
UNIT 1 POLLUTION

Structure

- 1.1 Introduction
- 1.2 Concept of Industrialization and Industrial Pollution
- 1.3 Industrialization – Special Economic Zone (SEZ)
- 1.4 Industrial Pollution – Environmental Impacts
- 1.5 Air Pollution
- 1.6 Water Pollution
- 1.7 Soil Pollution
- 1.8 Noise Pollution
- 1.9 Socio-Economic Impact of Industrialization
- 1.10 Let Us Sum Up
- 1.11 References and Selected Readings
- 1.12 Check your Progress – Possible Answers

1.1 INTRODUCTION

Are Industries a boon or a bane? Why is a group of nations against Industrialization and another group of nations pro Industries? These are some questions which give rise to hot debates across ‘borders’. Let us try to understand in this unit, various issues related to ‘Industries’ from national and global perspectives, as well as the implications of Industrialization and the various environmental concerns associated with Industrialization.

The process of Industrialization began around 17th Century in Britain and spread quickly to the other European countries. When we see from a historical perspective, we will discover that it is because of Industrialization that nations have progressed from under-developed to developing nations and from developing to developed nations of the current modern era. It was because of the Industrialization that India’s growth rate is moving ahead since 1980s. Since then Industrial growth has helped us in becoming self-reliant and has been a major source of providing employment to hundreds and thousands of jobless people. In today’s era, however, Industries are looked upon not only as ‘providers’ but also as ‘polluters’. They are being held responsible for the very survival of the mother earth. How? and Why? We will try to see this as we go through this unit.

After going through this unit you should be able to:

- Explain the concept of Industrialization, development and environmental pollution.
- Classify the main kinds of pollutants arising as a result of Industrialization.
- Elaborate the environmental impacts of Industrialization.

UNIT 2 URBAN HERITAGE

Structure

- 2.1 Introduction
- 2.2 Heritage: Concept and Meaning
- 2.3 Types of Urban Heritage
- 2.4 Challenges of Urban Heritage
- 2.5 Conservation and Rehabilitation of Urban Heritage
- 2.6 Urban Heritage Policies
- 2.7 Let Us Sum Up
- 2.8 References and Selected Readings
- 2.9 Check Your Progress–Possible Answers

2.1 INTRODUCTION

Urbanization is a natural growth known to all human civilization across the globe. The progressive transformation from traditional rural economies to modern industrial economy resulted in creating Urbanization. In other words, it is the growth of cities and the movement of people to cities. Studying urbanization and its heritage gives us deeper knowledge about human existences and their experience that often is useful for development of human society. For example, the knowledge we learn from the Indus valley civilization gives us knowledge about urban planning, sustainability, sanitation, roads and infrastructure which is often what the modern urban planners need to learn. Moreover, it teaches us about an urban culture that is inclusive where public get access to the best urban amenities.

After reading this unit, you should be able to:

- Define urban heritage and types of urban heritage
- Discuss various challenges
- Explain specific use of urban settings

2.2 HERITAGE: CONCEPT AND MEANING

Today, when we imagine a city, we probably think of a modern city such as New York, Beijing, New Delhi, etc. But urbanization is not a today's phenomenon, it existed in ancient times too. Urbanization began in ancient Mesopotamia in the Uruk period (4300-3100 BCE), Egypt (3300 B.C), Indus Valley Civilisation 2600 BC, Mycenaean and Minoan Cities 2,000 BC (Athens about 800 BC), China along the Yellow river, 2000-1500 BC, Ancient Rome - 700-500 BCE, Mesoamerica (Mexico, Guatemala, Belize, Honduras and El Salvador), about 200 BC. This type of urbanization has happened due to the permanent settlement and surplus food grain. Gradually, division of labour became more complex and hierarchical power structure developed with some form of administrative leadership, which further made urbanization to flourish. During medieval time, urbanization flourished in many parts of the world. Modern urbanization is closely linked to modernization, industrialization, and the sociological process of rationalization.

Ancient cities differed in architecture and design from cities today, but like modern cities, they were centers of commerce, government, and culture. All these developments left behind a rich heritage which not only has historical significance but often provide scientific knowledge about urban planning, resource use, etc. Besides, some urban centers also provide deeper insight into sustainable human existence by providing knowledge on more eco-friendly human existence. Urban heritage are the most important symbols of the history of urbanization in a place. It traces the roots of the urban development in a location.

Most of us visit urban areas to see historical sites, ancient monuments, museum, etc. to have a sense of history. We also visit urban areas to see the religious places especially those places which grew as urban centers as a result of pilgrimage. It fascinates us and take us away from the present times to past providing an imaginative journey to the past that helps us to compare and contrasts many things that we have today. Most of these can come under a concept called heritage. Before we talk details on the subject “urban heritage”, let us know what really is urban heritage? To understand this we should also know what is heritage?

Heritage has aesthetic, historic, scientific, social or spiritual value for past, present or future generations. Heritage has been defined as ‘... an expression or representation of the cultural identity of a society in a particular period’ (Koboldt, 1997). Heritage is the cultural property of a community or the nation surrounded by it. But the values often transcend the community and country. Human beings are partly the product of their history. We live our lives against a rich backdrop formed by historic buildings, landscapes and other physical survivals of our past. But the historic environment is more than just a matter of material remains. It is central to how we see ourselves and to our identity as individuals, communities and as a nation. So far as material heritage is concern, it is often a physical record of what our country is and how it came to be. Historic landscapes or iconic buildings can become a focus of community identity and pride. The identity of a nation is often linked to certain heritage. For example, the great wall immediately refers to China. Non-material heritage include such as knowledge, traditions, values and culture that are part of the urban living for generations. Every cities exhibit their own characters.

Taylor in his *Primitive Culture* (1871) mentioned “Culture ... is that complex whole which includes knowledge, belief, art, morals, law, custom, and any other capabilities and habits acquired by man as a member of society”. Heritages are the precious cultural property of human civilization.

2.3 TYPES OF URBAN HERITAGE

Heritages can be broadly categorized into three types: Natural, Cultural and Built, though they often intersect each other in certain conditions. The details are explained in the table 1.

Table 1: Natural, Cultural and Built Heritage

Natural	Cultural	Built
Landforms	Festivals	Historic Homes
Urban Scenery	Art/Crafts	Monuments
Flora and Fauna	Traditional Practices/products	Industrial Sites

UNESCO has categorized heritage into three types and the number of heritages in different countries of the World recorded by UNESCO as world heritage properties are given in the Table 2. Table 3 gives an account of urban heritages in India

Table 2: Types of Urban Heritage in different Continent of the World

Zone	Natural	Cultural	Mixed	Total	%	State Party Represented
Africa	33	42	3	78	9	28
Arab States	4	60	1	65	7	16
Asia-Pacific	48	129	9	182	21	28
Europe & North America (including Israel, Russia)	56	375	9	440	50	51
Latin America & Caribbean	35	83	3	121	14	25
TOTAL	176	689	25	890	100	148

Source: UNESCO World Heritage Properties; February 2010

Table 3: Types of Urban Heritage in India

Sr. No.	Category	No.	Heritage Properties (Year of Inscription)
Cultural Heritage			
1.	Fort, Palaces, Tomb	6	Agra Fort (1983), Fatehpur Sikri (1986), Humayun's Tomb, Delhi (1993), Qutub Minar Complex, Delhi (1993), Red Fort Complex (2007), Taj Mahal (1983)
2.	Monuments	4	Hampi (1986), Mahabalipuram (1984), Pattadakal (1987), Khajuraho (1986)
3.	Caves, ancient murals	3	Ajanta Caves (1983), Elephanta Caves (1987), Ellora Caves (1983)
4.	Buddhist Monuments	2	Sanchi (1989) Mahabodhi Temple Complex at Bodhi Gaya (2002)
5.	Ancient Temples	2	Great Chola Temples, Gangaikonda, Airavatesvara, Brihadeshvara (1987), Sun Temple at Konarak (1984)
6.	Archaeological Landscape	2	Champaner-Pavagadh Park (2004), Rock Shelters of Bhimbetka (2003)
7.	Mountain Railway (counted as one group)	3	Darjeeling (1999), Nilgiri Mountain Railway (2005), Kalka-Shimla (2008)
8.	Church	1	Churches and Convents of Goa (1986)
9.	British Architecture	1	Chhatrapati Shivaji Terminus (formerly Victoria Terminus) (2004)
	Total	24
Natural Heritage			
1.	Natural Park	4	Kaziranga (1985), Keoladeo (1985), Nanda Devi and Valley of Flowers (1988), Sundarbans (1987)
2.	Sanctuary	1	Manas Wildlife Sanctuary (1985)
	Total	5
	GRANT TOTAL	29	

