

**7**

HUMAN MODIFIED ECOSYSTEMS

The greed and need of human being has modified and changed the natural ecosystems greatly. The main reasons for the modification of natural ecosystems are and 1) increasing human population 2) increasing human needs and 3) changing life styles. In this lesson you will learn about different types of human modified ecosystems, the modifications brought about for their optimum utilization.



OBJECTIVES

After completing this lesson, you will be able to:

- *list the various human modified ecosystems;*
- *describe the overall changes in the environment due to rapid growth of human population and industrialization in India;*
- *explain formation of agro-ecosystems and impact of agricultural practices on natural environment;*
- *mention the impact of human practices - plantation of forests;*
- *analyze the effect of construction of dams and diversion of rivers on ecological balance;*
- *list merits and demerits of fish culture pond;*
- *describe the features of urban areas as human modified ecosystems and explain the environmental consequences;*
- *relate industrialization with environmental degradation;*
- *suggest methods to minimize human impact on ecosystems.*

7.1 HUMAN MODIFIED ECOSYSTEMS

Human modified ecosystems may or may not depend on solar energy e.g. in an industry energy is provided in the form of fossil fuel or electricity or both.

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Some examples of human modified ecosystems are:

- (1) Agro-ecosystems
- (2) Plantation forests
- (3) Urban ecosystems
- (4) Rural ecosystems
- (5) Aquaculture
- (6) Industrial areas
- (7) Laboratory cultures

7.1.1 Characteristics of human modified ecosystems

- (1) Highly simplified.
- (2) Species diversity is very low.
- (3) Food chains are simple and small.
- (4) Depend on human (anthropogenic) support for survival; need for fossil fuel energy, fertilizers, irrigation etc.
- (5) Attract large number of weeds.
- (6) More susceptible to epidemic diseases.
- (7) Suffer from soil erosion.
- (8) Highly unstable.



INTEXT QUESTIONS 7.1

- 1 Name two human modified ecosystems.

- 2 Give two characteristics of human modified ecosystems.

7.2 IMPACT OF INCREASING HUMAN POPULATION AND INDUSTRIALIZATION ON ENVIRONMENT IN INDIA

Human population is rapidly increasing in India consequently our demand for natural resources is also increasing. The industrialization in India is also increasing at a rapid pace. The increasing population and growing industrialization are severely affecting the environment in various ways: Some important impacts are briefly described below:



Notes

- **Pollution:** Development of Science and Technology is a boon to mankind in fulfilling growing human needs, but on the other hand they have caused environmental pollution. Pollution refers to the addition of any substance in the environment that has direct or indirect adverse effect on humans (Lesson 10). The consequences of pollution are many. Industrial accidents that have taken away several lives e.g. in Bhopal, accidental leakage of MIC (methyl isocyanate) gas from Union Carbide Company killed more than 2000 people within 12 to 72 hours. Many people lost their eyesight and suffered from serious medical complications.
- **Global warming:** Increasing use of fossil fuels is a leading cause of increasing levels of CO₂ and other green house gases in the atmosphere. Atmospheric build up of green house gases have caused considerable heating of the earth leading to global warming. Global warming is causing melting of glaciers and rise in the sea level. Rising sea level poses a serious threat to low lying coastal areas and specially to thickly populated coastal cities like Mumbai, Chennai and Kolkata etc.
- **Human health and disease:** An increase in the population is leading to increasing incidences of epidemic diseases such as AIDS (Aquired Immuno Deficiency Syndrome), Hepatitis, T.B. (tuberculosis), bird flu, swine flu, Syphilis, Gonorrhoea, cancer and many more diseases. These diseases are caused by environmental pollution or over crowding.
- **Over exploitation of natural resources:** Rapidly growing population results in over exploitation of resources. Over exploitation and introduction of a new or genetically modified species reduce the productivity of natural ecosystems. For example- introduction of new (genetically modified) high yielding variety or non- native species in any natural ecosystem reduces the population of native species. Over harvesting of edible fishes reduces their reproductive rate and their population start reducing in number and may become completely extinct after some time.
- Deforestation, over grazing, intensive cultivation, over irrigation etc. results in the loss of top soil and fertility of the land. Prolonged degradation of land leads to desertification.
- **Water bodies:** Rivers, lakes, ponds, estuaries and oceans are being increasingly abused. Rivers and other water bodies are being used for disposal of all liquid effluents and all other kinds of wastes. Today most of the water bodies suffer from growing pollution. Pollution of river Yamuna is one such example.

**INTEXT QUESTIONS 7.2**

1. Name any gas that contributes global warming.

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2. Write the full form of MIC and AIDS.

