Through regulatory intervention, in the absence of market incentives.

Following are some of the important measures adopted by the government in protecting the environment.

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Effluent Charges : It is one of the fiscal tools used in environmental management. Effluent charges is one when correctly imposed will induce the firm to decrease output. This in turn, will lead to a cleaner environment. The levy of effluent charges brings about two main reactions among the business firms. They are :

(i) instead of using unclean sources of energy, the firms may switch over to other cleaner sources of energy.

(ii) firms may avoid effluent charges by adopting methods to reduce the emissions.

Therefore, it has been realised that the effluent charges should be made high enough to make the firms realise that the less polluting production techniques are more profitable than paying effluent charges.

Pollution Fines : Imposition of pollution fines is also used as a strategy in environmental pollution control. For example, oil spill in which pollution is sudden and serious but it has to clean up quickly. The costs for such clean up may be imposed on the polluters by imposing pollution fines. These fines create cost burden and at the same time, they serve as an incentive for adopting safety measures in the production activities.

Subsidies for Better Environmental Quality : The subsidy is an opportunity cost in terms of foregone revenue and also has the effect of internationalising the social costs of waste discharges. A subsidy scheme treats the structure of property rights in air and water in a different manner. The government offers a payment to the polluter not to exercise this right. Therefore the polluter treats waste reduction as another marketable good and more efficient firms try to maximise their subsidies by more efficient waste reduction methods.

Regulatory / Legal Measures : Rules and regulations are of course, the essential environmental policy instruments. Environmental legislation supported by well-drafted regulations and enforcement systems and administrative machinery is an essential component of environmental management. The legislative scope covers a wide range of spheres including land-use, water rights, pollution control and abatement, forest protection, wild-life conservation, town planning, industrial licensing, use of toxic chemicals, disposable of solid wastes and effluents and so on. Many governments have passed environmental laws relating to water pollution regulation, air quality regulation and noise pollution.

Government Expenditure on Environmental Protection : The economic development of an economy depends upon its environmental quality. Protecting the environment is possible by incurring 'costs' in the form of pollution abatement techniques, recycling materials etc. These pollution preventing techniques require heavy investment. Here arises the question of 'who has to bear the pollution abatement cost'? The private firms are usually motivated with profit sector to bear the total pollution cost is neither meaningful nor possible. Passing this cost to the consumers by increased prices may not also be feasible. Therefore, it is expected that the government should allocate certain percentage of gross national product (GNP) for achieving environmental quality just like any other investment made by the government on developmental plans or projects.

7.4.2. Peoples' Participation

Creating awareness among people about environment has become a must. The area of environment requires large-scale participation of people in environment management, Government is adopting many environmental programmes to improve the quality of life

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of the people. But the people who benefit by government programmes are unaware of the importance of these programmes.

To encourage peoples' participation in environmental management, it is necessary to launch country wide environmental awareness cum appreciation campaign. The 'Chipko' movement in our country has played a vital role in safeguarding forests in Himalayas. In this movement, especially women activities play a dominant role in creating 'social fence' to save our forests. This movement is creating conservative awareness by the innovative use of folk songs, dances and village level camps. The destruction of forests in Himalayas has been averted successfully by this movement. Today, it is impossible to fell trees in the Chamoli region, because of the 'Chipko' activities. This kind of people's involvement in ecological or environmental management programmes has to be encouraged in order to improve environmental quality.

7.4.3. Environmental Education

Environmental education particularly relating to environmental impact assessment of major and medium developmental projects are necessary for better environmental management. There are both protectors and destroyers of the environment in villages. Therefore, knowledge and experience through environmental education from the primary level is essential especially in rural areas.

Educating students in environmental management and environmental economics will help them : (i) to assess the existing nature of economic and environmental set up, and (ii) to help framing economic policies including environmental aspects and thereby facilitating better environmental control, planning and management.

7.4.4. Voluntary Agencies

The role of voluntary organisations are crucial in tackling environmental problems as it has been realised that whatever may be the level of development and efficiency of the government, it cannot solve the environmental problems all by itself. The voluntary organisations are expected to work on the following objectives.

(i) Conservation and development of land, water, air, flora and fauna;

(ii) Promotion of environmental awareness at all levels by organising seminars and workshops;

(iii) Taking part in environmental education programmes of the Government.

For achieving success in environmental management, there is no need to stress the role and importance of voluntary agencies.

Today, the world environment is in a state of emergency and to bring about effective environmental management, the above mentioned strategies need to be implemented not only immediately but with greater force and concerted efforts.

Check Your Progress - 1

What is the use of educating students in environmental management?

Note : a) Write your answer in the space given below.

b) Compare your answer with the one given at the end of this unit.

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7.5. OPTIMAL UTILIZATION OF RESOURCES

The cultivated land area can be increased by two to three times if the cropping intensity is stepped up from the present 120 per cent to 200 - 300 per cent. But that is possible only if water is available to irrigate crops for the second or third time in a year in the same field. There is urgent need to find out ways to increase water supply. The following are suggested irrigation strategies to overcome water problems.

1. Control and proper method of irrigation in canal and tank command areas specially for paddy.
2. Providing drainage and water facilities.
3. Conjunctive use of surface and ground water.
4. Using sprinkler irrigation in canal / tank command areas.
5. Introducing drip irrigation in well irrigated areas.
6. Biwall irrigation for closely spaced crops like sugarcane, vegetables and cotton.
7. Introducing the concept of supplemental irrigation.
8. Water / fertilizer production function.
9. Training to farmers and extension officers on water management.
10. Demonstration / pilot programmes in the farmers fields together with seminars and workshops.

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Minor irrigation, particularly through the use of ground water, must be the mainstay or all future irrigation plan. The potential or utilisable groundwater resource for irrigation was earlier estimated at 41.8 million hectare metres but this has recently been revised upwards to 45.6 million hectare metres. Despite large-scale development, nearly two-thirds of the development still remains untapped. Exploitation of untapped potential calls for the installation of a large number of pumpsets and their energisation.

In the present set-up, rural areas are starved of power because of poor availability and poor affordability. Because of the scarcity of energy inputs, productivity and income generation are limited and rural people have no option but to meet their subsistence needs through non-commercial energy sources which has resulted in a large scale degradation of natural resources. What is needed is a multi-dimensional integrated approach including augmentation of energy supply resources, technology transfer for optimum and productive use of resources, R & D inputs for developing low cost energy options for the rural poor and education and training for rural users.

There are two important forms of bioenergy sought to be developed. Biogas is perhaps the most important component of renewable energy supplies. A by-product of biogas is

a very valuable enriched fertilizer. Biogas can be used for cooking, lighting or for generation of power for all the various uses which electricity can put to. The other component of bio-energy is the bio-mass programmes - that includes development of selected species of energy plantations and power generation, conversion of wood and utilization of agriculture residues. New schemes would include large scale cultivation of fuelwood, biomass based wood gasifier engines for irrigation and drinking water purposes; solid fuel through conversion of agricultural wastes into pellets and briquettes and production of liquid for transportation from biomass such as ethanol and methanol. Vegetable oils can serve as possible substitute or supplement to diesel oil.

Mineral resources of ocean occurring along the continental margins are large and await exploitation. These occur along the west coast of India and mining of these has already begin.

The most obvious form of energy from sea is the energy from the tides and from the oscillation of waves. The economic viability of setting up a tidal power plant in the Gulf of Cambay is under study. The ocean water is also a rich source of inorganic chemicals. Common salt (sodium chloride) has been recovered from sea water since ancient times. Now technology is available to recover potassium and magnesium salts and bromine from sea water economically.

The ocean can also be a source of fresh water and thus a major benefit to coastal areas for meeting requirements for domestic, agricultural and industrial purposes. The development of a cheap desalination technology is required.

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7.6. MINIMIZATION OF WASTAGE

The increasing scarcity of water is a matter of serious concern. In major irrigation projects, farmers use as much water as possible without understanding the adverse effect of over-irrigation. Since paddy consumes nearly 40-45 per cent of total agriculture water in the country, the water saving method must be introduced. To maintain the ground water table atleast 1.5 to 2 metres below ground level, farmers should pump water from their wells. This will help in controlled irrigation.

A serious concern is that a major irrigation project suffers from a long gestation period extending quite often to decades. They also demand large areas of precious agricultural land for the distribution systems. Above all, the water they impound is subject to heavy losses by evaporation and seepage and accompanying soil problem. The key to better water management lies not in the construction of big irrigation projects but in the maximum conservation of precipitation, soil moisture and ground water.

The need to tackle the rural energy crisis and its complex nature was recognised in the sixth plan and the plan document recommended the setting up of an Integrated Rural Energy Programmes (IREP) which would provide a mix of energy options for meeting the diverse energy needs of the rural areas in the most cost effective manner. For the preparation of block level IREP projects different energy options are considered from ongoing schemes of the Central and State Governments including those involving conventional sources of energy such as rural electrification, supply of petroleum products, oil, fuelwoods and soft coke as well as new and renewable sources of energy.

7.7. RECYCLING

For stable economic growth, resources must be used carefully and technologies for recycling of wastes and residues are to be evolved. Waste materials, which are obtained after the necessary usage, can be recycled to maintain the ecological balance through replenishment. For example, human and animal faeces may be used to produce biogas which effectively gives us usable energy and also prevents atmospheric pollution. This process is called waste recycling. Similarly it is possible to recycle the effluent to get water. This water can be used for irrigation purposes. Paper recycling is also popular. Without the production of biogas, several waste materials can be recycled through the preparation of compost which is a fertilizer obtained from the remnants of plant and animal residue. Compost may be prepared by enzyme action on such wastes and can be used equally well as a chemical fertilizer.

A major thrust has been given to the utilization of urban waste, both solid and liquid, for generating energy and also improving the urban environment. In July 1984 a contract for a project for incineration of 300 metric tonnes of Delhi city garbage per day was entered into by the Department with a Danish company. This plant would generate approximately 3.75 MW of power as a byproduct and is estimated to cost Rs. 18 crores. This incineration plant is of considerable experimental value as means of converting low calorific value garbage of cities into power.

A pyrolysis plant, using solid urban refuse, is proposed to be set up at Bombay. Utilising 600 metric tonnes of waste per day, it would generate 6 MW of power. Another project for generation of 9 MW of surplus power from bagasse at a co-operative sugar mill in Tamil Nadu is on the anvil. Two rice husk and straw based power plants of 5 to 6 MW range are planned in Punjab. Recycling of materials not only eliminates pollution problem but also decreases the need to get new resources from the earth, a process that often involves its own environmental problem.

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7.8. LONG TERM VERSUS SHORT TERM OPTIONS

7.8.1. Population

The population of India is increasing at a very high rate. The increase in population has had its impact on the rural and urban environment. In rural areas, availability of arable land has now become a problem of great concern. For better environmental management, population control is necessary.

7.8.2. Deforestation

We have plundered our priceless forest resource for fuel, fodder and timber requirements. Large forest areas have been cleared to supply land for various purposes. This has also changed the local climate. There has been increased soil erosion, floods and droughts. All this now requires costly remedial measures. It is unfortunate that in India, the management of wildlife area and parks is carried out in an unscientific manner. The forest officials who look after these areas are not properly trained in wildlife techniques. The main drawback is the lack of information and data on the structure and functioning of the ecosystems. All these areas need the urgent attention of consideration to protect the natural resources which are in danger due to human interferences.

7.8.3. Toxic Substances

There are a number of industries which wholly depend on metals and release toxic substances. These substances and metals are dispersed along with other wastes in the environment as effluents or atmospheric emissions. These metals pollute the soil, water and air. The heavy metal pollution of the soil is increasing due to human activities such as excessive use of fertilizers, insecticides and dumping of the industrial wastes. Other common sources of soil contamination in the urban areas are sewage disposal, effluents from industries such as from sugar industries, electroplating industries etc. The excessive use of insecticides and pesticides such as D.D.T. has posed serious problem. It is feared that the impacts of these substances are very severe in the long term. Efforts should be made to reduce the use of toxic substances and non-biodegradable materials.

7.8.4. Energy and Environment

Energy is most vital for all development activities including agricultural development. So far in India, electricity, one of the important forms of energy, is used mainly to cater to the urban population. The main energy source in India is coal resources. The mining of coal and the smoke and particulate materials from the coal in various processes at various stages cause serious environmental problems. The other sources of energy in India are oil, nuclear fuel, hydroelectric power and non-commercial sources of energy such as fire-wood, agricultural waste and cow-dung. The dangers of pollution from oil refineries and the fear of radioactivity from nuclear energy are well known. The construction of hydrological projects for electricity leads to large-scale damage of forest cover and vegetation. There are several other public health problems associated with the construction of dams.

There is an urgent need to explore the possibility of the use of non-commercial sources of energy. The biogas from organic waste and human waste may be given priority to solve energy problems in rural areas. The construction of hydroelectric projects and dams should ensure full protection to the nature and forest cover. The catchment areas should not be disturbed. The planning and the selection of the site should be based on ecological considerations and not on political considerations. Solar energy research activities should be given prime attention to develop alternative sources of energy in India.

7.8.5. Land Use Pattern and Land Utilization

The pattern of land utilization projected for the end of the century, incorporating the national forest policy to keep nearly one-third of the total land for further non-agricultural purposes. Better management techniques to reclaim unusable areas, ravines, saline-land and water logged areas, for the protection of suitable land from erosion or desertification, and for the use of undeveloped or under-developed land in human settlement, will require extensive scientific and technological inputs ensuring optimum ecological balance between human activities and natural environment.

Further evaluation of ownership of land and land tenure may also need to be considered to prevent its exploitation. The land which is limited should be wisely used for agriculture, forests, extractive industries, major industries and for human settlements. Land use practice should be based on ecological considerations.

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7.8.6. Environment Legislation

The need for the protection of the environment, forest and natural resources is included in the Indian Constitution. In addition, there are a number of central and state legislations. The legislations should be enforced strictly. .

7.9. CHOICE OF TECHNOLOGIES

Technology becomes appropriate only when it is related to the needs of the people. The technology has to bring about an improvement in the conditions. The technology has to suit local needs and make an impact on the lives of ordinary people by effecting improvements which could make better and more cost-effective use of existing materials and methods of work. Technological advancement has to be geared to bring about an improvement in the people's living standards. Technologies resulting in low cost production and in products marketable close to the point of manufacture, particularly in the rural sector, have to be promoted.

Biotechnological applications to pollution control, waste treatment and environmental clean up are being pursued all over the world. Advances in genetic engineering promise to make more effective biological methods to control pollution. With the application of recombinant DNA technology, it is possible to develop specifically engineered bacteria to clean oil spillings. In the field of energy and environment, the use of microbial techniques has assumed great importance. Genetically engineered microorganisms (GEM) e.g. *Pseudomonas putida* capable of loosening crude oil bound to rocks have been designed by Dr. Anand Chakrabarty in the USA. This is of great economic and environmental importance in the battle against oil slicks. Microbial mining is another important area in which the extraction of metals from ores is increased remarkably by EM, causing less pollution. Biofertilizers like ***Rhizobium, Frankia, Azotobacter, Azospirillum, Azolla, Mycorrhiza*** etc., help to replace the chemical fertilizer, culminating on having energy. Biological control is another approach that would minimize the use of fungicides and pesticides, leading to reduction in pollution.

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Check Your Progress - 2

Write briefly about recycling?

Note : a) Write your answer in the space given below

b) Compare your answer with the one given at the end of this unit.

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7.10. SUMMARY

The industrialization and technological advances set in process to determine the quality of life. So the environmental management is the necessity of the day, which has 3 objectives. Today, many strategies are followed to protect and preserve the environment.

The resources should be utilized properly and we should minimize the wastage. Waste materials can be recycled to avoid pollution. Need based technologies should be selected.

7.11. CHECK YOUR PROGRESS : MODEL ANSWERS

1. Educating student in environmental management will help them to assess the nature of environmental set up and help them to frame policies regarding environmental aspects.

2. Waste materials, which are obtained the necessary usage, can be recycled to maintain the ecological balance. Recycling of materials eliminates pollution problem.

7.12. MODEL EXAMINATION QUESTIONS

I. Answer the following questions in about 30 lines each.

1. What are the strategies adopted for environmental management?
2. Write briefly about optimal utilization of resources.

II. Answer the following questions in about 10 lines each.

1. What are the principles of environmental management?
2. Explain briefly about minimization of wastage.
3. What is the use of recycling?
4. Explain briefly about choice of technologies.
5. What is bioenergy?
6. Write briefly about pollution fires.

Dr. N. Raman

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UNIT - 8 : ENVIRONMENTAL PLANNING

Contents

8.1. OBJECTIVES

After going through this unit, you will be able to :

- explain the need to evolve a scientific and practical approach to solve the environmental problems through proper planning,
- describe the conflicts arising out of the interaction between social and developmental components of our society,
- introduce the concept of environmental planning in the context of development for human welfare, and
- identify the driving and motivating components which play a major role in formulating the developmental strategies.

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8.2. INTRODUCTION

A couple of decades ago, Environmental study used to focus the problems pertaining only to water and sewage and involved the sanitary and public health engineers to propagate the human role in assuring enough quantity of potable water for communities. The scenario has completely changed, thanks to the widening frontiers of environmental research and development. It is widely accepted fact that the study of 'environment' necessarily includes all the basic and applied sciences, all forms of engineering, social and economic sciences and ethics and law. Further, the scope of all activities aimed at human welfare and well being is quantified in terms of environmental responses - be it the construction of a dam across a river or the promotion of an industry or even the development of human dwelling through planned urbanization. The summative outcome of this and other modern approaches has been the birth of a new discipline termed 'Environmental Management'.

Environmental Management refers to the optimal allocation of finite resources between and/or among different possible uses. To make sure that such allocation is efficient, economic considerations are introduced along with other criteria. From the ecological view point, the principles of Environmental Management address to the protection and prevention of degradation of scarce and diminishing resources. When applied to mass

human activities such as fishing or mining and systems such as forests or rivers. Environmental Management implies careful avoidance of over exploitation (say of fish) and conservation (say of water).

As a concept the 'Environmental Management' links four working components, namely,

a) Environmental Planning

b) Environmental Status Evaluation

c) Environmental Impact Assessment

d) Environmental Legislation & Administration

In this unit let us restrict ourselves to the understanding of the first component. i.e., Environmental Planning.

8.3. ENVIRONMENTAL PLANNING - CONCEPT & PRINCIPLES

Now that we have had an insight into the structure and executive principles of EP, we should turn our attention to the application of the principles to real life situation. This is best done by identifying a few human concerns and assessing the relative impacts of the planning and programmes on the human society and vice-versa. Any attempt to identify the human concerns related to Environmental Projects and Economic Programmes will result in a long and exhaustive list. Such an exercise is not within the scope of the present study. Instead let us try to understand the practical implications of EP/IEP by considering two sectorial public utility programmes, namely, Transport and Housing and an economic planning tool called the Cost Benefit Analysis.

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8.4. ENVIRONMENT AND TRANSPORT

Developing and improving the means of transport has always been on the top of the agenda of Planners and Policy makers. Transport sector caters to the needs of passengers & industries alike. It is the second category which contributes to the problems of environment.

Transportation network consists of roads, railways, inland water-ways, coastal shipping, airways, pipelines etc. Along with the benefits accruing from increasing transportation i.e., accessibility, distribution of goods and services, trade and commerce, there is the potential danger of causing undesirable and harmful effects on quality of environment. This aspect of transportation needs to be looked into while drafting EP papers. The phenomenal increase in the number of automobiles has elicited considerable solicitude about the associated negative effects on plants, animals, humans and materials. Although much concern has been expressed by scientists and environmentalists, plausible solutions, are yet to come by. Unlike several other utility sectors, transport sector ramifies and magnifies the environmental problems with increased growth rate. For example, increased volume of transport involves more and more areas for roads, rail tracks, air terminus and bus terminus. Apart from this, there will be a spurt in automobile junk-yards, workshops, petrol pumps and refineries, oil and crude carriers etc. Each one of these components is bound to add to the degradation of the environment.

Briefly, the environmental effects of transportation can be summarized as under :

a) Landscape and aesthetics - natural landscapes and historic landmarks get affected due to the combined effects of transportation and industrial growth.

b) Soil erosion - mainly in mining areas the top soil gets eroded due to unplanned roadways and movements of vehicles.

c) Air and water quality - use of polluting fuels alter the quality of these resources.

d) Noise and vibration - increasing automobile growth, especially in cities is leading to noise and vibration problems.

Environmental planning with special reference to Transport - Environment combine would call for action along the following lines :

a) Developing measures to ensure the balance between different modes of transport on land, air and water.

b) Planned Public transport systems.

c) Corporate transport system as an alternative to individual transport system.

d) Organized tourism and conservation in National parks.

e) Laying down emission standards for automobiles.

f) Enforcement of environmental laws, constant monitoring and training.

g) Research and development of new non-polluting fuels (e.g., biofuels).

h) Development of test equipment.

i) Sociological and environmental awareness in the public at large.

Check Your Progress - 1

Write briefly on environmental effects of transportation.

Note : a) Write the answer in the space given below.

b) Compare your answer with the one given at the end of this unit.

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8.5. ENVIRONMENT AND HOUSING

The great increase in world population, and its flux into urban areas owing to a multitude of factors (social, political, communal etc.) have led to the problem of housing, including living space. In many regions, the urban population has doubled in a period of ten years and this trend is expected to continue. Rapid and uncontrolled urbanization generates a

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series of complex problems, ranging from housing, basic sanitation and environmental pollution to such little understood phenomena as the effects of life in urban environments on moral and social attitudes and values, and the morbidity associated with urban life.

The two most striking features of poor housing are (a) overcrowding and (b) a lack of basic sanitation. The action require seems obvious, but the economic implications are such that no adequate solution has been found in our country to deal effectively with, and to eliminate, these basic deficiencies of human settlements.

Poverty and filth are often closely associated with poor housing. Without proper water supply and sewage systems, it is very difficult to maintain personal hygiene. Such a condition leads to accumulation of wastes where there is no public service of refuse collection. Very often, the physical conditions of dwellings with leaking roof, cracked walls and earth floors favour the entry and accumulation of dirt, dust and soot. Filth paves way for lice, fleas, bugs and mites that may transmit diseases. Poor housing permits the harbouring of mice and rats, which can also be carriers and transmitters of disease.

Poor housing conditions caused by socio economic conditions have been shown to have a positive effect on the health of children. For example, measles and whooping cough tend to occur at earlier ages in overcrowded homes. More direct impacts of housing on the environment can be seen in industrial and urban areas. Newer human habitations in and around the industrial areas create more and more slums and reduce the so-called lung-spaces in these areas.

Environmental planning aimed at a balance between housing and environment should include the following to evolve a meaningful socio-economic programme :

a) Establishing housing standards to suit the local environmental conditions.

b) Incorporating the local climate, geography, social practices, customs and tradition and other related aspects while adopting the newer technologies.

c) Identifying the physiological and psychological responses of the human body to the physical and social environment.

d) Variation in housing requirements resulting from such variables as the demographic characteristics of the population (e.g. age, sex, family and household), social values, and socio-cultural heterogeneity.

Check Your Progress - 2

How does the poverty and filth effects the personal hygiene?

Note : a) Write the answer in the space provided below.

b) Compare your answer with the one given at the end of this unit.

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8.6. COST-BENEFIT ANALYSIS (CBA)

Cost-benefit analysis is an investment appraisal technique for analysing and measuring the costs & benefits to the community of welfare projects. CBA attempts to take into account all the costs and benefits that accrue from a project by defining the costs and benefits in much wider terms than those that would be included in traditional accounting in this analysis. For example, when CBA is applied to the appraisal of the circular Railway for a major city, it would set a monetary value on such varied and unrelated aspects as travelling time, hike in housing cost, environmental alterations, human displacement, energy conservation etc., and not just the revenue returns.

Introduction of CBA as a vital component of all welfare projects has changed the basic approach to resolve the environmental problems arising out of developmental projects. The generally accepted concept of 'Development without destruction' dictates that even if the CBA shows negative projections for a particular project, no compromise is to be made as far as the commitment to environmental protection is concerned. In other words, under special situations the benefits alone (especially to the environment) matter and not the costs!

8.7. SUMMARY

Environmental planning is one of the corner stones of environmental management. Scientific application of EP principles helps achieve a balance between the availability and utilization of natural resources such as land, water and air. The three components of human utility namely transportation, housing and CBA amply demonstrate the beneficial aspects of EP and IEP. The concept can be tested with reference to other components of Environment as well.

8.8. CHECK YOUR PROGRESS : MODEL ANSWERS

1. The environmental effects of transportation are : (a) damage to the landscape and aesthetics, (b) soil erosion, (c) decrease in the quality of air and water and (d) noise and vibration problems.

2. Poverty and filth are closely associated with poor housing. Lack of proper water supply and sewage systems leads to accumulation of sewage waters and wastes, and effects the personal hygiene of the people. Filth harbours lice, fleas, bugs and mites which are the carriers and transmitters of several diseases.

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8.9. MODEL EXAMINATION QUESTIONS

I. Answer the following questions in about 30 lines each.

1. What do you understand by the term Environment? Outline the usefulness of Environmental Management with special reference to mining industry.
2. What is Environmental Planning? Discuss the executive Principles of EP.
3. Differentiate between EP and IEP. What are the attributes of IEP?
4. Enlist the environmental effects of transportation. Suggest measures to curtail them.

II. Answer the following questions in about 10 lines each.

1. Write notes on :
   a) Organised Tourism.
   b) Sociology in Environmental Awareness Programme.
2. Identify the causes of housing problem.
3. What are the effects of poor housing on Environment?
4. Discuss the usefulness of CBA.

Dr. R. Nagendran

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BLOCK - 3 HEALTH

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UNIT - 9 : POPULATION GROWTH

Contents

9.1. OBJECTIVES

After going through this unit you will be able to :

- list out and describe stages of growth of world's population and India's population,
- describe the effects of populations on various sub-systems.

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9.2. INTRODUCTION

As a student of environment, you are expected to know what are the implications of population growth on environment as also its effects on the quality of life of the people.

According to United Nations Population Fund Document entitled 'Briefing Kit. 1992', World Population is 5.48 billion which will reach 6 million by 1998. It is growing faster than ever before : three people every second; more than 2,50,000 every day. At the beginning of the 90s the annual addition was 93 million, i.e., since 1990, every year 93 million are added to the total population of the World. Towards the end of this century, the addition rate will be 100 million. You must remember in this context that by the year 2001, world will have almost a billion more people (which is around the present population of China).

An interesting aspect of this growth is that 95% of this growth is taking place in the developing countries although the average size of a family in developing countries is decreasing from 6.1. children per woman in 1960s to 3.9 children per woman in 1990s. What is more interesting is that rate of growth of population in developing countries is also declining - from more than 2.5 per cent in 1960s to just over 2 per cent in 90s. But the world population has been growing in absolute numbers. Further, more than half the world's population in the 2000 A.D. is estimated to be below 25 years of age.

The first time when one billion of humans started to live on this planet was 1850 A.D. The second billion of the human population was added in 1930 i.e., eighty years later because of great advances in medical science and medicines which took place in the later half of the 19th century. In the next 30 years, the third billion to the world population was added, i.e., 1960 A.D. because of steep fall in mortality not only among the infants but also among the adults. The fourth billion to the world population came in just 12 years i.e., 1972. By the mid 90's the world population will be close to 6 billion.

What you should understand in this context is that the time it takes to add a billion people on this planet has become shorter and shorter. It took a century (1830-1930) to go from 1 billion to 2 billion people, 30 years (1930-1960) from 2nd billion to the third billion, 15 years (1960-1975) from the third to fourth billion and 12 years for the 4th to 5th billion. It takes around 10 years to reach the 6 billion mark.

Check Your Progress - 1

1. What is the present population of the world according to United Nations Population fund?

Note : a) Write the answer in the space provided below.

b) Compare your answer with the one given at the end of this unit.

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Moreover, according to the available indications, population growth is not expected to stop till the year 2200 A.D. By then, the world's population is expected to be around 12 billion. This is presently just double the World's population.

Demographers further warn that unless there is a fall in fertility levels, the World's population may reach the 6 billion level before the middle of the next century.

9.3. POPULATION GROWTH

The population growth in developing countries, developed countries and also the continentwise is given below.

9.3.1. Developing Countries Scenario

According to the latest reports, the population of developing countries has more than doubled in the last 35 years. From around 1.7 billion in 1950s it rose to more than 4 billion in 1990s. Experts in population science stated that out of an estimated 6.2. billion world's population nearly 5 billion will be from the developing countries.

9.3.2. Developed Countries Scenario

The developed countries (including eastern block, Europe, North America, Japan) on the otherhand increased from 832 million in 1950 to 1.2 billion in 1990 with around 1.26 expected by 2000 A.D.

Furthermore, it is estimated that the population of those living in developed countries would account for only three per cent by 2020. This means that world's majority population (of nearly 97%) lives in developing countries.

9.3.3. Growth of Population : Continent Wise

Again 97% of global population growth is projected to take place in Africa, Asia and Latin America between the years 1990-2050. While Africa's population increases by 4 times, India's population is expected to be doubled. It should be remembered here that these are the countries which are least equipped to handle growing numbers.

Africa's population now grows at three per cent annually; next to it is Western Asia (comprising Arab states and Iran) with 2.8 per cent and Southern Asia's (Indian subcontinent) score is 2.3 per cent which are regarded as the highest rates in the world. The overall growth rate of population of Asia stands at 1.9 per cent while that of Latin America is at 2.1 per cent.

Now, compare them with Europe (0.25 per cent). Former Soviet Union's rate is 0.8 percent. North America stands at 0.8 percent. Asia with a current population of 3.1 billion is expected to touch 4.9 billion by 2025; Africa with 642 million in 1990 is expected to reach 1.59 billion; Latin America with 448 million reaches about 757 million figure; Europe with 498 million is likely to reach 515 million while the former Soviet Union with 289 million will increase to 352 million and North America with 276 million will grow to 332 million.

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9.4. THEORIES OF POPULATION GROWTH

As stated in Unit 3 on population dynamics one of the Chief exponents of population theory was Thomas Malthus (1768-1834) an English Economist and Clergyman. His model is based on powerful (though now demographers regard it as unscientific) theory which relates poverty of the masses to rapid population growth. Malthus stressed that population growth is because of poverty. He propounded that the laws of nature condition the inevitability of a growing disparity between the rate of population growth and increase in the means of subsistence. His theory traced the poverty of masses and the suffering it entails to population growth in geometrical progression (1, 2, 4, 8) while the means of subsistence grow only in arithmatic progress (1, 2, 3, 4). Malthusians emphasise that there is only one way of overcoming this disparity - to keep the population growth at zero. Malthusians believe that population growth can be checked only by wars and epidemics and other natural disasters.

However, the major contradiction of Malthusian theory of population surfaced in the case of advanced countries. The theory of population growth and availability of foodgrains and other goods necessary for human subsistence became redundant since the advanced countries, because of continuous technological and educational progress could increase production on all fronts including foodgrains.

Although pushed to background for sometime, the Malthusian ideas have been revived after the end of second world war in the name of Neo-Malthusian ideas. Their proposition is that the world's growing population cannot be provided with the necessary food and hence poverty is a natural occurrence especially in the underdeveloped countries. They predict that there will be general doom as a result of depletion of life resources and environmental pollution. The neo-Malthusians attempt to trace the genesis of poverty and misery in the developing countries to their rapid population growth.