Source: India: Heritage as in UNESCO World Heritage List, August 2009



Fig.1:Qutub Minar, New Delhi

The three types of heritage are discussed below:

i) Natural Heritage

One of the most significant component of Urban heritage is related to its natural features such as wetlands, forests, thickets, prairie, streams, valleys, seashore and meadows. It also includes wildlife and plant movement corridors, groundwater recharge and discharge areas, biodiversity, and habitat for wildlife and plant species. The Natural heritage has many utilities and benefits such as improved air quality, improved surface and groundwater quality, flood and erosion control, groundwater recharge and discharge, enhanced biodiversity, improved aesthetics, etc.

ii) Cultural Heritage

Cultural heritage includes tangible culture and intangible culture. Tangible cultures includes buildings, monuments, landscapes, books, works of art, and artifacts and intangible culture includes folklore, traditions, language, and knowledge. In some cases the cultural heritage also include certain part of natural heritage that has some culturally significance. Cultural heritage unlike other heritage is more dynamic. It is a creative and relational process where places and communities are constantly remade through creative performance. Places of cultural significance enrich people's lives, often providing a deep and inspirational sense of connection to community and landscape, to the past and to lived experiences.

iii) Built Heritage

Built-environment refers to any 'man-made structure' which has significant human value especially in historical and architecture. Built-environment includes several other things such as masterpiece of artistic creation, major interchange of human values on developments in architecture or technology, monumental arts, town planning or landscape design; or expressing a unique testimony to a cultural tradition / civilization which is living or has disappeared, events and traditions, artistic literary works, etc.

Rishikesh

Certain heritage sites such as Rishikesh have been one of the attractions for spiritual, religious and cultural reasons for Hindus across the globe as well as other spiritual aspirants for centuries. It has the legacies and tradition of rituals, prayers and values that are passing from one generation to another for several centuries.

Rishikesh is one of the wonderful examples that combines all three types of heritages i.e natural, cultural and as well as the built heritage. There are many temples (built and cultural heritages) some of them are ancient and some new. Rishikesh is important not only as pilgrimage centre closely associated with the Ramayana, but it is also centre of Hindu religious thought and spirituality, Yoga, Ayurveda etc. Rishikesh is also the gateway for other important religious places like Badrinath, Kedarnath, Gangotri, and Yamunotri.

Alderman Fenwick’s House (Built Heritage)

Alderman Fenwick’s House is a 17 century building housing merchants till 1781 and in 1883 it became a political club. In 1962, the building was vacated and no repair work was done for long time. The building is the mute witness to the life of the merchants and politics of the 19th century. Preserving the heritage is very important for education purpose.



2.4 CHALLENGES OF URBAN HERITAGE

There are several forces that are continuously challenging the existence of urban heritages. In order to create a sustainable urban heritage, the planners need continuous up gradation approaches. The various urban heritage challenges are discussed below:

i) Growth of Urbanization

The growth of urbanization itself considered as a challenge to the urban heritage as it put more pressure on the existing facilities and infrastructures due to pressure of population and demand for their needs. It affects the land

use pattern, it exploits the natural and other resources often engendering many urban heritage. Economic pressures often led people to eliminate the older housing (heritage) stock and bring the new.

ii) Urban Heritage and Climate

The 22 Report of the World Heritage published by UNESCO World Heritage Centre in 2007 categorically emphasized that *World Heritage cultural sites are also exposed to climate threat, in the following words “Ancient buildings were designed for a specific local climate. The migration of pests can have adverse impacts on the conservation of built heritage. Increasing sea level threatens many coastal sites. And the conditions for conservation of archaeological evidence may be degraded in the context of increasing soil temperature. But aside from these physical threats, climate change will impact on social and cultural aspects, with communities changing the way they live, work, worship and socialize in buildings, sites and landscapes, possibly migrating and abandoning their built heritage” (Page 10)*

Several key indicators are used in the scientific literature to describe climate change among which: greenhouse gas composition (in particular Co₂), surface temperature, precipitation (rain, snow, hail), snow cover, sea and river ice, glaciers, sea level, climate variability, and extreme weather events.

iii) Urban Heritage and Industrialization

Industrialization provides new opportunity for employment and hence massive migration occurs to urban areas that put tremendous pressure on the existing urban infrastructure. This often creates problem to the heritage sites as the built heritages which were of pre-industrial era were not valued in the new context. Most of the Build heritages in the pre-industrial era have different utilities and values during that historical time than today. There is a need for inventing the value in the modern context. While the identification of heritage can be inherently subjective, classification of the degree of ‘cultural significance’ introduces an additional degree of subjectivity, thus making the sense of them become difficult.

iv) Urban Heritage and Modernization

The negative transformations are mainly the outcomes of such interactive factors as modernization / globalization and post-globalization, ever increasing population, high speed economic growth, rapid urbanization and commercial development, gigantic construction projects, environmental pollution, non-cultural-based and non-eco based tourism, cultural violation and abuse, etc.

In parallel to environmental impact assessment (EIA), cultural impact assessment, as proposed by current conservation authorities, should be a significant measure to evaluate the impacts of any gigantic construction projects, especially dam and expressway constructions which generally cause serious damages over vast regions of cultural landscapes, mostly embedded with Asia’s rich historic properties.

The promotion of cultural-based tourism should also take into consideration the impacts of a large number of tourists that are beyond the carrying capacity of the cultural setting. Bangkok’s Grand Palace exhibits traces of deterioration along the crucial routes of visitors’ movement. India’s splendid Taj Mahal faces similar threats over the site of the masterpiece of Mogul

Architecture. It should be stressed that adequate and suitable management could only reduce, but not significantly minimize, the vulnerable impacts of all the external forces.

2.5 CONSERVATION AND REHABILITATION OF URBAN HERITAGE

Sustainable conservation of Urban heritage is one of the key challenges in urban planning. There are different but often interrelated methods applied namely conservation, preservation, restoration, and adaptive reuse. Each of them is briefly discussed as below:

- 1) **Conservation:** This is a continuous process. For this the heritages site i.e. the geo-cultural region of a site need to be clearly defined so that the conservation process becomes smoother and efficient. This is important as there are various factors that directly affects the conservation process itself i.e. the rapid urbanization.
- 2) **Preservation:** This is a part of the conservation process which ensures the maintenance of existing state, while retarding further deterioration.
- 3) **Restoration:** This is often carried out in case of deterioration of the condition. This is done with all care so that the original conditions are adhered.
- 4) **Adaptive Reuse:** This is often very important aspect of heritage planning. This makes the heritage more productive and it provides productive use and making it more contemporary. This enables the heritage to become socially and economically more sustainable.
- 5) **Rehabilitation:** Rehabilitation of Urban heritage is another sustainable method however; it is a very complex issue that brings political, economic, cultural and social consideration. Political support in the prevailing time is one of the most important issues as this is the decision making body for policy and planning. The real challenge is related to the mobilization of political support towards conservation and rehabilitation of urban heritage. This can of course include the participation of the stake holders such as people living in the place.

Cultural aspects relates to the consideration of the value and contribution of the urban heritage especially the historic housing areas and monuments to the strengthening of indigenous cultural traditions and forms.

In this unit, you have read about In, types of urban heritage, urban heritage challenges and approaches for conservation and rehabilitation of urban heritage. Now answer the questions given in *Check Your Progress 1*.

Check Your Progress 1

Note: a) Write your answer in about 50 words.

b) Check your answer with possible answers given at the end of the unit.

1) What are the different types of Heritage? Explain briefly

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2) How does industrialization challenges the urban heritage? Explain

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2.6 URBAN HERITAGE POLICIES

Urban Heritage policies today are a complex interplay of political, economic, cultural and social factors. However, two approaches which can help the policies to provide meaningful solution to heritage issues are participatory urban heritage and effective knowledge management.

i) Participatory Urban Heritage

The importance and sustainability of Urban Heritage largely depends upon the perception of people about the value of urban heritage. The sustainability of the heritage also mainly depends upon the perception of the values by the citizens and the new generation that constitute students. Various techniques are followed in various countries. Often to create public awareness through education, awareness, cultural programmes or linking it with religious and other practices. The curriculum of the educational programmes promote students’ understanding of the different considerations and issues of concern of different stakeholders on heritage conservation and through students’ participation in social affairs and their sense of responsibility.

ii) Knowledge Management and the Urban Heritage

Scientific understanding of traditional materials and assemblies is the foundation of sustainable management of any issues including urban heritage.

a) Digitization

Digitization is the one of the recent phenomenon to give wide publicity as well as creating a knowledge base for the urban heritage site. There are both long term as well as short term benefits of using digital technologies. Advances in information technology have led to a growth in virtual (digital) recording as another means of conserving the past for future generations. This helps in promoting the heritage in a great way. This especially helps those heritage sites which does not get proper attention from the authorities and not having good access.