3. What causes soil erosion?

7.3 AGROECOSYSTEMS AND AGRICULTURAL PRACTICES

Agroecosystems are large areas where commercial crops are cultivated. Crop plants are sown and harvested by humans for economic purposes. They are also known as crop ecosystems and mostly cultivated as monoculture (growing only one type of crop) on the entire field or some times growing two or more crop species in the same field at the same time.

7.3.1 Characteristics of agro-ecosystems

- (1) They are highly simplified ecosystems supporting monoculture of a crop species.
- (2) Species diversity is lowest
- (3) Highly unstable and not self sustaining.
- (4) Attract weeds and susceptible to plant diseases.
- (5) Soil are poor, deficient in nutrients, require supplement of chemical or fertilizers.
- (6) Need artificial irrigation and water management.
- (7) Dependent on human care and management.

7.3.2 Economic importance

- (i) Agroecosystems fulfill the basic requirements of food, fruits, edible oil etc.
- (ii) Good quality grains can be produced with high yield.
- (iii) Provides livelihood to a large number of people. More than 70 % of Indian population depends on agriculture.

7.3.3 Disadvantages of agro-ecosystem

- Large scale monoculture of agricultural crops results in severe loss of native biodiversity including genetic diversity of crop plants.
- High yielding varieties of crop plants are more susceptible to disease e.g. smut of sugarcane, maize and sorghum and rust of wheat and bajra are common plants diseases. To protect crop from pests and diseases requires large scale use of pesticides and chemicals which pollute the environment.
- Deplete ground water in many areas due to well irrigation.

- Run off water from agricultural field laden with fertilizers and pesticides pollute river, lakes and ponds.



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7.4 PLANTATION FOREST

It is a man made ecosystem consisting of individuals of a particular tree species. Trees planted on barren land, private land, village panchayat land, roadsides, canal banks, along with railway line and on land not suitable for agriculture. The aim is to grow fast growing trees which are commercially valuable.

7.4.1 Characteristics of plantation forests

- (1) Plantation forests are generally monoculture, like oil palm plantation, rubber plantation, coffee plantation.
- (2) Plantation forests have trees of approximately same age.
- (3) Plantation forests are highly susceptible to pathogens and pests.
- (4) Poor in species diversity.
- (5) Requires constant human care and management.
- (6) Recently plantations of *Jatropha curcare* have become very popular for obtaining biodiesel.

7.4.2 Economic importance

- (1) Tree plantations are raised for fruits, oil, rubber, coffee, timber, fire wood, pulp wood for making rayon and paper industries.
- (2) Trees are also planted to serve as wind breaks or shelter belts.
- (3) Tree plantations are also raised for controlling soil erosion and for increasing soil fertility.
- (4) Tree plantation provides job opportunities and generate income.



INTEXT QUESTIONS 7.3

1. Name five types of plantations.

2. Which type of trees are preferred for plantation forests?

3. List any two common features of agro ecosystem and plantation forests.

4. Which plant you would recommend to raise a plantation for obtaining bio diesel?

**Notes****7.5 URBAN ECOSYSTEMS**

Urban life is the life in a city where many people live close together. Presently there seems to be an urban revolution as people all over the world are moving into towns and cities. In year 1800, only 5% of the world population was urban-dwelling (50 million people) and in 1985 it increased to 2 billion. At present 45% of the world population is urban population and by 2030 there will be more than 60% people living in cities.

7.5.1 Characteristics of urban ecosystems

- (1) High population density: The maximum population density is observed in Malta Africa. It is 1100 persons/sq km. Next ranking is Bangladesh with 888 persons/sq. km., Bahrain 759 persons/sq km, Netherland 441 persons/sq km and Japan 328 persons/sq km.
- (2) Conjestion, shortage of housing and growth of slum areas.
- (3) Urban areas import increasing quantity of energy, food and various other materials from outside to survive.
- (4) Generate large quantities of solid and liquid wastes and air pollutants causing problems of environmental pollution.
- (5) More employment opportunities as well as tough competiton.
- (6) Better education facilities.
- (7) Better medical facilities and health care is provided.
- (8) More and diverse sources of entertainment.

7.5.2 Advantages of urban ecosystems

- (1) Economically well developed.
- (2) Hub of industrial growth.
- (3) Centre of commerce.
- (4) Multicultural social environment.
- (5) Reduced infantile mortality.
- (6) Centres of political activity.

