Ecological Change and Diseases

Cultural changes bring about major ecological changes. Resulting ecological changes consequently may increase the severity of diseases. Cultural changes from rural to urban settlements brought about major ecological changes. The resulting urbanisation stress has affected human health. From an ecological viewpoint, there are good reasons to predict that disease burdens will be higher among settled populations for example, for a successful transmission, all diseases need a threshold level of host population density. The spread of an epidemic needs very dense population. Transmission is also enhanced by permanent settlements because the infective stages or the vectors are in constant contact with their human hosts.

There is much direct evidence that changes to more industrialised forms of agriculture in developing countries have caused much greater incidence of some of the debilitating tropical diseases. There are many examples of such diseases. We shall briefly examine the interrelationship of ecological and cultural changes with the prevalence of two diseases viz. **malaria** and **trypanosomiasis.**

Malaria

Malarial parasite *(Plasmodium* spp.) are spread by bloodsucking female mosquitos of the genus *Anopheles*. Standing water is needed to complete the life cycle as they have an aquatic larval stage. Felling of forest for agriculture produces many permanent or temporary bodies of water at ground level of varying dimensions. Even in deforested areas, changes in agricultural patterns may change the potential for malarial mosquitos. In Western Kenya when irrigated rice fields replaced scattered maize cultivation, seasonal swamps, and water holes with profuse plant growth, the proportion of malaria causing mosquitos increased.

Industrial agroecosystems based on indiscrimate heavy applications of pesticides have resulted into resurgence of malaria in Central America and the Indian subcontinent. In the late 1960s and early 1970s the number of infected people was much higher, upto several millions in India. During the same period, in both areas there occurred large-scale cash cropping of cotton and other similar crops which demand high pesticide applications. This increase use of pesticides caused the malarial parasite to evolve resistance to chemicals that previously had reduced malaria. Since 1969, the number of cases of malaria in India has increased exponentially in direct relation to increased applications of DDT to agroecosystems and the concurrent changes in agricultural practices. An irony of this situation is the conflicting policies within the United Nations. WHO was striving to eliminate malaria by judicious use of insecticide. At the same time FAO was advocating the use of high-yielding cultivars which demand heavy pesticides applications.

Trypanosomiasis

The trypanosomes which cause sleeping sickness in Africa and Chagas' disease in Latin America, are transmitted by biting flies and bugs respectively

which have wholly terrestrial life cycles. All trypanosomes in Africa are transmitted by tsetse flies which are ecologically segregated to some extent by environment and by the species bitten.

Both the African and Latin American diseases have spread due to increase of favourable habitats for the vectors. In East African case study, it has been shown that a sequence of cultivators and pastoralists replaced the forests with savannah vegetation around Lake Victoria. The new savannah environments led to the invasion of *Glossina morsitans* (tsetse fly). The disease was most likely introduced by the African porters of the European explorers in the 1880s. There was an epidemic of sleeping sickness killing about one-third of the local population in the next 20 years. It is thus clear that how the mobility of human populations can introduce diseases to new geographical areas. Much of the decline in populations of native Americans following the arrival of Europeans in the 16th century can be attributed to the introduced epidemic diseases like smallpox and measles. Cultural factors are also important in Chaga's disease.

Water in Relation to Human Health

In ancient times the solution to pollution was dilution i.e. disposal of wastes in air, water and soil. However, living space is becoming limited due to congestion or industrial expansion and therefore, dilution is no longer a solution and some other means are to be developed to reduce the ratio of waste to space.

Water quality

The standards for potable water or drinking water recommend that it must be free from pathogenic microorganisms and chemicals that are harmful to human health. Most of our urban population is served by surface waters (rivers, streams and lakes). The raw water obtained from these sources is frequently contaminated with (i) industrial wastes and (ii) domestic (chiefly human) wastes or sewage. These wastes are usually disposed of in the abovesaid water bodies.

1. **Industrial wastes.** Industry is the largest user of water. Industrial waste waters contain a wide variety of toxic inorganic and synthetic organic pollutants, most of which are not readily susceptible to biodegradation. Solvents, oils, plastics, plasticizers, metallic wastes, suspended solids, phenols and various chemical derivatives are common. The quantity and chemical composition of domestic or industrial sewage varies from hour to hour and from day to day. Packing plant sewage is rich in nitrogenous organic matter as manure, blood, fresh grease and hair. Sewage from wood-pulp plant is rich in cellulose, lignn and bisulphates. Almost all industries (dairy, tannery, cannery, distillery, oil refinery, textile, coal and coke, synthetic rubber, steel etc.) produce their own characteristic sewage. These are known to be highly toxic to living organisms including wildlife.

2. **Human waste (sewage).** The term sewage is sometimes used in collective sense for used water supplies of homes, communities, or industries, or polluted waters. The excreta of alimentary canal are called faeces. Generally we use the term sewage for wastes from homes or communities especially faecal

matter. They consist primarily of intestinal bacteria. Faeces are the most common pollutant of potable water. Many microbes produce bad taste and odour to water. These include algae, protozoa and iron bacteria. Some produce colour and slime which causes clogging of water filters and water pipes. Sulphur bacteria also produce foul smell to water.

Contaminated water and diseases

The potable water contaminated with faeces is the chief cause of some important diseases of man. The **enteric diseases** are transmitted mainly by swallowing food or drink contaminated with faeces. Typhoid fever, dysentry (bacterial and amoebic), cholera and other enteric diseases are caused by consumption of contaminated water. Some common human bacterial diseases transmitted by faecally contaminated water are given in Table 4.