- Digitized technology is affordable in terms of cost and help in recording the heritage for future generations, what it refers to as the ‘byways of heritage’ — that is, the plans, the construction techniques, photographs and, particularly, the oral histories of the people that were involved in those projects.
- Storage and Dissemination of heritage information through Audio and Video files with all interactive technologies

- These virtual recording technologies provide a number of marketing opportunities to increase the value and/or reduce the costs of conservation.

Though this not a substitute to the physical conservation, this can be adopted as a complimentary strategy to promote the value of urban heritage

b) Heritage tourism

Cultural tourism is growing faster than most other tourism segments and at a higher rate than tourism worldwide. Tourism is promoted systematically to provide economic incentive for its survival. The conservation and preservation of the built heritage needs continuous support and resources. Tourism can help to enhance the quality to great extent. Tourism often helps in providing employment to local people as well as providing value to many cultural artifacts. However, tourism market is highly competitive and not all historic heritage places are viable for commercial tourism. Often the other infrastructural facilities such as good transport, knowledge management such as interpretation or guide facilities, hospitality are required to promote the urban tourism to great extent.

World’s leading category of international trade, tourism, is increasingly offering a range of cultural heritage products, from visiting monuments to discovering unique ways of life as supply for increasing cultural and heritage tourism demand. UNESCO defines culture tourism as “to create a discerning type of tourism that takes account of other people’s cultures” (UNESCO, 2005). Indeed culture and heritage tourism has been gaining importance recently not only for its economic gains but due to more sustainable approaches.

Cultural heritage tourism is also, increasingly being used as a tool to stimulate regional development in rural and urban areas (New Zealand Tourism Research, 2007).

c) Role of UNESCO in promoting Urban Heritage

The United Nations Education, Scientific and Cultural Organization (UNESCO) is one of the pioneer organizations in the world that promotes heritage sites in urban areas and elsewhere. Its *Young People’s World Heritage Education Programme* (WHE Programme) is specifically designed to address the heritage conservation issues across the world through participation of youths. WHE was launched in 1994 which equip young people with the necessary knowledge, skills, network and commitment to actively participate in heritage protection from local to global levels. They learn about World Heritage sites, history and traditions different cultures, ecology and the importance of protecting biodiversity etc. The educational programme also sensitized the youth to become aware of the threats facing the sites and learn how common international cooperation can help save heritage. The World Heritage Centre and UNESCO Associated Schools, the WHE Programme has collaboratively taken several projects and activities that include:

- Development and publication of innovative educational and informational materials, among them notably the ‘World Heritage in

Young Hands’ an educational resource kit for secondary school teachers published in over 30 national language versions

- Development initiatives for multimedia educational resource material production, including the production of episodes of a cartoon series starring “Patrimonito”, the young World Heritage helper
- Youth Forums and summer camps
- National sub-regional and regional training seminars for teachers and educators
- Skills development and training courses for young people

This programme intends to provide holistic solution to the heritage conservation in general.

In this session, you have read about urban heritage policies. Now answer the questions given in *Check Your Progress 2*.

Check Your Progress 2

Note: a) Write your answer in about 50 words.

b) Check your answer with possible answers given at the end of the unit

- 1) What are the major approaches of urban heritage policies? Explain at least one you find more useful in the present context.

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- 2) How does heritage tourism promote the value of urban heritage?

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2.7 LET US SUM UP

In this unit we have discussed the concepts of urban heritage and various types of urban heritage and its importance. We have also discussed various challenges affecting the urban heritage and how to address them. Towards the end, we have also discussed on various policies on urban heritage practiced today.

2.8 REFERENCES AND SELECTED READINGS

- Ashworth, G.J. and J.E. Tunbridge. 1999. Old cities, new pasts: Heritage planning in selected cities of Central Europe, *GeoJournal* Vol. 49: 105–116
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- UNESCO. 2007. Climate Change and World Heritage (World Heritage Report 22), Paris: UNESCO World Heritage Centre

2.9 CHECK YOUR PROGRESS-POSSIBLE ANSWERS

Check Your Progress 1

1) What are the different types of Heritage? Explain briefly

Ans. The different types of heritage are : Natural, Cultural and Built. One of the most significant component of Urban heritage is related to it natural features such as wetlands, forests, thickets, prairie, streams, valleys, seashore and meadows. Cultural heritage includes tangible culture and intangible culture. Tangible cultures includes buildings, monuments, landscapes, books, works of art, and artifacts and intangible culture includes folklore, traditions, language, and knowledge.

Built Heritage :Built-environment refers to any ‘man-made structure’ which has significant human value especially in historical and architecture.

2) How does industrialization challenges the urban heritage? Explain

Ans. The growth of urbanization itself considered as a challenge to the urban heritage as it put more pressure on the existing facilities and infrastructures due to pressure of population and demand for their needs. It affect the land use pattern, it exploits the natural and other resources often engendering many urban heritage. Economic pressures often led people to eliminate the older housing (heritage) stock and bring the new.

Check Your Progress 2

1) What are the major approaches of urban heritage policies? Explain at least one you find more useful in the present context.

Ans. The major approaches of urban heritage policies are knowledge management and urban heritage and Participatory Urban Heritage .The participatory urban heritage is quite popular now a days. Participatory Urban Heritage: The importance and sustainability of Urban Heritage largely depends upon the perception of people about the value of urban heritage. The sustainability of the heritage also mainly depends upon the perception of the values by the citizens and the new generation that constitute students. Various techniques are followed in various countries. Often to create public awareness through

education, awareness, cultural programmes or linking it with religious and other practices.

2) How does heritage tourism promote the value of urban heritage?

Ans. Cultural tourism is growing faster than the most other tourism segments and at a higher rate than tourism worldwide. Tourism is promoted systematically to provide economic incentive for its survival. The conservation and preservation of the built heritage needs continuous support and resources. Tourism can help to enhance the quality to great extent. Tourism often helps in providing employment to local people as well as providing value to many cultural artifacts.



1.2 CONCEPT OF INDUSTRIALIZATION AND INDUSTRIAL POLLUTION

There is no doubt that Industrialization is the key for the progress of any country. Broadly, industries can be classified into different types depending upon their capital investment, i.e. Cottage Industries, Small Scale Industries, Large Scale Industries. Irrespective of the type/size of the industry, one thing is fundamental to all Industries and that is, they are an important source of employment and income for a large number of rural and urban families. Another thing that is central to all industries is that all industries generate wastes and contribute towards environmental degradation due to the lack of proper pollution mitigation measures. However, the quantities of wastes and the type of pollutants released vary to a great degree on the type of industry.

Industrialization is mostly responsible for the exploitation of the natural resources. It is the unthoughtful exploitation of natural resources which results in the depletion of biodiversity and resources and poses a danger to the very survival of the mankind. Release of toxic/hazardous by products during the manufacturing processes and the generation of large quantities of solid, liquid and gaseous wastes creates both treatment and disposal problems involving huge costs.



Industries are also classified depending on the raw materials used and the products made, for example:

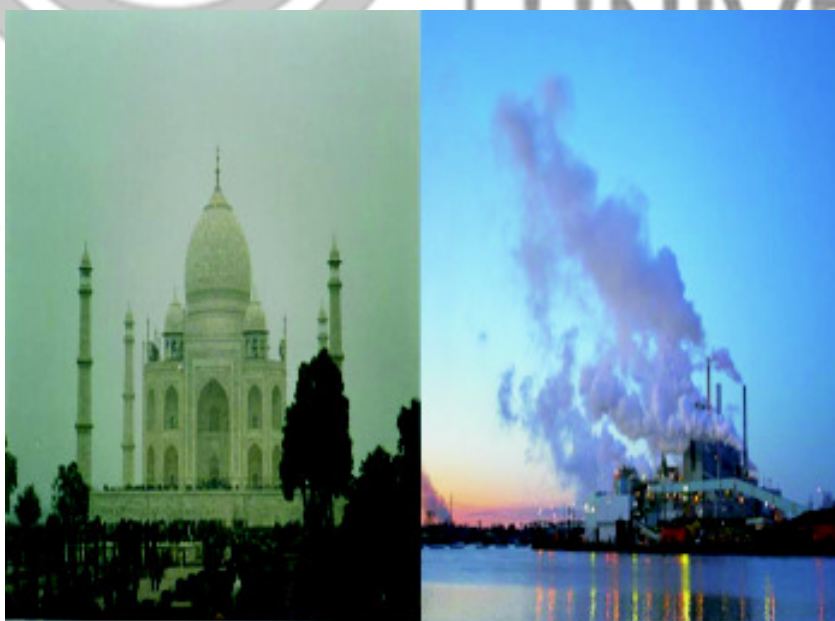
- 1) Power plants: Coal fired/Gas fired or Nuclear power plants. They are regarded as one of the largest contributors of environmental pollution.
- 2) Mining and Excavation Industries: These are also responsible for generating large quantities of hazardous waste and toxic pollutants.
- 3) Manufacturing Industries: Such as pulp and papers mills, leather and textile industries, rubber and plastic industries. We will study in detail how each of these industries contribute towards air, water, soil and noise pollution.
- 4) Chemical and pharmaceutical Industries: Since these industries are involved in the manufacturing of acids, bases, pesticides, detergents and many other organic and inorganic compounds, they are responsible for releasing a huge quantity of chemical wastes in the process.
- 5) Agro based Industries: These include sugar mills, brewing and distilling, meat and dairy products, canning food processing, etc. These industries are responsible for producing mainly organic wastes.