7.5.3 Disadvantages of urban ecosystems

- (1) Urban areas consume 75% of the earth's resources and produce 75% of the waste.
- (2) Urban areas are highly polluted since growing number of vehicles and industries emit large quantities of pollutants.
- (3) Suffer from problem of noise pollution is caused by industries and transport.

**Notes**

- (4) Urban ecosystems suffer from serious shortage of water availability.
- (5) High crime rate, unrest and unemployment.
- (6) Increasing population density in cities of the world compels some people to live in slums e.g. in Mumbai 3 million people live in slums pavement and squatter settlements which lack basic civic facilities like safe drinking water, waste disposed, health care etc.

Urban revolution is taking place more rapidly in developing countries like India. The average growth rate of population twice as fast as the average growth of population. Currently rate of increase in the population of city dwellers in developing countries is much faster as compared to the cities of industrialized countries.

7.6 RURAL ECOSYSTEMS

Rural ecosystems are midway between natural and urban ecosystems since the exploitation of nature and natural resources by humans is relatively much less. Rural people live relatively close to nature and follow a simple life style.

7.6.1 Characteristics of rural ecosystems

- Many villages belong to a single family.
- In rural areas people live in small clusters in thatched, mud houses surrounded by farm lands. In rural areas people are directly or indirectly dependent on agriculture and consume locally available resources.
- Drinking water is largely obtained from wells, canals, lakes or rivers.
- Education, healthcare, drainage, sanitation, hygiene, and transport etc. are inadequate or lacking.
- Rural areas are mostly free from air and noise pollution.

The government policies to reduce the migration of people from villages to cities are to increase the cost of land in the cities and reduce it in the villages. More employment opportunities should be created in the villages. Some incentives should be given to the people working in the villages.



INTEXT QUESTIONS 7.4

1. List any two advantages of rural ecosystems.

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2. Why do people tend to migrate from villages to cities?

3. List any two disadvantages of urban ecosystem.

4. Why do you like to go to a hill station during vacations?

7.7 AQUACULTURE—MERITS AND DEMERITS

Aquaculture is the artificial cultivation of aquatic plants or animals. It is primarily carried out for cultivating certain commercially important edible species of fresh and marine water fishes, molluscs, crustaceans and aquatic plants. Generally natural water bodies support a rich biodiversity, very few species are harvested by man. 20,000 species of fish are known of which only 22 of them are taken largely by man. **Fisheries** include the extraction of food from the sea and the fresh water where as **aquaculture** is rearing of the aquatic organisms in artificially made water bodies (Fig. 7.1) e.g. culture of fish like carps, tilapia.

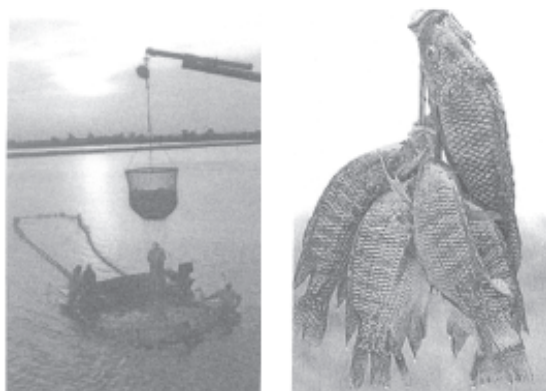


Fig. 7.1: Aquaculture

There are two types of aquaculture:

1. **Fish farming** is cultivation of fish in a controlled environment often a coastal or inland pond, lake, reservoir or rice field (paddy) and harvesting when they reach the desired size.
2. **Fish ranching** is a practice of keeping which fishes in captivity for the first few years in floating cages in coastal lagoons and releasing them from captivity into water bodies. Adults are harvested when they return for spawning to the lagoons.(for laying eggs) e.g. Salmon and Hilsa which migrate to rivers to spawn are cultivated by fish ranching method.



Notes

7.7.1 Fisheries and aquaculture in India

India has a very long coast line for trapping sea food. Marine resources include Bay of Bengal, Arabian Sea, Indian Ocean, numerous gulfs, coral reefs, mangroves and brackish waters like lagoons and Chilka lakes in Orissa. India's inland waters occupy about 1.6 mha (million hectares). They are in the form of major river systems such as Ganges, Yamuna, Brahmaputra, Narmada, Mahanadi, Cauvery and Krishna and others. Further, there are canals, ponds, lakes, and irrigation channels where culture fishery can be practised. The fresh cultured fishes are mostly various species of carps (*Labeo, rohita, Catla catla*) Chinese carp, green carp, mirror carps, cat fish etc.