On the contrary, critical social scientists attribute the whole phenomenon of population growth to exploitation and capitalist mode of production. The argument gets strength from the following. Comparative analysis of GNP of European countries upto 1970s reveals that in 1770, the per capita Gross National Product (GNP) in the European countries was $210 as against $170 for the developing countries. By 1870, the respective figures were $550 and $160. By 1970s, the figures were $2500 and $340. This glaring gap between developed and developing countries shows how the latter are exploited. In fact, the developed countries fears lay in the huge populations, the Third World Countries are having.

Population growth retards economic development and national power so long a country has low rates of capital accumulation and low levels of education. Once broadly participating growth is underway, however, high population and an underutilised labour force are conducive to high rates of economic growth and international power.

9.5. TRENDS OF POPULATION GROWTH IN INDIA

Theories of population growth thus could tell us the advantages as also the disadvantages of high population growth. Let us now look at the gradual growth of India's population since 1891 the year from which the population count in the modern sense started in India.

Table - 1 : Size & Growth of Population in India.

Year	Total	Decadal Growth		Average Growth Rate
		Absolute	%	
1891	235.9	-	-	-
1901	238.4	2.5	1.1	0.11
1911	252.1	13.7	5.7	0.56
1921	251.3	-0.8	-0.3	-0.03
1931	279	27.7	11	1.04
1941	318.7	39.7	14.2	1.33
1951	361.1	42.4	13.3	1.25
1961	439.2	78.1	21.5	1.98
1971	548.2	109	24.8	2.20
1981	683.3	135.1	24.7	2.20
1991	843.9	160.8	23.5	2.11

(Total in millions; absolute in millions)

Source : (1) Census of India, series 1 Provisional Population Tables Paper 1 of 1991. Registrar - General & Census Commissioner of India, New Delhi, 1991; pp : 19-21.

(2) Census not conducted in Assam in 1981. Projections are based on 1971 census and provisional results of 1991 census. Population of Assam as on 1.3.1981 was interpolated to 18.04 million. The total population of India as on 1.3.1981 was estimated at 683.33 million as against 685.18 million stated earlier.

(3) In Jammu & Kashmir census has not yet been conducted in 1991. As in the case of Assam the figures were projected.

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The above table shows the population of Indian Union for a century since 1891. India's population growth can be explained in terms of 3 phases, from unstable growth with high and low period between 1921 and 1951. The year 1921 was watershed in demographic history of India. Rapid population growth started with year 1951. As can be seen from the table before 1921 there was wide variation in population growth because of high mortality rate.

In the decade of 1890 several areas of the country suffered famines and plague. The census of 1901 registered a decline of 2% from 1891 level. Again 1901-1911 decade also witnessed natural disasters like famines in addition to plague in Bengal. During the year 1911-20 our country suffered from an epedimic that caused an estimated seven percent mortality.

The country witnessed steady rise in population between 1921-1951 with a sharp fall in death rate. Owing to advances in medicine, our population almost doubled from 347.5 million in 1957 to 683.3 in 1981. In 1981 decade our country's population increased by 161 million (from 683 million in 1981 to 884 in 1991). India's population in 1991 is nearly three times of what it was at the time of its independence. Further it is twice that of Latin America. India's annual addition we add almost the total population of Australia or of Srilanka. However, the past two decades have been showing a decline both in birth and death rates.

We now have a demographic history of around 100 years of changes in birth and death rates. The first stage of transmission in India continued till 1920s. This was the phase which are marked by high death and birth rates.

The second phase marked by industrialisation, major causes of mortality like famines, epidemics, plagues were controlled, thanks to appreciable advances in medicine. This period continued till 1971 and later it was marked by sharp decline in death rate. A birth rate of 1.96 per annum was registered between 51-61 in comparison to 1.25% during 1941-1951. During 1961-71 the birth rate was quite high with a further decline in death rate. The growth rate was slightly more than a percent.

The third phase of growth of population can be seen from 1971 in which birth rates also started showing some decline. For demographers and others although there is a decline in birth rate, the absolute population has been increasing alarmingly. What are its effects? Let us analyse them beginning with its effects on environment.

9.6. EFFECTS OF POPULATION GROWTH

What are the effects of population growth? Continued and rapid growth of population in developing countries brings human beings into almost collision course with a necessity to maintain their resources. It is considered a threat to global environment. Increased numbers and to the demands on land, air and water resources making it difficult to support growing population.

Further, increasing population and declining resources contribute to increasing migration from rural to urban areas. It is estimated that by the year 2000 A.D. over 40 percent. population living in countries of Africa and Asia and nearly 80 percent in Latin America would migrate to urban areas. Growing population will have its consequences on urban life in general besides other sociological implications. Raising population disturbs the delicate balance between the urban and the rural areas.

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Increase in population has a bearing on environment. According to a World Development Report between 1990 and 2030 World's population grows by 3.7 billion. Increased population naturally demands growth in food availability. Food production has to be doubled. Industrial out put has to be increased three folds. In developing countries like India electricity consumption will have increased five times. Increased population will bring in, environmental problems including health, immunisation, literacy. One third of world's population has inadequate sanitation and one billion are without safe drinking water. Over 1.3 billion are affected by soot and smoke. Between 300-700 million women are suffering from severe pollution from cooking fires.

Millions of farmers, forest dwellers whose occupation is agriculture have to think consequences of excessive use of pesticides, fertilisers, irrigation water. Environmental issues connected with land management, forests and fisheries have to be carefully planned as pressure of growth of population will have consequences on policy making.

Increase in population will have pressure on schooling especially girls, family planning services, agriculture extension, need for better sanitation and clean water. In the long term interests of people suitable policy choices are called for. Man is responsible for a wide range of changes in the eco-system. He has brought about changes in the chemical composition of soil, water in the streams, lakes and even in the sea. Changes in the air that collectively contribute to massive modification of the natural environment for living creatures of all kinds.

Check Your Progress - 2

Increase in population will have pressures on several aspects. What are they?

Note : a) Write your answer in the space provided below.

b) Compare your answer with the one given at the end of this unit.

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The projected addition of one billion people on the earth by 2000 A.D. brings about global catastrophe. We should remember that unlike other animals, man has power to regulate his own numbers. In addition to control of the population there is going to be need for a spectacular increase in food supply and other essentials if we do not effectively stop the rapid growth in population.

Increased population poses challenges to people living in rural areas. Resource degradation resulting from rapidly growing demand for food and fuel. Added to this, is poverty, illiteracy. Preserving valuable natural forests, wetlands, coastal areas and greenlands for commercial cultivation leads to a number of problems. In addition to these there will be large scale migration to certain areas.

Urbanisation is a dominant trend in the 20th century. Migration of people to cities is closely connected with the developmental strategy. In fact urbanisation is an inevitable aspect of development.

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According to census, an area is called urban if there are more than 5 lakh people in it and about 400 persons are living in an area of one square kilometre. Further an area is called urban if more than 75 percent of male population is engaged in non-agriculture occupations.

In India the number of people working in urban areas increased from 62 millions in 1951 to 290 millions in 1991. By 2001 it is estimated that more than 340 million are expected to live in urban areas in the world occupying only one percent of earth's surface : This itself shows the dimensions of problems of urban areas owing to unchecked population growth and migration. Although urbanisation is part of economic development it has its effects on environment. While industrial urdertakings and transport are the chief causes of environmental degradation in developed countries, slums, lack of drainage facilities, industrial effluents, poverty, illiteracy are the reasons for pollution of cities air and water sources. Much of the urban space is environmentally polluted and degraded. Unplanned urban expansion causes land slides also. Cities in developing countries are called concrete jungles due to large scale construction of multi-storeyed buildings. Over 40 percent of urban dwellers live in slums leading to various sociological problems. The mode of living habits, customs and the general outlook of urbanites has its effects on the environment. Increased population further complicates the problem. You can very well imagine the transportation system in cities like Bombay and other metropolitan cities in India which are experiencing severe strain owing to increased pressure on population.

Going by the present trends in production and the projected population increases, developing country out put would rise by four to five percent a year between 1930-2030. Towards the end of the period it would be about five times of what it is today.

Rising environmental pollution would upset this delicate balance between man and nature. Million die or become sick from bad environment. Water shortages become intolerable leading to large scale migration. At the rate in which forests are denuded tropical forests and other natural habitats decline to a fraction of their current size. A lot depends on substitution, technical progress and structural change. According to the Reports of World Bank, ninety percent of the doubling in food production over the past quarter century came from higher yields and only ten percent from cultivating more land. Intensification of land for more food will create environmental problems.

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9.7. SUMMARY

Both development and environment protection, population problems call for more attention. Since growth of population adversely affects development, censcious effort should be made to educate people about the benefits of small family. Education of girls is the most important aspect of this endeavour. More money needs to be pumped into better equipped better financed family welfare schemes.

As continuous population growth neutralises all the benefits of economic development, better policy instruments need to be devised to arrest it.

9.8. CHECK YOUR PROGRESS : MODEL ANSWERS

1. The present population of the world is 5.48 billion according to the United Nations Population Fund Document entitled 'Briefing Kit - 1992'.

2. Increase in population will have pressure on schooling especially of girls, family planning services, agricultural extension, better sanitation and clean water.

9.9. MODEL EXAMINATION QUESTIONS

I. Answer the following questions in about 30 lines each.

1. Explain different stages in the growth of world's population.
2. What are the main phases of India's demographic history.

II. Answer the following questions in about 10 lines each.

1. What are the effects of population growth in urban areas.
2. Outline the impact of population growth on environment.

Dr. I. Ramabrahmam

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UNIT - 10 : WATER SANITATION

Contents

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10.1. OBJECTIVES

After going through this unit you will be able to :

- identify the sources of water used for augmenting water supply,
- recognise the need and relevance of water quality and standards,
- describe the process of water purification,
- describe the significance of water softening,
- define transportation and distribution of water,
- list out the urban and rural water supply problems, and
- suggest the remedial measures.

10.2. INTRODUCTION

Water is the most essential commodity for all living things. No life exists without water. It has been estimated that two-thirds of human body is made up of water. Water is absolutely essential not only for survival of human beings but also for animals, plants

and other living beings. The demand for clean water has been increasing day by day. The misuse and abuse of the environment, the indiscriminate discharges of domestic sewage and industrial wastes into natural water sourses, the rapid industrialization and urbanisation contaminate the limited resources of water.

10.3. SOURCES OF WATER

The main source of water is the rain water. The World aquatic system covers about 3/4 of the earth's surface. The total water resources of the earth are estimated to be between 1336 x 10^6 km^3. and 1400 x 10^6 km^3. The various sources of water available on the earth are classified into two categories. They are 1) surface water sources and 2) subsurface water or underground water sources. They are also classified into fresh water, brackish water and marine water. The fresh water bodies include ponds, tanks, lakes, reservoirs, rivers and streams. The brackish water bodies include estuaries, backwaters, lagoons and lakes. The oceans constitute the marine system which cover 71 per cent of the earth's surface and contain 1420 x 10^{15} m^3 of water. India has a vast coastline of 6100 km. intricated with rivers, lagoons, lakes, estuaries and backwaters. The distribution of earth's water is given in Table 10.1.

Table - 10.1. The distribution of earth's water.

Source	Volume Km^3
Rivers and lakes	510 x 10^3
Ground water	5100 x 10^3
Glacial and other land ice	22950 x 10^3
Oceanic water	1369350 x 10^3
Water vapour and Condensate in the atmosphere	15.3 x 10^3

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The surface water sources include ponds, lakes, reservoirs, streams, rivers and oceans. Normally ocean water is not used for water supply. The ground water sources include wells, tube-wells, springs, infiltration galleries and infiltration wells.

Fresh Water Bodies

Among the fresh water bodies in India, ponds and tanks are undoubtedly larger in number than those of lakes and reservoirs. The ponds are rather small in area, shallow and usually rain-fed. They are most functional in their uses e.g., for bathing, washing, swimming, besides fish farming. Invariably they are present in the vicinity of villages, near places of religious worship and in gardens. Lakes and reservoirs are relatively bigger and most of them are man made. They are usually rain or river-fed and show marked seasonal fluctuations in water levels. Their main use is irrigation and generation of hydro-electric power rather than fish production. Lakes and reservoirs are commonly used as urban community water supply. Among the rivers and streams, those forming the Ganges system in the north and north-east of the country are most important. Other rivers in Kashmir and Punjab form a part of the Indus system in the northern part of the sub-continent. Also there are several rain-fed rivers and streams in the Central and peninsular India. The rivers in India like in other parts of the world receive a major part of the city sewage

and industrial wastes, besides being an indispensable source of potable water supplies and other uses. The fresh water bodies support luxuriant plant and animal life and form the major resources of organic productivity.

Most of the earth's water sources get their water supplies from precipitation, which may fall in various forms such as rain, snow, hail, dew etc. Precipitation is the principal source of water on the earth and is responsible for resultant yield of various sources.

Water evarporates from water bodies such as ponds, lakes, reservoirs, rivers, oceans etc., and also from the land and plants in the form of water vapours. These water vapours get collected in the atmosphere and condensed as mist, rain, snow, hail, sleet etc. The evaporated water thus returns to the earth's surface. This water which comes back to the surface of the earth in its various forms like rain, snow, hail, etc., is known as precipitation. The major part of the precipitation occurs in the form of rain and a minor part occurs in the form of snow. Other forms of precipitation such as mist, sleet, hail, etc., are all very small. The rain water on precipitation, collects dust, microbes and gases during its travel to the earth from the atmosphere. On reaching the ground, a part of it flows over the surface and picks up suspended matter such as clay, sand and grit. It also picks up organic matter from human and animal excrements and agricultural and industrial wastes. Another part of it percolates through the ground and picks up various salts depending on the soil characteristics and becomes fit for drinking and other uses. This warrants quality assessment.

10.4. WATER QUALITY AND STANDARDS

The quality of water is a function of concentration of various impurities present. It is subjected to constant changes and is never static. While assessing the quality of water, various parameters are usually specified. These parameters are physical, chemical and biological in nature. Some chemical parameters affect potability and some others affect health. Some are toxic and some are radioactive in nature. The presence of pathogenic organisms and excessive amount of organic matter affect the quality greatly.

The polluted water causes diseases. The water related diseases are classified into four groups. They are : 1. water-borne diseases; 2. water-washed diseases; 3. water-based diseases and 4. diseases with water-related vectors.

The water-borne diseases are associated with fecal pollution of water sources resulting from poor sanitation. The water acts as a passive vehicle for infective agents such as bacteria, virus and protozoa. The common water-borne diseases are cholera, typhoid, dysentery, leptospirosis, diarrhoea, infectious hepatitis, polio and jaundice. The inadequate supply of water and poor personal hygiene are responsible for water-washed diseases. The water-washed diseases include scabies, skin disease, leprosy, trachoma, typhus fever, conjunctivitis, dysentery, typhoid, viral diarrhoea and worm diseases such as ascariasis, trichuriasis, whipworm and hookworm.

The water-based diseases spread by aquatic animals. They are able to penetrate the skin and cause diseases in the human system. Schistosomiasis and Dracunculosis are typical examples of water-based diseases. The insect vectors that breed in stagnant or slow moving water spread diseases like yellow fever, dengue fever, malaria, filaria, sleeping sickness and so on. There are about 100 strains of viruses such as infectious hepatitis, polio virus, coxsackie virus, echo virus, adeno virus, reo virus and rota virus

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which on infection causes disease in the susceptible host. The water related diseases kill many thousands of people in India every year and millions of people are made chronically sick.

Check Your Progress - 1

How are the water related diseases classified?

Note : a) Write the answer in the space provided below.

b) Compare your answer with the one given at the end of this unit.

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10.4.1. Chemical Quality of Water

The excess of non-living matter present in water also causes disease in the human system. The nitrate rich water causes blue-baby disease. The excess of fluoride in water supply is responsible for dental decay and fluorosis. Lead poisoning, itai itai disease due to cadmium and minamata disease due to mercury are all typical examples of non-living matter causing diseases in human beings. This emphasises the need for periodical assessment of water for suitability for various uses. The factors relating to potability, health and toxicity govern the standards to be adopted for community water supply.

In establishing standards of water quality technical and economic considerations should be taken into consideration. The technical considerations pertain to the requirements relating to health, acceptability of water for consumption and aesthetics. The requirements relating to health are very stringent for drinking water supply scheme. The economic considerations relate to the cost of treatment, the size of the plant and the design period for the water supply scheme. Therefore the water quality standards serve as a basis for appraisal of the results of chemical analysis of water in terms of suitability of water for various intended uses. Drinking water quality standards for physical and chemical characteristics as stipulated by the Central Public Health and Environmental Engineering Organisation (Table 10.2)

10.4.2. Bacteriological Quality of Water

The water used for drinking should not contain any bacteria. The Most Probable Number (MPN), index of coliforms/*E. coli*/*S. fecalis*/*C. welchii* should be zero or 1 in any 100 ml. sample of water entering the distribution system. The indicator organisms should not be detectable in 100 ml. of any two consecutive samples or more than 50 per cent of the samples collected. A sample of water entering the distribution system that does not conform to this standard calls for an immediate investigation into both the efficiency of the purification process and the method of sampling. When the results obtained over a period of time are considered, not more than 10 per cent of the samples should have shown values greater than an MPN index of 10 per 100 ml.

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Table - 10.2. Water quality standard for physical and chemical characteristics.

Characteristics	Acceptable limits	Tolerable limits
Turbidity	2.5	10
Colour	5.0	25
pH	7.0 to 8.5	<6.5 or >9.2
Total dissolved solids	500	1500
Total hardness	200	600
Chlorides	200	1000
Sulphates	200	400
Fluorides	1.0	1.5
Nitrates	45	45
Calcium	75	200
Magnesium	30	150
Iron	0.1	1.0
Manganese	0.05	0.5
Copper	0.05	1.5
Zinc	5.0	15.0
Phenolic compounds	0.001	0.002
Anionic detergents	0.2	1.0
Mineral oil	0.01	0.3
Toxic Materials		
Arsenic	0.05	0.05
Cadmium	0.01	0.01
Chromium	0.05	0.05
Cyanides	0.05	0.05
Lead	0.1	0.1
Selenium	0.01	0.01
Mercury	0.001	0.001
Polynuclear aromatic hydrocarbons (g/1)	0.2	0.2
Radioactivity		
Gross Alpha activity (PCi/1)	3	3
Gross Beta activity (PCi/1)	30	30

Except colour and pH, others in mg/l

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10.4.3. Surface Water Quality

The water flowing over the surface of the earth is directly available for water supplies. The surface waters usually contain large amounts of dissolved and suspended impurities.

They can easily pick up organic impurities such as vegetables, dead animals, eatables and other household wastes. Generally the water drawn from storage reservoirs contains lesser suspended solids. The quality of water in a lake is generally good and does not require much purification. Larger and older lakes provide comparatively pure water than smaller and newer lakes. Self purification of water due to sedimentation of suspended matter and removal of bacteria makes the lake waters pure and better. However, the stagnant water supports rich growth of algae, weeds and other plant growth. They impart bad smell, taste and colour to their waters. The river and stream waters contain large amounts of silt, sand and suspended and dissolved impurities. The waste waters discharged into the rivers further contaminate the surface water. The surface waters need proper analysis and treatment before supplying to the public.

10.4.4. Ground Water Quality

The quality of ground water depends on the material through which the water passes. The ground water supplies are generally clear, cold, colourless, pure and safer because it passes through the earth strata before becoming ground water. These waters may contain large amount of dissolved solids, minerals and gases. The dissolved solids make these saltish and hard. Shallow and gravity well waters may contain higher bacterial loads. Ground waters generally require reduced treatment and can be supplied to public with no treatment or minor treatment alone.

10.5. WATER PURIFICATION

The raw water contains suspended, dissolved and colloidal impurities. The complete process of the removal of impurities is called water purification. The kind of treatment required depends upon characteristics and quality of available water and the quality requirement for the intended use. The treated water must be free from colour, taste, odour and disease causing organisms. The various methods used for purifying the public water supplies are 1) screening 2) sedimentation 3) filtration 4) disinfection 5) aeration and softening.

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10.5.1. Screening

Floating materials in raw water are removed by screens which are of two types - coarse and fine. A screen is a device with openings of uniform size, used to retain floating materials. The screening element may consist of parallel bars, rods or wires, grating, wire mesh or perforated plate and the openings may be of any shape. Fine screens are made of corrosion resistant metal. Screens need frequent cleaning to remove the clogging material.

10.5.2. Sedimentation

Sedimentation is the separation of suspended particles (that are heavier than water) from water by gravitational settling. There are two types of sedimentation processes : 1) plain sedimentation and 2) sedimentation with coagulation.

Plain sedimentation process requires the retention of the water in a basin or tank so that the suspended particles may settle as a result of gravity and other forces. Plain sedimentation can be used only for relatively pure water containing undesirable amount of suspended solids.

In the process of sedimentation with coagulation, certain chemicals called coagulants are added and thoroughly mixed with water. This results in the formation of a chemical precipitate known as floc. This insoluble floc entangles the fine suspended particles and colloids, or absorbs them into its large and sticky surface. Due to this, the action of sedimentation or settling of finer and colloidal particles is accelerated. The process of addition and mixing of the chemicals is called coagulation. The coagulated water is passed through sedimentation tank, where the flocculated particles settle down and are then removed.

Chemicals Used for Coagulation : The common chemicals generally used for coagulation are alum (aluminium sulphate), iron salts like ferric chloride, ferrous sulphate, ferric sulphate, chlorinated copperas, calcium hydroxide and sodium aluminate. These chemicals are most effective when water is slightly alkaline. Sodium carbonate, lime and sulphuric acid are used to bring the water to the required pH level.

The alum when added to water, reacts with the bicarbonate alkalinities and form a gelatinous precipitate of aluminium hydroxide. The flocs grow in size and finally settles down to the bottom of the tank.

$$Al_2(SO_4)_3 + 6H_2O \text{ ------> } 2A1(OH)_3 + 3H_2SO_4$$

Iron salts are said to produce faster, denser and quicker settling flocs than alum. Ferrous sulphate is unsuitable for the treatment of soft coloured waters because they are best coagulated at pH below 7.0. Ferric sulphate is quite effective in a pH range of 4 to 7 and above 9, whereas ferric chloride is effective in a pH range of 3.5 to 6.5 and above 8.5

The reactions with ferrous sulphate and ferric chloride are :

1) $FeSO_4 + Ca(HCO_3)_2 \text{ ------> } Fe(HCO_3)_2 + CaSO_4$

$Fe(HCO_3)_2 + 2Ca(OH)_2 \text{ ------> } Fe(OH)_2 + 2CaCO_3 + 2H_2O$

$4Fe(OH)_2 + 2H_2O + O_2 \text{ ------> } 4Fe(OH)_3$

When lime is added, the reactions are

$FeSO_4 + Ca(OH)_2 \text{ ------> } Fe(OH)_2 + CaSO_4$

$4Fe(OH)_2 + 2H_2O + O_2 \text{ ------> } 4Fe(OH)_2$

The ferrous hydroxide is then oxidised to ferric hydroxide and precipitates. The amount of lime added varies from 1 to 5 ppm.

2) $FeCl_3 + 3H_2O \text{ ------> } Fe(OH)_3 + 3H^+ + 3Cl^-$

Chlorinated copperas is a mixture of ferric sulphate and ferric chloride prepared by adding chlorine to a solution of ferrous sulphate.

$$6FeSO_4 + 3Cl_2 \text{ ------> } 2Fe_2(SO_4)_3 + 2FeCl_3$$

Sodium aluminate is an alkaline compound. It eliminates the corrosive qualities of water and reacts with a wide range of pH and alkali is not required for quick flocculation. It

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reacts with calcium and magnesium present in raw water and precipitates as calcium or magnesium aluminate.

$$Na_2Al_2O_4 + Ca(HCO_3)_2 \text{ ------> } CaAl_2O_4 + Na_2CO_3 + CO_2 + H_2O$$

Iron salts are good oxidising agents and remove hydrogen sulphide, taste and odour. It produces heavy floc and can remove more suspended matter than alum. Iron salts are frequently used for treating sewage and alum is used more frequently for treating water.

Check Your Progress - 2

2. What are the chemicals used for coagulation?

Note : a) Write the answer in the space provided below.

b) Compare your answer with the one given at the end of this unit.

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10.5.3. Filtration

Screening and sedimentation removes a large percentage of the suspended solids and organic matter present in raw water supplies. However, the resultant water still contains some fine suspended particles and bacteria. To remove the remaining impurities and to produce clear good water, the water is filtered through beds of fine granular material such as sand etc. The process of passing the water through beds of fine granular materials is known as filtration. Filtration removes colour, odour, turbidity and bacteria from water. Filters are mainly classified into two types.

a) Slow sand filter

b) Rapid sand filter

A third type of rapid sand filter works under pressure and is known as pressure filter. This can be used for a small plant and not used for treating large scale water supplies. The slow sand filter can remove much larger percentage of impurities and bacteria from the water but yields a very slow rate of filteration (about 1/30 times than the rapid sand filter) and require large areas and are costly.

The rapid sand filter removes suspended matter, colour, odour and bacteria from settled water applied to it. When the bacterial load is high, the filtration process must be supplemented by disinfection. Raw water having 35 to 40 ppm of turbidity can be successfully treated by rapid sand filter. With water of low turbidity the bacterial removal will be about 98 to 99 per cent. Rapid sand filter is more efficient in colour removal.

The pressure filter is in the form of a closed cylindrical water tight metal tank of 5 to 10 feet in diameter. It is a rapid sand filter in which the applied water is filtered under high pressure. The pressure filter may be of horizontal or vertical type. It is more compact and requires less space and filtering material and the rate of filtration is higher (2 to 5 times that of a rapid sand filter). They are costlier for treating large scale municipal water supplies.

The rate of water filtered per square foot area per hour through the filters in litres is 9 to 18 in slow sand filter; 450 to 675 in rapid sand filter and 900 to 1125 in pressure filter. In modern treatment plants, rapid sand filter is generally adopted. The water from coagulation sedimentation plant is directly fed into the rapid sand filter and the resultant water supplies are disinfected for killing pathogens.

10.5.4. Disinfection

The filtered water which is obtained either from slow sand filter or rapid sand filter contains disease causing pathogenic bacteria. They must be killed for making the water safe for drinking. The chemicals used for killing the bacteria are called **disinfectants** and the process is known as **disinfection.** Chlorine, bleaching powder, ozone, lime, potassium permanganate, iodine, bromine and silver are used as disinfectants. The amount of chlorine used in reducing organic and inorganic impurities present in water is called the chlorine demand of water. After the chlorine demand is fulfilled, chlorine will appear as free-chlorine residual. This residual chlorine will serve as disinfectant to kill pathogens. A free chlorine residual of 0.2 mg/l is normally used to disinfect water. A larger chlorine residual may cause bad taste.

10.5.5. Water Softening

The treated water by the processes of screening, sedimentation with coagulation, filtration and sterilisation, may still contain dissolved impurities like calcium and magnesium in combination with bicarbonate, chloride and sulphate, that water is said to be hard. The removal of hardness from water is known as water softening. Water softening is essential to reduce the consumption of soap in laundry work, lower the cost in maintaining plumbing fixtures and improve taste of food preparation. Hardness is of two kinds. 1) Temporary and 2) Permanent. The temporary hardness is due to bicarbonates of calcium and magnesium and can be removed by boiling.

$$Ca(HCO_3)_2 \text{ ------> } CaCO_3 + CO_2 + H_2O$$

The permanent hardness is due to the presence of sulphates or chlorides or both of calcium and magnesium. The addition of caustic soda will remove permanent hardness.

$$MgSO_4 + Na_2CO_3 \text{ ------> } MgCO_3 + Na_2SO_4$$

The ground water sources may contain iron and manganese as impurities. Iron causes brown spots on clothes and rust stains in household fixtures. Manganese causes black stains on clothes and household fixtures. To remove iron, water is aerated and passed over a coarse filtering material such as coke where iron is precipitated. Combinations of coagulation, aeration and softening can be used to remove iron. Aeration removes carbon dioxide and hydrogen sulphide which otherwise inpart taste and odour in water supplies. Manganese can be removed by aeration or chlorination and filtration or by coagulation with ferric salts. The aeration of water can be carried out by air diffusionor using spray

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nozzles or permitting waters to trickle over cascades or using trickling beds. The flow diagram explains the various steps involved in water purification (Fig. 10.1).

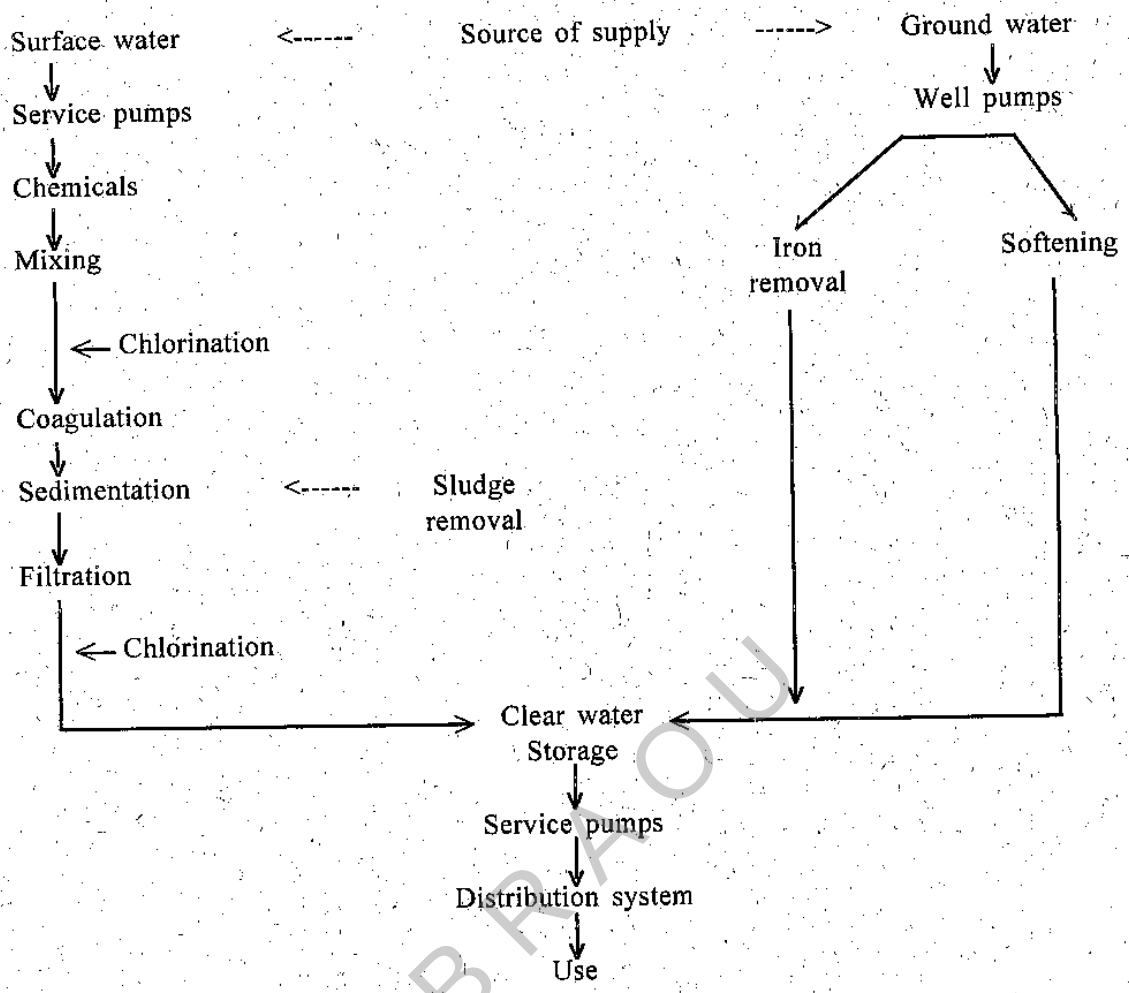

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Fig. 10.1. Water Purification flow diagram.