Besides, some other industries like health care, tourism, research laboratories, information technology, construction and other small commercial set-ups like photography, tailoring, dyeing, printing press, workshops etc., all contribute towards environmental pollution in either big or small way.

While on the one hand industries are the key sources of generating wealth and employment, on the other hand, they are responsible for many undesired consequences such as:

- Pollution of air, water and soil
- Climate change
- Acid rain
- Natural resource depletion
- Deforestation
- Degradation of land
- Production of hazardous wastes
- Adverse health effects
- Life threatening accidents

Thus, we can say that Industrialization has led to environmental degradation of an undesirable degree. Construction of large dams, hydropower schemes, diversion canals, vast irrigation systems have all caused ecological disturbances. These systems are poisoned by industrial effluents and agricultural runoffs. River and water bodies die, massive deforestation causes severe soil erosion and depletion of biodiversity problems. Developing countries like India are faced with challenges involving protection of land, water, forest and air resources, provision of high quality health standards and environmentally sound development initiatives. Thus, what require today is ‘sustainable Development’, which meets the needs of the present generation without comprising with the needs of the future generations.



Decay of Taj Mahal due to Industrial Pollutants

The suspected decay of Taj Mahal, the magnificent historical monument, is an alarming example of the onslaught by polluted atmosphere. The pollutants making the Taj Mahal vulnerable come from the following main sources.

- 1) Mathura oil refinery that emits about 25-30 tonnes of SO₂ daily.
- 2) Two thermal power stations at Agra (these are closed now)
- 3) Heavy automobile traffic on Agra-Mathura highway and on other radial roads.

Although the refinery used low sulphur content fuels, yet the emitted SO₂ on combining with humidity converts to dry and wet precipitation and wind spreads it in adjoining areas. This acid deposition reacts with Calcium Carbonate (CaCO₃) present in the marble of Taj Mahal, and forms calcium sulphate (CaSO₄), which causes deterioration. The detrimental effect of this precipitation on Taj Mahal is visible in following forms.

- Discoloration of white marble
- Appearance of yellowish or yellow-gray or brown stains particularly in arches and niches
- Chipping and breaking of the marble slab edges
- Formation of cracks in the marble

1.3 INDUSTRIALIZATION – SPECIAL ECONOMIC ZONES (SEZ)

The concept of Special Economic Zones (SEZs) was an initiative of the Government of India, started in 2000, to address the insufficient capital needs of the country by increasing the industrial capacity and to put India on an export-led growth path. The objective of SEZs were to address the infrastructural deficiencies, procedural and bureaucratic hassles and to have an inbuilt legal protection measure with regard to monetary, trade, fiscal, taxation, tariff and most importantly labour policies. It was started with some promising gains such as employment opportunities for the local people and technology transfer from the more developed sectors in order to benefit the domestic industry. Thus, the aim of building SEZs was to have economic growth led by mainly private capital investment and the promotion of exports, with the widening of the industrial base, research and infrastructure development.

Though, the SEZs scheme promises increase in employment and improvement in infrastructure, there is a contrasting view to this. It is felt by a group of people that employment claims are varied and dubious. There will be only one job created for every four taken away. Only a handful of skilled workers and staff are likely to benefit. It will bring with it, displacement of a large number of families dependant on agricultural farms as their source of income. Acquiring of agriculturally productive land for setting up industries in SEZ is not an environmental friendly decision. Besides, displacement of poor farm families and villages amounts to gross human rights violations. Thus, while on one hand SEZs promise a boost in the economy by promoting industrial growth, on the

other hand, displacement of local farmers and acquisition of agriculturally productive land are some of the important socio-economic and environmental concerns that need attention.

1.4 INDUSTRIAL POLLUTION- ENVIRONMENTAL IMPACTS

Industries have impacted our environment in a big way, be it the air we breathe, the water bodies, the soil or the habitat we live in. In this section, we will see how each of the above are impacted by the various types of industries that have come up.

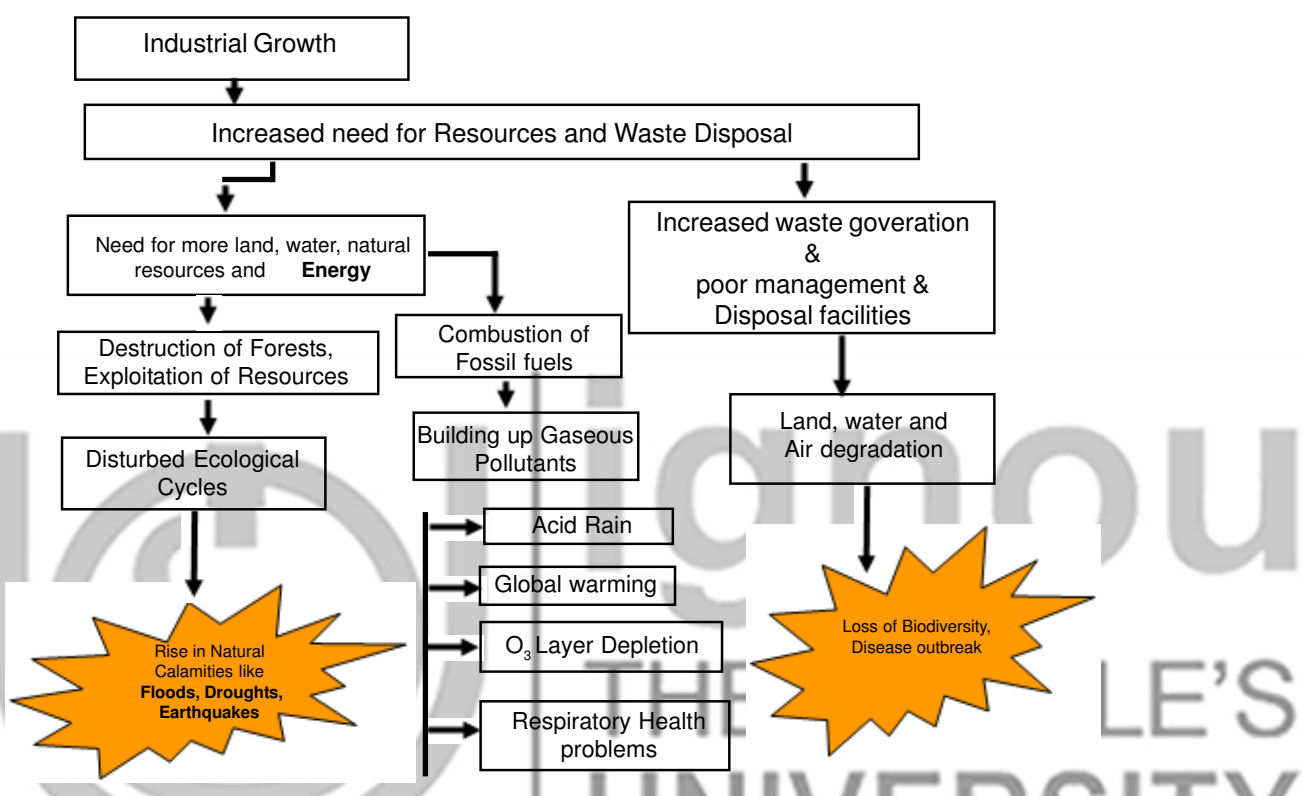


Figure 1.3: Environmental Consequences of Industrial Growth.

In this sessions you read about concept of industrialization as SEZs, now answer the questions given in *Check Your Progress 1*.

Check Your Progress 1

Note: a) Write your answer in about 50 words.

b) Check your answer with possible answers given at the end of the unit.

