
UNIT 13 URBAN AREAS

Structure

- 13.1 Introduction
- 13.2 Objectives
- 13.3 Urbanization
- 13.4 Impacts of Climate Change on Urbanization
 - 13.4.1 Impact of Floods in Urban Areas
- 13.5 Environmental Degradation
 - 13.5.1 Greenhouse Gases Emissions
- 13.6 Impact of Extreme Weather Events in the Spread of Diseases in the Urban Areas
- 13.7 Let Us Sum Up
- 13.8 Keywords
- 13.9 Suggested Further Reading/References
- 13.10 Answers to Check Your Progress

13.1 INTRODUCTION

The humans in the beginning of their evolution were wanderers and did not settle at a place. They were all the time wandering for food and shelter. It was only after the beginning of agricultural practices that they settled at a place closer to the river and started growing the food grains. This is the reason why almost all the civilization like Harappa, Mesopotamia and the Nile valley civilization flourished near the banks of the rivers like Indus, Tigris and Euphrates, and Nile respectively. The population has from then started expanding. Because of the availability of better prospects for employment and facilities, rural people move towards cities. Various human activities like clearance of the forest for expanding agriculture lands, house construction, industrial area or special economic zone development have all resulted in the urbanization process. This unit explains about impact of climate change on urbanisation.

13.2 OBJECTIVES

After studying this unit, you should be able to:

- discuss the causes of urbanization;
- explain the impacts of climate change on urbanization; and
- explain the impacts of the extreme events and extreme temperature conditions on the spread of diseases in the urban areas.

13.3 URBANIZATION

Urbanization can be simply defined as the shift from a rural to an urban society. It also involves an increase in the number of people in urban areas during a particular year. Urbanization is the outcome of the social, economic and political developments that lead to urban concentration and growth of large cities, changes in land use and transformation from rural to metropolitan pattern of organization and governance. Urbanization is increasing in both the developed and developing countries. Available statistics shows that more than half of the world's population live in urban areas, crowded into 3 percent of the Earth's land area. In Asia and Africa where urbanization is still considerably lower (40 percent), both are expected to be 54 percent urban by 2025.

There are many reasons for increase in urbanization; some factors can be natural population increase (high births than deaths) and migration. The natural increase is further increased by improved medical care, better sanitation and improved food supplies, which reduce death rates and cause populations to grow. In many developing countries, the rural poverty drives the people from the rural areas into the city in search of employment, food, shelter, education and other facilities. Although urbanization is the driving force for modernization, economic growth and development, there is increasing concern about the effects of expanding cities, principally on human health, livelihood and environment and also the changing climate.

13.4 IMPACTS OF CLIMATE CHANGE ON URBANIZATION

Urbanization involves a change in the land use patterns. Climate change is resulting in catastrophic conditions like increase in the number and intensity of extreme weather events like floods, droughts, heat waves, cyclones, hurricanes, etc. Due to these extreme events, cities are also vulnerable to any damage to the larger systems on which they depend - for instance for water supply and treatment, transport and electricity and thus everything that depends on electricity, including lighting, pumping and communications. All these extreme events also result into health hazards for the humans and animals. The droughts lead to famine conditions hence posing a threat to the human food security. The floods result in many water borne diseases like cholera, diarrhoea as human health impacts. The heat waves also kill a large number of people in the developing countries. The cyclones and hurricanes devastate the infrastructure and means of communications. All the extreme events thus kill a huge population of the humans and animals and also destroy the vegetation.

13.4.1 Cities as Heat Islands

As cities add roads, buildings, industry, and people, heat islands are created in urban areas. An urban heat island is the name given to describe the characteristic warmth of both the atmosphere and surfaces in urban sprawls as compared to their non-urbanized or less urbanized surroundings. The heat island is an example of unintentional climate modification when urbanization changes the characteristics of the Earth's surface and atmosphere. An urban heat island is a metropolitan area that is significantly warmer than its surrounding

rural areas. Unlike, global warming which causes a worldwide rise in temperature, heat islands occur at the local level. According to the US Environment Protection Agency (EPA), many cities and suburbs have air temperatures up to 5-8°C warmer than their neighbouring areas. Heat islands result due to the replacement of the natural land cover in the cities with pavement, buildings and other infrastructure. This change contribute to higher urban temperatures as removal of trees, soil and vegetation takes away the natural cooling effects that shading and water evaporation from soil and leaves ordinarily provide. Also the tall buildings and narrow streets heat the air trapped between them and reduce airflow. And waste heat from vehicles, factories and air conditioners adds warmth to the surroundings, further enhancing the heat island effect.