10.6. TRANSPORTATION OF WATER

The structures used for the transportation of water from the source of supply to the treatment works and subsequent distribution to the inhabitants of towns and cities are known as conduits. The conduits are classified into Gravity conduits and pressure conduits. Gravity conduits are those in which water flow by gravity. These include canals, flumes, aqueducts and tunnels. Pressure conduits are those in which the water flows under hydraulic pressure. The type of conduits to be selected depends on the topography, type of soil, volume of water to be carried and costs.

10.7. DISTRIBUTION SYSTEM

The function of carrying water from the treatment plant to the individual home is accomplished through a well planned distribution system. A distribution system consists of pipe lines, valves, hydrants, meters, services, pumps and service reservoirs. Further water may be

supplied to the public either continuously for all the 24 hours of the day or intermittently during certain fixed hours of the day. The main object of a distribution systems is to develop adequate water pressures at various points of the consumer's taps.

The distribution system is classified into 1) Gravity system, 2) System with direct pumping and 3) System with pumping and storage.

Gravity System : In gravitational system, water from the high level source is distributed to the consumers at lower levels by gravity without any pumping. This method is most economical and reliable but it needs a lake or reservoir as a source of supply.

System with Direct Pumping : In this system, water is directly pumped into the mains. Consumption is the only outlet. This system is least desirable because power failure may lead to the breakdown of the system. Also, pressures in the mains vary with consumption.

System with Pumping and Storage : In this system, the treated water is pumped at a constant rate and stored into an elevated distribution reservoir from where it is distributed to the consumers by gravity. This system is the most economical and reliable one.

10.8. URBAN AND RURAL WATER SUPPLY PROBLEMS

The rain waters flowing in the rivers, streams, canals, lakes and reservoirs constitute the major surface water sources for urban water supply. Infiltration gallery, deep bore wells and open wells may also augment water supply for urban population. The surface raw water quality varies depending on the nature of catchment area, habitation in the catchment area, misuse of sources, interaction between the biotic and abiotic components and disposal of waste waters generated by the local population. This affects the normal functioning of treatment plants since they are designed for a particular characteristics of water quality. This will impair the quality of water in treatment plant. Further the intermittent water supply, illegal tapping of water and lack of pressure in the distribution system degrade the quality of treated water in the distribution system. To improve the urban treated water quality, proper maintenance, adequate and intermediate chlorination in the distribution system, proper drainage and avoidance of stagnation of used water around the surroundings of the taps, prompt attempt in the replacement of leaky and damaged pipes and maintaining sufficient pressure in the distribution system are required.

Rural water supply schemes mostly depend upon open dug wells, tanks and deep bore wells in our country. Since the deep bore well waters are safe and relatively free from pollution, preference is given to bore well waters in rural areas and to some extent in urban cities. The open dug wells are prone to pollution from several sources. Poor drainage of the used water from the well surrounding, stagnation of wastewater around the bore-wells, storage of waste materials in excavations, broken and cracked platforms and hand pumps without properly maintained head arrangements account for poor water quality in rural areas. The conventional treatment methods usually employed to urban water sources namely sedimentation and filtration and disinfection are not applicable to rural water sources. Further fixing the sites for wells in rural areas, the WHO guidelines of 15 m. distance from the soak pits and privies are not adopted. The rural water quality can be improved if the wells are properly constructed and maintained; provided with an RCC cover, fitted with a hand pump for the drawal of water and avoiding priming of pumps and stagnation of water around the wells. Chlorination of well water will certainly improve the quality of rural water.

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It is also necessary and desirable that critical review and objective evaluation is made of urban and rural water supply schemes already implemented in different parts of the country to identify the factors that have contributed for their success and those that have hampered their progress. The resulting feedback will help avoid pitfalls in future implementation of the programme and contribute to optimum utilisation of available resources.

10.9. SUMMARY

Water is the essential commodity for living things. The primary source of water is precipitation. The rain water on reaching the earth's surface becomes surface water. A portion of surface water percolates and becomes ground water. The surface and ground water gets contaminated from different sources. The contaminated water is treated in order to get rid off the pollutants which otherwise may cause disease in human system. The process of the removal of impurities is called water purification. It includes screening, sedimentation, filtration and disinfection. The treated water is transported and distributed for public consumption. A judicious planning and execution of urban and rural water supply schemes will prevent the sporadic outbreak of diseases dangerous for the general health of the public.

10.10. CHECK YOUR PROGRESS : MODEL ANSWERS

1. The water related diseases are classified into four categories. They are : (a) water-borne diseases, (b) water washed diseases, (c) water based diseases and (d) diseases with water related vectors.

2. The common chemicals used for coagulation are alum (aluminium sulphate), iron salts like ferric chloride, ferric sulphate, ferrous sulphate, chlorinated copperas, calcium hydroxide and sodium aluminate.

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10.11. MODEL EXAMINATION QUESTION

I. Answer the following questions in about 30 lines each.

1. Give an account of different sources of water available for augmenting water supply schemes.
2. What are the impurities to be removed from an urban water supply scheme? State the standard of purity you would insist upon it.
3. Enumerate and discuss briefly the various methods of treatment of public water supplies drawn from a river.
4. Write briefly about sedimentation and coagulation? How do they help in the purification of water?
5. Explain the urban and rural water supply problems and remedial measures.

II. Answer the following questions in about 10 lines each.

1. Do the water quality and standards have relevance in water supplies?
2. How is water purified?

3. How are the water related diseases classified? Give examples.
4. Enumerate the important water-borne diseases in India.
5. What is water softening?
6. Define sedimentation, coagulation and disinfection.
7. How is water transported and distributed for consumption?
8. Enumerate the urban and rural water supply problems.
9. Write short notes on the following.
   (a) Iron and manganese removal.
   (b) Slow sand and rapid sand filters.

Prof. V.S. Govindan

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UNIT - 11 : VECTOR CONTROL

Contents

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11.1. OBJECTIVES

After going through this unit, you will be able to :

- define vectors,
- describe the methods of transmission of diseases by vectors,
- describe the life cycles of some of the vectors such as mosquito and house fly, and
- suggest the various control measures.

11.2. INTRODUCTION

Arthropods comprise the most numerous and varied of the living things in the environment of man. Some of them are man's allies helping in the fertilisation of flowers but majority of them are his enemies. Some of them live close to man and act as **Vectors or Carriers of Disease**. A study of the arthropods of medical importance is known as Medical Entomology and is a branch of Preventive Medicine.

11.3. ARTHROPODS OF MEDICAL IMPORTANCE

The arthropods of Medical importance are given in Table 11.1.

Table - 11.1. The arthropods of Medical importance belonging to different classes

Class Insecta	Class Arachnida	Class Crustaceae
1. Mosquitoes	1. Ticks	Cyclops
a. Anophelines	a. Hard	
b. Culicines	b. Soft	
2. Flies	2. Mites	
a. House flies		
b. Sand flies		
c. Tsetse flies		
d. Black flies		
3. Human Lice		
4. Fleas		
5. Reduviid bugs		

11.4. ARTHROPOD-BORNE DISEASES

Arthropod borne diseases constitute a major health problem in India. Malaria continues to be an important vector-borne disease with an annual morbidity of 4 to 5 million cases.

Filaria is another important arthropod borne disease with an estimated 236 million people living in filaria endemic areas.

About 5 million people are estimated to be living in areas where guinea-worm disease is endemic.

Scabies is widespread disease especially in rural areas.

The arthropods are responsible for much ill health and deaths.

Table - 11.2. Arthropods and diseases transmitted by them

Arthropod	Disease Transmitted
Mosquito	Malaria, Filaria, Japanese encephalitis, Dengue, West Nile - Viral fever, Yellow fever, Haemorrhagie fever.
House fly	Typhoid and Paratyphoid fever, Diarrhoea, Dysentery, Cholera, Amoebiasis, gastro-enteritis, Poliomyelitis, Trachoma, conjunctivitis, Anthrax, Yaws.
Sand fly	Kala-azar, Oriental sores, Orya fever, Sandfly fever.

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Tsetse fly	Sleeping sickness - Africa
Louse	Epidemic typhus, Relapsing fever, Trench fever.
Rat flea	Plague, Typhus fever.
Black fly	Onchocerciasts - Africa
Reduviid bug	Chagas disease - Africa
Hard tick	Typhus fever, Viral encephalitis, Kyasanur forest disease, Tularemia, Babesiosn
Soft tick	Q-fever, Relapsing fever.
Trombiculid mite	Scrub typhus, Rickettsial pox.
Itch mite	Scabies
Cyclops	Guinea worm disease (Dracontiosis)
Cockroaches	Enteric pathogens

Check Your Progress - 1

1. What are the diseases transmitted by sand fly and Tsetse fly?

2. What are the transmitting agents of Malaria and Typhoid?

Note : a) Write the answers in the space provided below.

b) Compare your answers with those given at the end of this unit.

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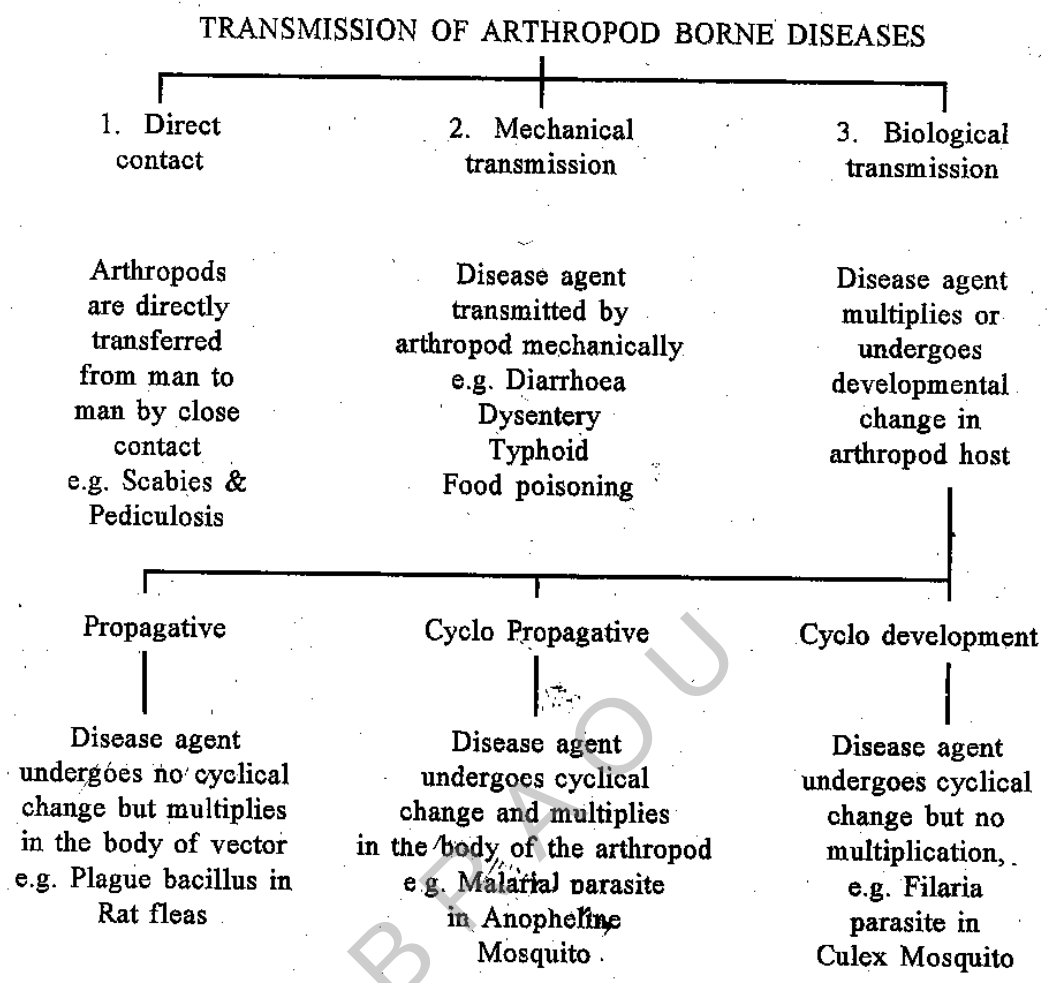
11.5. TRANSMISSION OF ARTHROPOD BORNE DISEASES



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11.6. DEFINITIONS OF VECTOR AND ALLIED TERMS

Vector : "An arthropod or other invertebrate which transmits infection by inoculation into or through the skin or mucous membrane by biting or by deposit of infective materials on the skin or on food or other objects".

Extrincic Incubation Period : Period of time necessary for the development of the disease agent in the arthropod host.

Definitive host : The host in which the sexual cycle of the agent occurs.

Intermediate host : Host in which the asexual cycle of the agent occurs.

Infestation : The lodgement, development and reproduction of arthropods on the surface of the body or in the clotting.

11.7. MOSQUITO

The 4 important groups of mosquitoes in India related to disease transmission are the Anopheles, Culex, Aedes and Mansonia.

The body of the mosquito consists of 3 parts

Head : a pair of compound eyes

a long needle like proboscis

a pair of antennae - to distinguish male & female

Thorax :a pair of wings dorsally

3 pairs of legs ventrally

Abdomen : long and narrow and has 10 segments.

LIFE CYCLE

4 stages are present in the life history.

Egg, Larva, Pupa, Adult

Metamorphosis is complete

The Egg is laid on the surface of water.

100 - 250 at a time

Egg stage lasts for 1 - 2 days

The period that elapses from the moment a blood meal is taken until the eggs are laid is called the gonotrophic cycle. It is 48 hours in hot tropical areas.

The Larva is a free swimming creature with an elongated body divisible into head, thorax and abdomen. It feeds on algae, bacteria and vegetable matter and passes through 4 stages of growth called "instars" with moulting between each stage.

The larval stage occupies 5 - 7 days.

The Pupa is comma shaped in appearance with a large rounded cephalothorax and a narrow abdomen. The small respiratory tubes project from the upper surface of thorax. The pupa represents the resting stage. It does not feed but stays quiet at the water surface. When disturbed it swims rapidly down into the water.

The pupal stage lasts for 1 - 2 days.

The Adult when the development is complete the pupal skin spilts along the back and adult mosquito or imago emerges. It rests for a while on the pupal skin and then flies away.

The life cycle from egg to adult is 7 - 10 days. The adult mosquito lives for about 2 weeks.

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11.8. DIFFERENTIATION BETWEEN ANOPHELINI AND CULICINI

Tribe/Genus	Anophelini/ Anopheles	Culicini/ Culex, Aedes, Mansonia
Egg	Laid singly	Laid in cluster/rafts Each raft 100-250 eggs
	Boat shaped with lateral floats	Oval shaped
		no lateral floats
Larvae	Rest parallel to water surface	Suspended with head downwards at an angle to water surface
	No siphon tube	Siphon tube present
	Palmate hairs present on abdominal segments	No palmate hairs
Pupae	Siphon tube is broad and short	Siphon tube is long and narrow.
Adults	When at rest, inclined at an angle to surface	When at rest body exhibits a hunch back
	Wings spotted	Wings unspotted
	Palpi long in both sexes	Palpi short in female

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11.9. HABITS OF MOSQUITOES

Feeding Habits : Males never bite; Females are haematophagous - need blood meal once in 2 - 3 days for development of eggs.

Time of biting : Generally bite in the evening or in the early part of night.

Breeding habits : Anophelines prefer clean water; culicines prefer dirty polluted water, Aedes prefer artificial collections of water.

Dispersal : Range of flight 11 Kms.

11.10. MOSQUITO CONTROL MEASURES

Methods of Mosquito Control

ANTI LARVAL MEASURES

a) Environmental control

b) Chemical control

c) Biological control

ANTI-ADULT MEASURES

a) Residual sprays

b) Space sprays

c) Genetic control

PROTECTIONS AGAINST MOSQUITO BITES

a) Mosquito Net

b) Screening

c) Repellents

ANTI LARVAL MEASURES

Environmental Control

To reduce the number of mosquitoes is to eliminate their breeding places i.e., Source Reduction. The salinity of water is changed as to render the water unsuitable for breeding.

Engineering methods such as filling, levelling and drainage of breeding places, intermittent Irrigation are used.

In case of Mansonia, aquatic plants are removed by herbicides.

Chemical Control

Commonly used larvicides are

a) Mineral oils

b) Paris green

c) Synthetic insecticides

Mineral oils : Oils most widely used are diesel oil, fuel oil, kerosene and mosquito larvicidal oil. Oil kills by cutting off the air supply to the larvae and pupae as it spreads as a thin film. Application rate is 40 - 90 litre per hectare.

Paris green : is copper acetoarsenite - emerald green micro crystalline powder insoluble in water. It is a stomach poison and to be effective it must be ingested by the larvae. It is applied as 2% dust which is prepared by mixing 2 kg. of Paris green and 98 kg. of diluent as soap stone powder.

Dusting is accomplished by hand or Rotary blowers.

Recommended dose is 1 kg/hectare of water surface.

Synthetic Insecticides : Tenthion, Chloropyrifos and abate are organophosphorus compounds which hydrolyse in water. These are larvicides.

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Toxicant	Dosage (g/ha)
Abate	56 - 112
Malathion	224 - 672
Tenthion	22 - 112
Chloropyrifos	11 - 16

Biological Control

Small fish like *Gambusia affinis* and *Lebister reticulatus* feed on larvae. It is effective when used in conjunction with other methods.

ANTI-ADULT MEASURES

Residual Sprays : Residual insecticides as DDT, 1-2 g/Sq. mt. applied 1-3 times a year to walls is the choice. In areas of DDT resistance, malathion and Propoxur (GMS-33) and lindane are used. The disadvantage is resistance to these insecticides.

Space Sprays : The insecticidal such formulation is sprayed in the form of mist or fog to kill insects.

Pyrethrum extract : An extract of the flowers is used which is a Nerve Poison (Pyrethrin). Dosage used is 102/1000 c.ft. of space. It reduces the number of mosquitoes but it has only a temporary action.

Residual insecticides : Ultra low volume space spraying is done with malathion, fenitrothion for ULV flogging.

Genetic Control

i) Sterile male technique }
ii) Cytoplasmic incompatibility }
iii) Chromosomal translocations } ----------> Research Phase
iv) Sex distortion }
v) Gene replacement }

Protection Against Mosquito Bites

Mosquito Net : Material should be white, top as well as sides should be of netting, the size of the openings should not exceed 0.0475 inch in diameter. The number of holes in one square inch is 150.

Screening : Screening of buildings with copper or bronze gauze having 16 meshes to the inch is recommended. The aperture should not be larger than 0.0475 inch.

Repellants : Diethyl toluamide (deet), indalone, dimethyl pthalate, dimethyl carbate, ethyl hexanediol are used for application on the skin.

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11.11. HOUSE FLIES (*MUSCA DOMESTICA*)

Houseflies are the commonest and most familiar of all insects which live close to man. They are *Musca domestica, M. vicina, M. nebulo* and *M. sorbens*.

They are regarded as a sign of insanitation and their number an index of that insanitation.

General Characters

M. domestica is mouse - grey in colour. Body is divided into head, thorax and abdomen. Head has a pair of antennae, a pair of large compound eyes and a retractile proboscis. The thorax is marked with 2-4 dark longitudinal stripes. The thorax bears a pair of wings and 3 pairs of legs. The legs and body are covered with hairs called tenent hairs. Abdomen is segmented and shows light and dark markings.

Life History

The housefly undergoes a complete metamorphosis with 4 stages.

Egg : The female lays 120-150 eggs at one sitting. *M. domestica* and *M. vicina* breed profusely in human excreta. The eggs hatch in 8-24 hours. The eggs are pearly white in colour and 1 mm. long.

Larva : (Maggots) measure 1-2 mm. in length. They are white, segmented, footless with a narrow anterior end and a broad posterior end. They moult twice and the full grown larva measure 12 mm. in length. The larval period lasts for 2-7 days.

Pupae : are dark brown, barrel shaped and measure quarter of an inch. The pupal stage lasts 3-6 days.

Adult : The life cycle from egg to adult is 5-6 days. Their life span is 15 days in summer and 25 days in winter.

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Habits

Breeding habits : Feed on fresh horse manure, human excreta, garbage, decaying fruits and vegetables.

Feeding habits : It cannot eat solid food; it devours solid foods, makes a solution and sucks.

Vomit drop : The fly vomits frequently which is a culture of disease agents.

Dispersal : They disperse frequently up to 4 miles.

TRANSMISSION OF DISEASES : Flies transmit diseases by : (a) Mechanical Transmission, (b) Vomit drop, and (c) Defaection

11.12. FLY CONTROL MEASURES

Environmental control

Overall improvement of environmental sanitation by a) storing garbage, kitchen wastes in bins with tight lids, b) Efficient collection, removal and disposal of refuse by incineration, composting, c) Provision of sanitary latrines, d) Sanitary disposal of animal excreta.

Insecticidal control

a) ***Residual sprays*** : Methoxychlor (5%), Lindane (5%), Chlordane (2.5%). Others are diazinon (2%), dimethoate (2.5%), fenthion (2.5%), malathion (5%) etc.

b) ***Baits*** : 1-2% diazinon, malathion, dichlorofos, ronnel dimethoate. Liquid baits with 0.1 - 0.2% of an insecticide with 10% sugar give good results.

c) ***Cords and Ribbons*** : Cords and strips impregnated with diazinon, fenthion or dimethoate are effective.

d) ***Space sprays*** : Pyrethrin, DDT, HCH are used.

e) ***Larvicides*** : 0.5% diazinon, 2% dichlorovos, 2% dimethoate, 1% ronnel are applied as 28-56 lts/100 sq.mts.

Fly papers : By mixing 2 lbs. of resin and one pint castor oil, heating and applying to papers which when hung cause reduction of flies.

Protection against flies : Screens with 14 meshes to the inch well keep out house flies.

Health education : A "fly consciousness" should be created among the people.

11.13. SAND FLIES *(PHLEBOTOMUS)*

Sandflies are small insects, light brown, measuring 1.5-2.5 mm. in length. The important ones are ***Phlebotomus argentipes***, ***P. papatasi***, ***P. sergenti*** and ***Sergentomyia punjabensis***.

GENERAL CHARACTERS : Body is divided into head, thorax and abdomen. Head has long, slender, hairy antennae, long maxillary palps and proboscis.

The thorax has a pair of wings and 3 pairs of legs. The wings are lanceolate and densely hairy. The 2nd longitudinal vein on the wings branches twice, the first branching takes place in the middle. Abdomen has 10 segments and is covered with hair. In male there are claspers.

Sandflies hop about and do not fly.

LIFE HISTORY : Metamorphosis is complete with 4 stages : egg, larva, pupa and adult.

Egg : large, torpedo shaped and hatch within 7 days.

Larva : are hairy maggots with head, throax and abdomen. Larva becomes pupa in 2 weeks. Pupal stage lasts for 1 week.

Adult : The average life is 2 weeks.

HABITS : Sandflies are nocturnal pests. Bite is irritating and painful. Females require blood meal every 3 days.

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UNIT - 12 : EPIDEMIOLOGY

Contents

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12.1. OBJECTIVES

After going through this unit you will be able to :

- explain the principles of epidemiology and investigation of infectious epidemiology,
- describe dynamics of disease transmission and their spread,
- explain water pollution with infectious agents, and
- suggest remedial measures of infectious agents.

12.2. INTRODUCTION

Epidemiology is the basic science of preventive and social medicine. It has three main aims :

a. To describe the distribution and size of disease problems in human populations.

b. To identify aetiological factors in the pathogenesis of disease; and

c. To provide the data essential to the planning, implementation and evaluation of services for the prevention, control and treatment and to the setting up of priorities among the services.

These aims of epidemiology lead to effective action :

a. to eliminate or reduce the health problem or its consequences and

b. to prevent its occurrence in future.

12.3. INFECTIOUS DISEASE EPIDEMIOLOGY

Infection : The entry and development or multiplication of an infectious agent in the body of man or animals - causing disease.

Contamination : The presence of an infectious agent on a body surface, cloth, surgical instruments or other inanimate substances like water, milk and food. .

Pollution : The presence of offensive, but not necessarily infectious matter in the environment.

Infestation : The lodgement, development and reproduction of arthropods on the surface of the body of human or animals.

Host : A person or animal that affords subsistence or lodgement to an infectious agent under natural conditions. Obligate host means the only host for a particular infectious agent (e.g., Man is obligate host for **Typhoid bacilli**).

Definitive host (Primary host) : Host in which the parasite attains maturity or passes its sexual stage.

Intermediate (Secondary host) : Host in which the parasite is in a asexual stage of development..

Transport host : It is a carrier in which the organism remains alive but does not undergo multiplication.

Infectious disease : A clinically manifest disease of man or animals resulting from an infection.

Contagious disease : A disease that is transmitted through contact (e.g., Scabies).

Communicable disease : An illness due to a specific infectious agent capable of being directly or indirectly transmitted from man to man, animal to man or from the environment (through air, dust, water, food etc.) to man or animals.

Epidemic : It refers to the constant presence of a disease or infectious agent within a given geographic area or population group, without importation from outside.

Sporadic : It means that the infectious disease occurs irregularly, haphazardly from time to time and generally infrequently.

Endemic : An epidemic affecting a large proportion of the population and occurring over a wide geographic area, such section of a nation, entire nation, a continent or world.

Zoonosis : An infectious disease transmissible under natural conditions from vertebrate animals to man (e.g., rabies, plague).

Nosocomial infection (Hospital acquired) : An infection originating in a person while in a hospital or other health care facility.

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Opportunistic infection : This is an infection by an organism that takes the oppurtunity provided by a defect in host so that it infects the host and cause disease (oppurtunistic infections are very common in AIDS).

Iatrogenic (physician-induced) disease : Any untoward or adverse consequence of a preventive, diagnostic or therapeutic procedure, that causes impairment, handicap disability or death resulting from a physician's professional activity.

12.4. DYNAMICS OF DISEASE TRANSMISSION

Communicable diseases are transmitted from the reservoir/source of infection to a susceptible host. The "source of infection" is defined as the person, animal object or substance from which an infectious agent passes or is disseminated to the host. A "reservoir" is defined as "any person, animal, plant, soil or substance in which an infectious agent lives and multiplies and where it reproduces itself in such a manner that it can be transmitted to a susceptible host.

The reservoir may be of three types :

a. Human reservoir

b. Animal reservoir

c. Non living things as reservoir

a. Human Reservoir

All infected humans are potential sources of infection to others. The disease producing agent is leaving the body through stools, vomiting, coughing, sneezing or other means and are potentially capable of infecting other persons.

Usually after recovery from infectious disease, there will not be any disease producing organisms in human body. But in some diseases, the disease agent is not completely eliminated leading to a carrier state. A carrier is defined as "any infected person or animal that harbours a specific infectious agent in the absence of discernible clinical disease and serves as a potential source of infection for others"

b. Animal Reservoir

Animals which suffer from an infection or act as a carrier may be a potential source of that infection to human. The diseases which are transmissible from vertebrates to man are called **Zoonosis** (e.g., rabies, yellow fever and Leptospirosis).

c. Reservoir in Non-living Things

Soil inanimate matter can act as a reservoir of infection. For example soil may harbour agents that cause tetanus, anthrax and gas gangrene.

12.5. ROUTES OF TRANSMISSION

Communicable diseases may be transmitted from the reservoir or source of infection to a susceptible person in a variety of ways, depending upon the infectious agent, portal of entry and the local ecological conditions.

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A. Direct Transmission

i. Direct contact
ii. Droplet infection
iii. Contact with soil
iv. Bite of an animal
v. Transplacental

B. Indirect Transmission

i. Vehicle-borne
ii. Vector-borne
   a) Mechanical
   b) Biological
iii. Air-borne
   a) Droplet nuclei
   b) Dust
iv. Fomite-borne
v. Unclean hands and fingers

A. Direct Transmission

i) **Direct contact** : During physical contact like by touching, kissing or sexual intercourse. These include sexually transmitted diseases.

AIDS, Conjunctivitis, Gonorrhoea, Syphilis.

ii) **Droplet infection** : During sneezing, coughing, spitting or talking by an infected person, the organism is sprayed as droplets and fall on the nose, eye or mouth of other persons and infect them. e.g., Respiratory diseases, Diphtheria, Whooping cough, Pneumonia, Influenza etc.

iii) **Contact with soil** : Tetanus spores are plenty in the soil. When the wound of a person comes in contact with this soil (as in road accidents) the tetanus spores present in the soil enter into the body through the wound, produce exotoxin - causing disease, Tetanus.

iv) **Bite of an animal** : The bite of a dog infected with **rabies** virus is responsible for the transmission of this virus to the human.

v) **Transplacental infection** : Some diseases are transmitted from the mother to the foetus while it is growing in her uterus (e.g., Toxoplasma, AIDS, Syphilis etc.).

B. Indirect Transmission

i) **Vehicle-borne** : Infectious agents are transmitted through the agency of water, food (raw vegetables, fruits, milk, meat etc.) blood, serum, plasma or other biological products such as tissues and organs. Diseases transmitted by water and food causes acute diarrhoeas, typhoid fever, cholera, polio, hepatitis A and

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intestinal parasites. Those transmitted by blood and blood products include hepatitis B, malaria, syphilis and AIDS.

ii) **Vector-borne** : Generally a vector is defined as an arthropod or any other living agent that transports an infectious agent to a susceptible individual. The transmission may be mechanical or biological (wherein the infectious agent passes through a developmental cycle or multiplication in the vector). e.g., Malaria, Kala Azar, Typhus fever, Dengue etc.

iii) **Air-borne** : (a) Droplet nuclei are a type of particles (1-10 microns range) that represent dried residue of droplets from sneezing, coughing or they may form as aerosols during manipulations of clinical samples in the laboratory. They remain air-borne for longer time and can be inhaled by other persons and produce diseases in them, e.g., Respiratory illness, Influenza, common cold, tuberculosis, pneumonia etc. (b) Some of the larger droplets formed during sneezing or coughing, containing the infectious agents settle as dusts. Later during sweeping the floor they become once again air-borne and infect others (e.g., Staphylococci, fungal spores).

iv) **Fomite-borne** : Fomites are articles or substances capable of transmitting an infectious agent. They include soiled clothes, handkerchiefs, clips, pencils, books, drinking glasses, door handles, syringes etc. e.g., Respiratory diseases and diarrhoeal diseases - caused by the presence of organisms, cyst, ova etc.

v) **Unclean hands and fingers** : Infectious agents from skin, nose, bowel etc. are transmitted through unclean hands of infected persons to others while serving food, water etc. e.g., carriers and in phase of convalescence.

12.6. WATER - BORNE DISEASES

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Water may be divided according to their source as, a) surface and, b) deep water. Since the surface water (rain, shallow wells, rivers, lakes, sea water) are frequently exposed to contamination from dust, sewage, they may contain large numbers of bacteria, many of which are intestinal in origin. Deep waters (deep wells and springs) generally do not have bacteria.

Water is one of the chief vehicles of gastro-intestinal disease :

Bacterial diseases	-	Typhoid, dysentery, cholera, Acute gastroenteritis
Viral diseases	-	Hepatitis A, Diarrhoeal viruses, Polio virus, Rota virus etc.
Parasitic diseases	-	Amoebiasis, Giardiasis, Tapeworm, Ascariasis etc.