1) What are the socio-economic environmental concerns of SEZs?

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2) List the various undesirable environmental consequences associated with setting up of Industries.

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1.5 AIR POLLUTION

Components of clean air that we breathe include: Nitrogen (78.08%), Oxygen (20.95%), Argon (0.93%), Carbon Dioxide (0.033%) and other trace gases such as Neon, Helium, Methane, Krypton, Nitrogen Dioxide, Hydrogen. When the concentration of any of the trace gases increases beyond their acceptable level or when some harmful/ toxic gases or aerosols are introduced in the ambient air, they are termed as pollutants.

Historical events of Air Pollution Episodes

- **“Donora Smog”**, in 1948 a “killer Smog” emerged in Donora, Pennsylvania, making 7,000 people ill and leaving many dead as SO₂ NO_x and metal dust spewed from the local steel plant (EPA, 2000).
- **New York**, 1953, air pollution killed as many as 200 people in New York city and in 1963, air pollution killed as many as 405 people (American Lung Association, 2002).
- **Los Angeles** 1954 Smog, Industry and Schools were shut down due to heavy air pollution which resulted in severe respiratory problems amongst the local population.

Air pollution is caused due to both natural and anthropogenic activities. On the other hand volcanic eruptions and forest fires are some of the naturally contributing causes to air pollution. Industrial Revolution is one of the biggest man-made causes of deteriorating air quality, particularly in areas inhabited by large number of people. Factories which are dependent on fossil fuel burning release huge amounts of particulate matter and gases into the atmosphere. The release of these pollutants is responsible for adverse health effect. Industries have been associated with many incidents of air pollution in the past that have been responsible for morbidity and mortality of innocent people. Some of the historical events are presented in the Box below.

Industrial Accidents causing deaths due to air pollution

Bhopal Gas Tragedy

The MIC gas leak in Bhopal on December 03, 1984 has been regarded as the worst industrial accident which is related to air pollution. Around 2,00,000 Bhopal residents were effected by the leak of poisonous MIC gas from the Union Carbide Pesticide plant. Around 5000 people were killed. Doctors reported that about 50,000 people were seriously effected & many went blind.

MIC i.e., Methyl-iso-cyanate is a toxic gas used in the manufacture of pesticides. It reacts quickly with water and causes the lungs to swell and eyes to develop cataract. Many died in Bhopal because their lungs filled with fluid.

Bhopal's victims continue to die. Out of every 3 children born to women who were pregnant on the night of the disaster, only one survived. Out of 1,350 new born babies, 16 were physically deformed and 60 premature births. Deformities include children suffering from congenital hearts, holes in arms and impaired eye sight. High levels of thiocyanates were detected in water in Bhopal and continued exposure to this may cause adverse functioning of organs like thyroid, which in turn may effect pregnancy.

Chernobyl Nuclear Disaster

The nuclear accident at Chernobyl occurred in Ukraine on 28th April, 1986. The nuclear power plant using Uranium as a fuel resulted in the tragedy. The fuel rods overheated and ruptured releasing Uranium and other radioactive particles into the atmosphere. Clouds of dark and dangerous radiation spread over the European countries effecting vast population. The radiation coming from Chernobyl has long as well as short term ill effects. About 31 people died as a result of explosion, while more than 1 lakh people were evacuated from the area within 30kms. radius from the plant and not allowed to return for about 4 years. till the time the radiatons were expected to go down.

Besides, Industrial accidents are also responsible for some of the worst episodes of air pollution related deaths. One such event occurred in India, in which thousands died and several hundred thousand people and animals were affected.

1.5.1 Impacts of Industrial Air Pollution:

Some of the impact of industrial air pollution are as follows:

i) Health and Wellbeing

Health impacts can be categorized on the basis of the type of pollutant and the effect it produces when its concentration exceeds the acceptable safe limits. Some of these effects are given below in Table 1.

Table 1: Air Pollutant and Health Effects.

Pollutants	Major Sources	Adverse Effects
Particulates	Anthropogenic as well as natural	Broncho-constriction, cough, nasal and eye irritation, Chronic Obstructive Pulmonary Disease
Sulfur dioxide	Power plants, oil refineries, smelters	Broncho-constriction
Nitrogen oxides	Automobile exhausts	Bronchiolitis, Pulmonary Edema
Carbon monoxide	Incomplete combustion (vehicular exhaust)	Asphyxiation
Ozone	Automobile exhausts and compressors	Bronchiolitis, Pulmonary Edema
Polycyclic hydrocarbons	Diesel exhaust	Lung Cancer
Benzene	Vehicular exhaust, gasoline pumping, household combustion engines, solvents and cleaners	Carcinogenic, dizziness, nausea, unconsciousness
Lead	Leaded petrol and other fossil fuels	Anaemia, neurological, metabolic and behavioral changes in children

ii) Environmental Impacts

Some serious environmental impacts produced by air pollutants of global and local magnitude are given below:

a) Green house effect

Green house actually refers to a glass chamber where plants are kept under controlled conditions. This greenhouse effect is seen in environment also. Some gases present in the atmosphere perform function similar to that of glass. The main green house gases are carbon dioxide, methane, nitrous oxide, and ozone. These gases form a blanket over the earth's surface and allow the incoming short wave solar radiations to pass through and fall on the earth thereby heating the earth's surface. However, these gases do not allow the long wave radiations reflected back from the earth's surface to escape into the space. These reflected long wave radiations are re-emitted back to the earth's surface by the green house gases, thereby resulting in the build up of temperature. Figure 1 shows the effect.

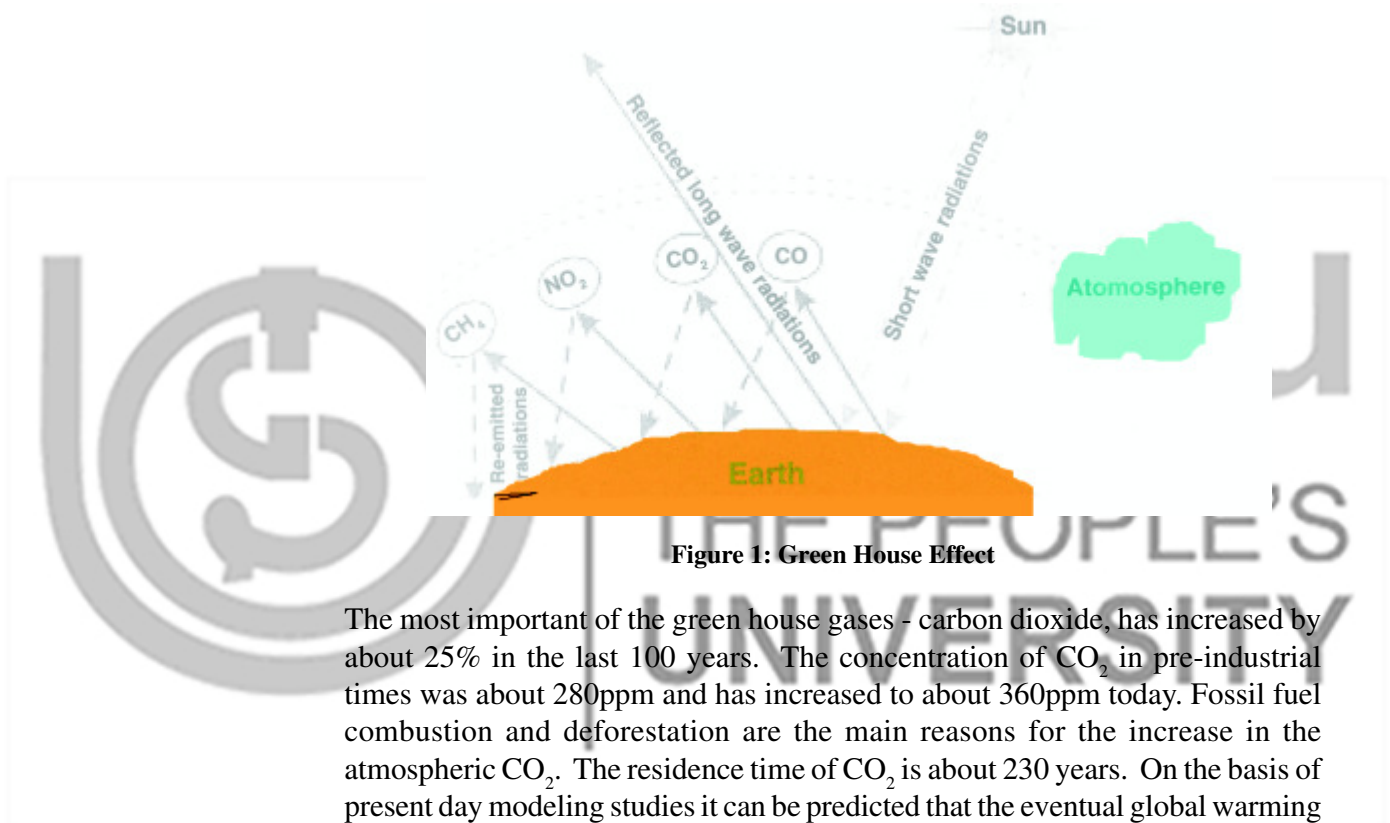


Figure 1: Green House Effect

The most important of the green house gases - carbon dioxide, has increased by about 25% in the last 100 years. The concentration of CO_2 in pre-industrial times was about 280ppm and has increased to about 360ppm today. Fossil fuel combustion and deforestation are the main reasons for the increase in the atmospheric CO_2 . The residence time of CO_2 is about 230 years. On the basis of present day modeling studies it can be predicted that the eventual global warming of about 1.5 to 4.5 °C will take place with the doubling of the CO_2 concentration. If this happens, it will have far reaching consequences for the life on earth.