A number of factors contribute to the occurrence and intensity of heat islands. These include: weather, geographic location, time of day and season, city form and city functions. Urban heat islands also can impact local weather, altering local wind patterns, spurring the development of clouds and fog, increasing the number of lightning strikes, and influencing the rates of precipitation. There are three types of heat islands such as Canopy Layer Heat Island (CLHI); Boundary Layer Heat Island (BLHI) and Surface Heat Island (SHI). The CLHI and BLHI refer to a warming of the urban atmosphere while the SHI refers to the relative warmth of urban surfaces. Scientists measure air temperatures for CLHI or BLHI directly using thermometers, whereas the SHI is measured by remote sensing.

The heat island effect can be reduced through the use of white and light-coloured construction materials (including white roofing materials) in buildings, which will reflect the sun's heat skyward rather than absorb it (as dark surfaces tend to absorb). A biologically related solution is to use vegetation to reduce urban heat. Vegetation provides important shading effects as well as cooling through evaporation. Some examples include: planting trees around individual buildings to shade the urban surfaces. This reduces temperature, especially roofs and south, east, and west facing walls. The reduction in surface temperature also leads to substantial reductions in energy use for air conditioning. Preserving or creating pockets of green space and vegetation including creation of green roofs or rooftop gardens will certainly help to cool areas naturally.

13.4.2 Impact of Floods in Urban Areas

A flood is an excessive amount of water on land that's normally dry and is a situation where inundation is caused by high flow, or overflow of water in an established water-course such as a river, stream, or drainage ditch or water-pond at or near the point where the rainfall has taken place. A flood can strike anywhere without warning, it occurs when a large volume of rain falls within a short time.

The changes in land use associated with urban development affect flooding in many ways. In urban areas, where much of the land surface is covered by roads and buildings, have less capacity to store rainfall. Construction of roads and buildings often involves removing vegetation, soil, and depressions from the land surface. The permeable soil is replaced by impermeable surfaces such as roads, roofs, parking lots, and sidewalks that store little water, reduce infiltration of water into the ground, and accelerate runoff to ditches and streams. Urbanization generally increases the size and frequency of floods and may expose communities to increasing flood hazards.

Frequent flooding in the urban streams increases channel and bank erosion. In many urban areas, stream-bank erosion represents an ongoing threat to roads, bridges, and other structures that is difficult to control even by hardening stream banks. There are many approaches for reducing flood hazards in basins under development. Areas identified as flood-prone can be used for parks and playgrounds that can tolerate occasional flooding. Buildings and bridges can be elevated, protected with floodwalls or designed to withstand temporary inundation. Drainage systems must be expanded with increased capacity for detaining and conveying high stream flows. Techniques that promote infiltration and storage of water in the soil column, such as infiltration trenches, permeable pavements, soil amendments, and reducing impermeable surfaces must be incorporated into new and existing residential and commercial developments to reduce runoff from these areas. The runoff water can be reduced by incorporating vegetation and native tree plantation. It is also necessary to develop a flood information and notification system (FINS) to address the need for prompt notification of flood conditions in urban areas where streams rise and fall rapidly. Similarly, stream flow-gauging stations provide a continuous record of stream flow that can be used in the design of new urban infrastructure including roads, bridges, culverts, channels, and detention structures. Storm water managers can use stream flow information in combination with rainfall records to evaluate innovative solutions for reducing runoff from urban areas.

13.5 ENVIRONMENTAL DEGRADATION

The environment comprises of four interlocking systems: the atmosphere, the lithosphere, the hydrosphere and the biosphere. Environmental degradation can be of two types:

- Degradation of the productive capacity of the life support systems (like land, water and forest) on which the humans rely and
- Pollution which destroys the natural resources and makes them unfit for various usage.