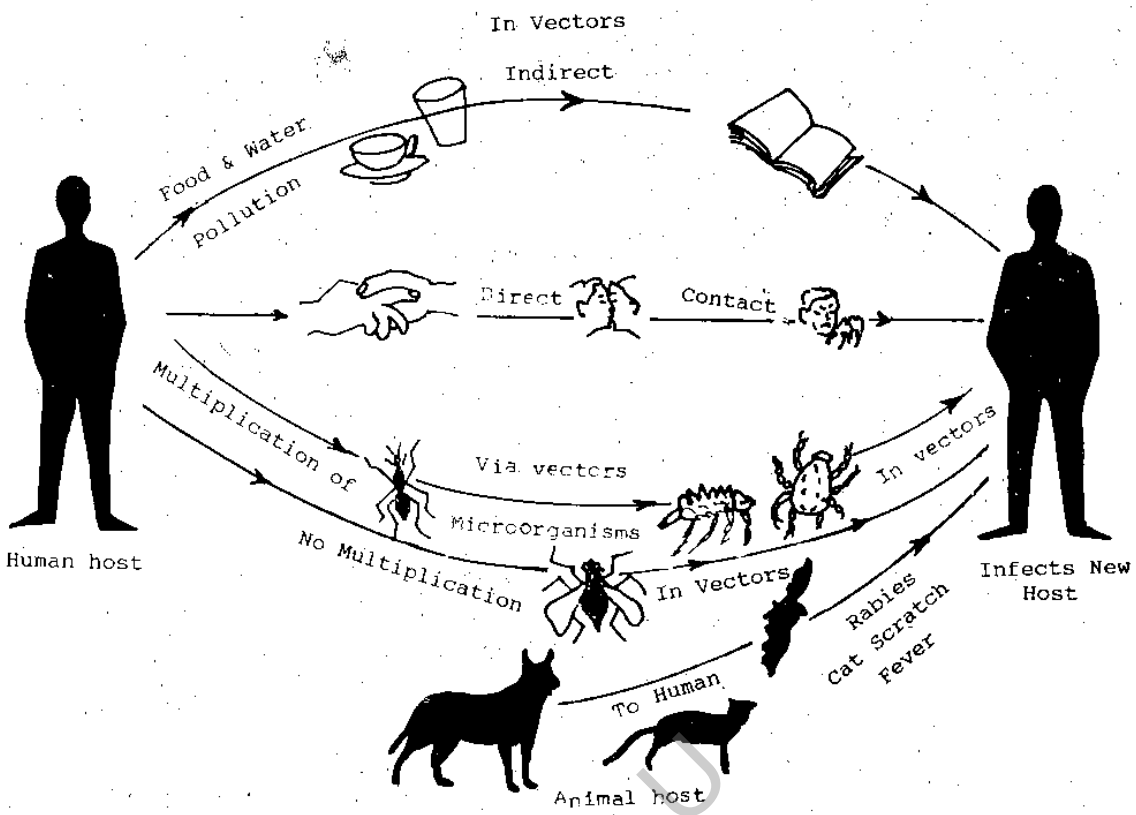

Fig. 12.1. Transmission of pathogenic micro-organisms from person to person by various means.

Fig. 12.2. Spread of microorganisms causing many respiratory diseases from one person to another in aerosols generated by sneezing, coughing or even in conversation.

12.7. MODE OF CONTAMINATION AND PURIFICATION OF WATER

Contamination of water supply may occur at source, during storage or during distribution.

The commonest causes are

1) Pollution of shallow wells and surface water
2) Seepage of surface water into gravity conduits
3) Cross connection between a purified and a polluted supply
4) Suction of contaminated soil water into fractured or imperfectly joined water mains when only an intermittent supply is provided.

General Measures to Prevent Contamination of Water

1) Protection of gathering grounds.
2) Health of persons working should be checked regularly.
3) Generally river water is being stored and later supplied for drinking. This type of water has to be treated by storage, chemical precipitation, sand filtration and chlorination.
4) Better sewage disposal methods (e.g. activated sludge process).

Bacteriological Analysis of Water

The presence of human intestinal bacteria in water is a indirect indication of contamination of that water. For this purpose, presence of the following bacteria is looked in water samples :

Escherichia coli	-	Indicates faecal coli contamination
Faecal streptococci	-	Presence indicates recent contamination
Clostridium perfringens	-	Spores denote past contamination

4) Look for **pathogenic organisms** like **Typhoid bacilli, Dysentery** and **Cholera bacilli**

Two methods are generally used to estimate the number of coliform bacilli in water :

Liquid dilution method : Here a fixed volume of water is diluted and plated on Mac Conkey agar. The number of bacterial colonies grown are counted and multiplied with the dilution factor to get the number of bacteria in the original sample.

Membrane filtration : Measured quantities of water are filtered through a membrane filter. The filter retains the bacteria. Then the filter is placed on Mac Conkey agar and the number of colonies growing is calculated.

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12.8. ACUTE DIARRHOEAL DISEASES AND REMEDIAL MEASURES

The infectious agents cause acute diarrhoeal diseases which are many : (Gastro enteritis - Vomiting and loose motions).

a) **Viruses** - Rota virus, Echo virus, Coxsackie virus, Adeno virus, Parvovirus.

b) **Bacteria** - Escherichia coli, Shigellae, Campylobacter, Salmonella.

c) **Protozoans** - Giardia, Entamoeba

Man is the principal reservoir of these infectious diseases. The organisms are present in the faeces of the diseased person. They are transmitted through a) mainly water b) contaminated food and c) flies. They enter through the mouth and produce acute diarrhoea.

Control of Diorrhoeal diseases can be through :

Treating Diarrhoeal cases,

Increasing host resistance to infection,

Reducing the transmission of pathogenic agents,

1. Treating Diarrhoeal patients :

   a) Oral rehydration theraphy : Plenty of water, salt and glucose.

   b) Chemotherepy : Administration of appropriate drugs.

2. Increasing host resistance to infection :

   a) Good nutrition to mothers

   b) Good nutrition to child

   c) Immunization with appropriate vaccines.

3. Reducing the transmission of pathogenic agencies

   a) Water supply and excreta disposal : Clean, boiled or filtered water and good sanitation are the essential components of prevention of water borne diseases.

   b) Household hygiene : Simple hygienic measures like washing the hands after bowel clearance, keeping the nails cut and using toilets help in the prevention of occurrence of water borne diseases.

   c) Food hygiene : Prefer clean vegetables, fruits etc. are essential.

   d) Fly control : Flies breeding in association with human or animal faeces should be controlled.

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12.9. PRINCIPLES OF EPIDEMIOLOGY AND INVESTIGATION OF OUTBREAKS

Epidemiology is a subject covering a wide field without any natural boundaries. It has been defined in different terms by various workers. For practical purposes it deals with the nature, distribution, causation, mode of transfer, prevention and control of disease.

Epidemiology is the counterpoint of clinical medicine, taking the population group as the unit of study rather than the individual patient. The clinician observes differences between the patient and healthy persons of similar age and sex. The epidemiologist compares the occurrence of disease in the population group in question with that in other groups differing in various respects - **race, climate, diet, occupation** and general **environment**. The clinician deals with absolute numbers, the epidemiologist with rates - **prevalence, incidence, morbidity, mortality** and so on expressed as ratio of cases to the population.

Investigation of outbreaks : An outbreak tends to be localized to a small area or confined to a particular group of persons such as school children, dinners at a restaurant or on a trainer participants at a conference coming from a distance. **An epidemic,** on the other hand, spreads over a wide area, such as a region, the whole country or as a pandemic over several countries.

Definition of terms : Prevalence denotes the proportion of persons in a defined population which at any given time are or have been affected with a particular disease. Prevalence represents the accumulated incidence of new cases during previous years from which have been subtracted deaths from all causes.

Incidence on the other hand, is a measure of the frequency with which a particular disease occurs during a stated period of time, usually a year. Incidence is a longitudinal section that takes account only of new cases during a period of time.

The incubation period is the time between the occurrence of infection and the appearance of manifest symptoms or signs of the disease.

Mortality rate refers to the proportion of deaths in the population within a given time, usually a year, fatality rate to the proportion of patients that die of particular disease. A mortality rate obtained by calculating the proportion of deaths in a given time to the whole population is known as the **crude mortality rate**. For more exact purposes, a mortality rate adjusted for age and sex is often used and is called **standardized mortality rate**.

The morbidity rate corresponds to the mortality rate, indicating the proportion of cases of a particular disease or group of diseases in the population during a given time. Both rates are expressed as a rule as numbers per 1 lakh of the population.

The term attack rate is often used, particularly in outbreaks of food poisoning, to denote the proportion of those exposed to a given risk who become ill.

The term **"Cohort"** is used to denote a population characterised by birth within a given period of time and followed up for a certain number of years or throughout life. As an example, one may choose the death-rate from tuberculosis in England and Wales during the past 100 years.

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Check Your Progress - 1 & 2

1. Define the term incubation period

2. What is the difference between crude and standardised mortality rates?

Note : a) Write the answers in the space provided below

b) Compare your answers with those given at the end of this unit.

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12.10. TYPHOID BACILLI

Water - borne infection : The part played by water in the spread of typhoid fever was first established by the painstaking observations of William Budd (1856, 1873).

Among the most frequent causes of contamination of water are cross-connection of a main with a polluted water supply, seepage of surface water or sewage into a gravity conduit, surface contamination of shallow wells and inadequate filtration or chlorination.

The pollution which gives rise to an epidemic is often temporary or intermittent. Water-borne outbreaks are generally characterised by a typically explosive onset. Water-borne outbreaks of paratyphoid B infection are uncommon, but a few small ones are on record.

Food-borne infection : Not only typhoid, but also paratyphoid A and B infection, may be spread in this way if there is opportunity for the organisms to multiply in the food. Paratyphoid B bacilli have gained access to milk from polluted rivers or streams on several occasions.

House wives may contract typhoid fever by handling contaminated fish before it is cooked. **Typhoid bacilli** may be disseminated on salad vegetables which have been manured with sewage. Canned food may be contaminated if the cans are cooled in polluted water.

Shell-fish, particularly Oysters are another important source of infection of typhoid fever. They are often bred or fattened in the sewage polluted waters of tidal estuaries, and they are usually consumed uncooked. Numerous epidemics are on record which can be traced to this source.

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Milk follows close on water as an important source of explosive epidemics. The organisms may gain access to the milk from the hand of an infected person or from contaminated milking utensils. Enteric bacilli multiply in milk at ordinary atmospheric temperatures so that even a trivial contamination may cause an explosive outbreak.

Other dairy products or substitutes such as cream, artificial cream, synthetic cream, custard and ice-cream are frequent vehicles for the enteric group of organisms, particularly paratyphoid bacilli.

Numerous other foods, including meat products, have been responsible for outbreaks of enteric fever in which there was evidence that contamination had taken place from a human source during preparation of the food.

Hygienic measures : The most important are those designed to ensure that excreta are safely disposed of, that a safe water supply is provided and that food is handled hygienically. Exposure to infection in endemic region could be halved by the construction of privies and the provision of uncontaminated water.

12.11. CHOLERA

Numerous outbreaks are on record in which the water supply has become infected and has led to the development of Cholera. Outbreaks originating in this way are generally explosive, the ascending limb of the incidence curve raises very steeply, the epidemic soon reaches its maximum and with the cleansing of the water, it begins to fall. Raw water, ice, utensils, sweet soft drinks, sliced fruits, food contaminated after cooking or pasteurization and fruits & vegetables refreshed with sewage polluted water eaten raw are the most important vehicles of infection.

Moreover, outbreaks of Cholera have occurred in a number of countries in which illness followed the consumption of raw or partly cooked sea-food.

Prophylaxis : It can be controlled by good sanitation and personal hygiene. Special attention must be paid to the purity of water and ice for human consumption and of all food, especially those to be eaten raw, to the disposal of excreta and garbage, to the disinfection of soiled clothing, to proper drainage, to the control of flies to notification and isolation of cases, to the examination of contacts and pilgrims to surveillance after an epidemic is over and to health education.

12.12. CAMPYLOBACTER ENTERITIS

Animals probably constitute the main reservoir of this bacteria. The organism has been isolated from the intestinal contents or faeces of normal sheep, pigs, horses, dogs, cats, simian primates, wild birds and other animals. Many animal isolates are indistinguishable by current typing methods from human strains but whether they are all potentially pathogenic for man is still, uncertain.

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12.13. BACTERIOLOGY OF WATER

Bacteriological Examination of Water : Drinking water supplies can be contaminated with sewage or other excreted matter and may cause outbreaks of intestinal infections such as typhoid fever. In safeguarding public water supplies, health authorities and water engineers rely on information obtained from the results of frequent bacteriological tests. The demonstration of pathogenic bacteria, e.g., the typhoid bacillus would obviously constitute the most direct proof of a dangerous impurity, but these pathogens, if present, are usually so scanty that the technical difficulty of their isolation makes the test impracticable for ordinary purposes. Instead we rely on tests that will reveal the presence of commensal bacteria of intestinal origin such as those of the coliform group, ***Streptococcus faecalis*** and ***Clostridium welchii***. These do not themselves constitute a hazard, but they indicate that faecal matter has entered the supply and that the water is therefore liable to contamination with more dangerous organisms. The coliform bacilli are the most reliable indicators of faecal pollution. Although the presence of Streptococci is strong evidence of faecal pollution, their absence does not exclude such impurity. The sporing anaerobes on the other hand, being highly resistant in the absence of the other intestinal organisms would indicate pollution of some remote period rather than one of the recent occurrences.

Since the coliform group of bacteria may be derived from the intestines of various animals and birds, they are likely to occur in small numbers even in water supplies far removed from the possibility of human contamination. Water grossly polluted with human excreta matter, e.g., sewage, contains them in larger numbers. The test for their presence is an index of the degree of pollution and must therefore be carried out on a quantitative basis. The coliform group of lactose-fermenting gram-negative bacilli includes a number of different organisms. Those referred to as "typical" or "faecal" (e.g., *E. coli*) are essentially commensals of the intestine and are derived almost exclusively from this source. Others known as "atypical" (e.g., *Klebsiella aerogenes*) may grow also in the soil and on vegetation and by derivation from these sources may often be present in water that are not subject to excretal pollution. The typical faecal bacilli die in water during the course of several days or weeks after leaving the animal intestine. Thus, their presence in water is an indication of recent faecal contamination, whereas the presence of the hardier atypical coliforms is not necessarily so. In carrying out the test for coliform bacilli in water it is therefore advisable to determine whether the strains present are typical or atypical.

The test is carried out in duplicate at 37°C and 20-22°C. The bacteria that grow at 37°C are those most likely to be associated with organic material of lumen of animal origin, whereas those growing at the lower temperature are mainly saprophytes that normally inhabit the water or are derived from soil and vegetation.

The routine tests generally used in bacteriological examination of water are :

1) The quantitative test for all coliform bacilli known as the "presumptive coliform count".

2) A differential test for typical coliform bacilli (**E. coli** known as the "differential coliform test").

3) An enumeration of viable bacteria known as the plate count. This is done in duplicate cultivating at 37°C and 22°C.

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Presumptive Coli form Count (Multiple Tube Technique) : An estimation of the number of coliform bacilli in a water supply is usually made by adding varying quantities of water to bile salt lactose peptone water or in a chemically defined medium in which the bile salt has been substituted by glutamic acid, known as improved formate lactose glutamate medium contained in bottles with Durham tubes to show the formation of gas; acid and gas formation (a positive result) indicates the growth of coliform bacilli. In this way it is possible to state the smallest quantity of water containing a **Coli form bacillus** and thus to express the degree of contamination with this group of organisms.

This method requires examination by culture of several samples of different quantities of water so that an average result can be stated. It has been shown that if one 50 ml., five 10 ml. and five 1 ml. volumes or five 10 ml., five 1 ml. and five 0.1 ml. volumes are tested; the probable number or **Coli form bacilli** in 100 ml. can be computed according to the various combinations of positive and negative results, tables compiled by McCrady being used for the purpose.

Differential Coliform Test : To ascertain whether the coliform bacilli detected in the presumptive test are ***E. coli*** the Eijkman test is usually employed. This depends on the ability of ***E. coli*** to produce gas when growing in bile-salt lactose peptone water at 44°C, and the inability of atypical coliform bacilli to do this. After the usual presumptive test, subcultures are made from all the bottles showing acid and gas into fresh tubes of single strength MacConkey's medium. It is advisable to heat the tubes to 37°C in a water bath before inoculating them. They are incubated at 44°C and examined after 24 h. Those yielding gas may be regarded as containing ***E. coli*** and a computation of the number in 100 ml. of water can be made as before. This is the "confirmed ***E. coli*** count".

The plate count (Colony count) : With a sterile graduated pipette, place 1 ml. water in a sterile petri dish and add 10 ml. of yeast extract agar, melted and cooled to 50°C; mix thoroughly and allow it to solidify. The agar should be as transparent as possible. If the water is suspected of being contaminated, plate out a small quantity e.g., 0.1 ml., and in dealing with specimens which may be highly polluted it is advisable to make a series of plate cultures with further decreasing quantities of water.

Prepare duplicate plates from each volume or dilution and incubate one at 37°C for one day and the other at 20-22°C for three days. Those organisms that grow rapidly at 37°C are mainly parasitic and are derived from excremental contamination, while those growing best at 20-22°C are the natural saprophytes of water and soil. After incubation, the colonies that have developed in the medium are counted using a hand lens. Each colony may be taken to represent one viable bacterium in the original specimen.

Interpretation of Results : It must be realized that it is not possible to lay down rigid bacteriological standards to which all drinking water supplies should confirm. The bacteriological flora of water varies widely according to the nature of the supply i.e., whether it is derived from a well, river, lake or reservoir and to the climatic conditions prevailing in the gathering grounds.

For water taken in the distribution system, the following standards are recommended :

1) 95 per cent should not contain any coliform organisms or ***E. coli*** in 100 ml.

2) No sample should contain more than 10 coliform organisms per 100 ml.

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3) No sample should contain 1 or 2 ***E. coli*** in conjunction with a total coliform count of 3 or more per 100 ml.

4) Coliform organisms should not be detectable in 100 ml. of any two consecutive samples.

Examination for Streptococci : The type of ***Streptococcus*** indicative of faecal pollution is ***Streptococcus faecalis***. The organism grows in the medium used for the test for coliform bacilli and by itself ferments the lactose but without gas production. Its presence in water can therefore be determined by further examination of the contents of the bottles showing acid or acid and gas formation in the presumptive coliform test.

Sub-cultures from all positive bottles in the presumptive coliform test are made into tubes containing 5 ml. of sterile sodium azide medium. The presence of ***Streptococcus faecalis*** is indicated by the production of acid in the medium within 48 h at an incubation temperature of 45°C. Their presence in any tube which becomes acid should be confirmed by plating out a heavy inoculum on MacConkey's agar. ***Streptococcus faecalis*** produces characteristic minute red colonies. The demonstration of ***Streptococcus faecalis*** is of value in confirming the faecal origin of **Coliform bacilli** in cases where there may be difficulty in interpreting the results of the coliform test.

Examination for ***Clostridium welchii*** : 50 ml. of water are added to 100 ml. of sterile milk in a stoppered bottle of suitable size. The bottle is heated at 80°C for 15 min., to destroy non-sporing organisms. Sterile liquid paraffin is run on to the surface of the medium to maintain anaerobiosis.

The tubes should be incubated for at least 5 days at 37°C, although the "stormy clot" reaction which is indicative of the presence of *C. welchii* may develop within 24 to 72 h. If varying quantities of matter are examined as in the presumptive coliform test, an estimate of the probable number of *C. welchii* in 100 ml. of water can be made.

Although in recently contaminated water, *C. welchii* occurs in much smaller numbers than *E. coli*, it is able to survive for much longer periods than the non-sporing bacteria of faecal origin. The chief value of the test therefore is in detecting pollution of some earlier date or to confirm the faecal origin of a typical **Coli form bacilli** in the absence of *E. coli*.

12.14. SUMMARY

Epidemiology is the science that evaluates the determinants, occurrence, distribution, and control of health and disease in a defined population.

The epidemiology of an infectious disease involves the determination of what agent caused a specific disease, the source and/or reservoir of the disease agent, how the disease was transmitted, what host and environmental factors could have caused the disease to develop within a defined population, and how to best control or eliminate the disease.

Epidemiological data can be obtained from such factors as morbidity, prevalence and mortality rates.

Surveillance is necessary for recognizing a specific infectious disease within a given population. This consists of gathering data on the occurrence of the disease, collating and analyzing the data, summarizing the findings, and applying the information to control measures.

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One of the purposes of the clinical microbiology laboratory is to isolate and identify the agent responsible for an infectious disease outbreak.

A common-source epidemic is characterized by a sharp rise to a peak and then a rapid, but not as pronounced, decline in the number of individuals infected. A propagated epidemic is characterized by a relatively slow and prolonged rise and then a gradual decline in the number of individuals infected.

Herd immunity is the resistance of a population to infection and spread of an infectious agent because of the immunity of a large percentage of the individuals within the population.

The infectious disease cycle or chain involves the characteristics of the infectious agent, the source and / or reservoir of the agent, the transmission of the agent, the susceptibility of the host, the exit mechanism of the agent from the body of the host, and its dissemination to a new reservoir or host.

The public health system consists of individuals and organizations that function in the control of infectious diseases and epidemics.

Epidemiological control measures can be directed towards reducing or eliminating infection sources, breaking the connection between sources and susceptible individuals, or isolating the susceptible individuals and raising the general level of herd immunity by immunization.

Nosocomial infections are infections that develop within a hospital and are produced by an infectious organism acquired during a patients's stay. These infections come from either endogenous or exogenous sources.

Hospitals must designate an individual to be responsible for identifying and controlling nosocomial infections. This person is known as a nurse epidemiologist, hospital epidemiologist, infection control nurse, or infection control practitioner.

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12.15. CHECK YOUR PROGRESS : MODEL ANSWERS

1. The time between the occurrence of infection and the appearance of the signs of the disease is called incubation period.

2. The crude mortality rate is the proportion of deaths in a given time to the whole population and the mortality rate adjusted for age and sex is called standardised mortality rate.

12.16. MODEL EXAMINATION QUESTIONS

1. Answer the following question in about 30 lines each.

1. Write briefly about Routes and spread of infectious agents.

2. Answer the following questions in about 10 lines each.

1. What are the principles of epidemiology?
2. Briefly write about dynamics of disease transmission.
3. What are the acute diarrohoeal disease agents? Write briefly about them.
4. Write briefly about cholera transmission and control.

Prof. S. Subramanian

UNIT - 13 : OCCUPATIONAL HAZARDS

Contents

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13.1. OBJECTIVES

By the end of this unit, you will be able to :

- list out the potential hazards of industries,
- identify the components of industrial environment,
- describe the air quality and standards,
- evaluate the health risks and devise protection measures, and
- initiate case study.

13.2. INTRODUCTION

Not withstanding the grim topicality of the subject of this chapter, it must be said in its favour that "Development, Environment and Peace" are issues with a perennial significance, They have a curious interrelationship among themselves, which surfaces only in times of crisis. This crisis is the product of modern era which is characterised by industrial development as a means of human welfare. One of the most important sordid effects of the industrialization has been the diversification of man's occupation. This has understandably led to changes in the environment and has also posed problems of occupational hazards. Though occupational hazards are arresting man's attention in the post industrial revolution era, its history starts much earlier. In fact, diseases related to workmen have been documented since antiquity. One of the earliest accounts on the subject is a book written by the Italian Physician

"Bernardino Ramazzini" (1633; 1714). After the industrial revolution, a large number of observations were recorded by a number of industrial workers and physicians on the subject. This subject has developed to such an extent that it forms an integral part of all developmental project proposals. In this unit we will attempt to understand the fundamental principles related to occupational hazards and relate them to air quality and public health concerns. We will also study aspects related to industrial safety standards.

13.3. OCCUPATIONAL HAZARDS AND DISEASES

Occupational hazards are often encountered in industry, agriculture, mining and other working environments. The hazardous effects generally manifest in the form of diseases that are commonly called occupational diseases. Occupational diseases are usually defined as diseases arising out of or in the course of employment. In the strictest sense, this term includes only those diseases which are specific to the occupation i.e., those in which the etiological agent occurs only in the occupational exposure. In contrast, industrial hygiene is concerned with all types of diseases and impairments to health which are caused or effected by the working environment or the conditions of work. From this view point, the relation of occupational exposures to diseases, such as the common respiratory infections or circulatory diseases is of equal importance.

The agents responsible for specific occupational hazards are generally classified into 3 categories, namely, chemical, physical and biological agents. In addition to these, a special fourth category is recognised. This is the psycho-social factors. Very often these factors do not act individually but exert combined stress on the individual. Occupational hazards also result from the joint action of both environmental and human factors.

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13.3.1. Chemical Agents

Chemical agents responsible for occupational hazards and diseases vary depending upon the nature, the size and the production profile of industry. Chemical agents in all the forms namely, solid, liquid and gas may bring about undesirable effects (e.g., chemical-dust, industrial effluent, NH_3 to gas). A basic principle of occupational health with respect to chemical agent is that, despite the potential health hazards inevitably associated with toxic substances, there exists for each a definable and measurable level of human exposure at some point above O, below which there is no significant threat to human health. This may not be applicable to substances that are considered to be potential carcinogens or mutagens. Such an acceptable level of exposure expressed in appropriate terms of magnitude end duration is variously called "Threshold limit value" (TLV), "the maximum allowable concentration" (MAC), "the permissible dose" (PD) etc.

In numerous industries, workers must handle potentially toxic chemicals. Many industrial processes involve chemical reactions in which toxic or hazardous substances to man are liberated. The major hazards arise from dusts, fumes, mists, vapours, gases and solvents.

Dusts : Dusts are solid particles generated by handling, crushing, grinding and disintegrating organic and inorganic material such as rocks, ore, metal, coal, wood and grains. The exposure of man to dust can lead to a wide variety of respiratory diseases, including pulmonary fibrosis, obstructive lung disease, allergy and lung cancer. Toxic dusts may produce systemic poisoning after inhalation or act as skin irritants to produce dermatosis, allergic reactions and cancer.

Silica : Free silica (SiO_2) in the form of quartz, tridymite or cristobalite can cause silicosis. Quartz dust is produced by drilling, crushing, grinding or handling quartz sand. Occupational exposure occurs in mines and quarries. Entry into the body is by inhalation. Symptoms that develop later include cough and shortness of breath (dyspnoea). Silicosis is often combined with tuberculosis.

Asbestos : Asbestos is a mixture of magnesium and iron silicates in fibrous form. It appears as dust in the form of fine fibres in the air. Occupation exposure occurs in asbestos mines, textile industry in the manufacture of fibre proof materials. Asbestos enters the body by inhalation. The dust deposited in the lungs cause fibrosis, pleural plaques, mesothelioma and lung cancer.

Lead : Lead appears as dust or fumes in the air of the work-place. Occupational exposure occurs in mines commonly in lead smelters, shipyards, car factories, glass and ceramic factories and printing and paint shops.

Solvents : Solvents include aliphatic and aromatic hydrocarbons alcohols, aldehydes, ketones, chlorinated hydrocarbons and carbon disulphide. The vapours of organic solvents may be toxic. Occupational exposure occurs in different processes such as degreasing of metal in the machine industry, extraction of fats or oils in the chemical or food industry, in dry cleaning, painting, plastic industry and in viscose-rayon industry. Solvent vapours enter the body mainly by inhalation. Most solvent vapours have anaesthetic effect in the central nervous system.

Carbon monoxide : Occupational exposure occurs in mines after explosions, in the iron and steel industry, where carbon monoxide is used to reduce the iron oxide to iron and in gas plants. Carbon monoxide enters in body by inhalation. Symptoms of poisoning include headache, dizziness and unconsciousness.

Sulphur Dioxide : Occupational exposure may occur in certain mines for sulphur or sulphur containing ore, in smelters where sulphur containing ore is roasted, paper and pulp industry, factories manufacturing sulphuric acid and in chemical plants where sulphur dioxides is used for organic synthesis. Sulphur dioxide acts on the upper respiratory tract causing cough, shortness of breath and spasm of larynx.

Skin Irritants : Occupational dermatosis may be caused by organic substances such as formaldehyde, and solvents or inorganic material such as acids and alkalis, chromium and nickel compounds. Skin irritants may cause dermatosis or eczema mainly on the skin areas of hand and forearm. Exposure to fine arsenical powder may cause development of warts on the skin.

13.3.2. Physical Agents

The hazardous physical agents and conditions considered here are the following : vibration; unsatisfactory lighting conditions, ultraviolet radiation and heat and cold.

Vibration : Vibration, especially in the frequency range of 10-500 HZ may be encountered in work with pneumatic tools such as drills, hammers and chisels, mines, quarries, foundries or machine industry or with other machines such as those used in the shoe industry and motor saws in forestry. Exposure to vibration may also produce injuries of the joints of hands, elbows and shoulders.

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Unsatisfactory lighting conditions : The assessment of lighting conditions at work includes not only the light intensity and distribution but other characteristics such as shadows, glare, contrasts and colour. The desirable quantity of light depends on the fineness of detail and accuracy required in performance of task. Dim light associated with high visual demand may lead to eye strain and fatigue. Natural day light appears to be best for visual comfort.

Ultraviolet radiation : Occupational exposure to ultraviolet radiation occurs mainly in arc welding. Such radiation may affect eyes, causing intense conjunctivitis and keratitis (welder's flash).

Exposure to heat and cold : Exposure to heat is common in work-places in many branches of industry. Acute disorders may result either from excessive demands on, or failure or, the temperature, control mechanism or from a combination of the two. Heat may adversely affect alertness, reaction time and psychomotor co-ordination. Important hazards associated with cold work are chilblains, erythrocyanosis, immersion foot and frost bite as a result of cutaneous vasoconstriction.

Check Your Progress - 1

1. Name the toxic chemical hazardous substances liberated from industries.

Note : a) Write the answer in the space provided below.

b) Compare your answer with the one given at the end of this unit.

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13.3.3. Biological Agents

These may be a part of the total biological environment or may be associated with certain occupations. Biological agents in the work environment include viruses, rickettsiae, bacteria and parasites of various types. In addition, food intake is an important factor in work performance in different occupations.

Diseases transmitted from animal to man in agricultural work are of common occurrence in view of the fact that agriculture is the major economic activity in India. In such work, infectious and parasitic diseases may result from exposure to contaminated water or insects.

Occupational infectious diseases may also occur in industry and mining. The common infectious and parasitic occupational diseases include anthrax (wool sorting and handling of infected hides), brucellosis (contact with infected animals), tetanus (from infected wounds), anchylostomiasis (hook-worm disease) and schistosomiasis. Fungi from organic dusts, such as bagasse and cocoa, may cause myotic respiratory diseases or skin infections. As an example, the case of schistosomiasis as an occupational disease may be mentioned.

In endemic areas in Brazil, workers in plantations are exposed at work to infected water and soil. It was found that the proportion of stool-positive cases was 59% among exposed worker, as compared with only 10% among other workers in the same area who did not come into contact at work with infected water or soil.

Check Your Progress - 2 & 3

2. What are the biological agents in work environment?

3. What are the common parasitic occupational diseases in industry and mining?

Note : a) Write the answers in the space provided below.

b) Compare your answers with those given at the end of this unit.

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13.3.4. Psycho-Social Factors

A high degree of mechanization may increase psychosomatic disorders, reduce job satisfaction and contribute to a higher rate of absenteeism. Shift work creates a psychosocial working environment that may adversely influence the health of the worker. Such stresses affect the nervous system, increasing the frequency of peptic ulcer and of nervous symptom such as fatigue, nervousness, irritation and insomnia.