b) Ozone Hole

Another important global issue is the stratospheric ozone depletion. The stratospheric ozone is commonly known as 'Ozone Layer'. It forms a protective covering over the earth's atmosphere and prevents the entry of harmful solar UV radiation. Worldwide monitoring of stratospheric ozone has shown that it has been decreasing for the past two decades or more. Globally averaged losses have been estimated to be about 5% since the middle of 1960's with aggregate losses of 10% in spring and winter and 5% in summer and autumn over locations in Europe, North America and Australia. Since late 1970's ozone hole has appeared

over Antarctica in southern hemisphere in the months of September/October, registering depletion of ozone. What is the cause of this ozone depletion? Large increase in atmospheric concentrations of chlorine and bromine rich CFCs (chloro-fluoro-carbon compounds) released into the atmosphere are responsible for this depletion. Laboratory studies show that free chlorine reacts with and destroys ozone in a catalytic manner.

During 1992-1993 ozone concentrations dropped by as much as 20% in some populated northern mid-latitude regions and the levels in Antarctic ozone hole decreased to a record low level. This unusual large depletion in ozone concentration was attributed to volcanic eruptions of Mount Pinatubo in Philippines during 1991. These eruptions fed large quantities of sulfate aerosols into the stratosphere, which increased the ozone depletion caused by anthropogenic chlorine and bromine compounds.

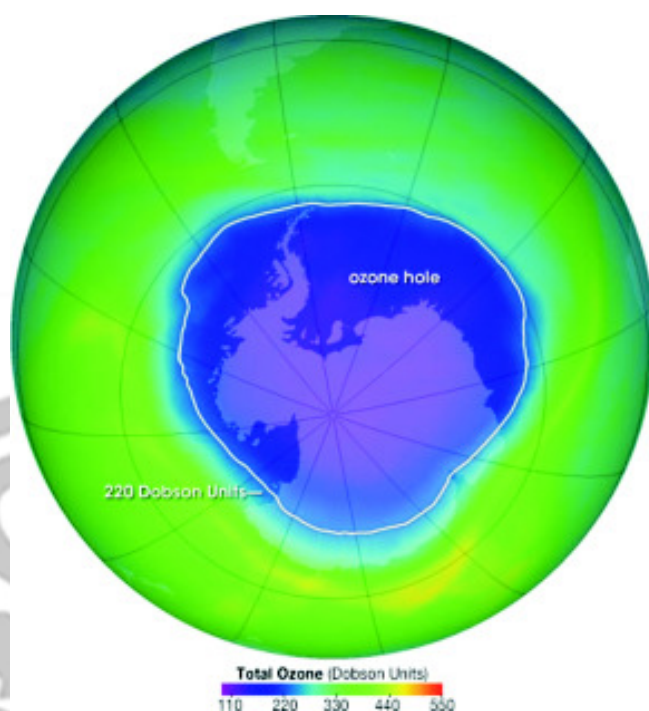


Figure 2: Ozone Hole

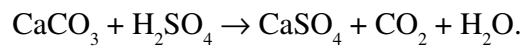
Recent observations have shown that these aerosols have now been swept out of the stratosphere and the ozone has returned back to the earlier levels observed prior to Mount Pinatubo Eruption. During the period 1992-1993 increase in UV-B radiation was also observed at mid and high latitudes in the Northern Hemisphere. The enhancement clearly correlated with the depleted ozone concentration observed during this period.

The depletion of the protective ozone layer in the upper part of the atmosphere leads to greater exposure to UV radiations, which results in increased cases of skin cancer, especially among people of temperate latitudes and the weakening of the immune system of humans and animals. UV radiation can also cause damage to eye and certain types of cataract.

c) Acid Rain

Natural rainfall usually has pH value between 5-6. Acid rain refers to rainfall with $\text{pH} < 5.0$. Oxides of sulfur are emitted into the atmosphere as a result of

combustion of fossil fuels, petroleum refining, copper smelting and cement manufacture. About 80% of oxides of sulfur come from burning of fossil fuels. Sulfur dioxide (SO_2), through series of chemical reactions gets converted into SO_3 . This trioxide form of sulfur on reaction with water produces sulfuric acid (H_2SO_4) and this is the principal component (60-70%) of the acid rain. The conversion of sulfur dioxide into sulfuric acid has increased by the presence of metal ions like copper, lead and manganese and radicals like hydrocarbons and nitrogen oxides in the atmosphere and photo-chemical oxidation. Nitric acid (HNO_3) is the second most abundant component (30-40%); hydrochloric acid (HCl) the, third and carbonic acid, the fourth in acid rain. Acid rain can damage vegetation, corrode metals and building materials, weaken organic fiber and destroy aquatic organisms. Acid rain decreases the pH of water bodies. Certain toxic substances like aluminum, lead and mercury which are insoluble otherwise, become soluble and can be life threatening to fish and other organisms. Prolonged exposure to acid rain can cause serious damage to building material including marble, limestone and mortar as the carbonates in these materials are replaced by sulfates. The reaction between lime stone (CaCO_3) and H_2SO_4 takes place in the following manner:



CaSO_4 produced in this reaction is water soluble and is easily washed away, leaving behind an eroded and pitted surface. Many of the world's historic monuments (e.g. Taj Mahal) and statues have been gradually degraded as a result of exposure to acid rain.

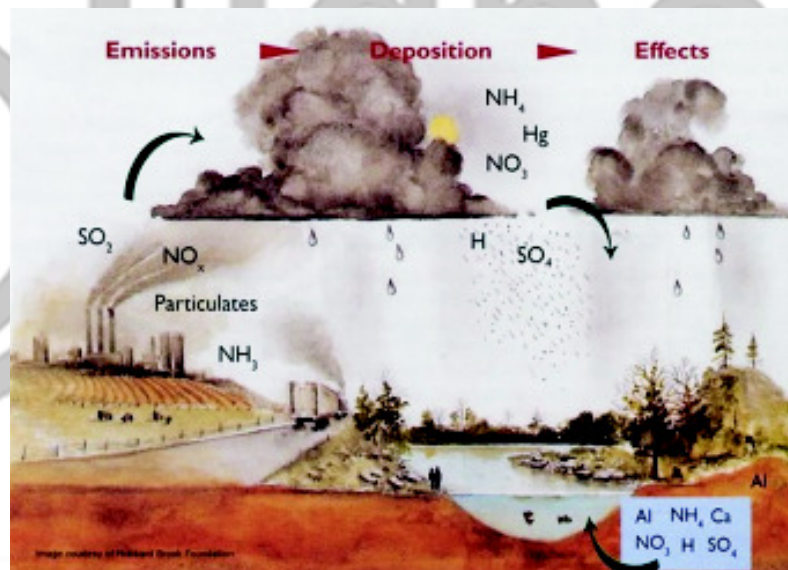


Figure 3: Acid Rain

d) Atmospheric Thermal Inversion

This is an atmospheric phenomenon which further worsens the air pollution by concentrating the pollutants near the earth's surface. Infact, it was the combined effect of inversion and industrial pollution that led to 'Donora' tragedy. As the pollutants are released from an industrial stack, a layer of cold air traps the pollutants and a layer of warm air above it prevents its dispersion into the atmosphere. Figure 4 gives a diagrammatic representation. Thus, this heavily loaded air with a cocktail of pollutants stays in the atmosphere for days together, resulting in severe respiratory problems that can lead to medical attention and

even hospitalization. It was after the ‘Donora’ episode that the public outcry forced the government to bring in force various air pollution control acts.