It has been established by science that global climate change increases the intensity and frequency of climate related disasters like cyclones, floods, forest fires, and droughts and causes environmental degradation. This reduces the resilience of the ecosystems and the humans against the impacts of the climate change and extreme environmental disasters. It also degrades the environment and converts the carbon sequestering ecosystems (carbon sinks) to carbon sources. Thus it further enhances the climate change phenomenon.

As a result of the expanding urban sprawl, the water bodies in the cities like lakes, rivers, groundwater, etc. are all under pressure of the increasing human demands. They are also getting overexploited due to the human activities such as industrial and domestic utilities. The encroachment around the water bodies has resulted in the shrinking of the lakes and rivers. Even people have started settling on the river beds as well as on the dried lakes. The water bodies in urban areas also get polluted through sources such as industrial effluents, sewage disposals and domestic wastes.

The extent of environmental degradation is increasing; India and China are cited as prime examples. River systems contain four times more pollution than the

global average. The total forest cover is 65 percent below world standards and is falling fast. The environmental degradation in the region is now becoming pervasive, accelerating and are largely unmanageable. The natural resources that underpin long-term economic development are at risk. Within the next 15-20 years, at least about 50 percent of Asians are expected to be migrating into huge urban sprawls with some of the most important industrial facilities. Large tracts of fertile farmland have been lost to salinization and water logging because of poor irrigation and drainage practices in Indian sub-continent. Another large chunk of the land has been converted into deserts in semi-arid areas of South Asia. The prime cause of land deterioration being deforestation is occurring at the rate of 1 percent a year, destroying hundreds of species with it. Asia accounts for 40 percent of the world's species of plants and animals; but in the present state, Asian countries have lost 70-90 percent of their original wildlife habitats to agriculture, infrastructure, deforestation and land degradation. Biodiversity loss reduces the resilience in ecosystems and it results in loss of the livelihoods of the poor who depend on these ecological resources.

Climate change as a result of anthropogenic activities increases the risks of climate related disasters. The IPCC Report has projected that the resilience of the ecosystems is going to exceed by 2100 because of a combination of changing climate, associated disturbances (like droughts, floods, forest fires, ocean acidifications, increase in the pest and vector populations) and other climate change drivers (like land use change, pollution and over exploitation of resources). The ecosystems which are the most vulnerable to the climate change are the boreal forest, tundra, mountains, Mediterranean type ecosystems, mangroves and salt marshes, coral reefs and the glaciers and sea ice.

Check Your Progress 1

- Note:** 1) Use the space given below for your answers.
2) Check your answers with those given at the end of this unit.

1. Define urbanization. What are the causes of urbanization?
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2. What is the Heat island Effect? How is it caused? How can it be prevented?
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3. Describe in short the impacts of flooding in urban areas.
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13.5.1 Greenhouse Gases Emissions

Atmosphere is a complex system of gases and suspended particles. However, the composition of the atmosphere keeps on changing and so also its structure

is variable in time and space. The atmosphere is mainly composed of gases like N_2 (78.8%), O_2 (20.95%), argon (0.93%), and other trace gases like CO_2 (387ppm), CH_4 (2ppm), N_2O (0.3ppm), water vapour (variable in ppm), etc. Long lived gases that are increasing at a substantial rate because of human activities are of particular current interest since they eventually lead to stratospheric ozone depletion, global warming and disturbances in the atmospheric chemistry that will be harmful to the ecosystem. Air pollution occurs due to the stationary sources, but the greatest source of air pollution is the mobile source, which are mostly automobiles. Various types of natural processes like volcanic eruptions, lead to the changes in the global atmospheric composition along with the man-made activities like industrialization, urbanization and modernization of agricultural activities.

Vehicular air pollution contributes to the air pollution by emissions such as carbon monoxide, unburnt hydrocarbons, nitrogen oxides, sulphur oxides, lead compounds, smoke, particulates and odour. The vehicular pollution has increased fast throughout the world owing to an increase in the transportation. Industrial air pollution contributes to air pollution by the release of particulates, smoke, fluoride, ammonia, hydrocarbon, odour and gases like SO_2 , NO_x , CO , CO_2 , etc.