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13.4. INDUSTRIAL ENVIRONMENT

Rapid growth of industrial sector, the world over has necessitated the division of our environment into 2 broad categories namely industrial environment and non-industrial environment. Structurally both the categories have same components namely air, water, land and living beings. Industrial environment differs from the other category in terms of its functional attributes. While the major part of its function is man managed, its impact on natural resources is very often beyond human control. Irrepairable damage and degradation of land, water and soil in and around industrial regions bear testimony to man's negligence to manage the industrial environment. However, in the last few decades there has been considerable change in man's attitude towards this. It is recognised that environmental criteria and standards are to be evolved for a better future. In the following sections environmental health criteria and standards are discussed in the context, of industrial environment.

The scientific criteria for establishing environmental health standards are the quantitative relationships between the intensity, frequency and duration of exposure to various environmental influences, on the one hand, and the risk or magnitude of an undesirable effect on man or his environment, on the other hand. Environmental health standards are emerging as a major obligatory function in industries owing to the increasing negative effects of pollutants

on our natural resources as shown in (Fig. 13.1). Environmental health standards are "acceptable" or "permissible" limits of concentration established to protect a defined population, from the undesirable effects of a specified exposure to one or several environmental hazards. e.g., in the work environment.

Table 13.1. Air Pollutants and their effect on environment

Type of Industry	Main Pollutant	Effect on environment
1. Fertilizer, oil and their refineries	Ammonia, suspended particulates, sulphur dioxide (SO_2)	Deposition on leaves and hence reduced photo-synthesis
2. Thermal power house	Suspended particulates, sulphur dioxide (SO_2)	Deposition on leaves and hence reduced photo-synthesis
3. Cement	Suspended particulates	Deposition on leaves and hence reduced photo-synthesis
4. Blue, Sulphuric acid, Sodium Bisulfide	Sulphur dioxide (SO_2)	Acid rains, leaf burn, Chlorophyll destruction
5. Nitric acid	Nitrogen oxides (NO_x)	Pigment lesions on leaves, Collapse of corn leaves, acid rains.
6. Caustic soda	Chlorine (Cl_2)	Pigment lesions on leaves, Collapse of corn leaves, acid rains.
7. Boilers of different industries	Sulphur dioxide (SO_2), Nitrogen oxides (NO_x) and suspended particulates	Deposition on leaves and hence reduced photo-synthesis, acid rains.
8. Petrochemicals	Hydrocarbon	Injury to vegetation

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13.4.1. Air Quality and Standards

Air quality undergoes continuous and varied changes in any industrial environment. Common industrial air pollutants and their effect on environment are presented in Table 1. There are at least two different approaches to air pollution control, namely "air quality management" and the "best practical means". The former approach relates control requirements to the desired air quality. It is a more logical approach and involves combined action by those concerned, e.g., with town planning, industrial development and transport policies. The latter approach is based on the principle that pollution should be reduced to the greatest extent possible with the methods available in practice. "Alert levels" are a special type of air quality standards. These standards call for restrictions in the operations of certain industries when pollutants released by them exceed certain prescribed levels.

13.4.2. Water Quality Standards

It is impossible to draw up water quality standards that would cover all water uses and all types of water bodies. In the context of industrial environment, whether water quality standards and classifications exist or not, the control process invariably involves the setting up of effluent standards. Such standards depend on the number of pollution sources and on the capacity of a given water body to receive the wastes discharged.

13.5. TOXICITY AND TOXIC SUBSTANCES

A distinction must be made between toxicity and hazard. Toxicologists generally consider toxicity as the ability of a chemical to produce an unwanted effect when the chemical has reached a sufficient concentration at a certain site in the body; hazard is regarded as the probability that such an effect will occur. Many factors intervene in both situations and these include route of entry, dosage, physiological state, environmental variables, and many others. Risk/benefit judgements for toxicity and hazard apply universally to chemicals, and only experience coupled with increased scientific research can supply the solid base on which such judgements need to be made.

A large number of toxic substances have been identified over the years and their effects on the environment and human health have been studied. A few of the toxic substances and their effects have been outlined in section 13.1. Table 13.2 lists some of the toxic substances and their safe concentration levels.

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Table - 13.2. Toxic substances and their safe concentration level

Substance	Concentration Zone (mg/m^2)
Hydrogen Chloride (hydrochloric acid)	5 - 7
Phosgene	0.4 - 0.5
Hydrogen sulfide	10 - 15
Sulfur dioxide	10 - 13
Sulfuric acid and Sulfuric anhydride	1
Ozone	0.1 - 0.2
Ammonia	20 - 35
Arsine	0.2 - 0.3
Ethanol	1000 - 2000
Methyl acrylate	20 - 35
Nitrobenzene	3 - 5
Dinitrobenzene	1
Dinitrotoluene	1 - 1.5
Trinitrotoluene	1 - 1.5
Parathion	0.05 - 0.1

Iodine	1
Beryllium and compounds (as Be)	0.001 - 0.002
Molybdenum, Soluble compounds, dust (as Mo)	4 - 5
Vanadium (as V_2O_5)	
dust	0.5
fume	0.1
Ferrovanadium	1
Zinc oxides (fumes)	5
Zirconium and compounds (as Zr)	5
Chlorinated derivatives of diphenyl	1
Chlorinated derivatives of diphenyloxide	0.5

13.6. CASE STUDIES

Inclusion of case studies in academic curricula has been recognised as an useful exercise, especially in inter-disciplinary courses such as environmental studies. The case study approach enables the student to collect necessary data in person and also provide exposure to the various aspects of environmental study related to industries. During this exercise the student gets first hand information on the principles, processes, pollution sources and pollution abatement measures undertaken by the industry. In order to provide an insight into this exercise two industries namely, cement industry and chemical industry have been taken and discussed below.

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13.6.1. Cement Industry

The methodology includes :

a) Identification of the products,

b) Identification of the raw materials,

c) Learning the process,

d) Identification of sources of pollution,

e) Listing out the effects of pollutants, and

f) Study of control measures.

Product : Cement is the general term given to the powdered materials which initially have plastic flow when mixed with water or other liquids, but has the property of setting to a hard solid structure in several hours with varying degree of strength and bonding properties. The cement currently used by engineers is called Portland Cement.

Raw materials : The essential raw materials for the manufacture of cement are limestone and clay, which supply all the four principal ingredients namely, CaO, Al_2O_3, SiO_2 and Fe_2O_3. While CaO and Fe_2O_3 are obtained from limestone, SiO_2 and Al_2O_3 are obtained from clay.

Process : There are 2 methods for manufacturing Portland cement. They are the wet process and dry process. In the wet process, the limestone is crushed to obtain particles of required size and washed with water to obtain a slurry containing 60% water. Similarly a clay slurry is prepared and the two slurries are mixed and pulverised to obtain what is called the raw slurry containing about 40% water. The slurry is treated in a rotary kiln to produce klinker. The klinker is subjected to a series of treatments to obtain greenish-black or grey coloured mass called cement klinker. It is in the form of balls. The balls are passed through rotary cooler and crushed in grinding machines. The resulting product is the cement.

In the dry process, the raw materials are separately crushed and ground. They are mixed in proper proportions and pulverised. The mixture is made uniform by means of compressed air mixing. The resulting product is called the raw meal. The raw meal is treated, the way raw slurry is treated to obtain cement.'

Source of Pollution : The sources of pollution in a cement industry are : a) cooling - thermal pollution b) Raw material washing - waste waters with high pH, alkalinity, total dissolved solids and suspended solids c) process units - cement dust.

Effect of pollutants : Some of the environmental effects of pollutants from cement industry are : a) respiratory diseases in man b) diseases of skin and eyes c) clogging of stomatal pores of leaves and consequent interference in the exchange of gases d) decrease in chlorophyll content in leaves e) non-production of fruits in some plants e.g., lemon f) aesthetic defects in buildings.

Control measures : The following control measures are generally used : a) dust control - use of wet scrubbers to collect kiln dust b) water spraying on roads to enable dust settling c) use of solid settling ponds where dust is mixed into a slurry d) use of electrostatic precipitators for collecting cement particles e) good house keeping practices.

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13.6.2. Chemical Industry

It is extremely difficult to distinguish and draw a line between material industries and chemical industries owing to the fact that all material industries use and sometimes produce chemicals as well. In general, however, the chemical industry encompasses smaller plants which produce basic chemicals and raw materials to be used by other manufacturers. Chemical wastes are produced by plants that manufacture acids, bases, detergents, powder and explosives, insecticides and fungicides, fertilizers, plastics, resins, synthetics and other similar substances.

Product identification : This depends on the specific industry chosen for the study.

Raw materials : The raw materials vary from one chemical industry to the other.

Process : The process varies depending upon the product.

Sources of pollution : The sources of pollution vary from one chemical industry to the other depending on the raw material used and process followed.

Wastes from chemical industry : Chemical wastes include acids, bases, toxic materials, matter high in BOD, colour, solids, etc.

Effects of pollutants : Effects of wastes from chemical industries have been outlined in sections 13.3 to 13.5.

Control measures : Control measures vary from one chemical industry to the other.

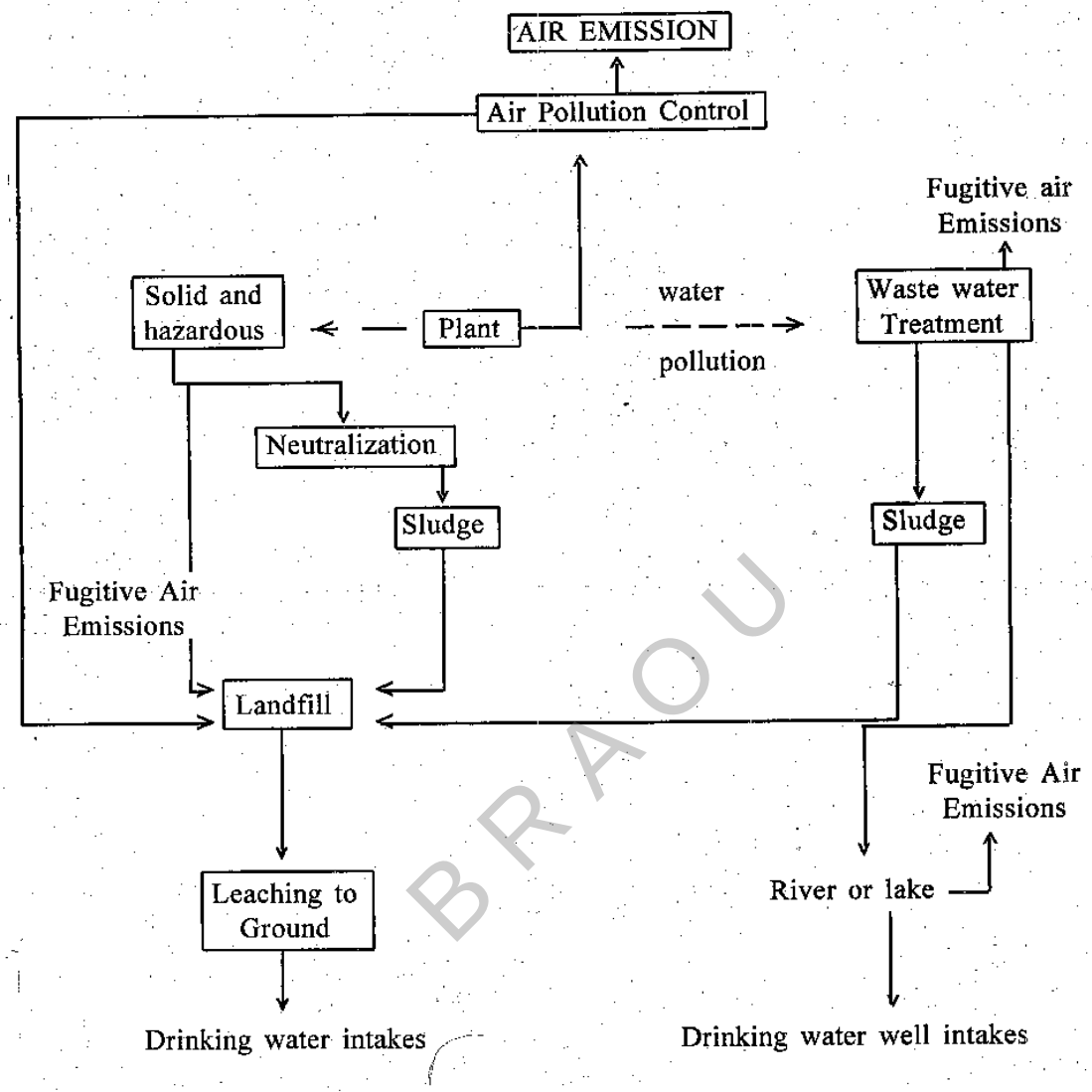

Fig. 13.1. Pollutant flows and exposure pathways for a generalized industrial plant

13.7. SUMMARY

Occupational hazards are the necessary evils of industrialisation and development. Occupational hazards and diseases are caused by chemical, physical, biological and psycho-social factors. In the context of occupational hazards it is useful to differentiate between general environment and industrial environment. Such a distinction would help develop environmental health criteria and standards with reference to industrial effects on environment. Case study approach is being used as a tool to make a student understand and appreciate the environmental problems and their control.

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13.8. CHECK YOUR PROGRESS : MODEL ANSWERS

1. The chemical agents liberated from industries which are hazardous to man are dust, silica, asbestos, lead, solvents, carbon monoxide, sulphur dioxide etc.

2. The biological agents in work environment are viruses, rickettsiae, bacteria, parasites of various types etc.

3. The common parasitic occupational diseases in industry and mining are anthrox, brucellosis, ancylostomiasis, and Schistosomiasis.

13.9. MODEL EXAMINATION QUESTIONS

I. Answer the following questions in about 30 lines each.

1. What are occupational hazards and diseases? Identify and classify the agents responsible for hazards and diseases. Give suitable examples?
2. With suitable examples outline the role of chemical and biological agents in occupational hazards and diseases.
3. What do you understand by the term industrial environment? With suitable examples compare the structure and function of industrial environment with that of general environment.
4. What are quality standards? Discuss the importance of air quality and water quality standards.
5. Prepare an approach presentation for a case study taking the example of cement industry.

II. Answer the following questions in about 10 lines each.

1. What are toxic substances? List their effects on human health.
2. How is cement manufactured?
3. Write a note on the role of phycho social factors in industrial environment.
4. Differentiate between occupational hazards and occupational diseases.
5. List the environmental control measures followed in a chemical industry of your choice.

Prof. V. S. Govindan

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BLOCK - 4 DISASTER MANAGEMENT

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UNIT - 14 : EARTHQUAKES AND LANDSLIDES

Contents

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14.1. OBJECTIVES

After going through this unit, you will be able to :

- define earthquakes and explain the possible causes for earthquakes,
- define the landslides and environmental problems,
- describe different aspects of prediction and control of earthquakes, and
- explain the role of voluntary organisations in the affected areas.

14.2. INTRODUCTION

The natural calamities *viz.*, volcanic activity, earthquakes, landslides and floods are generally occur on the earth and will cause damage to the life and property. To minimise the natural disasters, the disaster management studies are intensified in recent years to save the human life.

Among the above said natural disasters the earthquakes and landslides are the most fearful and cause great havoc to human civilisations. Earthquakes and landslides are described in this unit.

14.3. EARTHQUAKES

An earthquake is the vibration of the earth produced by the release of energy. This energy radiates in all directions from its source. The earthquakes can also occur by atomic explosion or by volcanic eruption. The large reservoirs with its hydro-static pressure of water may also cause earthquakes which is referred to as induced seismic activity.

The earthquake generates the waves in the ground. The study of these waves is called seismology. The instrument which record the earthquake is called seismograph. The record of different waves is referred to as seismogram and it will provide information relating to the behaviour of seismic waves. There are four types of seismic waves *viz*., longitudinal waves, shear waves, rayleigh waves and love waves.

The longitudinal waves consists of alternating pulses of compression and refraction, acting along the direction in which the waves travel. Longitudinal waves behave like sound waves. These are also known as P - waves.

The shear waves create oscillations at right angles to the direction of wave travel. They are similar to light waves. The shear waves are also known as S - waves.

The rayleigh waves are the particles set into motion in circles along vertical plane. Love waves make particles oscillate along the lines in horizontal plane at right angles to the direction of wave travel. These two types of waves together known as surface waves or L - waves.

In order to understand the strength and severity of the earthquakes, it is necessary to measure its intensity. The intensity is measured by the effect of an earthquake on the seismograph or by the damage produced to the life and property. This was introduced by the Rossi and Forel, Italian seismologists and is referred to as Rossi and Forel scale. It consists of ten divisions. The higher the number in the intensity scale, the greater will be the effect of the earthquake. Another Italian seismologist put forwarded 12 divisions scale and it is known as Mercali scale or Richter scale in which the damage is 10 times higher between the successive points.

The earthquakes are classified on the basis of depth of the focus. Focus of the earthquake means the exact place of disturbance beneath the earth's surface and the vertical projection of focus point onto the surface of the earth is called epicentre. The deep focus earthquakes are those where focus is more than 300 km and the intermediate focus earthquakes are those whose focus is in between 70 and 300 kms.

The distribution of earthquakes on the globe is restricted to few relatively narrow zones. The greatest energy is released along a path near the outer ridge of the Pacific Ocean known as "Circum Pacific Belt". Another major seismic activity runs through mountain ranges that flank the Mediterranean Sea and continues through Zagros mountains of Iran to Himalayas of India. The third seismic belt extends for thousands of kilometers through the world's ocean. This zone coincides with the oceanic ridge system known as Mid Oceanic Ridges (MOR).

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Check Your Progress - 1 & 2

1. What is an Earthquake?

2. Name any two recent severe Earthquakes occurred in India.

Note : a) Write the answers in the space provided below.

b) Compare your answers with those given at the end of this unit.

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14.3.1. Earthquake Causes

In the early days, ancient people believed that the earth appears to be immobile and earthquakes occur whenever evil deeds exceeds on the earth. Later on Aristotle was the first man to propose the process oriented theory for the cause of earthquakes. He believed that the earthquakes resulted due to rumbling sound in the earth which were caused by hot air masses trying to escape from the hollowed outer parts of the earth's interior.

Recently the modern ideas came into existence by delicate, improved high sensitive seismic instruments. As a result new ideas developed to explain the occurrence of earthquakes in different parts of the globe. Generally the earthquakes occur as a result of Faulting and also due to volcanic activity.

The great San Francisco earthquake of 1906 was the first to explain scientifically by H.F. Reid who has formulated the "Elastic Rebound Theory". The springing back of the rock was termed as elastic rebound; the rocks behave elastically similar to a stretched rubber band. However the reported earthquakes in different parts of the globe were explained differently by geoscientists and seismologists. The reported recent earthquakes namely Uttarkashi earthquake on 20th October, 1991 in Garhwal Himalaya of Uttar Pradesh and Latur earthquake of 1993 of Maharastra have killed several people and damaged crores worth of property. The causes for these earthquakes were explained by geoscientists and seismologists as a result of faulting and can be ascribed to various tectonic events.

Recently the Government of India has proposed to construct the Tehri dam in Garhwal Himalaya of Uttar Pradesh which has created high debate and controversy among the geoscientists and seismologists in India and abroad. The basic reason is that the Himalayas are tectonically active mountain Belt and formed as a result of continent - continent collision of Indian and Eurasian plates around 65 million years. As a result many lineaments are reported to exhibit earthquake activity very frequently. The unplanned human activities accelerated earthquakes during recent years. This may be possibly due to the unplanned construction of dams and reservoirs, mining and artificial blasting together with nuclear tests etc. The relationship between artificial reservoirs and earthquakes was first discovered in Greece in 1931. The Marathon Dam in Greece first impounded water in 1929 and

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then in 1931 when the reservoir reached its highest level. The earthquake activity was always associated within these periods as a result of rapid rise in the water level of Marathon Dam.

14.3.2. Earthquake Predictions

The earthquake prediction is the recent branch of science and many efforts are going on to forecast the earthquakes so that the human lives can be saved by these catastrophic events. The earthquake prediction studies have revealed two new theories to explain the physical behaviour of rocks and materials associated with earthquake producing phenomena. They are 1. Dilatancy Diffusion Theory and 2. Dilatancy Unstability Theory. The tiny fractures will develop due to stress as a result of the volume expansion in the rock mass which is known as 'dilatancy'. The basic ingredient in both the theories is the occurrence of dilatancy as a result of rock strain in the earth's crust. The rocks that undergo the dilatancy will exhibit precursory events which are the signals for major earthquake events. These observations are important in the earthquake prediction studies. These are classified into four types.

1. Changes in seismicity
2. Physico-chemical changes
3. Landform changes
4. Animal behaviour

1. **Changes in Seismicity** : The change in the velocity of P and S waves are generally noticed in certain types of earthquakes. However, it may not be essential in all the earthquakes.

2. **Physico-chemical Changes** : The following are some of the physico-chemical changes generally observed as precursory events :

   a. Change in electrical resistivity observed as a precursory event and is generally depends upon the amount of water it possessess.

   b. A steep decrease in water level in the wells is usually observed.

   c. Emission of radon gas in the deep wells or even in fault zones is noticed.

3. **Changes in Landforms** : Most commonly anomalous terrain changes observed as a precursory event. For the first time the U.S. Geological Survey has noticed the provocative and perplexing uplift in an earthquake along San Andreas Fault Zone in California.

4. **Animal Behaviour** : Some of the animals are very sensitive to the earthquakes and are used as a precursory phenomena. This art of science is developed by the Chinese scientists. The close observation of these animals show erratic movements that might signal an impending earthquake. The following animals show erratic behaviour.

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* The cattle, sheep, mules and horses do not enter; Corals and rats move their homes and flee.

* Hibernating snakes leave their burrows early; frightened pigeons continously fly and do not return to the nests.

* Rabbits raise their ears and jumps aimlessly.

* Fishes are frightened and jump above the water surface.

(Source : Seismological Office, Tiensin, China 1973)

14.3.3. Control of Earthquakes

The control of earthquakes is the most important aspect. The following are some of the control measures for the earthquakes :

* Dewatering by extensive pumping operations along the fault zones; it will reduce the frictional resistance of the rocks along the fault plane.

* Nuclear detonations along the proved hazardous faults result in microfracturing which will absorb the build up stress, ultimately a single long distance displacement can be controlled. The legal ramifications of such actions is immense and so it is impossible for practical implementation.

Check Your Progress - 3 & 4

3. Write about the precursory events related to earthquake?

4. What are the controlling measures of earthquakes?

Note : a) Write the answers in the space provided below.

b) Compare your answers with those given at the of this unit.

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14.4. LANDSLIDES

Generally the landslides occur in almost all the terrains and in different climates. The landslides generally result whenever the shear resistance threshold exceeds in the earth material. The term landslide is used wherein the earth material is dislodged by falling, sliding and flowing. Even the rapid subaqueous gravity movements are also included in the category of landslide events. It is estimated that damages around $ 1 billion occur

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every year in U.S.A.. The occurrence of the landslides are possibly due to the increasing trend of urbanisation which forced the man from flat lying areas to flood plains lying adjacent to hill slopes. The hill slopes can help the man to avoid severe flood calamities which frequently occur in low lying areas. But the hill slope areas are hazardous due to unstable earth materials. Therefore it is essential to recognise the landslide prone topography and is important in landuse/landcover planning decisions for sustainable development.

14.4.1. Causes of Landslides

Generally the landslides occur when there is a loss of support under or in front of the shear surface or when there is a change in physico-chemical constitution of earth material.

Some of the causes of landslides are given below :

Internal properties of the earth's materials : It includes the degree of consolidation, and cementation, thickness and arrangement of different rock types; strike and dip of beds; and along major discontinuities; joints and other fracture bedding surfaces.

Geomorphic setting and environment : It includes the degree of relief and steepness of slopes; shape of land surfaces, vegetation and moisture conditions.

Independent external factors or triggering mechanisms : It provides immediate stress that initiated movement of the earth material. Generally an equilibrium exists between the earth materials and the geomorphic environmental set up. If disequillibrium exists in any one of them it results in the triggering mechanism.

14.4.2. Landslide Prevention

To assess landslide problems it is essentially needed a regional reconnaissance mapping of the area. Depending upon the preliminary surveys appropriate control and prevention methods have to be determined. Some of the landslide prevention methods are mentioned below :

1. Avoiding landslide prone area is the safest prevention method provided stable area is available nearby.

2. Water is the dominant ingredient for the cause of landslides. Therefore different techniques have to be developed in order to control landslides. The most widely known technique is the removal of loose earth material resulting in the stabilisation of hill slopes. This will prevent landslides and aid in the stabilisation of hill slopes.

3. Cracks and other openings are to be filled up with grouting in order to prevent the water penetration into the regolith or bed rock.

Check Your Progress - 5

5. Define the Landslide and mention the factors responsible for Landslides ?

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14.4.3. Control Measures for Landslides

Landslide control is essentially needed in order to minimise the damage due to landslides in the slopy region. To control the landslides of any region, one has to observe the following two aspects :

1. Try to decrease the developed stress within the earth material of a given area.

2. Develop some techniques to increase the shear resistance of the earth materials.

If appropriate scientific techniques are applied to above mentioned remedial measures it will control landslides in any geomorphic terrain.

14.5. ROLE OF VOLUNTEERS

The role of volunteer organisations are important to mention in this unit. These organisations are generally render their help in the natural disaster prone areas *viz.*, earthquakes, landslides, floods and man made disasters etc. The international volunteer organisations namely REDCROSS and UNESCO are actively participating all over the world.

In India, especially the recent earthquake affected areas like Uttarkashi, (U.P.) and Latur (Maharastra) the immediate rescue operations were carried out by Indian army. They saved thousands of lives by providing primary medical aid to the injured.

The above mentioned international volunteer organisations together with Indian volunteer organisations have provided free medicines, clothes and primary basic amenities. Resettlements were also made in the later stages. The low cost housing plans were introduced by the scientists which will be minimised the net loss due to earthquakes in future.

Check Your Progress - 6

6. Name any two important international volunteer organisations.

Note : a) Write the answer in the space provided below.

b) Compare your answer with the one given at the end of this unit.

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14.6. TRAINING POPULATION

The earthquakes frequently occur along the fault zones. But the fault zones and other regions of earthquake prone regions have to be selected by volunteer organisations. In such places these organisations have to come forward to train the population about earthquakes awareness programmes.

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The following are some of the earthquake awareness programmes which are to be implemented:

1. The people should come out of their houses and should lay down on the open grounds available nearby.
2. They should not stand nearby walls and the multistoried buildings.
3. The power lines should be switched off.
4. The moving vehicles should immediately be stopped.
5. Concrete building structures are not advised to construct in the earthquake prone areas.

Some of above said precautions among the people may reduce the human loss, however may be the intensity of the earthquake.

14.7. LESSONS FOR FUTURE

The earthquakes and landslides are the natural disasters. In these areas, the sufferers are the living things. They also damage the property. The historic record reveals that in India many earthquakes have occurred in different states (See Seismological Bullettin, National Geophysical Research Institute, Hyderabad or Seismological Bullettin of United States of America). These natural disasters provided a bitter lesson for the future to the affected areas. The memories of such earthquakes are still with the people who were survived by these earthquakes.

It has provided the following lessons for the future :

* Concrete structures are not recommended along the fault zones.
* Approved designs for the houses in the earthquake areas have to be adopted so that the future damages may be minimised.
* Settlements should be shifted to the safer areas available nearby.

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14.8. SUMMARY

Volcamic activity, earthquakes, landslides and floods are the natural calamities and these cause damage to the life and property. Among these natural disasters Earth quakes and landslides are the most fearful and cause havoc to human civilisations.

An earthquake is the vibration of the earth due to the release of energy and it radiates in all directions from its source. The earthquake generates different types of waves and they are longitudinal waves, shear waves, rayleigh waves and love waves. The study of these waves is called seismology. The intensity of the earthquake is measured on the Rossi and Forel scale which has 10 numbers. The higher the number, the greater the effect. The intensity depends upon the acceleration produced by the seismic waves referred to as Mercali scale or Richter scale. Generally the earth quakes occur due to faulting and also due to volcanic activity. The earthquakes can be predicted due to the several observations such as changes in seismicity, physico-chemical changes, Land-form changes & Animal behaviour. The earthquakes can be controlled by extensive pumping operations along fault zones, nuclear detonations along the proved hazardous faults etc.

Landslides generally occur in almost all terrains and in different climates. The disloding of earth's material by falling, sliding and flowing is called landslide. It is estimated that in each year the damage due to land slides in USA is $ 1 billion. Internal properties of the earths materials, geomorphic setting and environment & independent external factors are the main causes of landslides. Avoiding landslide-prone areas for living, removal of earth material resulting in the stabilisation of hill slopes, filling up of cracks and other openings with grouting to prevent water penetration into the regolith or bed rock are some of the landslide prevention methods. To control landslides one has to decrease the developed stress within the earth material of a given area & develop techniques to increase the shear resistance of earth materials.

14.9. CHECK YOUR PROGRESS : MODEL ANSWERS

1. An earthquake is the vibration of Earth produced by the release of energy.

2. The recent severe earthquakes occurred in India are the Uttarkashi earthquake of Uttar Pradesh and the Latur Earthquake of Maharastra.

3. The precursory events for earthquakes are : (i) Change in Seismosity (ii) Physico-chemical changes (iii) Landform changes and (iv) Animal behaviour.

4. The controlling measures for earthquakes are : (i) Dewatering by extensive pumping along the fault zones, and (ii) Nuclear detonation along the proved hazardous zones.

5. Landslides can be defined as the displacement of the earth material by falling, sliding and flowing. The possible causes for such action may depend upon the internal properties of the earth materials, the geomorphic setting and environment and the independent external factors.

6. The REDCROSS and UNESCO are the two international volunteer organisations.

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14.10. MODEL EXAMINATION QUESTIONS

I. Answer the following questions in about 30 lines each.

1. Define Earthquake and write about the causes and control of Earthquakes.
2. What are landslides. Explain their causes and write down the control measures.

II. Answer the following questions in about 10 lines each.

1. Define Earthquake predictions.
2. Explain the role of volunteer organisations.
3. Write down the necessity of training programmes during earthquakes and landslides.

Dr. M. Jafaruddin

UNIT - 15 : FAMINES AND FLOODS

Contents

15.1. OBJECTIVES

After going through this unit you will be able to :

- define natural disaster,
- describe the causes of floods and famines,
- give some of the case studies of famine and floods,
- describe some of the development strategies at the National level,
- analyse the remedial measures, and
- describe role of Voluntary Organisation/NGO's in relief and restoration works.

15.2. INTRODUCTION

Natural disaster adversely affect the lives of large number of people and cause considerable damage to property world-wide, especially in the developing countries year after year. This fact has engendered global keeness to prevent occurrence of natural disasters and to mitigate their impact. Keeping this in view, the UN General Assembly has declared the decade of nineties as International decade for National Disaster Reduction and has called for concerted global action for reducing the occurrences and minimising the adverse effects of national disasters. The UN General Assembly has also disignated the second Wednesday of October every year as the International day for Natural Disaster reduction.

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Development strategies are, therefore required to be pursued for various disaster reduction programmes in order to achieve the goal of sustainable development. It is well recognised that human activities can significantly alter the natural forces which are responsible for such disasters.