Tilapia, trouts, salmons and some more species of fishes are cultured in net pens. Milk fish and mullets are cultured in enclosures or bamboo fences. Tilapia is a very favourite fish of many. It is also known as aquatic chicken. They are also grown through small scale aquaculture by many poor farmers. This fish can grow well even on a low protein diet, and resistant to many diseases and parasites. It can breed rapidly under captivity.

7.7.2 Merit of aquaculture

- (1) Ecological efficiency is high. 2 kg. of grains are required to add 1 kg live weight.
- (2) High yield in small volume of water.
- (3) Improved qualities of fish obtained by selection and breeding and genetic engineering.
- (4) Aquaculture reduces over harvesting of fisheries.
- (5) High profit.

7.7.3 Demerit of aquaculture

- (1) Large inputs of feed, water and land are required.
- (2) Loss of native aquatic biodiversity. As it replaced by monoculture of a commercially important fish species.
- (3) Produces large amounts of fish wastes that pollute water bodies.
- (4) Destroys mangrove forests or coastal vegetation.
- (5) Aquaculture fishes are very sensitive to pesticide runoff from croplands.
- (6) In aquaculture ponds high population density is maintained that makes them highly vulnerable to diseases leading to total collapse of the crop.
- (7) Aquaculture tanks or reservoirs are often get contaminated after a few years.

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INTEXT QUESTIONS 7.5

1. What is the difference between fisheries and aquaculture?

2. Name any two fresh water fishes that are being grown in pond culture.

3. Name the fish that is commonly known as aquatic chicken.

4. In what way aquacultures affect the mangrove forests?

7.8 DAMS, RESERVOIRS AND DIVERSIONS

A dam is a structure built in order to store river or tidal water. Dams, reservoirs and diversions capture and store runoff water and release it as needed. They are used for:

- (1) controlling or moderating floods,
 - (2) producing hydroelectric power, and
 - (3) supply water for irrigation, industry and other uses to rural, suburban and urban areas.
- Support recreational activities such as swimming and boating.

7.8.1 Advantages of dams

- (1) Water released from dams to generate electricity.
- (2) Reduce the use of coal and thereby reduce CO₂ emission.
- (3) Reduce downstream flooding.
- (4) Reduce river silting below the dam.
- (5) Supply irrigation water for croplands.

7.8.2 Disadvantages of dams

- (1) Permanently submerge large areas of forests and crop lands.
- (2) Displace large number of native people.
- (3) Increase water pollution on account of reduced water flow.
- (4) Reduce nutrients replenishment of down stream flood plains.
- (5) Disrupt spawning and migration of some fish species.



- (6) High cost.
- (7) Large dams i.e. more than 15 meters high (492 feet) increase the risk of inducing earthquakes specially in earthquake prone areas.
- (8) Change physico-chemical quality of water.

7.9 INDUSTRIALIZATION AND ENVIRONMENTAL DEGRADATION

A rapid increase in urbanization is resulting in a simultaneous growth of industrialization. The industrial processes involve mining, manufacturing, metallurgical processing, welding, grinding and synthesis of chemicals. Industries which are being made by man to make better use of the primary raw materials produced under natural environmental conditions cause environmental degradation in the following manner:

Pollution: All these industries discharge several waste gases and particulate pollutants into the atmosphere. Some of them are as follows:-

- (i) Gaseous pollutants: Oxides of carbon, nitrogen and sulphur.
- (ii) Particulate matter: Fine metal dust, fly ash, soot, cotton dust and radioactive substances.
- (iii) Burning of plastics: Emit poly chlorinated biphenyles (PCBs) which are harmful for lungs and vision.
- (iv) Accidental release of some poisonous gases like phosgene (COCl_2) and methyl isocyanate (as it happened in Bhopal) are fatal.
- (v) Secondary air pollutants formed from complex reactions between primary pollutants, such as smog and acid rain, which are harmful all living organisms, buildings and monuments.

Land use and habitat destruction: The natural ecosystems are modified to fulfill the increasing needs of growing human population 83 % of the earth's surface is affected (excluding Antarctica) by human. Wild life habitat have been degraded, forests have been cleared which provide habitat for thousands of large and small animals. Industries and modern transport networks have not only destroyed the natural habitat of animals but also create noise and thermal pollution. This is seriously affecting growth and reproduction of wild species of plants and animals resulting in loss of biodiversity.

Human health: Use of various type of chemicals today have serious health implications. Incidence of cancer, genetic mutations and damage to nervous, immune and hormonal systems. New disease such as AIDS, mad cow diseases, bird flu and swine flu have emerged in fast succession due to growing damage to ecology.

Increased sensitivity to diseases: Cultivated species of plants, fishes and other domesticated animals have become increasingly sensitive to pest and diseases.