Important greenhouse gases are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), water vapour (H_2O) and ozone (O_3). Further, human activities in recent decades have also added HFCs (Hydrofluorocarbons). Carbon dioxide (72%), nitrous oxide (9%), and methane (18%) are the three main greenhouse gases that trap infrared radiation and contribute to climate change. The important greenhouse gases have long lifetimes in the atmosphere with large fractions of emissions remaining there for decades to centuries and in some cases like carbon dioxide for around 100 years. Cutting emissions of such long lived gases therefore leads to only slow reductions in their warming effects.

As regards the CO_2 emissions from automobiles, the rapidly increasing number of motor vehicles in India and other developing countries due to urbanization is contributing to high level of urban air pollution including socio economic, environmental and health impacts. Every decade has seen the number of motor vehicles doubling in many Asian countries but the increase in the European countries is only 2-5% per annum. The number of the two wheelers dominates the roads of Asian countries. The rapid growth of automobiles is of prime concern as it causes air pollution and also regional and global impacts relating to energy security and climate change. Transportation consumes about half of the world's oil. It has been reported that the energy consumption and carbon dioxide emissions due to transport has increased tremendously, maximum of which was contributed by the developing countries. The main pollutants released as a result of automobile pollution are hydrocarbons, nitrogen oxides, sulphur dioxide, carbon monoxide and carbon dioxide. Since CO_2 is one of the leading greenhouse gases and vehicular pollution contribute about 12% of total global CO_2 emissions. The CO_2 emissions from the vehicles need to be taken care of by either using efficient fuel or making the fuel efficient or by making fuel efficient cars so as to reduce CO_2 emissions. Today cars with the emission capacity of 89-500 g CO_2 per kilometer are available in the market.

In order to reduce air pollution being caused by the release of the pollutants from the factories, certain measures can be implemented. The measures include

the replacement of the burning of fossil fuels by renewable sources like solar energy, tidal energy and geothermal energy for energy generation or by using efficient fuels like biofuels from palms, jatropha, etc. Another method to control air pollution can be by a number of mechanical devices that can in a way be helpful in reducing the amount of air pollutants at the time of their emission like gravity settling chambers, cyclone collectors, dynamic precipitators, spray towers, venturi scrubbers, electrostatic precipitators, etc.

Air pollution and climate change are thus correlated and an increase in the practices contributing to air pollution enhances the level of greenhouse gases in the atmosphere resulting in global warming. Hence reducing the level of air pollution at the grass root levels of industrial and vehicular emissions will surely bring down the levels of greenhouse gases in the atmosphere and thus make earth a better place to live.

13.6 IMPACT OF EXTREME WEATHER EVENTS IN THE SPREAD OF DISEASES IN THE URBAN AREAS

Global climate change would disturb the Earth's physical systems (for example weather patterns) and ecosystems (for example disease vector habitats). These disturbances, in turn, would pose direct and indirect risks to human health. Researchers have found that there is a close link between local climate and the occurrence or severity of some diseases and other threats to human health. Higher temperatures, in combination with favourable rainfall patterns, could prolong disease transmission seasons in some locations where certain diseases already exist. It is estimated that climate variability and climate change cause 150,000 deaths and 5 million illnesses per annum.

Extreme Temperatures

In a warmer world, heat waves are expected to become more frequent and severe, with cold waves becoming less frequent. Increased frequency and severity of heat waves may lead to an increase in illness and death, particularly among the young, the elderly, the poor, the frail and the ill, especially in large urban areas. Heat-related illness and death are largely preventable through behavioural adaptations such as use of air conditioners and increased intake of fluids. In the United States, use of air conditioning is expected to become nearly universal by the year 2050. Other adaptive measures include development of community-wide heat emergency plans, improved heat warning systems, and better heat-related illness management plans.