The Asia and Pacific region faces 60 per cent of the natural disasters occurring in the world. India is a major disaster-prone country in the region. Due to its geographical situation and climate conditions, India is affected by one or the other form of natural disasters every year. Of all natural disasters, the more important are drought, floods, cyclones and earthquakes to which the country is frequently exposed and which cause extensive damage to life and property. Areas vulnerable to these disasters extend over 84 per cent of the geographical area of the country. India was affected 144 times and tops the list among the Asian Countries.

'Disaster' denotes any odd event, be man made or natural, which brings about sudden and immense miseries to humanity with great surprise and intensity on a very large scale, causing loss of life, destruction and damage to properties and blocking the enormous productivity efforts of the country, either completely or partially.

In the tropical and sub-tropical regions of Asia, particularly in India the Vicissitudes of droughts and floods are common. The effect of droughts is continuous and prolonged, while that of floods is devastating, but instantaneous and short lived. There is a greater scope to mellow down the effect of droughts occurred due to failure of rainfall whereas the floods involves excessive rains which may be caused by cyclones or flash floods. Both the calamities brings about untold misery to the community at large and the damage done to agricultural systems is generally more serious. More often the crops fail, the tree component is devastated and the livestock seriously damaged.

The disasters are mainly divided into two major groups, i.e., (a) man-made and (b) natural.

(a) Man-made Disaster

(1) Ecological disturbances like deforestation and its allied related problems like soil erosion, land slides etc.

(2) Nuclear explosion/accidents etc.

(3) Wars/Arson/Sabatoge/Internal disturbances.

(b) Natural Disasters/Calamities

(1) Wind based : Cyclones, Tidal waves, Storms etc.

(2) Water based : Flood, drought, excessive rains etc.

(3) Seismic : Earthquake

(4) Ecological : Flash floods and land slides etc.

The increase in the frequency and the number of natural disasters is attributed to a number of man-made factors. The build up of carbondioxide and other heat trapping gases in the atmosphere, which is known as "Greenhouse effect", may bring about truly catastrophic consequences ranging from prolonged drought to rise in the sea level. The afformath of natural disaster is all pervasive. Besides injuring and killing human beings and the livestock,

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they affect services essential for human survival, such as water supply and sanitation and severage facilities. They can also change environmental conditions in many ways because environment and disasters interact closely.

The importance of this can be realised from the fact that about 85 per cent of the country is prone to one or the other disaster. The drought prone area constitute 68 per cent of the total sown area. The flood prone area is estimated to be 40 million hectares, of which annually on an average 8 million hectares are affected. A long coastline, of 5700 km. is exposed to hazards of tropical cyclones. More than half of the total geographical area of the country is vulnerable to seismic activities of varying intensity.

15.3. FAMINES

The word 'Famine' has been defined in various ways. The Chambers Twentieth Century Dictionary defines famine as 'a general scarcity of food - extreme scarcity of anything'. According to the Encyclopedia of social sciences, "Famine is a state of extreme hunger suffered by the people of a region as a result of the failure of the accustomed food supply". The main cause of famine is the failure of basic food crops due to a failure of the monsoon. But famine can be caused only by a succession of season of drought.

Droughts are one of the most serious natural hazards to mankind. They have been the root causes of famines in many parts of the world and more so in our country, where agricultural success and prosperity are vitally dependent on the amount and distribution of rainfall. Droughts are usually defined as periods of dryness due to lack of rainfall though the concept varies from one place to another depending upon the normal climatic conditions, available water resources, land use, agricultural practices and various other economic activities of the region.

India, with its diverse climates because of its strong dependence on monsoonal rainfall experienced in the past several famines of both widespread and local nature. Historical evidences, however, has pointed out that no single drought that affected our country as a whole though in exceptional years like 1877, 1899 and 1918, a major portion of the country was striken by famines following rainfall failures. The North India suffered from droughts of a more frequent and severe nature during the early part of the present century, whereas in South India droughts occurred only in the latter decades of the century.

Drought in its varying intensities has become almost an annual feature ravaging one part or the other of the country. The devastating consequences of economic loss and social deprivation of drought have been well documented since late 1880, but the approach to the problem remained marked by relief measures to keep the affected population alive. Inspite of huge resources spent on these measures the impact has been ephemeral.

The drought and floods are like twins in Indian agriculture and it is very true even today in spite of advances in Science and Technology. The success and failure of Indian agriculture is intimately connected with the occurrence of monsoons. Rain water has not been properly conserved either to provide water to the thirsty lands or to control floods in floral prone areas. The uncertainity of rainfall is the biggest challenge to the Indian agriculture.

The Irrigation Commission assuming that districts which receive less than 75 cms of rainfall per annum are liable to drought. There are 50 districts accounting for one fourth of the cultivated area of the country which could be considered as vulnerable to drought.

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There are in addition another 22 districts in Maharastra, Gujarat, M.P., Karnataka, Rajasthan and U.P. accounting for 9 per cent of the cultivated area of the country which gets between 75 to 85 cms of rain. The only regions which are not vulnerable to drought are Assam, West Bengal, the West Coast and certain parts of Central India.

The hard core areas of drought comprise about 16 per cent of the total geographical area of the country. Most of the areas susceptible to drought clearly fall within arid and semi-arid zones of the country. If the rainfall tends to decrease by more than 30 per cent over the mean, those areas are classified as drought-prone. In India 60 million hectares in 72 districts declared as drought prone.

Many of the great famines in South India have been caused by droughts covering a periods of years e.g., 1876-78 and the famine of 1896-98. There were a number of successive famines from 1805-1861, the most being the Guntur famine of 1833. The famine of 1861 strike parts of Agra, Punjab, Rajasthan and Kutch region of Gujarat. The next famine fell on the whole of the East Coast from Madras to Orissa with an area of 1.8 lakh sq. miles with a population of 4.75 crores, but distress was greatest in Orissa. The position was not grasped till the end of May, 1866 by then the monsoon was set in. The famine of 1876-78 was the most widespread and the most prolonged that India had ever experienced. It is in fact known in history as the "Great famine of South India". The area affected was 84.36 sq. miles with a population of 1.93 crores. The chief cause of famine was the failure of both the monsoons during 1876. The recurrence of famine in 1899-1900 led to the appointment of a commission presided over by Sir Anthony MacDonnel, whose own relief measures were successful. The construction of irrigation schemes which would provide water, independent of rain was effective measure of prevention of droughts and famines. The cheap and rapid means of communication made it possible to meet the deficit in one part from abundant supply of another part. The sinking of well, building of tanks and canals and accumulation of rain water in artificial irrigation was another effective measure of prevention. In a large part of the country extensive projects of this type had been carried out and to that extent the horrors of famine were reduced. The later half of the 19th century witnessed marked change due to increased transport facilities. During the famines the areas of scarcity and distress were ensured with grains and other forms of help from the rich districts. This is mainly due to the progress of science and mechanisation.

In Andhra Pradesh, the western and north western parts of Rayalaseema are more prone to drought than the rest of the area. Anantapur is classified as the hard core drought district followed by Kurnool and Cuddapah. The probability of drought occurrence in most part of the Anantapur is once in 4 years, whereas in Kurnool District it is once in 5 or 6 years and Cuddapah it is once in 7 years. About 36 famines have occurred over a period of 183 years from 1790 onwards.

15.3.1. Spatial Distribution

Seventy two districts have been identified wholly or partly as drought prone. These are distributed all over India in 13 states. However, they are concentrated mainly in the western and central zones covering Rajasthan, Gujarat, Haryana, Maharastra, Karnataka and Andhra Pradesh. The drought prone districts are distributed in three distinct rainfall zones, namely (1) Arid zone, where the average rainfall is below 375 mm. (2) Semi-arid zone where the rainfall is between 375 mm. and 750 mm. and 3) Sub-humid zone where rainfall is between 750 mm. to 1125 mm.

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In these areas land productivity levels are very low, grossly inadequate grazing lands, soils are poor in nutrients and shallow, except in some black soil belts. Rainfall is erratic and ill dispersed with fairly widespread rainless periods with crops reduces crop yields drastically. Conservation of extensive areas of shrub forests or grazing land areas into arable lands has also decreased, no trees or shrubs are allowed to grow. Human beings and animals are jointly destroying vegetation and hastening the process of desertification.

Irrigation is much less. Major source of water is monsoonal precipitation, which creates potential for surface control of run off and also recharges the ground water acquifers. Due to scanty precipitation recharging for ground water acquifers in the districts of Andhra Pradesh, Rajasthan, Karnataka, Maharashtra and Gujarat is comparatively slower than the discharges.

As compared to other areas, the drought prone tracts are more vulnerable to ecological degradation, leading to an expanding economic dependence and social deprivation. A strategy for development of such areas is therefore essential. The main emphasis was on keeping the population alive through relief measures and creation of some protective assets like irrigation tanks/small canal system like Tungabhadra system in Rayalaseema, Ganganahan canal system in Rajasthan.

Economically the drought prone areas, have a fairly large impact on the nations total food economy. These areas are major contributors in groundnut, bajra and jowars. These crops account for about 25 to 30 percent of the total national production. Apart from contribution to the grain economy, these areas are also major livestock tracts, providing the country's best drought and dual purpose breeds. The drought tracts alone constitute to percent of the total sheep population of the country.

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15.3.2. Case Studies

The study of drought proneness of A.P. reveals that during 73 years of study, Anantapur, Cuddapah and Kurnool are the worst effected areas of the State. Out of 26 years of study 13 years of Anantapur were the drought years. This shows that among the 3 regions Rayalaseema is greatly liable to droughts in A.P. The drought proneness is increasing towards Southern districts of A.P. with highest percentage in Anantapur and Cuddapah districts. Anantapur is classified as the hard core drought district followed by Kurnool and Cuddapah. The probability of drought occurrence in most part of the Anantapur is once in 4 years. Whereas in Kurnool district it is once in 5 or 6 years and Cuddapah it is once in 7 years.

The study of drought proneness of Karnataka reveals that a zone extending from Bijapur in the north to Kolar in the South comprising of 111 talukas in Bijapur, Belgaum, Gulbarga, Raichur, Chitradurga, Shimoga and Kolar districts. In this zone these areas had an annual rainfall of less than 600 run are identified as core drought area. The hard core is found to occur in patches covering Chitradurga, Dharwas and Belgaum districts. These talukas were identified on the basis of rainfall, soil conditions and aridity etc.

Droughts are not new to Maharastra. The state has witnessed 56 severe droughts since 1801. During 1965-1975 as many as 5 famines occurred. Nearly 1/5 of the total population of Maharastra was affected by the drought and about 5 million people living in 5281 villages came in the grip of the drought. The districts affected were Ahmedabad, Osmanabad, Bhir, Jalgaon, Thane and Solapur lie in the core of the chronically drought prone areas and have been traditionally suffering areas in this regard. These districts lie in the rain

shadow of the Sahyadri and in the heart of the Deccan Plateau. The droughts in Maharastra are so disastrous that besides creating unemployment they bring diseases, malnutrition and starvation. Thousahds of deaths are reported during droughts due to starvation and malnutrition and diseases.

In Madhya Pradesh the western part lying in the rainshadow effect of the maikal range and the South eastern tip of the region have the greatest probability of drought. The west central part of the region covers the northern part of Raghandgaon district, NW part of Durg, SE tip around Deobhog in Raipur district. The North east portion which cover most of Raigarh district is the least drought prone area of the region.

The study of Tamilnadu drought prone areas reveals that the rainfall decreases from the coastal lands towards interior. Forty percent of Tamilnadu receive less than 600 mm. rainfall is described as semi arid zone. The areas which are affected by adverse conditions marked by low rainfall zone such as : a triangular area encircled by coimbatore, Karus and Palani. (2) Uthamapalayam, Virudhunagar and Sivagiri and Tuticorn and Kulasekharapatnam. The droughts have high irregular trend within the same place. The drought years very rarely occur contiguously

The state of Rajasthan is situated in the NW part of India is well known that it has less rainfall than other parts of India. About 60 percent of the state comes under arid condition. All the districts of western Rajasthan comes under drought prone area. The districts of Ganganagar, Jaisalmer, Jodhpur, Barmer and SE of aravali are facing acute and frequent recurrence of drought.

15.3.3. Development Strategies at National Level

The district level information would provide first approximation for spatial differentiation and grouping of districts on the basis of rainfall and irrigation and crop region. Such analysis would serve to evaluate the problems of development of drought prone areas. Socio-economic characteristics and major development activities should also be quantified with district as a unit and aggregate it at National level. Such an approach would lead to development strategies at sub regional level e.g., Rayalaseema region of A.P.

The development strategies for Rayalaseema region should focus on : (1) need for extensive development of tank irrigation (2) low land productivity areas away from water resources (3) Demarcation of areas for grass land : afforestation in wastelands and rock wastes. With the help of large scale tops graphical maps and surveys, an attempt has been done for land use planning with water scarcity as the focus of attention for long term planning.

Land capability, settlement and population pattern for which future strategy is spelt out at the regional levels leads to preparation of spatial development plan in which priority areas and sectors of the plan are identified.

Improvements to existing irrigation tanks, wells, dams, canals, should be carried out to prevent wastage of water through structural deficiency, inadequate storage capacity and seepage. In areas of low ground water and precarious well irrigation special attention should be given to the construction of percolation tanks and check dams. Areas with accute scarcity of water, economic use of water should be ensured through drip and sprinkler irrigation and finally improved water harvesting practices should be propagated in drought prone areas.

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As forests play a role in ameliorating chronic conditions of drought by reducing excessive levels of temperatures, conserving moisture and also supply wood and other produce, afforestation programmes must be implemented wherever possible. Vigorously grassland and fodder development programme should be adopted and through this the existing gap in the fodder supply in these areas must be bridged.

For preparing the detailed development plan, it might be desirable to proceed on the basis of individual watersheds, as it is the most suitable unit. The adoption of watersheds as the units of development was mainly intended to facilitate optimum utilisation of land water resources according to the ecological principles. Deliniation and identification of watersheds for development was only to be the first step.

Afforestation and pasture development will have to be received priority in order to increase the vegetative cover of the land and to promote the ecological quality. Afforestation will cover some of the waste lands and scrub forest lands. This prevent soil erosion, preserve soil moisture, fodder to animals and forest based industries. Sericulture can also be introduced in a small scale in some regions under the tanks along with subsistence crops. Some areas can be allotted for raising pastura. The direct benefit is derived through dairy development. The spread affect will bring an all round development in the region.

In the recent years, however, a beginning has been made towards a scientific approach to the problem of drought with a view to arrive at permanent solution to the problem. It is increasingly realised that the stability and prosperity of Indian agriculture are intimately related to finding lasting solutions to the problem of drought. There is a great need for bridging the gap between the scientific knowledge of drought and drought prone areas on one hand and the application of their knowledge into appropriate policy measures on the other.

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Development of Drought Prone Areas (Long Range Solutions) : There is to be found a great scarcity of perennial rivers in these areas. A great stress need to be laid on developing irrigation in these areas through smaller works like anicuts, bandharas, tanks and dug wells. Though percolation tanks and check dams do not provide direct irrigation, they do contribute to firm-up and augment supplies in nearby wells and thus irrigation may be facilitated.

Dry Farming Technology : Dry farming methods including conservation technology should be popularised so as to conserve as much natural moisture as possible.

- To capture and retain as much rainfall as possible. For this, depending upon the soil type, a suitable tillage and moisture conservation technology has to be introduced. Low cost water reservoirs may be constructed for water storage. The new water harvesting technology has to be introduced in graded steps.
- To develop a crop variety which grows quickly after sowing. Two crops can be grown in the place of single long duration crop even in the climatically bad years.
- Livestock and pasture development.
- If the above measures are taken, there is likely to raise in the cropped area.
- **Soil and Moisture Conservation** : The soil conservation measures such as contour bunding, furrowing, terracing and levelling have naturally to be part of the programme.

- It is necessary to stress the role of forests. In several drought areas, there has been indiscriminate felling of trees for fuel and this, in turn, has adversely affected the soil and agro-climatic situation. Afforestation programme is, therefore, conceived as an important element of the programme.

- To ensure the optimum use of soil moisture, it is necessary to choose crops which have a deep root system and have the capacity for establishing roots in deeper layers of the soils. Non traditional crops like sunflower and castor which are drought resistant have to be adopted. Besides grasses, non-conventional crops are promising for stabilising production on dryland.

- **Limestone Development** : In the drought-prone areas, the strategy of development is structured mainly around animal husbandry. In some of the districts, particularly in Rajasthan, there are cattle of reputed breeds. But grass and fodder resources are dwindling. Every alternative year, a number of cattle perish on account of drought. For development of animal husbandry, pasture lands are a pre-requisite. A portion of the village common lands should be developed to serve as fodder banks. Further, these fodder crops can also be developed around sources of irrigation.

- Many of the drought prone areas offer considerable scope for the development of sheep husbandry. These areas have a sizeable sheep population but they are often of low genetic potential and suffer from malnutrition on account of poor quality of foliage.

- In the drought prone areas special provision for the benefit of the small and marginal farmers and agricultural labour to be made under the programme.

- It is necessary that the integrated development plan for each drought prone district is very carefully drawn-up, after making proper survey and proper resources inventory of the district.

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In the country, Rainfall varies from as low as 100 mm per annum in Thar desert (Rajasthan) to more than 2000 mm in eastern states like Assam, Meghalaya and West Bengal. Nearly 107 million hectares or about 33 percent of the area and 29 percent of the population are affected by drought. The drought during 1987, an eye opener for all concerned, resulted in the reduction of about 15 million tonnes of food grains output and the inflation rate was about 11 percent.

In 1987, the total Bovine population effected by drought was 120.4 million of the total 214.3 million. The Government tackled the situation through provision of forest grasses to the extent of 38,000 tonnes and encouraging the fodder production in about 1,76,000 hectares. Further, in the more severely affected areas, about 2200 cattle camps were organised involving about 1.7 million cattle. These efforts are further augmented through regular fodder supply and providing top feed in the lean period by afforestation of pasture lands.

The small land holding farmers and the landless labour will be the most affected under drought situation. These farmers are affected as their land will be of poor quality, unable to hold much water. Since agriculture in general is affected, the agricultural labour will be last with little earnings. To meet the gap in income generation, the Govt. of India created about 1,20,000 works of afforestation, soil conservation, irrigation, roads and buildings involving about 6 million people, spending Rs. 6240 million. Inspite of these effects, there are people going hungry during drought years, owing to either lack of purchasing power or lack of availability of materials.

The Government is tackling the situation under the programmes of : (1) Pilot project for dry land farming (2) Desert development programme (3) Crash programme for rural employment (4) Drought prone area programme (5) Watershed development programme and (6) Afforestation programme.

15.4. FLOODS

Natural disasters in India have ranged from rampaging floods, when rivers have sought to extend their watery grip over large land areas, to scorching droughts, which have left in their wake festering sores upon once fertile lands. Floods however, have occured in the country more frequently.

Floods are a major cause of human misery in India every year. Out of 96 internationally recognised natural disasters, the country experienced between 1960 and 1980's, 28 floods, earning the nation unhappy distinction of being the most flood affected country after Bangladesh. The statistics show that between 1953 and 1987 about 57,000 people died in floods at an average of about 1500 deaths per annum. During the same period floods affected an average of 7.66 million hectares, affected 31.84 million people, damaged 1.2 million houses and caused damage to crops, houses and public property worth Rs. 768 crores per year.

Floods, often described as natural disaster, turn out to be social disasters as well, tending to choose their victims by class. It is usually the poor who are severely affected because they live on the periphery of the human habitat. An event, which would not result in the loss of many lives in the affluent north, often results in a major disaster, when it takes place in the south.

The floods are a phenomenon older than the cities that exist on the banks of the rivers in the Indo-Gangetic plain and the art of flood control is an ancient one in India. Large scale measures to control floods were only undertaken after independence and that too after the floods in Bihar in 1954. A corresponding jump in flood relief expenditure and an alarming increase in flood affected area, despite protection, makes it obvious that flood control measures have failed to deliver the goods.

15.4.1. Flood Prone Area

The most clinching evidence of floods having increased as a physical phenomenon comes from the increase in the flood affected area. The flood affected area increased from an annual average of 6.48 mill. ha. in 1950's to over 9 mill. ha. during 80's. This increase is definitely an indication of the country's growing flood proneness.

The national commission of floods took the maximum areas affected by floods in a state, in any year, as its flood prone area and added up the flood prove areas of all the states to get the flood prone area of the country. The commission put the country's prone area at about 58 mill. ha. This report reveals that a rapid increase in flood proneness in just over a decade.

The most flood prone basins are those of the Ganga and Brahmaputra in Uttarpradesh, Bihar, West Bengal and Assam followed by Vaitarani, Brahmani and Subarnarekha basins in Orissa. These five states are the most flood prone. Floods were also experienced in Andhra Pradesh, Rajasthan, Haryana, and Gujarat after 1976 onwards.

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Floods had increased more because of human factors, like deforestation, drainage, congestion caused by badly planned construction of bridges, roads, railway tracks and other developmental activities, reduction in infiltration because of increased occupation of land by industries and large scale urbanisation and construction of embankments along rivers. These damages increased because of the increased flood incidence and encroachment of the flood plains.

15.4.2. Causes of Floods

Floods are the combined results of natural, ecological and anthropogenic factors. The Brahmaputra river causes deforestation and shifting cultivation in the adjoining hills. Some of the experts believe that geological processes, which cannot be stopped, constitute the major factor. The Brahmaputra area is earthquake prone and the river has a tendency to create flood problems by creating drainage bottlenecks.

The scientific studies do show that floods are inherent to the ecological setting of the northeast and human beings can do precious little to prevent or control them; there is no doubt that unthinking human intervention has increased the vulnerability to floods over the years.

The construction of embankments has had a disastrous impact. The embankments have adversely affected the river's morphology. The embankments also seem to have increased the flood levels. Drainage congestion has become a particularly significant problem in Bihar with the construction of embankments as it fails in a heavy rainfall zone and consequently has a huge runoff. With riverbeds rising after embanking, the protected area along the embankment on the river Kosi and Gandak is getting water logged. Apart from embankments, communication net work like roads and railways, which have inadequate provision for water ways, have played a major role in creating this problem.

During first plan period in 1951 it was decided that the construction of large dams to store these flood waters is the most effective way of preventing flood damage. Dams were conceived on the flood prone rivers of damoder, Mahanadi and Kosi. In 1954, came a spate of severe floods - one of the worst in the country. All Northern rivers flooded simultaneously and led to enormous devastation across U.P., Bihar, West Bengal and Assam. The severe floods attracted public attention to the inadequacy of flood control measures.

There are 410 large dams with a height of 15 mts. and above are in completion or under construction. Many of these are supposed to provide multiple benefits like water, electricity and flood control. These dams have often have to make panic discharges which can create massive floods downstream, especially as rivers at that time are also brimming with monsoon floods. The devasting September, 1988 floods in Punjab followed exactly this pattern. Panic discharges came from the dam added to streams in full and led to a flood that affected vast areas which affected over 4.3 million people in Punjab. Even in 1978 also heavy discharges caused affecting an estimate of 65,000 people in Punjab. The West Bengal floods where 10 districts and 3 million people were affected in September, 1978 were also attributed to the proper maintenance of the dams.

Most of the dams in India are multipurpose dams. As a flood control measure, the reservoirs have to be kept as empty as possible to arrest any oncoming floods, but for irrigation and power generation, the reservoirs have to be kept as full as possible. Since the reservoirs are not kept empty, with the onslaught of rains dams themselves have some times become major causes of floods.

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15.4.3. Case Studies

The Hirakud dam in Orissa was one of the first multipurpose dams with flood control as primary objective. Before the dam, the major form of flood control in the Mahanadi delta was embankments. A study of Hirakud dam reveals that the normal floods came once in 3 years, fairly heavy floods once in 5 years and abnormally heavy floods once in 12 years. The share of very large floods went down from 76 percent to 42 percent after construction of dam. The dam has had a positive impact.

The flood prone vamsadhara which broke all its bunds in September, 1980 form a drain basin covering part of Andhra Pradesh and Orissa. Floods in Vamsadhara are mainly due to rainstorm arising over Bay of Bengal. The water gets diverted for irrigation purpose by the Gotta barriage. The 1980 floods, defied all calculations as the river flows reached unprecedented levels. The damage costs were of the order of 130 crores. Earlier floods in 1938, 1972 and 1977 took an almost identical but only it varies quantum of discharge and height of water levels.

A study of peak floods in Yamuna river reveals that during 1900-1960 floods occurred in 17 occasions. The worst floods in memory in 1924, 1947, 1955 and 1956 were caused by monsoon over the Punjab-Kumaon, Himalaya. The 1968 floods remain the biggest in recent years. The 50 km. road between Silgural and Darjeeling was cut in 92 places and 20,000 people were killed, injured or displaced. Numerous bridges were washed away and rail traffic was closed for 32 days.

The Brahmaputra basin is one of the most flood prone basins in India. The 19th Century saw massive floods in Assam. Between 1953-84 an average of 0.8 mill. ha. were affected by floods every year. The maximum area affected was 5.68 mill. in 1984. The 1988 flood affected 4.22 mill. ha. were over the earlier periods and people affected was also very high at 12.68 million. Since 1986, floods have turned from bad to worse. The 1986 floods were said to be the worst in memory. But the floods in 1988 turned out to be even more devastating. In normal years, 2000 villages were affected, but in 1987 and 88 the number was 7290 and 8770 respectively.

Check Your Progress - 1 & 2

1. What is disaster?

2. What are the soil conservation methods?

Note : a) Write the answers in the space provided below.

b) Compare your answers with those given at the end of this unit.

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In the tropical and sub-tropical regions floods are not uncommon. They occur due to many reasons, both anthropogenic and natural.

Man-made Floods : Among the man-made floods is the large scale of deforestation in the catchment areas of the major rivers which leads to large scale flow of water to the plains causing floods and inundation of the area. The water recedes with time partly through the natural drainage (river) systems and partly through evaporation. The extent of flood affected area in the valleys of Assam, plains of Bihar and Eastern Uttar Pradesh is 4.8 mill.ha in the Ganga and Brahmaputra basins. Gradual expansion of industries makes the country vulnerable to industrial hazards. While social and ethnic problems results in various types of man-made disasters.

Natural Floods : The natural causes includes cyclones and flash floods and the resultant devastation. e.g., Andhra Pradesh has a coastline of 1030 km and one or two cyclones are common every year. The last 97 years data indicate that this coast line experienced 67 cyclones. They occur mostly in September - December, but some occur in April - May as well.

The cyclone havoc in 1977 is caused by high speed winds (e.g., in May 1990 it was 250 km/hour). This leads to tidal waves upto 4 mts. height reaching the coastline and intruding upto 10km inland in some areas. The rainfall would also be very high (e.g., 300-500 mm over 3 days in May, 1990). Due to these cyclones during November, 1977 and May 1990 there was heavy damage caused to various things such as Irrigation canals, minor irrigation systems, streams and rivers were flooded, saline water entered into all the drinking water tanks, roads and bridges were washed away in many areas, electricity supply was severely effected, standing crops were destroyed, thousands of livestock, people and poultry died in a large number, fisherman suffered badly, many fish water and brackish water prawn ponds were damaged and houses were badly damaged.

The damage to major crops such as paddy, legumes, peanuts, orchards, mangoes, livestock etc. worked out to be Rs. 4652.2 millions. These includes infrastructure and other items too.

Several floods occur almost every year in part or the other causing tremendous loss of life, large scale damage to property and untold misery to millions of people.

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About 40 million hectares (one-eighth of the country's geographical area) is flood prone area. The total area affected annually on an average is about eight million hectares. The cropped areas affected annually is 3.5 mill. ha. and was as high as 10 mill. ha. in the worst year. On an average 1439 lives are lost every year due to floods. As many as 11,316 lives were lost in 1977 alone. The total loss on account of flood damage to crops, houses, cattle and public utility was estimated at Rs. 26,800 crores during 1953-87. The maximum flood damage was estimated to be Rs. 4059 crores in 1985.

Most of our rivers are perennial rivers fed by snow from Himalayas. When the rain comes, the volume of water flow into these rivers naturally increases, but it does not necessarily mean that it will cause floods. If the catchment of the river is well forested, most of the falling rain is absorbed by the soil and released slowly by natural springs and small streams thereby regulating the inflow into the river. But if the forests are cut down indiscriminately and the soil is laid bare, not only does the rain water gush down the barren slopes but also carries with it soil which, with no vegetation to hold it together. (1) So, when forests are cut down in the catchment, the flow of water increases several times during the rainy season. (2) The silt laid by the river increases which gets deposited in the downstream raising riverbed gradually, which leads to the increase of inflow in the upstream which leads to flooding in down stream (i.e., cutting down of trees in the catchment of the river, can trigger a chain of events leads to a natural disaster).

Most parts of Tamilnadu are susceptible to one kind of natural disaster or the other. Nine out of 22 districts of Tamilnadu are situated along the east coast stretching over 940 kms. These coastal districts often face cyclones and floods. Since beginning of the century nearly 400 cyclonic storms cut the Tamilnadu coast, of which 15 were severe. Thanjavur, Tiruchirapally, South Arcot and Tirunelveli districts are affected by floods in major rivers. Ramanathapuram and Dharmapuri districts are chronically drought affected. During last 30 years the state experienced severity of natural calamities 15 times (1970, 71, 72, 73, 75, 77, 78, 79, 80, 81, 83, 88, 90, 91 and 1992).

BRAOU

These natural calamities adversely affect the developments in several ways. The agriculture sector is affected by the submergence of vast area of standing crops, plantations etc. leads to decline in agricultural production, sand silting in croplands and wells. Fisherman affected by damage caused to their fishing crafts and nets. The rains and floods damage houses rendering the poor homeless. Infrastructure facilities such as roads, bridges, culverts, electricity, public buildings, drinking water source etc., get affected.

In the case of drought the impact is slightly different. Scarcity of water reduces the acreage under crops. As a result of decline in production, agricultural labour faced chronic unemployment, scarcity of food grains and rising prices add to their lives misery. The animal husbandry sector affected by the scarcity of food and water. The adverse effects of drought would be widespread and intense if the state of Tamilnadu has to experience prolonged dry-spells.

Role of Voluntary Agencies/NGO's

When such natural calamities occur, the Government machinery geared up to undertake relief and restoration work. It is essential for them to secure the support and Co-operation of voluntary organisation/agencies and humanitarian organisations as well as student communities in the relief work, particularly when the damage is extensive. It may be mentioned that in the relief work of Divi-disaster of Andhra Pradesh in 1977 and in the relief operation in the Garwal region when an earthquake shattered the Uttarkashi in 1991 and Lathore in 1993, a

few humanitarian organisations rendered service in the relief work. Similarly, the student community could also be involved in providing service to the victims of the natural disaster. The social service league, NSS Volunteers and NCC could be utilised in the relief operations.

The NGO's actively participate in maintaining cattle camps. They also helped in running free feeding centres besides assisting in ground water exploitation. They also helped in making water available to both human beings and livestock and assisted in health care.

The "CAPART" which is the nodal agency for providing funds to the NGO's provide grants, interest free loans and other funds with prevailing subsidies for the NGO's to take up, besides the above, works on resource conservation through afforestation and soil conservation.

As in the case of various people's welfare schemes, the co-operation and active participation of the local community in flood management would go a long way in achieving the objective of reaching the loss of life, damage to property and economic disruption caused by natural disaster. The local administration should be encouraged to take appropriate steps to mobilize and enlist the necessary support from the public and private sector in achieving the purpose.

15.5. MEASURES OF DROUGHT

1. A well organised food security system is a must so that adequate buffer foodgrains are stored to meet the peak demands in drought periods.