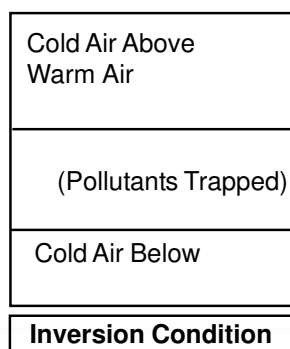
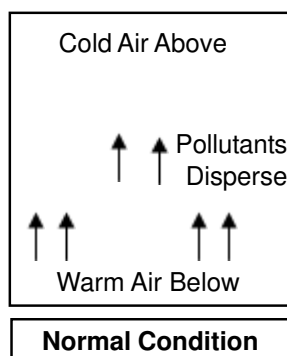


Figure 4: Atmospheric Inversion

In this sessions you read about air pollution, now answer the questions given in *Check Your Progress 2*.

Check Your Progress 2

1) What are CFC's and what harm do they cause?

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2) List the main green house gases and explain green house effect.

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3) What is acid rain?

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1.6 WATER POLLUTION

Addition of any excess material (or heat) to water, that renders it unfit /harmful for use by humans, animals, aquatic life or for agriculture or mere discharge into a larger water body is termed as water pollution. Every use of water, be it, washing, irrigation, flushing of wastes, cooling, processing of some product, has been adding something or the other to water. Rivers and Oceans are often treated as the dumping grounds for human sewage and industrial wastes, many of which are highly toxic. Industries contribute to water pollution in the following manner:

- i) **Thermal Pollution:** Water is often used as a cooling agent in many industrial processes, especially in the power generating plants. This water carrying excess heat is generally released in nearby water bodies such as lakes, rivers, etc. affecting the aquatic life. Rise in temperature renders a water body unfit for the survival of fishes and other aquatic flora and fauna as it depletes the dissolved oxygen in water which is essential for their survival. Besides, it may favour breeding of various vector borne insects, bacteria and viruses. Thus, a healthy water body would be converted to a stagnant/polluted water body.
- ii) **Inorganic Chemical Pollution:** Many industries such as petro-chemical, fertilizer factories, pulp, paper, textile, tanneries, distilleries, sugar and steel mills, drugs, fibers, rubber and plastic manufacturing unit are responsible for discharging many kinds of organic and inorganic pollutants. The common industrial wastes discharged include metals (copper, lead, zinc etc) acids, alkalies, detergents, oil/grease, phenols cyanide, arsenic, chlorine and other toxic effluents that may bring about death or affect the reproductive, excretory, digestive or nervous systems. Fish mortality is another deadly consequence. In many rural areas severe skin diseases are seen to be on the rise due to exposure to the industrial pollutants. Dental diseases and bone deformities in newborns and children are seen to develop after prolonged exposure to these dangerous industrial effluents. Some important phenomena associated with water pollution are:

a) **Bio-accumulation**

Bioaccumulation occurs when a person is exposed to a substance over a period of time accumulating higher levels of the substance in the body.

b) Bio-magnification

Bio-magnification occurs when organisms low on the food chain are consumed by organisms higher on the food chain, increasing the levels of the toxic agent in the predator as a result of concentration in the prey. For example, DDT, a pesticide which kills insects is not easily degradable and remains in the environment for more than 10 years once applied. This pesticide often biomagnifies to as much as ten thousand times as it passes from one organism to another in the food chain.

- iii) Organic Chemical Pollution:** Organic wastes released from mainly agro-based industries contribute heavily towards the bio-chemical oxygen demand (BOD) and chemical oxygen demand (COD) of water. These pollutants can render a water body stagnant. As the demand for oxygen increases, the survival of fishes and other aquatic flora and fauna is threatened. An important phenomena associated with water pollution is: Addition of phosphates, nitrates and organic wastes from industries like tanneries, slaughter houses, starch factories, paper mills, milk plants, run-offs from agricultural lands increase the nutrient concentration in the water bodies. Eutrophication refers to the enrichment of a water body through the addition of organic waste containing nutrients, mainly nitrates and phosphates. In the presence of oxygen, the aerobic bacteria in water bodies release nutrients from the organic wastes. These nutrients act as fertilizers and cause population explosion of aquatic flora like algae, duck weed, water hyacinth, etc. The abundant growth of algae is called the 'algal bloom'. Bacterial activity consumes a lot of dissolved oxygen and so do the algae and other green plants for respiration. This leads to decrease in the oxygen available to fishes that ultimately caused their death. The chemical cycle and ecosystem of the water body changes. In due course of time the water body diminishes and eventually disappears. Eutrophication occurs only in stagnant water bodies and not in flowing water because flowing water carries away the wastes and the nutrients and disperses it to larger area.



Fig. 5: Eutrophication

- iv) **Heavy Metals Pollution:** Serious health hazards have been reported due to release of heavy metals like lead, cadmium and mercury in industrial wastes. Mercury is released as a by-product in the production of vinyl-chloride and from laboratories, hospitals, power plants and incinerators. In Japan, many people become crippled and some died following exposure to methyl mercury released from Japanese coastal industries. Heavy metals are known to cause severe adverse effects even when present in very small quantities.
- v) **Other Pollutants:** These include some chemical (i.e., disinfectants & their by-products) and biological (i.e. microorganisms) pollutants which lead to adverse health effects. Release of untreated municipal waste may build the concentration of E.coli and other pathogenic bacteria and viruses, capable of causing diseases like: typhoid, cholera gastroenteritis, etc. with symptoms of vomiting and diarrhea. Thus, Coliform Index or Most Probable Number (MPN) is an important indicator for measuring the E. coli count in water. Addition of disinfectants like chlorine in water, if added in large quantities can also persist as 'Residual chlorine' which has undesirable effect on fish and plankton mortality as well as in corrosion of pipes as it is a strong oxidizing agent.

Minamata Disease Exposure to Mercury Waste

The "Minamata disease" got its name from Minamata Bay where it was first observed as disease of central nervous system in the nearby communities. The initial symptoms were numbness of the limbs and area around the mouth, sensory disturbance, and difficulty with everyday hand movement, lack of coordination, weakness and tremors, slowed and slurred speech, and altered vision and hearing leading to general paralysis. Initially the illness was suspected due to some infection. Later, it was found to be because of eating fish contaminated with mercury. The investigation revealed that the water of the bay was polluted from 1932 to 1968 by dumping of an estimated 27 tons of mercury compound by Chisso Corporation, a company located in Kumamoto, Japan. The levels of methyl mercury chloride were found to be very high- 50 ppm in fish and 85 ppm in shell fish from contaminated area. About 121 people were poisoned, 46 of which died. Over 3,000 victims have been recognized as having "Minamata Disease".

In this sessions you read about water pollution, now answer the questions given in *Check Your Progress 3*.

Check Your Progress 3

- Note:** a) Write your answer in about 50 words.
- b) Check your answer with possible answers given at the end of the unit

1) List the water polluting agents.

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2) Explain Bio-accumulation, Bio-magnification and eutrophication in brief.

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1.7 SOIL POLLUTION

Main contributors to soil pollution are the huge quantities of solid wastes and chemicals. Industrial wastes like chemicals, fly ash and cinder (mainly from coal based power plants and other industrial sectors), garbage, crop residues (from agro-processing units), paper, plastics and other packaging materials, discarded manufactured products or machines, etc all contribute towards soil pollution. Many fertilizers, pesticides / insecticides and pharmaceutical industries release chemicals directly into the soil or aerosols that ultimately settle down as soil pollutants. These chemicals may have serious implications on species composition of plants and animals. These pollutants may inhibit the process of soil formation and may reduce the fertility of soil. Some of the main soil pollutants and their effects are listed below in Table 2.

Table 2: Sources, Types and Effects of Soil Pollutants

Source and Type of Soil Pollutants	Effects
Smelting and mining complexes release metals like cadmium, zinc, lead, copper, arsenic and nickel into the soil.	These are phytotoxic and make plants unsafe for human and animal consumption.
Power plants, chemical & fertilizer manufacturing units, iron & steel plants may release huge amounts of fly ash into the environment.	Fly ash if not controlled properly may be drifted away by wind to several kilometers & may settle on crops & reduce soil fertility & Effect crop production. It is also responsible for respiratory problems.
Many modern agricultural practices release chemical fertilizers, herbicides, insecticides & fumigants.	These stable chemical may remain in the soil for long periods without degradation and have a cumulative effect on plant and animal species.
Many agro-based industries accumulate huge quantities of bio-degradable wastes which when not managed properly create unhygienic conditions.	These when dumped carelessly often become dwelling place for rats, flies, bacteria, viruses and other vectors, resulting in the spread of diseases.
Some of the more toxic compounds released into the air as emissions from industries may settle down ultimately on the soil.	These chemicals may be carcinogenic or teratogenic in nature & may persist in soil for a long time. Leaching from soil into the water bodies and ultimately into the biotic system produce genetic disorders.