Extreme Events

It has been postulated that there will be increases in the frequency and severity of extreme events, which may result in an increase in deaths, injuries, toxic contamination or ingestion, infectious diseases, and stress-related disorders, as well as other adverse health effects associated with social disruption, environmentally forced migration, and settlement in poorer urban areas. Frequencies of heavy precipitation events have been increasing. Extreme weather events such as urban floods, storms, droughts can have disastrous effects on health. Floods are responsible for increased spread of diseases causing organisms, increased insect

breeding, and spread of water-borne diseases such as typhoid, hepatitis, cholera, etc. Climate change is responsible for spread of diseases through emergence of disease friendly conditions in new regions, and extension of geographic range of disease-causing organisms. Mosquitoes are extremely sensitive to changes in temperature. Changing climate influences mosquitoes population, as the increasing temperature increase the reproduction rate, extends the breeding season, increase the number of blood meals, etc. Eventually, mosquito-borne disease causing organisms such as dengue fever, malaria are responsive to changes in temperature. It is reported that insect-borne diseases are observed in the higher elevations due to warming temperatures. It is also reported that drought intervened by heavy downpour causes the population of insects and rodents to increase. Climate change is also expected to contribute to some air quality problems too. Respiratory disorders may be exacerbated by warming-induced increases in the frequency of smog (ground level ozone) events and particulate air pollution.

Check Your Progress 2

Note: 1) Use the space given below for your answer.

2) Check your answers with those given at the end of this unit.

1. Establish a correlation between extreme weather events and the spread of diseases in urban areas in the scenario of climate change.

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13.7 LET US SUM UP

Climate variability and climate change impact the urban ecosystem through their influence on urban life support system. Urbanization leads to urban heat island effect which makes life difficult for humans. The extreme temperature conditions are reported to cause deaths of thousands of people due to heat waves especially in the poor and developing countries. There are also the cold waves as in Russia and China where in the humans, animals and plants all succumb to the changing temperature. The extreme events of the weather like cyclones, hurricanes, droughts and floods are all resulting in the death of thousands of humans, plants and animals not only due to their extreme behaviour but also due to the miserable conditions they bring along with them like water-borne vector-borne, rodent-borne diseases including viral, bacterial and other infectious diseases. There needs to be the strict implementation of the environmental standards so as to prevent further degradation of the environment due to the anthropogenic activities.

13.8 KEYWORDS

Urbanization : It is the expansion of the urban areas (cities) due to economic growth and migration from the rural areas.

Heat Island Effect : Various anthropogenic activities lead to the increase in the temperature of the urban

areas which is more than the surrounding non-urbanized areas. This results in the heat island effect.

- Floods** : A flood is an excessive amount of water on land which is normally dry and occurs due to overflow of water in an established watercourse such as a river, stream or pond of water at or near the point where the rainfall has occurred.
- Environmental Degradation** : Depletion or degradation of the potentially natural resources like forests and biodiversity.
- Extreme Weather** : The increase in the uncertainties as well as the intensities of the occurrence of certain weather conditions like cyclones, floods, etc. due to climate change.

13.9 SUGGESTED FURTHER READING/ REFERENCES

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13.10 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

1. Your answer must include the following points
 - Expansion of the human population
 - Causes: Population explosion, industrial setups, migration, economic growth and development.
2. Your answer must include the following points
 - Heating of the urban areas more than the surrounding areas
 - Types of heat island effects: CLHI, BLHI, SHI
 - Causes: Increasing pollution, emissions from vehicles and industries, material of building construction,
 - Prevention: Tree plantations, roof gardens, use of white construction material.
3. Your answer must include the following points
 - Destruction of infrastructure, roads, bridges;
 - Economic losses;
 - Cut-off of various means of communication (transport, electricity, etc.); and
 - Spread of diseases.

Check Your Progress 2

1. Global climate change would pose direct and indirect risks to human health. There is a close link between local climate and the occurrence or severity of some diseases and other threats to human health. Extreme weather events such as urban floods, storms, droughts can have disastrous effects on health. Floods are responsible for increased spread of diseases causing organisms, increased insect breeding, and spread of water-borne diseases such as typhoid, hepatitis, cholera, etc. Climate change is responsible for spread of diseases through emergence of disease friendly conditions in new regions, and extension of geographic range of disease-causing organisms. Mosquitoes are extremely sensitive to changes in temperature. Changing climate influences mosquitoes population, as the increasing temperature increase the reproduction rate, extends the breeding season, increase the number of blood meals, etc. Eventually, mosquito-borne disease causing organisms such as dengue fever, malaria are responsive to changes in temperature.