2. This should be followed by income generation. Particularly small holder and landless labourer through meaningful employment generation schemes.

3. The effects of droughts are going to be gradual and extreme. The effected areas can be managed through alternative cropping systems, compensatory programmes, streamlining supply of food grains and fodder-taking due care of human and animal health, and involving NGOs besides enlisting media support.

4. There are 24 states and union territories which are most vulnerable. Of the 443 districts 90 are under drought prone area programme and 21 under desert development programme.

5. Soon after occurrence of one disaster everything about it is generally forgotten until another disaster hits. Not much attention is paid to the long term socio-economic consequences of such disasters. Efforts would be made by all concerned to draw up and implement a comprehensive plan of action to mitigate the effects of native disasters and ensure sustainable economic growth.

6. Soil and water management practices such as tillage and seeding, weed control, compaction of deep sands, deep ploughing. Use of brackish ground water, moisture conservation, rain water, harvesting and reuse etc., have an important role to stabilise and increase the agricultural production in dryland areas. Proper fertiliser use can help the crops in overcoming the effect of drought stress. Use of drought resistant varieties of crops and fodder plants can considerably reduce the hardship of the affected. Establishment of fodder banks is another possibility to tide over the difficult period.

BRAOU

Intensive afforestation measures can also bring back the rain and prevent recurring droughts.

8. Increased reliability of drought interpretation by satellite surveillance, spatial variability within the district, surface water assessment at the end of the south west monsoon and quantitative estimation of drought impact on production need to be taken up. A pilot study on drought assessment at mandal level in Andhra Pradesh has shown encouraging results. Augment ground data collection on fodder/grain yields will help improve quantitative drought impact assessment.

9. A number of programmes have been initiated to reduce incidence of natural disasters and improve the resilience of the areas.

These include the desert development programme, drought prone areas programme and water Development Programmes.

15.6. MEASURES OF FLOODS

1. **Forecasting and Warming** : Every year nearly 5,500 forecasts are issued through 157 stations, many important flood-prone rivers and tributaries are yet to be covered. The state Governments should take initiative in consultation with the centre, to set up forecasting stations at least to cover major rivers in their respective states.

2. **As Physical Measures** like embankment, dams and drain channels cannot provide protection to all food prone areas in the country for all times. It is necessary to take non-structural measures to mitigate the impact of floods, because structural measures are found to have brought about a certain measure of complacency among the people living close to dams or embankments. There is now a growing realisation that it is not possible to mitigate damage caused by floods by only keeping the water away from the people, but efforts need to be made to keep the people away from the water.

3. While flood forecasting and advance warning is one of the most important measures to reduce the impact of floods, flood plain zone and regulation as well as flood proofing are among the other measures of importance and relevance of flood management.

4. "Floods are acts of God" but acts of man cause flood damage". Unregulated and unplanned use of flood plains by the people; disregarding the basic fact that it is part and parcel of the river, leads to damage. The controlled and indiscriminate development of land adjoining rivers due to pressure of population is one of the main factors for increasing flood damage.

   Flood Plain Zoning, aims at determining the locations and the extent of areas likely to be affected by floods and to develop areas that the damage of floods is reduced to the minimum, while ensuring that the valuable flood plains are simultaneously put to development use.

5. **Flood Proofing** : It includes location and construction of vital installations, industries, public utilities, electric installations, water supply, telephone exchange, railway station etc., are above the observed flood levels so that they are not damaged in the event of a flood.

BRAOU

6. One possible measure for long term to prevent recurrence of floods is to go in for intense afforstation programmes in the mountain slopes and in the catchment areas. Once vegetation cover is re-established, the soil will be no more exposed to erosion; with less silting in the bed, the river will be able to carry larger volume of water without flooding the banks.

7. The floods occuring due to overflow of rivers can be managed with alternative cropping strategy matching with the time of recession of water from the fields.

8. There are 137 districts identified as flood prone and 13 are cyclone prone and are assisted by various programmes.

9. It is now universally accepted that since it is not possible to fully control the floods, the emphasis has to be shifted essentially to management. In this context flood-forecasting has assumed paramount importance as a tool to reduce damage caused by flood. With a strengthened forecasting system and a suitable blend of structures and non-structural measures, it should now be possible to reduce the damage potential and property losses as well as to minimise, if not avoid, loss to human and cattle lives.

10. The centrally sponsored scheme of soil conservation in the catchment of river valley projects and flood prone rivers are also designed to reduce the vulnerability of flood plains.

Check Your Progress - 3

What are the effects of 1977 Andhra Cyclone?

Note : a) Write the answer in the space provided below.

b) Compare your answer with the one given at the end of this unit.

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BRAOU

15.7. SUMMARY

Natural disasters such as famines and floods affect the lives of large number of people and cause considerable damage to the property worldwide. The disasters are of 2 types : (1) Man made disasters and (2) Natural disasters. The man made disasters are deforestation, soil erosion, nuclear explosions, wars, internal disturbances etc. The examples for natural disasters are cyclones, tidal waves, storms, floods, drought, excessive rains, earthquakes, floods & land slides. In this unit famines and floods are described in detail.

The word famine can be described as a general scarcity of food. Famine is a state of extreme hunger suffered by the people of a region as a result of the failure of the accustomed food supply. The main cause of famine is the failure of basic food crops due to the failure of monsoon. In India 72 districts have been identified as drought prone and they are distributed in 13 states.

Floods are a major cause of misery in India every year. India is the most flood affected country in the world after Bangladesh. Usually the poor people suffer severely due to floods as they live in small huts and cottages which can be damaged easily.

The Govt. naturally undertake the relief measures against famines and floods. The Govt. also takes the help of voluntary organisations and humanitarian organisation for the relief measures.

BRAOU

15.8. CHECK YOUR PROGRESS : MODEL ANSWERS

1. 'Disaster' denotes any odd event, be man made or natural, which brings about sudden and immense miseries to humanity with great surprise and intensity on a very large scale, causing loss of life, destruction and damage to the properties and blocking the enormous productivity efforts of the country, either completely or partially.

2. To ensure the optimum use of soil moisture, it is necessary to choose crops which have a deep root system and have the capacity for establishing roots in deeper layers of the soil. Non-traditional crops like sunflower and caster which are drought resistant have to be adopted. Besides, grasses, non-conventional crops are promising for stabilising production on dry land.

3. The cyclone havoc is caused by high speed winds leads to tidal waves upto 4 mts. height reaching the coastline and intruding upto 10 km in land. Due to this cyclone there was much damage caused to various things such as irrigation canals, minor irrigation systems. Streams and rivers were flooded, saline water entered all the drinking water tanks, Roads and bridges were washed away in many areas, electricity supply was seriously affected, standing crops were destroyed, livestock and poultry died in large numbers.

15.9. MODEL EXAMINATION QUESTIONS

I. Answer the following questions in about 30 lines each.

1. What are the different causes of famines and floods?
2. Explain briefly the spatial distribution of famines in India?

3. Discuss any two of the case studies of famines and floods and suggest their remedial measures?

4. Discuss in detail about the development strategies with special reference to famine and floods?

II. Answer the following questions in about 10 lines each.

1. What are the major types of Natural disasters?
2. What is famine?
3. Do you think that dry farming technology can solve the problem of famine?
4. What are the causes of floods?
5. Explain briefly the flood prone areas of India?
6. Explain the role of voluntary agencies in relief and restoration operations?

Dr. P. Panmanabha Rao

BRAOU

UNIT - 16 : INDUSTRIAL ACCIDENTS

Contents

16.1. OBJECTIVES

By the end of this unit you will be able to :

- list out the main factors normally considered for locating industries,
- describe the causes and impacts of Bhopal gas tragedy,
- describe some aspects of Disaster Control.

BRAOU

16.2. INTRODUCTION

Selection of a site for a major industry is often a controversial issue, since the interests of many are involved. The problems arising from faulty location of Industries must be kept in mind to promote sound policies for the future. Both regional and local interests are to be safeguarded before selecting a site for an industry.

16.3. LOCATION OF INDUSTRIES

Three aspects are normally considered for locating an industry at a particular site. They are :

i) Technical Aspects

ii) Socio-political Factors

iii) Environmental Factors

16.3.1. Technical Aspects

The technical feasibility and desirability is based on engineering aspects and economic viability of a particular location. Some of the favourable conditions are :

i) Easy availability of raw materials

ii) Good marketing net work

iii) Infrastructural needs like water, land, power, work force etc.

16.3.2. Socio-Political Aspects

Socio-Political aspects are to be voiced by public opinion and are to be taken care of by the Government. The ideal location from these considerations should be :

1. Regional imbalance in technical growth and industrialisation should be avoided, so that the limits of industrial growth are accessible to the entire people of the country.
2. The location should not be vulnerable to sabotage or attack by the enemy.
3. Demands of the political parties and voters are to be appressed.

16.3.3. Environmental Factors

Normally environmental factors take a backseat due to lack of awareness among people, lack of expertise capable of objective evaluation and loopholes in the legislation. Fortunately the campaign for environmental protection has started gaining momentum all over the world as well as in India. The following factors are to be considered for locating an industry.

i) Waste disposal facility without adverse ecological imbalances.

ii) Background pollution should be low enough to permit the inevitable additions by the industry.

iii) The meteorological parameters should be favourable for the dispersion and dilution of pollution into harmless spaces. For this the industry should be necessarily located on the down wind side of residential and other ecological sensitive areas.

iv) The topography of the proposed site should permit good dispersion of air pollutants under all climatic conditions.

v) The ecosystem likely to be effected by the proposed industry should not have same species of flora and fauna, monuments or other sensitive and valuable assets.

vi) The natural resources of the area should not face the risk of depletion or imbalance by the proposed industry.

vii) The sociological impacts caused by the industry should not undermine the cultural or aesthetic assets of the locals. Considering all these factors, the environmental impact assessment reports, for possible alternative sites for locating new industry are to be prepared, to enable a good choice.

The cleaning agencies like pollution control boards or Ministry of Environment and Forests may recommend or accept a particular site with some conditions imposed, for the mitigation of possible adverse effects.

BRAOU

Check Your Progress - 1

What are the considerations for the selection of a site for an industry?

Note : a) Write the answer in the space provided below.

b) Compare your answer with the one given at the end of this unit.

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16.4. BHOPAL GAS TRAGEDY

One of the devastating chemical accidents in the world occured in Bhopal on the night of 2nd December and the early hours of 3rd Dec. 1984. According to reliable sources, more than 2500 people killed and around 1,00,000 people were afflicted with serious health problems.

The Bhopal unit of Union Carbide was launched in 1969 mainly to import, dilute, pack and ship the most important pesticide 'SEVIN'. Subsequently the company expanded its activities and started a production unit in 1980. Though there are several processes to produce 'SEVIN' even without using MIC (Methyl-iso-cyanate), Union Carbide did not import these technologies to India as they were expensive and produced large volume of waste material. Ultimately the plant at Bhopal was transformed into a 25 million dollar manufacturing unit in 1984.

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Accidents : During the first year of operation in 1981, one worker was killed and 3 others became sick due to exposure to phosgene, a gas used in the production of MIC. In 1982, and 1984 the local press published sensational articles regarding the defects in the safety standards in the plant and the damages it posed to the people of Bhopal. Neither the government nor the factory administration has taken note of these articles.

Safety Standards : The Bhopal plant did not provide even a single safe route for neutralising MIC at high temperature before it founds its way into the atmosphere. This was clearly pointed out by the American safety team that visited Bhopal Plant in 1982. In addition to the original defects, the management is reported to have made some short-sighted equipment modifications one year before the accident that might have been responsible for leaking the water to get into the MIC storage tank in which the run away reaction occurred. Among the deficiencies in safety standards, some of crucial uses are :

1) The devices used to measuring the changes in temperature and pressure in the various units of the industry including MIC storage tank were so poorly maintained that the workers got used to ignore even the early signals of trouble.

2) The refrigeration plant attached to MIC storage tank has been shut-off for some time.

3) The gas scrubber intended to neutralise any escaping MIC even though it was inefficiently designed for the purpose was also shut-off for maintenance.

4) The flame tower intended to burn the MIC gas that escaped from the gas scrubber was also shut down for replacement of a corrosive pipe.

5) The water container intended to neutralise any MIC gas was too short to reach the top of the flame tower from along MIC was getting into the atmosphere.

The early indication of MIC leak was noticed around 11.30 p.m. on 2nd December 1984 and the same matter was brought to the notice of the concerned. The officer in-charge of the unit did not take immediate action and by 12.40 a.m. both pressure and temperature rose enormously paving the way for the escape of MIC into the atmosphere causing one of the most tragic chemical accidents in the world.

Check Your Progress - 2

What are the main reasons which resulted in the Bhopal Gas Tragedy?

Note : a) Write the answer in the space provided below.

b) Compare your answer with the one given at the end of this unit.

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16.5. EMERGENCY RESPONSE SYSTEM

Emergency response plans have to be devised at all levels. The planning of emergency response requires the multidimensional impact of the disasters, the multisectoral and multidisciplinary approach. The response will be specific situation encountered, success of any response action is itself a measure of effectiveness of preparedness planning undertaken by the agency or by the country.

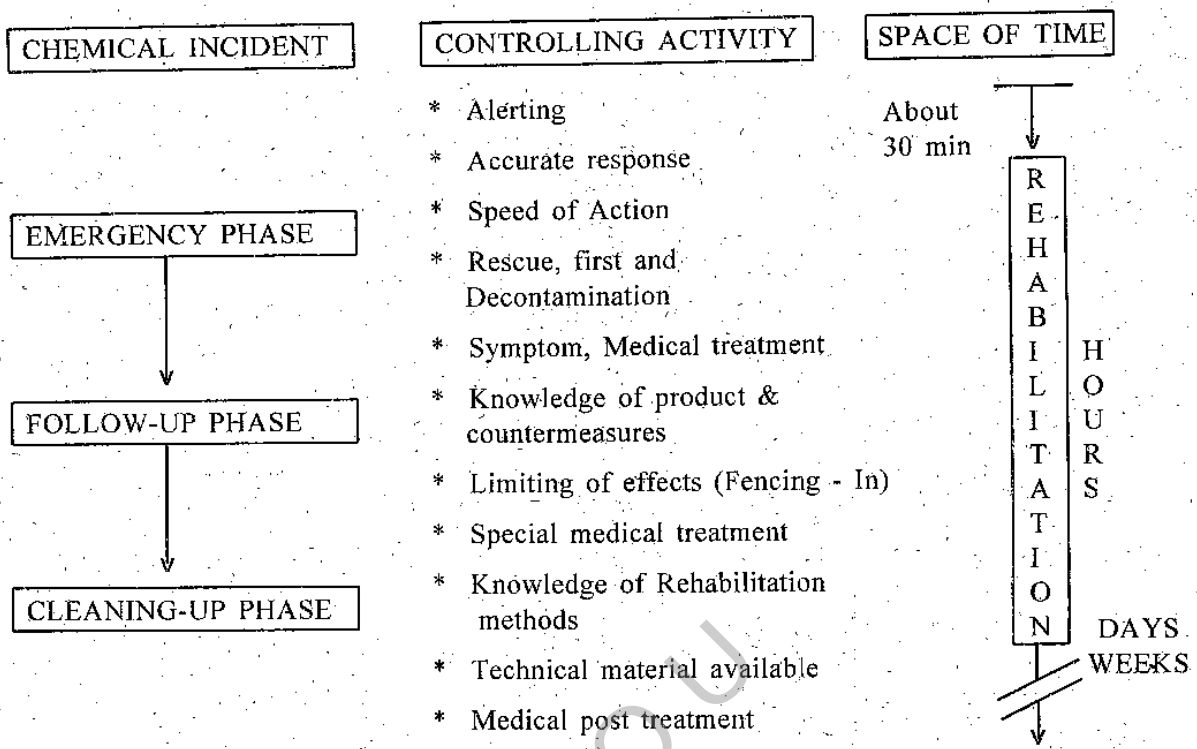
Due to the accidental effects and magnitude of their offsite impacts on public health and the environment, emergency response is a joint venture of civil authorities, public utility, health-services etc. Communication is the vital element and it plays an important role in all the phases of a disaster and hence the information support at the site must be prompt, previse and reliable. Communication is essential not only within the net work of the emergency response system but also with the public and the media. So that it can be conveyed as early as possible and there the loss or effects of the hazards on the life can be reduced to a maximum level.

The following illustrations indicate :

A) Chronology of a chemical disaster and

B) System for disaster control management.

(A) CHRONOLOGY OF A CHEMICAL DISASTER



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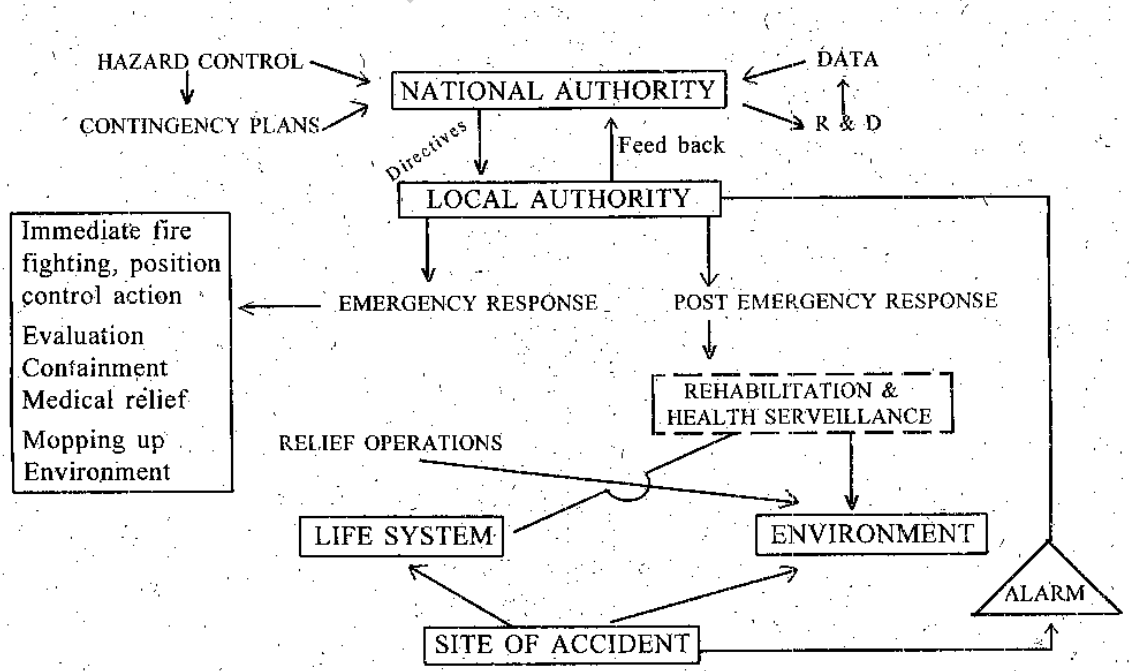
(B) SYSTEM FOR DISASTER CONTROL MANAGEMENT



16.6. SUMMARY

The location of industry is an area which is to be considered primarily along with the meteorological and environmental factors to reduce the impact of industry in the environment. Proper safeguards, viable disaster management system technical manpower and strict implementation of the enforcing authorities standards, will minimise the effect of any disaster. The tragedies that has occured in the past either in India or elsewhere has prompted the governments to make strict legislation and if they are implemented in letter and spirit then only the objective of the said legislation is achieved.

If these factors are not taken care, in future many more accidents, like Bhopal type may occur in many of the Indian Industrial cities such as Bombay, Calcutta, Baroda, Visakhapatnam etc. which are in the Industrial belt with oil refineries, metallurgical units, chemical plants, etc.

16.7. CHECK YOUR PROGRESS : MODEL ANSWERS

1. The selection of a site for an industry must be considered keeping in view socio-political, economical, technical and environmental factors.

2. Bhopal gas tragedy of 1984 is the result of human failure, lack of proper emergency response system and safeguards, resulting in the loss of men and material in and around the Union Carbide.

16.8. MODEL EXAMINATION QUESTIONS

I. Answer the following questions in about 30 lines each.

1. Describe the aspects, that are normally considered in locating an industry.
2. Describe in brief the causes and effects of Bhopal Gas Tragedy.

II. Answer the following questions in about 10 lines each.

1. Write a brief account of Emergency response system.
2. Describe the role of community in safeguarding the environment.
3. Give an account of failure of implementation of rules and regulations in Indian Industries.

Dr. P.V.V. Prasada Rao

BRAOU

UNIT - 17 : POPULATION DISPLACEMENT

Contents

17.1. OBJECTIVES

After going through this unit, you will be able to :

- explain the role of major dams in displacement of people, and
- list out the problems that arise on account of taking up mega-dams.

BRAOU

17.2. INTRODUCTION

The process of development sometimes results in displacement of people from their occupations, place of living etc. While it cannot be totally avoided, efforts are being made to minimise the hardships to the people. Planners and policy makers are now focusing their attention on the effects of mega dams. While the mega dams led to increase in agriculture output, the negative effects like displacement of people from their occupation and lands is seriously raising the issue of relevance of the development strategy based on mega projects. This unit discusses issues connected with displacement of population.

In a developing country like India where three fourths of total population are depending on agriculture, the policy of taking up of river valley projects immediately after independence was considered as an important element of growth strategy. This has been facilitated by the process of planned socio-economic development initiated under successive five year plans. India has the distinction of having largest number of river valley projects in the world. It was recorded by 1985 that the country has 1978 major dams built at a cost of Rs. 15,026 crores. Known as symbols of national development a good number of these are located in backward and tribal areas. Many people living in these areas still look at these projects with high hopes. Conventional theoreticians of development still believe that major dams have the potential of solving such crucial problems like food shortage, floods, famines, unemployment, urban water and power shortages.

Of late, however, there is a new realisation that although these projects result in benefits, they also lead to colossal damages. The basic objective of implementing the river valley projects is raising the standard of living of the people through increased agricultural production.

But some of the unintended consequences of the mega dams include huge displacement, submergence of vast tracts of usable land as also of forests, water logging, soil erosion etc. Let us examine the sector-wise negative impact of the dams as displacement seems to be in large scale especially where work on river valley projects is intensive.

Although we have succeeded in increasing the irrigation potential critical observer hold the view that there are flaws in its calculation. For instance according to a newspaper report the figures furnished in the Annual Report of Ministry of Water Resources, Government of India, 1992-93, the achievements of major dams of previous plans needed to be substantially revised. This amounts to unexpected admission on the part of the Ministry which incidentally affected its credibility as also suggests faulty planning process. By the end of VII plan in 1990 the major and medium irrigation sector should have created irrigation potential of 34.8 million hectares (m.h.) which is inclusive of 9.7 m.h. before independence. It is now stated that actually it is only 29.9 m.h. according to the latest report of the Ministry. The difference is 4.9 m.h. which is actually 25 percent of total irrigation potential created since 1950 (29.9 - 9.7 m.h.). The revision involving the 'writing off' of irrigation potential amounts to the 'writing off' of the money spent as also the new potential.

Check Your Progress - 1

What is the role of major irrigation projects

Note : a) Write the answer in the space provided below

b) Compare your answer with the one given at the end of this unit.

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If the cost of the lost potential of 4.9 m.h. is calculated @ Rs. 42,700 per hectare, an investment of Rs. 20,923 crores would be needed to make up for the loss which would not exclude the escalation during the VIII plan period. The bureaucracy of the ministry will be accountable for this.

It is not surprising, therefore, that speaking at the State Irrigation Ministers Conference held on July 8, 1986 the then Prime Minister observed 'We need some definite thrusts from the projects that we started after 1970. Perhaps we can safely say that almost no benefit has come from these projects. For sixteen years we have pumped money out. The people have got nothing back, no irrigation, no water, no increase in production, no help in their daily life. Statement draws attention to the basic aim of policy making which is targeting of specific goal related to the welfare of the people and the improvement of quality of their life.

17.3. ECONOMIC COSTS

Building large dams at every conceivable location was regarded as panacea for solving economic problems facing the country. By 1977-78 the country became self sufficient in food production with increase in average under cultivation from 22 million hectares in 1950 to 68 million hectares in 1985. The total area under irrigation has increased from a mere 18 per cent in 1950 to 60 per cent in 1985. The major projects generated 13,000 mega watts of power. These projects have also created tremendous employment opportunities by the construction of not only dams and canals but also residential office complexes, roads and other infrastructural amenities.

Despite these visible and invisible benefits the major dams are yet to attain the specific economic objectives. Instead of achieving the expected increase in agricultural output of 4.5 tonnes per hectare, it achieved 1.7 tonnes only per hectare. Further, most of the major irrigation schemes fell short of the specified irrigation potential. On the other hand it is increasingly realised that the river valley projects are no more positive propositions especially in countries like India which are densely populated. The planning commission of India usually sanctions a major project when the cost benefit ratio is at 1:1.5. But several studies indicate that the cost benefit ratio in case of major irrigation projects in India is only 1:0.56. Further the extent of under-utilisation of the capacity of mega dams is quite alarming which is one fourth of what was visualized by planners. While in the case of minor dams it is as high as 94 per cent. The average cost of providing irrigation facilities to one hectare of land is Rs. 7,224, under major dams. However it works out to only Rs. 1,754 in case of medium/minor project. Again the net benefit derived by the displaced people under various major irrigation schemes is alarming. Without denying the benefits accruing from the construction of a major dams, it may be mentioned that because of not only the enormous cost overruns but the enormous gestation period which tends to tax the patience and the endurance of its prospective beneficiaries.

Further the delays that inevitably occur in paying compensation to the persons displaced by the construction of the reservoir and resultant suffering suggests minor or smaller dams are to be preferred to the major ones. Significantly major dams say for instance the Narmada Valley around which there is lot of controversy cannot anymore be regarded as Modern Temples as termed by Pandit Jawaharlal Nehru since they have become Mausoleums signifying the death of the fond people's expectations. Similarly tribals living around Nagarjuna Sagar and Srisailam Dams in Andhra Pradesh are yet the benefited by these dams constructed 25 years ago.

Displaced by the construction of the dams, the families were paid a nominal compensation which caused untold misery to the affected people and made them destitutes forcing them to change their traditional occupation from agriculture to other occupations to which they find it difficult to adjust. Thus the project affected people, became unskilled daily wage earners and are forced to migrate to urban areas in search of livelihood.

Projects initiated in the 50s are yet to be completed. Of the 1812 major irrigation projects initiated in the sixth five year plan more than 80 per cent spread to the 7th plan also. The total estimated cost went up from Rs. 13,154 crores to nearly Rs. 33,000 crores. The cost of Nagarjuna Sagar Project also rose from Rs. 91.12 crores originally estimated to Rs. 844.63 crores towards its completion i.e., more than nine fold. The cost of Sriramsagar dam increased 25 times (from Rs. 40 crores to Rs. 1,007 crores). The cost of Maharashtra Khandavalsa Project climbed to Rs. 175.13 crores from an estimate of Rs. 11 crores.

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The cost of Bihar Subarnarekha Project had also gone up from Rs. 480.9 crores to Rs. 1,056.69 crores. Regarded as the largest river projects in the world, the Narmada Valley was originally estimated to cost Rs. 9,000 crores and is likely to soar well beyond Rs. 25,000 crores. According to an enquiry committee which scrutinised 64 dams, it was reported that the average increase of the cost of major irrigation projects is any where between 100-108 percent.

17.4. SOCIAL COSTS : DISPLACEMENT

Besides economic costs major river projects also raise the issue of social costs. The greatest cost of the project is the widespread displacement of local people from their habitat and loss of their traditional occupations. It is estimated that the number of people affected directly or indirectly by all irrigation project in India over the past 40 years can be as high as 20 million. For instance, the Hirakud dam in Orissa, one of the largest in the country, executed in fifties, has displaced more than 20,000 people residing in 249 villages. However, the government could evolve a resettlement package which could take care of the bare minimum needs of people living in 33 villages out of 249. Again in Andhra Pradesh, the Srisailam project, completed in 1983, displaced over a lakh of people. The Tungabhadra river project in Karnataka displaced more than 55,000 spread over 90 villages. Further more, due to execution of 233 minor, medium and major dams in Maharashtra, about 2,220 villages have been affected displacing more than 1.25 lakhs of families.

In any massive displacement, the most affected are poorest sections of the population consisting of Scheduled Castes, Tribes and landless labourers. A report of the Commission for Scheduled Castes and Scheduled Tribes says that about 119 large irrigation and hydroelectric projects, implemented in various parts of the country led to the displacement of nearly 17 lakh population in which more than half are tribals. Further, it is estimated that the Narmada Sagar Project displaces a large number of SC & ST population. It is observed that benefits like additional electricity generation, additional irrigation etc. are likely to be enjoyed by a small number of people comprising of farmers and industrialists compared to lakhs who are displaced.

Check Your Progress - 2

Who suffer most because of displacement and why?

Note : a) Write the answer in the space provided below.

b) Compare your answer with the one given at the end of this unit.

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According to several newspapers reports, and freelance journalists the rehabilitation measures adopted under various projects are inadequate. For example, the number of families displaced between first and the second plans due to development projects in Bihar was around 47,000 while it was more than 20,000 in Orissa and West Bengal. However, only 25 percent of these families are rehabilitated so far i.e., after nearly 20 years. For example several thousands of families were displaced because of dams in Bengal and Orissa. Only a fraction of them could be rehabilitated. In Madhya Pradesh similar position is prevailing in case of most projects. The Bhakranangal dam constructed during 1950's had resettled only 33 percent of those families which were displaced.

The displaced villagers mostly comprise cultivators who have very deep attachment to their lands and homes. Further they are distressed because they believe that their lands are abodes of their Gods and the spirits of their ancestors whose displeasure may affect their survival. When they are forced to give up their love and attachment to their ancestral property and are denied opportunity of living together among their kinsmen, great disruption in their social life is bound to follow. The payment of money by way of compensation does not provide adequate relief to the displaced persons because of social and psychological factors.

Despite the policy pronouncements for rehabilitation and resettlement, the mega dam projects in India caused widespread displacement of people and disruption of their lives including their exposure to health hazards for which rehabilitation measures have often been inadequate. The ecological damages caused in terms of water management, soil erosion, earthquakes etc. are colossal. Public policies governing planning, programming and implementation of large river projects therefore call for a review especially in the context of displacement of huge populations.

17.5. DISPLACEMENT AND REHABILITATION

According to the report prepared by the Tata Institute of Social Sciences, Bombay, the Sardar Sarovar project will submerge 37,000 hectares (92,500 acres) of land in three states, i.e., Gujarat, Maharashtra and Madhya Pradesh. Conservative estimates place the number of displaced at approximately 1,52,000 persons (about 27,000 families as per government estimates) residing in 245 villages of these states, to be affected by the submergence.

A number of studies on 'cost-benefit analysis' of the Sardar Sarovar Project were done. These studies have shown that trey were conducted without fully taking into account the social and environment costs. The Narmada Tribunal on Resettlement & Rehabilitation (R & R) was based on the critical minimum requirements of resettlement for the displaced. A detailed estimations of cost benefit analysis of Resettlement and Rehabilitation package of the project, it appears, were not undertaken. However, the Narmada award was hailed as a breakthrough in rehabilitation as it made provision not only cash compensation but also other aspects. Some of which include : a) Schemes to improve the standard of living they were enjoying prior to displacement, b) Plans to relocate their village units in accordance with their preference, c) to work for integration within the community in which they are resettled d) work out appropriate compensation and adequate social and physical rehabilitation infrastructure.