Table 4. **Some common diseases transmitted by faecal contamination (water-borne diseases)**

Disease	Causal agent	Gram-Reaction
Typhoid fever	*Salmonella typhi (S. typhosa)*	Negative rod
Cholera	*Vibrio cholerae*	Negative curved rod
Bacterial dysentry (Shigellosis)	*Shigella dysenteriae*	Negative rod
Enteric fevers, gastroenteritis, Salmonella septicemias (bacterial food- poisoning).	*Salmonella typhimurium, S. schottmulleri S. choleraesuis*	Negative rods

Index organisms of faecal contamination

There are some parameters that indicate the level of water pollution by faecal matter. These are as follows:

1. Coliform group. Among the most common organisms of the intestine or sewage (or faeces) are the bacteria of the coliform group. These are aerobes and facultative anaerobes, gramn-negative, non-sporeforming rods that produce acid and gas from lactose fermentation within 48 hours at 35°C. The most prevalent in the group are strains of *Escherichia coli* followed by *Enterobacter (Aerobacter) aerogenes*. Their number in polluted water is in millions.

2. Other index organisms. Other group of bacteria present invariably in human (and animal) faeces are (i) faecal streptococci, especially *Streptococcus faecalis* (ii) *Clostridium*, especially *C. perfringens* and (iii) certain anaerobic bacteria as *Lactobacillus bifidus*.

The survival time of these index organisms in water is of significance. Their presence in considerable numbers suggests relatively recent pollution- a few hours or days.

Urbanisation Stress and Health

Industrial expansion results into congestion. The pressure is building up on big cities in developed world. But the process is more complicated in third world countries, particularly tropical ones as ours where bacterial diseases flourish in an epidemic form. Congestion of cities leads primarily to air and water pollutions, that are the starting points for many diseases. Due to congestion quality of air and water is greatly affected becoming unfit for human consumption. The unfortunate outcome of industrial growth has been the stress on urban areas due to migration of rural population.

The picture in next 20 years or so would be that India would become increasingly industrial and there would be even more people (about 70%) in urban areas. Slum settlements arise in metropolitan cities due to acute shortage of housing. Due to influx of rural poor into urban areas in search of some means of subsistence livelihood, they are not able to find a dwelling. The dwelling has no civic facilities of water supply, drainage, roads, transport etc. that leads to many social evils and ill health. Slums are not only over-crowded, but present an environment of insanitation that breeds social complications and health and economic problems. According to a survey of National Building Organisation, there are about 25 million people in slum settlements of which 40% live in metropolitan cities of Ahmedabad, Pune, Bombay, Nagpur, Bangalore, Madras, Calcutta, Lucknow, Kanpur, Delhi and Jaipur. About 67% of population in Calcutta and over 45% in Bombay are slum dwellers.

Slum dwellers face environmental, social, economic, health, educational and cultural problems. The most prone element are the children on account of poverty, malnutrition, poor drinking water and insanitary environment together with sickness and disease and lack of education. Pt. Jawaharlal Nehru once had remarked "if you cannot provide buildings for those dwelling in slums, give them open space to live and give them atleast some social services like good sanitation and water supply. The result will follow."

Since there are no basic amenities of drinking water, sewerage, sewage, storm water drainage, paved lanes, bathrooms and latrines, there develop health hazards not only in slum dwellers but also in other people of the urban areas. Slum dwellers and those living in areas without proper water and other supplies, dispose of their wastes in unplanned way that contaminate water and air.

Housing should not be taken as an isolated issue but it is interrelated with many aspects. The unchecked growth of metropolitan and other big cities needs to be drastically cut down. There is need to work out carrying capacity of urban areas not only in terms of physical space but also with reference to services, supplies (food, water etc.), transport and shelter etc. A scheme for Environmental Improvement of Urban Slums (EIUS) was launched in 1972, that envisaged one tap per 150 persons, one lavatory seat for 20-50 persons, one bath for 20-50 persons. Also improvement in health services needs to be made under the plan "Health for all by 2000 A.D". On November 10, 1980 an "International Drinking

Water Supply and Sanitation Decade" was launched to supply clean water and disposal of night soil as also dirty water. It is not only supply of piped water alone but also proper sanitation system as also health education that will help. If water is supplied without proper sanitation, there will be dirty water and encouragement to vectors of diseases. More than 50% of water supply poses health hazard due to negative pressure whereby pollutants get sucked in. Water supply and sanitation programme was launched in 1954. The targets for India for 1990 five year plans are:

(1) Urban water supply – All people.
(2) Rural water supply – All area.
(3) Sewerage and Urban sanitation –100% in class I cities; 50% in class II; overall coverage in each state would be 80% of the urban population
(4) Rural sanitation –25% coverage.

Questions

1. What is toxicology? Give an account of harmful effects of physical and chemical toxicants on organisms.
2. Define ecotoxicology. Describe in the light of recent information, behaviour of any toxicant studied in test model.
3. Explain the following:
   (i) Biological magnification (ii) Ecotoxicology (iii) Fall out problem.
4. Describe the toxicological relations of atomic power plants.
5. Give an account of behaviour, alongwith the toxic effects of DDT, lead or mercury in the environment.
6. With suitable examples, discuss the impact of developmental processes on environmental degradation and human health.
7. Explain the following:
   (i) Urbanisation stress and health (ii) Water, vehicle of diseases.
8. What are the main ecological and environmental disruptions that resulted into spread of diseases in tropical developing countries?
9. What types of diseases are common in tropical countries? Discuss the role of ecology in diseases.