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Genetic resistance: An increased use of insecticides, pesticides and antibiotics has speeded up directional natural selection and caused genetic resistance in the pathogens.

Effect on native populations: Introduction of new alien species or non-native species reduces the populations growth of native species.

Stress due to over harvesting: Overgrazing by livestock results in soil erosion and loss of productivity. Similarly over harvesting of edible fishes reduces population and may become completely extinct if the over fishing continues for long.

Effect on nutrient recycling: Use of fertilizers in agricultural fields interferes with the natural biogeochemical cycles.

7.10 METHODS TO MINIMIZE HUMAN IMPACT ON NATURAL ECOSYSTEMS

Reduce our needs: We should change our habits, curtail our needs and try to conserve our resources especially food, fuel and water.

Ecoindustrial revolution: The solution to many of the above problems is ecoindustrial revolution. It refers to a new resource and efficient production system generating minimum waste. Ecoindustry or industrial ecology is to make industrial manufacturing processes more sustainable by redesigning the industrial processes along the pattern of natural processes.

- One way is by recycling or reutilizing most of the industrial waste.
- Networking of different industries in complex resource exchange web where the waste of one industry is used as a raw material by for the other and so on.
- Industry should strive for higher efficiency of energy and resource use.



INTEXT QUESTIONS 7.6

1. List any two advantages of dams.

2. Name the harmful gas that is released during burning of plastics.

3. How does the introduction of an alieu species affects the indigenous species?

4. What effect does overgrazing by livestock have on grassland?

**WHAT YOU HAVE LEARNT**

- Human modified ecosystems are man made ecosystem, such a agro ecosystem, aquaculture ponds, cities etc. for his own benefits. They require inputs of fossil fuel for their survival.
- Growth of population and migration of people from rural areas to cities is the root cause of increased urbanization.
- All human modified ecosystems suffer from loss of biodiversity and are not sustainable on their own.
- Most of the current environmental problems are caused by the uncontrolled growth of human population and growing urbanization and industrialization.
- Over harvesting of any species of plant or animal should be controlled to maintain ecosystem balance.
- Agro ecosystems have created many environmental problems such as soil erosion, ground water depletion and environmental pollution by fertilizers and pesticides.
- Ecoindustrial systems should be encouraged to protect the environment.

**Notes****TERMINAL EXERCISE**

1. Define human modified ecosystems.
2. Give differences between natural and human modified ecosystems.
3. Why the following conditions lead to stress in a population
a) over crowding b) over harvesting c) human intervention
4. Give characteristics of human modified ecosystems
5. Write short notes on the following
i) Human population explosion
ii) Industrial pollution
iii) Human health and disease
6. What are the advantages of tree plantation?
7. List some impacts those are leading to environmental degradation?

**ANSWER TO INTEXT QUESTIONS****7.1**

1. Agro ecosystem, plantation forest, urban ecosystem, rural ecosystem aquaculture (any two).

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2. (i) Low species diversity, unsustainable and need inputs of human beings in the form of energy, fertilizers and irrigation and human care to survive etc., They are highly susceptible to rapid spread diseases. (any two)

7.2

1. CO₂, Methane
2. Methyl Isocyanate (MIC),
Acquired Immuno Deficiency Syndrome (AIDS)
3. Overgrazing, poor irrigation, over cultivation, deforestation

7.3

1. *Acassia*, *Lucaenas* (Subabus) *Prosopis*, *Sesbannia*, *Caruarin* *Jatropa*, *Monnga* and neem (any)
2. Fast growing tree species of economic value are preferred.
3. Refer to text
4. *Jatropa curcare*

7.4

1. Clean and natural environment is available, people have simple life style.
2. For better employment, health and education opportunities and for better living amenities.
3. Refer to text
4. Highly congested and highly polluted (high levels of water, air and noise pollution), shortage of living space leading to slum development. (any two)

7.5

1. Aquaculture is the artificial cultivation of aquatic plants and animals whereas fisheries refers to capturing of fish and other aquatic organisms from seas and other fresh water bodies.
2. Eel, Tilapia, Rohu, Catla, Cat fish (any two)
3. Tilapia
4. Destroys mangrove forest.

7.6

1. They store water, generate hydro electric power increase provide water for crop irrigation and other domestic uses, reduce downstream flooding (any two).
2. Poly chlorinated biphenyles (PCB)
3. Reduced population of nature species.
4. It results in soil erosion and future loss of productivity.
5. It aims to make industrial manufacturing process is more sustainable by redesigning them to mimic how nature sustain them.