The policy of rehabilitation/resettlement was good. When it comes to implementation, there are several problems. For instance in the case of Narmada Valley Project, the

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governments of Gujarat, Maharashtra and Madhya Pradesh are following different methods and rules. The disparities marking the implementation of R & R package has resulted in reducing the choices available to the displaced (project affected persons). For example there is no uniformity in determining the quantum of aid payable to PAPs in Maharashtra and Gujarat states towards the compensation for land. The absence of parity between the packages across states has given rise to dissatisfaction among the displaced. Some state governments pay higher compensation, others less, still others delay it. Each mega dam evolved its own package of rehabilitation and resettlement. For example rehabilitation plan for the displaced population is reported to be better over the earlier ones in so far as Narmada project is concerned as the land owning family which loses 25 percent of land gets atleast 5 acres as compensation in addition to a settlement grant. There are plans in the resettlement to provide primary schools, panchayat ghars, dispensaries, seed stores, children parks, drinking water wells, main link roads and house sites as part of resettlement package.

Some of the measures are not doubt appreciated. Compensation for houses seems not only reasonable but also generous, along with transport costs and bank accounts opened for the PAPs in order that they may not be tempted to sell them. However, critics hold the rehabilitation package still to be unsatisfactory.

Since, there is a gap between intention and reality, the entire package is marked by loopholes and omissions. The 'Land for Land' policy has not been a total success with states having their own compulsions. Here again some states deviate from this policy and offer cash instead of land which eventually defeats the very purpose of having a relief and rehabilitation policy common to atleast two or three states.

In case of Sardar Sarovar Project, as pointed out earlier, the plan for Land for Land policy has not succeeded to the extent the policy planners th ught. The policy of planned rehabilitation of oustees hardly materialised. In trying to buy land, the tribal oustees found themselves scattered over several villages which might entail greater hardship to the remaining tribals. This is bound to have serious effects on the closely knit social life of the tribals. A majority of those displaced under Narmada Valley Project belong to Scheduled Tribes category.

Again among the STs and SCs majority are cultivators of forest land. Since the land they are cultivating belong to the government, they get no compensation eventhough it is under cultivation for more than hundreds of years by them. For many families this will obviously be a severe blow. Some states like Madhya Pradesh tackled this problem by regulating forest encroachment.

17.5.1. Response of Bureaucracy to Displacement Problems

Rehabilitation is a delicate matter, calling for a great deal of understanding and dedication. It is observed that the rehabilitation officers were at times quite ignorant of the happenings in the field, and their attitude towards their work varied from commitment to indifference. The frequent transfers adds to the problems as the officers concerned have had to begin all over again in discharging their duties and their attitudes towards tribals is generally inconsiderate and even callousness.

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17.5.2. Critical Issues in Rehabilitation

Most of the oustees of major river valley projects are yet to get benefits. For realising, it is necessary to ensure that alternate land is given for land submerged; firewood and fodder alternatives are also be given. All members of single village be resettled together, that land be given in the command area and the landless be looked after with special care. It needs to be recognised that without a total understanding of the cultural ethos and psychological make-up of the tribal and the peasants, rehabilitation is bound to be a failure.

17.6. SUMMARY

Although there are advantages in going ahead with the mega dams as they provide river water cultivation and consequent increase in agricultural production the negative effects of the dams like displacement, its effects an eco-system of the areas, seismographic effects, disturbance to the social and cultural fabric of the region, problems in resettlement and rehabilitation, loss of forests, danger to the flora and fauna apart from health hazards strongly suggest the revision of the policy on major dams. In the absence of clearcut policy on relief and rehabilitation, millions of people are displaced now and they are undergoing untold sufferings. In fact issues of displacement led to violent agitations.

These agitations produced leaders like Sunderlal Bahuguna (of Chipko movement and more recently Tehri Dam) and Ms. Medha Patkar who succeeded in mobilising masses against mega-dams like Narmada Valley. A burning issue in these agitations/protests is the issue of displacement and unsatisfactory relief measures. Unless these are settled perhaps the benefits of mega-dams are outweighed by limitations.

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17.7. CHECK YOUR PROGRESS : MODEL ANSWERS

1. The role of major irrigation projects in irrigation is to increase the irrigation potential and the agricultural output.

2. In any massive displacement, the highest sufferers are poorest sections of the population consisting of scheduled castes, Tribes and landless labourers. It is because of the widespread displacement from their habitat and loss of their traditional occupation.

17.8. MODEL EXAMINATION QUESTIONS

I. Answer the following questions in about 30 lines each.

1. Trace the major causes for displacement of population.
2. Analyse the causes for imbalances in R & R policies of different states.

II. Answer the following questions in about 10 lines each.

1. What are the mega dams in our state and list the advantages accrued from them?
2. What are the social and psychological consequences of displacement?

Dr. I. Ramabrahmam

UNIT - 18 : TOXIC AND CHEMICAL WASTE

Contents

18.1. OBJECTIVES

After going through this unit you will be able to :

- differentiate and distinguish between various types of wastes,
- describe the disposal or management of wastes, and
- explain the method of treatment of tannery.

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18.2. INTRODUCTION

The unproductive material which is a by-product of handling, process and utilization of material often referred to as "WASTE". However, such material continue to be as waste until its potential for utility is explored.

The peculiar nature of human being is that he progressively changes his environment to suit his biological and social needs. In this transaction he utilizes the material necessities (other wise called Resources) and produces harmful waste materials. Population explosion and man's quest for more material comforts have resulted in the generation of large amounts of various types of waste material. This has necessitated the human race to think and desire ways and means of managing these waste material. Wastes may be classified into: gaseous, liquid, and solid wastes. In this unit the discussion is mostly limited to solid and liquid wastes.

18.3. TOXIC AND CHEMICAL WASTE

Origin of Waste : The peculiar nature of human beings is that they progressively changed their environment to suit their biological and social needs. In this transaction they utilise the material necessities (other wise called Resources) and produces worthless and sometimes harmful by-products. These products are normally referred to as wastes. Waste products may be of gaseous, liquid or solid in nature.

18.3.1. Agricultural Waste

One of the consequences of Technological progress and Agricultural revolution has been the release of large number of chemicals into the Environment.

Very broadly, Agricultural pollution is caused by refuse of any form from agricultural operations of any kind. In common usage, the term agricultural refuse generally includes the following type of wastes.

i) Manure and other wastes from farms and the operations feed lots of poultry houses.

ii) Slaughterhouse wastes

iii) Fertiliser and pesticide runoff from croplands.

iv) Harvest Wastes (plant residues)

v) Salt and silt drained from irrigated lands (sediments)

Sediments contain soil and mineral particles washed from the land by storms and flood waters, from croplands, unprotected forest soils, overgrassed pastures, strip mines, roads and bulldozed agricultural lands. Sediments have been both a blessing and a curse to agriculture. They augment the fertility of the soil where they deposit (e.g., River Deltas) and they also destroy the irrigation systems like canals, reservoirs and even multipurpose dams. Sediments can interfere with the movement and spawning of fish and other aquatic organisms. It also interferes with the domestic and industrial usage of waters and affects the recreational quality of water sourses.

Control of soil erosion will drastically reduce the sediment content and soil erosion can be minimised by covering the land with grass and vegetation. Plant residues from crops and orchards can constitute environmental pollution when they harbour plant diseases and pests or when they are burned and omit gaseous pollutants. Agricultural burning and related Air pollution problems are likely to continue until better methods of controlling plant diseases are available.

Agricultural runoff contains plant nutrients and pesticides as those are employed indiscriminately. Excess amounts of plant nutrients like phosphates and nitrates causes a phenomenon called 'Cultural Eutrophication' which renders the water body useless for domestic and other needs. The presence of toxic chemicals like chlorinated hydrocarbons and organophosphates makes the life of the aquatic organisms more worse. The peculiar property of these materials is that they concentrate over food chains.

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Apart from the above, animal disease agents, dead animals, and waste from agriculture based industries can also be included under Agricultural pollution.

18.3.2. Industrial Wastes

As a consequence of population explosion and better Technical knowhow, rapid industrialisation took place in recent times, prior to which our economy was largely agrarian, the problems of industrial waste has grown steadily and significantly.

Water is an essential raw material in almost all manufacturing industries, though only a small part of it may appear in the finished product. The remainder becomes a waste material, contaminant to a smaller or larger degree depending on its usage in the plant.

Industrial effluents are as varied in nature as industries themselves, the problem gets aggravated as no standard procedure for treatment can be recommended. Industrial wastes include waste from food and kindered products, textile products, paper and allied products, chemical industry, petroleum industry, mining, rubber and plastics, metal and other industries. Industrial wastes contain many substances like inorganic salts, acids and alkalis, organic substances in the form of dissolved, suspended solids and sediments.

Methods for Disposal of Industrial Effluents : There are 3 alternatives for the disposal of Industrial Wastes :

1. Direct disposal into streams without treatment.
2. Discharge into municipal sewage and combined treatment.
3. Separate treatment of Industrial waste.

The selection of the above process depends on various factors like :

1. Self purification capacity of streams
2. Threshold value set by ISI
3. Cost factor
4. Advantages if any if mixed with domestic waste

The disposal of Industrial wastes broadly consists of :

a) Equalisation

b) Neutralisation

c) Physical treatment

d) Chemical treatment

e) Biological treatment

Equalisation and Neutralisation tanks are optional where as the sedimentation tank is provided only when the waste contains high percentage of suspended solids. Coagulation, and flotation followed by clarification remove suspended and dissolved solids. Advanced methods like Reverse Osmosis, Electrodialysis, Ion exchange and Thermal Reduction are normally employed only when faced with acute shortage of water, Biological treatment

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consists of activated sludge process, Trickling filter, stabilisation ponds, aerated lagoons, Oxidation ditches and Bio-discs.

Check Your Progress - 1 & 2

1. What does the Agricultural runoff contain? What phenomenon does it cause?

2. What are the three alternatives for disposal of industrial effluents?

Note : a) Write the answers in the space provided below.

b) Compare your answers with those given at the end of this unit.

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18.3.3. Garbage

Garbage is a type of solid waste and mostly consists of putricible (Decomposable) material. The disposal of Garbage is really a serious problem in most Urban areas and the real magnitude of the problem is evident only when one passes through a open dump yard. The changed complexion of garbage into a complex mixture of paper, plastics and putrifying materials make it a potential pollutant of the environment. The sources of garbage are given below.

i) Wastes from food, slaughter houses, canning, Freezing industries etc.

ii) Municipal waste - street sweepings, sewage treatment plant wastes, wastes from schools and other institutions

iii) Domestic waste - Rubbish, Kitchen waste and Occasional large wastes from houses.

iv) Commercial wastes

Table - 18.1. Composition of Garbage (Municipal refuse)

Sources	Present estimate % (w)	1980 estimate % (w)
Dust and cinders	12 - 28	9 - 12
Vegetable and Putrecent matter	17 - 35	19 - 98
Paper and Card board	30 - 32	37 - 47
Metals	6 - 8	0 - 9
Rags and Textiles	2	1
Glass	8 - 10	7 - 8
Unclassified debris	2.5 - 6.5	2
Plastics	0 - 5	3
Density as collected	150-178Kg/m3	120-130Kg/m^3

The steady increase in Garbage content throughout the Globe is mainly due to the throwaway culture and if this is not checked, probably the human race has to bear the difficulties in handling the Garbage.

The percapita Garbage (Municipal waste) generated by an urban resident is estimated around 350-1000 g/head/day

Table - 18.2. Percapita solid waste in some of the Indian Cities.

City	Per capita solid waste (in grams/head/day)
Bangalore	4168
Bombay	445
Calcutta	813
Delhi	400
Hyderabad	309
Madras	400
Visakhapatnam	3739

Collection of Garbage : When the quantities of Garbage handled is relatively small then collection and transport may be done manually. However, when the quantities are large mechanical means are normally employed.

Garbage must be collected atleast once per week. In general, the amount of Garbage collected per stop receiving twice a week would be greater than the total amount of Garbage per stop receiving once a week collection.

a) **Back yard collection** : Collections remove refuse from the back yards of premises and return the containers. The disadvantages of this system have been higher costs, damage to fences and landscaping as collectors generally resort to short cut methods.

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b) **Block collection** : In this system, a collection vehicle travels a regular route at prescribed intervals and it stops at every street intersection. The residents of all the streets leading from that intersection empty their waste containers into the vehicle.

c) **Kerbside collection** : This collection also requires a regular service, and fairly precise time-table. Residents must put their bins on the foot way in advance of the collection time and remove them after they have been emptied.

As for as the Indian scenario is concerned the municipal corporations, municipalities and the Panchayats are entrusted with the task of collection and disposal of garbage.

Disposal Methods : A number of disposal methods of garbage are available of which some important areas are presented here.

a) **Hog feeding** : Hogs were extensively used for garbage disposal. In colonial times hog wandering in the streets were scavengers of wastes in gutters. Experimental data suggests that a gain of 100 kg live weight could result from the feeding of 6 metric tons of garbage and this results in the production of 55 Kg of pork, How ever this practice has led to a high incidence of trichinosis and other viral diseases in human beings. Thus the practice of Hog feeding on Garbage is insignificant now a days.

b) **Open Dumps** : Disposing of Garbage in open dumps is the most common waste disposal method practised throughout the world. The disadvantage associated with this method are

   i) Aesthetic insult on the surrounding environment

   ii) Public health problems (e.g., Typhoid fever, cholera and dysentry, Tuberculosis, Anthrax, and other diseases)

   iii) Air Pollution problems

c) **Sanitary land fills** : In sanitary land fill operations, the Garbage is spread in thin layers that are compacted by heavy bulldozers before another layer is spread. After the refuse is perhaps 3 mts. deep, it is covered by a thin layer of clean earth which is again compacted. At the end, the fill is topped with another meter of compacted earth.

The advantage of a Sanitary landfills are

i) Public health problems are minimised, because flies rats and other pests are unable to breed in the covered refuse.

ii) There is no air pollution from burning and none from dust or odour.

iii) No fire hazards or its probability is very less.

Land fills can be used to convert swamps, marshes, and used out gravel pits into playgrounds, parking areas, and other facilities. Landfill sites, after completion of filling, can thus become valuable properties. However, these sites are also associated with some problems.

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The disadvantages of Sanitary landfills are :

i) Possible explosion because of production of methane if the landfill is not properly filled.

ii) Possibility of ground water and surface water pollution if the land fill is not properly located

iii) Settling of land

Incineration : Incineration is a process in which the garbage is subjected to burning at high temperature. This process leaves behind roughly 1/3rd to 1/4th of the original volume as unburnt which can again be disposed off in a landfill. The main disadvantage with incineration is Air pollution.

Ocean Dumping : Coastal cities can only practice this process and infact this process is obviously will be a dangerous policy with regard to toxic wastes.

Composting : One of the best way of utilising municipal waste or garbage is composting, which is practiced on a large scale in Europe. Composting, involves fermentation of refuse into a product, 'Compost' which supplies valuable humus for soil. The composting is generally accomplished by heaping the refuse and moistening it, then letting it to ferment for six months. The fermentation occurs at 50 - 80°C which is apparently too high for pathogens to survive. Compost is a valuable soil condition because no artificial product is capable of adding humus to the soil. It's fertiliser value is very low 0.5% Nitrogen, 0.4% Phosphorus and 0.2% Potassium. Composting is most common in Netherlands, where it is used to dispose 1/6th of all the municipal refuse.

Resource Recovery : In recent years many countries have launched programmes to recover resources present in municipal wastes. In Andhra Pradesh the municipal corporation of Visakhapatnam is planning to generate Energy from Garbage generated in the Corporation limits.

The two major approaches for better management of Garbage are :

i) Source reduction

ii) Resource recovery

This phenomenal increase in the volume of Garbage is due to the 'Throw-away' policy of the society. Unless this is changed, the world population has to bear the problems associated with Garbage.

Check Your Progress - 3

What are the different methods of garbage collection

Note : a) Write your answer in the space provided below.

b) Compare your answer with the one given at the end of this unit.

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DR. B.R. AMBEDKAR OPEN UNIVERSITY

FACULTY OF SCIENCE

P.G. DIPLOMA IN ENVIRONMENTAL STUDIES

COURSE - II : ENVIRONMENTAL AWARENESS AND HEALTH

MODEL EXAMINATION PAPER

Time : 3 Hours **Max. Marks : 100**

SECTION - A

Answer any four of the following questions.
Each question carries 15 marks.
Answer the following questions in about 30 lines each.

1. Can the NGO's supplement or replace the welfare programmes of the Government and other Institutions? Elaborate.
2. Write in detail about major Chemical Accidents and impact assessment.
3. Write about optimal utilisation of resources.
4. Enumerate and discuss briefly various methods of treatment of public water supplies drawn from a river.
5. Write briefly about routes and spread of infectious agents.
6. What are the Occupational Hazards and Diseases? Identify and classify the agents responsible for hazards and diseases. Give suitable examples.
7. Describe the aspects that are normally considered for locating an Industry.
8. What are the different causes of Famines and Floods?

SECTION - B

Answer any five of the following questions.
Each question carries 8 marks.
Answer the following questions in about 10 lines each.

9. Differentiate between Fertility and Fecundity.
10. What is Thanrao Struggle?
11. Write briefly about Films and Publicity.
12. Discuss the usefulness of CBA.
13. Outline the impact of Population Growth on Environment.
14. Write briefly about Biological Control of Mosquitoes.
15. Define Earthquake Predictions.
16. What are the Social and Psychological Consequences of Displacement?
17. How is Nuclear Waste disposed?
18. Write briefly about Chemical Wastes.

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This phenomenal increase in the volume of Garbage is due to the 'Throw-away' policy of the society. Unless this is changed, the world population has to bear the problems associated with Garbage.

Check Your Progress - 3

What are the different methods of garbage collection

Note : a) Write your answer in the space provided below.

b) Compare your answer with the one given at the end of this unit.

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18.3.4. Nuclear Wastes

Unlike other wastes, Radio active wastes can not be disposed but must be stored in perpetuity. Nuclear waste is mainly generated from Nuclear Power Plant, Experimental nuclear reactors, and from Laboratories and Hospitals, where radio-isotopes are employed for diagnosis and curing.

The major threat to the environment from radioactive pollution comes from the phases of Nuclear Power Plant operation, chemical processing of the spent fuel and waste disposal. Some of the fission products can escape into liquids and gaseous effluents and may cause significant damage to life.

Table - 18.3. Environmental Effects of some fission reactor emissions.

Radio Isotope	Half Life	Environmental Effects
Sr-90	25 years	Collects in Bones, may cause leukemia
I-131	8 days	Concentrated in the Thyroid
Cs.-137	30 years	Deposits in soft tissues, irradiates the body.

Apart from somatic effects like leukemia and Bone cancer, Radio active waste can bring about significant genetic effects.

Disposal : Radio active waste materials are now stored in steel containers in underground concrete vaults, but as the quantity of waste grows, a more efficient and less expensive method must be found for disposal. The technique most often suggested in burial of the steel tanks in salt mines.

It is expected that the heat of the waste will melt the salt, which will then tightly enclose the tanks. Although, the steel containers are expected to disintegrate in six months to ten years, salt has good radiation- shielding properties, is quite strong and is usually quite stable to disturbances such as earth quakes.

A major difficulty in this programme is finding suitable sites for disposal as those may likely to cause ground water pollution

18.3.5. Chemical Wastes

Modern technological developments have only multiplied the hazards to which human beings are exposed. Nearly 5 million chemicals have been synthesised in the last 40 years and 50,000 to 70,000 chemicals are used extensively in different commercial products. All most all the industries use some chemical or the other as raw material or intermediate in the production.

Episodes in Sweden and Japan have pointed to changes arising from the discharge of large quantities of chemicals into the environment. Near Minamata in Japan over 40 people died and many others suffered neurological problems because of Mercury poisoning in between 1953-1960. In Iraq and Sweden the organomercurials were used as fungicides

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and therefore effected both human and bird populations. Some of the chemicals (e.g., metals, chlorinated hydrocarbons etc.) are accumulated slowly over food chains resulting in bioamplification.

The following methods are normally adopted for the disposal of Chemical waste

1. Neutralisation
2. Precipitation
3. Evaporation
4. Solvent Extraction
5. Re-use or Recycling

Check Your Progress - 4 & 5

4. Where does the major share of radioactive pollution come from?
5. Where did Mercury poisoning occur between 1953-1960? What is the result?

Note : a) Write the answers in the space provided below.

b) Compare your answers with those given at the end of this unit.

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18.4. CASE STUDY : TANNERY WASTE

Among the variety of wastes, Tannery wastes can create serious pollution problems in the receiving water bodies. The Tanning Industry is one of the oldest industries in India and the Tannery wastes are characterised by strong colour, high Biochemical Oxygen Demand, high pH and high dissolved solids. Much of the Tannery waste is liquid with a large proportion of solids, suspended solids, soluble material and odour.

Various unit operations are involved in the processing of raw animal skins or hides into different types of leather. The Tanning process consists of 3 basic things.

1. Preparation of hides for tanning

2. Tanning proper

3. Finishing

In the first process, the hides are washed and then limed with a paste of lime and sodium sulphide (8:1). Limed hides are then cleaned and subjected to Bating process. The Bating process prepares the hide for tanning.

The Tanning process makes the hide non-putricible and soft when dried. Tanning is of 2 types :-

i) Vegetable tanning : The materials used are extracted from trees.

ii) Chrome tanning : Chromium salts are used.

The final stage of finishing consists of stuffing and fat liquoring followed by dyeing, these processes make the leather soft, pliable and resistant to tearing. Dyeing is done using synthetic dyes.

Sources of Waste Water : The waste water originate from all the operations in the tanning process. The waste is of both continuous and intermittent type. The former has a larger volume but the pollution load is less and the latter is small in volume but has a high pollution load.

Characteristics of the waste (combined)

Colour - brown

pH - 12.3

Cl - 10,600 mg/litre

Total solids - 23,410 mg/litre

Suspended solids - 3,310 mg/litre

Chemical Oxygen Demand - 6,675 mg/litre

Biological Oxygen Demand - 4,000 mg/litre

Effects of Waste on Receiving Waters : The Tannery wastes are characterised by high Bio-chemical Oxygen Demand, suspended solids and strong colour. These wastes deplete the dissolved oxygen rapidly in a water body due to both chemical and biological Oxidation of Sulphur and Organic compounds.

Chromium is toxic to aquatic life and inhibits the growth of fish in the water body.

18.5. COMMUNITY ACTION

Community action in other words means "Peoples participation" and the basic purpose of Public participation is to promote the productive use of inputs and different perceptions from Private citizens and Public interest groups in order to improve the quality of environmental decision making and in some cases stop the complete process that leads to environmental degradation.

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One can identify at least three functions that a community can play in terms of general development programmes and projects and regarding environmental conservation in particular.

1. **A catalystic role** : The community can be responsible for initiating dialogue and action regarding specific issues. The community concerned may itself be the catalyst or in some cases a Non-Governmental Organisation or an individual may act as a catalyst, spread awareness and start a movement involving community action.

2. **A consultative role** : A community can give advice to the government and other agencies regarding the strategies and objectives of specific efforts. This can be said to be a continuous two way communication process which involves full public understanding of the processes and mechanisms and soliciting actively from all concerned citizens and people, their opinions and perceptions.

3. **An implementative role** : In such a case, the community participates in the implementation of the programmes, objectives and projects.

Some other very important areas of community action are in waste management and environmental conservation.

Community Action in Waste Management : Resource recovery has been a high technology area but gains importance as Resources become scarcer. Utilization of wastes constitute both direct and indirect contribution to economic development by way of employment generation. In many cities of developing countries garbage is sorted out for reuse. Some of the recyclable wastes are tins, glass, paper, plastics, rags and bones which in developing countries are sorted out manually. But in some countries like Japan the wastes are sorted out at the source itself by the people. Separate containers for different categories of garbage are used and collected for recycling. Therefore collection of waste in such a way reduces cost and can be done only by active peoples participation and cooperation. The plus point is that instead of making it totally mechanical, waste collection could be partly labour intensive, especially in India with immense man power, with its utilization at the source end.

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People's Participation in Conservation : In nature, plant, animal and human populations do not exist in isolation. This fact poses man with an immensely complex puzzle as he tries to find ways to manage the resources. Thus any effort to control or manage a particular aspect must involve participation of the entire community.

To determine which of the various popular conservation movements is the most stirring. The pioneering one, the 'Chipko Movement' is viewed as the first true ecological movement of the people in India. This tree hugging movement has saved the rich Himalaya vegetation of Garhwal. The commercial exploitation of these forests had given the people of this region a rallying point to collectively oppose the exploitation of their natural resources. This movement has created an awareness among the people regarding the implications at ecological destruction. The chipko movement has demonstrated the workability of a powerful model of people's participation.

This movement has inspired other environmental protection movements like the Appiko movement of Uttara Kanara and Save the Silent Valley movement of Kerala etc.

Nature can never be managed well unless the people closest to it are involved in its management and a healthy relationship is established between nature, society and culture.

Today with no participation of the common people in the management of local resources, the poor have become marginalised and alienated from their environment, that they are ready to discount their future and sell away the remaining natural resources for a pittance.

Check Your Progress - 6

Write the three functions that a community can play in the general development programmes and projects.

Note : a) Write the answer in the space provided below.

b) Compare your answer with the one given at the end of this unit.

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18.6. SUMMARY

There are various activities of the human-being and almost all activities generate Toxic and Chemical wastes. Wastes are of various types like Agricultural wastes, Industrial, Domestic wastes in the form of garbage, nuclear and chemical wastes.

The characteristics of each waste and its effects are different. As a result the treatment of each is different. Some of them also involve social factors like garbage collection which involves community action.

Community action is of utmost importance in environmental conservation and the 'Chipko' movement in India is the pioneering and the most successful one.

A case study of Tannery waste which involves the process and its effects has been given.

18.7. CHECK YOUR PROGRESS : MODEL ANSWERS

1. Agricultural run off contains plant nutrients and pesticides which are applied indiscriminately. Excess amounts of plant nutrients like phosphates and nitrates causes a phenomenon called 'Cultural Eutrophication'.

2. The 3 alternatives for the disposal of Industrial effluents are : (i) Direct disposal into streams without treatment, (ii) Discharge into municipal sewage and combined treatment, (iii) Separate treatment of Industrial waste.

3. The different methods of Garbage collection are : (a) Backyard collection, (b) Block collection, and (c) Verbside collection.

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4. The major threat to environment from radioactive pollution comes from phases of Nuclear power plant operations, chemical processing of spent fuel and Nuclear waste disposal.

5. Mercury poisoning occurred near Minamata in Japan and over 40 people died and many other suffered with neurological problems.

6. The 3 functions that a community can play in the general development programmes and projects are : (a) Catalystic role, (b) Consultative role, and (c) Implementative role

18.8. MODEL EXAMINATION QUESTIONS

I. Answer the following questions in about 30 lines each.

1. Give an account of Agricultural waste and its effects.
2. Write an essay on Garbage collection and disposal.
3. What are the methods for disposal of Industrial effluents?
4. Give a detailed account of Tannery waste.

II. Answer the following questions in about 10 lines each.

1. Write briefly about collection of Garbage.
2. How is Nuclear waste disposed?
3. Write briefly about community action.
4. Briefly write about Chemical wastes.

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FACULTY OF SCIENCE

P.G. DIPLOMA IN ENVIRONMENTAL STUDIES

COURSE - II : ENVIRONMENTAL AWARENESS AND HEALTH

MODEL EXAMINATION PAPER

Time : 3 Hours **Max. Marks : 100**

SECTION - A

Answer any four of the following questions.
Each question carries 15 marks.
Answer the following questions in about 30 lines each.

1. Can the NGO's supplement or replace the welfare programmes of the Government and other Institutions? Elaborate.
2. Write in detail about major Chemical Accidents and impact assessment.
3. Write about optimal utilisation of resources.
4. Enumerate and discuss briefly various methods of treatment of public water supplies drawn from a river.
5. Write briefly about routes and spread of infectious agents.
6. What are the Occupational Hazards and Diseases? Identify and classify the agents responsible for hazards and diseases. Give suitable examples.
7. Describe the aspects that are normally considered for locating an Industry.
8. What are the different causes of Famines and Floods?

SECTION - B

Answer any five of the following questions.
Each question carries 8 marks.
Answer the following questions in about 10 lines each.

9. Differentiate between Fertility and Fecundity.
10. What is Thanrao Struggle?
11. Write briefly about Films and Publicity.
12. Discuss the usefulness of CBA.
13. Outline the impact of Population Growth on Environment.
14. Write briefly about Biological Control of Mosquitoes.
15. Define Earthquake Predictions.
16. What are the Social and Psychological Consequences of Displacement?
17. How is Nuclear Waste disposed?
18. Write briefly about Chemical Wastes.

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P.G. DIPLOMA IN ENVIRONMENTAL STUDIES

COURSE - II : ENVIRONMENTAL AWARENESS AND HEALTH

ASSIGNMENT - 1

Time : 2 Hours

Note :

1. Do Not copy the answer directly from any of the books.
2. As far as possible, try to answer the questions independently in your own words.
3. If it is necessary to quote from any source, give the correct reference.
4. Use your own foolscap pages for writing the assignment.
5. Leave sufficient margin for the comments of the evaluator.
6. Completion of this assignment normally should not take more than two hours time.

I. Answer the following questions in about 30 lines each.

1. What are the problems arising due to urbanisation? Write briefly about them.
2. Can be NGOs supplement or replace the welfare programmes of the Government and Other Institutions? Elaborate.
3. Write in detail about major Chemical Accidents and Impact Assessment.

II. Answer the following questions in about 10 lines each.

1. Differentiate between Fertility and Fecundity.
2. What is Thanrao Struggle?
3. Write briefly about Films and Publicity.

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P.G. DIPLOMA IN ENVIRONMENTAL STUDIES

COURSE - II : ENVIRONMENTAL AWARENESS AND HEALTH

ASSIGNMENT - 2

Time : 2 Hours

Note :

1. Do Not copy the answer directly from any of the books.
2. As far as possible, try to answer the questions independently in your own words.
3. If it is necessary to quote from any source, give the correct reference.
4. Use your own foolscap pages for writing the assignment.
5. Leave sufficient margin for the comments of the evaluator.
6. Completion of this assignment normally should not take more than two hours time.

I. Answer the following questions in about 30 lines each.

1. Write briefly about Optimal Utilisation of Resources.
2. Enumerate and Discuss briefly various methods of treatment of Public Water supplies drawn from a river.
3. Write briefly about routes and spread of infectious agents.

II. Answer the following questions in about 10 lines each.

1. Discuss the Usefulness of CBA.
2. Outline the impact of Population Growth on Environment.
3. Write briefly about Biological Control of Mosquitoes.

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P.G. DIPLOMA IN ENVIRONMENTAL STUDIES

COURSE - II : ENVIRONMENTAL AWARENESS AND HEALTH

ASSIGNMENT - 3

Time : 2 Hours

Note :

1. Do Not copy the answer directly from any of the books.
2. As far as possible, try to answer the questions independently in your own words.
3. If it is necessary to quote from any source, give the correct reference.
4. Use your own foolscap pages for writing the assignment.
5. Leave sufficient margin for the comments of the evaluator.
6. Completion of this assignment normally should not take more than two hours time.

I. Answer the following questions in about 30 lines each.

1. What are the Occupational Hazards and Diseases? Identify and classify the agents responsible for hazards and diseases. Give suitable examples.
2. Describe the aspects that are normally considered for locating an Industry.
3. What are the different causes of Famines and Floods?

II. Answer the following questions in about 10 lines each.

1. Define Earthquake Predictions.
2. What are the Social and Psychological consequences of displacement?
3. How is Nuclear Waste disposed?

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