Besides the soil pollution, industries have also been responsible for destroying the soil productivity by either encroaching an agriculturally productive land for industrial use, rendering it unfit for cultivation or by carrying out various industrial

activities such as waste dumping, washing/cleaning, combustion and other such processes which ultimately lead to the release of undesirable pollutants into the otherwise productive and healthy soil.

1.8 NOISE POLLUTION

The presence of ‘wrong sound’ at the ‘wrong time’ in the ‘wrong place’ constitutes ‘Noise’. Noise in an industry originates from processes causing impact, vibration/movements, friction and turbulence in air or gas streams. Sound is measured by several complex systems but the best known unit of measurement is the decibel (dB). The decibel measures sound intensity or the loudness. Human ear is known to be sensitive to extremely wide range intensity from 0 to 180dB. While 0decible is the threshold of hearing, 140dB is the threshold of pain. By threshold, it implies the lowest intensity at which stimulus gets perceptible. Some people feel discomfort even with sound of 85 dB whereas most do not feel discomfort with sound of 115 dB. Pain is usually felt at 140 dB. Ordinary talk or discussion is having the frequency range from 30-60 dB while noise produced by a jet plane at take-off may exceed 160 dB. The effect on man depends upon the frequency or pitch of the sound. Table 3 below gives the level of sound and their effects on human beings.

Table 3: Sound Levels and their Effect on Humans.

Source	Sound Level (dB)	Perception of Sound	Effect
Rocket Engine	180	Painful	Eardrum rupture
Jet takeoff (25 meters away)	150	Painful	Eardrum rupture
Jet takeoff (161m away), textile loom, live rock music	120	Uncomfortably loud	Pain threshold
Steel mill, automobile horn	110	Uncomfortably loud	
Jet takeoff (305m away), power lawn mower, farm tractor, printing plant, motorcycle	100	Uncomfortably loud	Hearing damage (in 8 hours)
Busy urban street, diesel truck, blender/mixer speech interference	90	Very loud	Impaired hearing (in 8 hours),
Average factory, freight train at 15 meters, dishwasher	80	Very loud	Possible hearing damage
Freeway traffic at 15m, vacuum cleaner, noisy party	70	Moderately loud	Annoying
Average office, supermarket, restaurant	60	Moderately loud	Intrusive
Quiet suburb (daytime), conversation in living room	50		Quiet
Library, soft background music	40		
Whisper, rustling leaves	20		Very quiet
Breathing	10		

Noise is undesirable in any setup and has its own ill effects. Some of the adverse effects of noise are:

- a) **Interference in sleep:** Areas of high noise often cause disturbance in sleep and can thereby affect the health & well being.
- b) **Effect on hearing:** Continuous exposure to noise levels much above 100dB can have an adverse effect on hearing ability in a short time. Hearing defects are seen in workers of noisy workshops and factories.
- c) **Effect on Communication:** Undesirable sounds interfere with conversation and can thus Effect the efficiency of offices, schools and others places where communication is vital.
- d) **Other effects on health:** Noise also effects mental and physical health of an individual and reduces their work efficiency. People often feel uncomfortable to work if there is persistent noise. Noise contributes to development of cardiovascular problems like heart disease and high blood pressure. Workers exposed to high noise levels have more circulatory problems, cardiac disturbances, neurosensory and motor impairment and even more social conflicts at home and at work. Studies have shown that workers exposed to high noise levels had twice the incidence of hypertension & up to four times the incidence of peptic ulcers.
- e) **Effect on Work efficiency:** Noise often brings about distraction and could therefore Effect the efficiency of people whose jobs demand concentration and creativity.

To prevent the population from adverse effects of noise it is recommended that the noisiest parts of the factory should be kept as far as possible from the boundary of the site where workers/residents are present.

In this sessions you read about noise pollution, now you would be able to answer the questions given in *Check Your Progress 4*.

Check Your Progress 4

- Note:** a) Write your answer in about 50 words.
 b) Check your answer with possible answers given at the end of the unit.

1) Give the Adverse Health Effects of any two heavy metals released as Industrial Effluents.

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2) What effects are produced in human beings by high noise levels?

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1.9 SOCIO-ECONOMIC IMPACT OF INDUSTRIALIZATION

There is no doubt that the country has greatly benefited from the industrial projects. However, it is unfortunate that while planning, the negative effects on physical and social environment were not taken into account. We have seen in the previous sections how man has impacted the various components of our environment for the sake of industrialization. But, it is also ‘the man’ who in turn has been affected by the same very process of industrialization in a number of different ways. First and foremost issue related to any industrial project is that of land acquisition. Whenever, a project is initiated some agricultural/forest land is requisitioned for it. The population living there is displaced and the affected persons have to leave their homes and profession and look for new jobs and a place to live. This brings vast changes in living conditions, employment pattern and social organization amongst the local population. Some of the main socio-economic impacts of Industrialization are:

1) *Displacement of Population and Migration*

Land is the first requirement for any developmental project. In any overpopulated country it is difficult to find land that is not already inhabited or under cultivation. The first step in any project is clearing it for human population. Unfortunately, the resettlement of these uprooted persons is generally not a part of the project and they are mostly left to themselves. The displaced persons find it impossible to start their life afresh. Thus, they start migrating to other areas in search of basic living conditions. Large scale migration is seen to occur wherever dams are constructed. Most of the people migrate to already crowded cities and larger towns, where they can earn to sustain themselves. The main drawback of developmental activities is inadequate provision for rehabilitation of effected population.

2) *Change in Employment Pattern*

While the developmental projects have on one hand created jobs but, on the other hand, have taken away the jobs of traditional workers and forced them to migrate to the cities. To take care of such anomalies, the Government and other organisations have to make efforts to provide employment to the jobless people who have been rendered unemployed in their own areas. Dams and irrigation projects displace large numbers of people from their land. Their rehabilitation thus becomes the prime concern for the government.

3) *Formation of Slums*

Slums represent the worst type of environmental degradation that has become concomitant to urbanization and industrialization. Slums cause deterioration of surrounding region and are a threat to human health. Some of the contributing factors causing the growth of slums are inadequacy or non-existence of civic amenities, failure to improve rules regarding house building and encroachment of public land, etc. Lack of basic facilities like water supply, electricity, sewers, storm water drains, community baths and latrines and improved lanes in these areas pose health hazards and poor living conditions for the migrated population.

While, there are a number of negative socio-economic impacts of Industrialization, there are a few positive ones also, these are:

a) Employment Opportunities

With heavy industrialization comes other developmental activities: power generation, mining, railways, road and air transport, post and telegraph services, etc. The industries and other projects employ millions of people who get an assured income. Thus, employment opportunities are provided to a number of people.

b) Changes in Economy

The developmental projects directly affect economy as more income is generated by way of products and many people get involved in the economic process. Also, the traditional kinds of activities are replaced by more advanced activities and the resources are better utilized. Thus, provision of better amenities and living conditions attracts more and more migratory population resulting in the development of cities and towns.

4) *Environmental Refugees*

Environmental Refugees is a new class of people who are displaced from their native areas due to certain environmental catastrophes such as rising sea levels, droughts, desertification, deforestation, weather induced flooding and other serious natural disasters due to climate change. These are people who can no longer gain a secure livelihood in their homelands because of environmental problems, together with associated problems of population pressure and profound poverty. They are compelled to abandon their homelands with little hope of a returning in search of better/more secure habitats.

In 1995 these environmental refugees totaled to at least 25 million people. Scattered throughout the developing world are 135 million people threatened by severe desertification, and 550 million people subject to chronic water shortages. While certain of these people will have been included in the 25 million figure, many could well have been driven to migrate without being counted as environmental refugees (Norman Myers). The environmental refugees total could well double by 2010. In near future, global warming and associated environmental effects such as sea-level rise and flooding of coastal-zone communities, increased droughts and disruptions of rainfall regimes such as monsoonal systems, could threaten large numbers of people

with displacement by 2050 or earlier. There could be as many as 200 million people overtaken by disruptions of monsoon systems and other rainfall regimes, by droughts of unprecedented severity and duration, and by sea-level rise and coastal flooding.



Of the 25 million environmental refugees in 1995, there were roughly five million in the African Sahel, where a full ten million people had fled from recent droughts, only half returning home. Another four million, out of eleven million refugees of all types, were in the Horn of Africa including Sudan. In other parts of Sub-Saharan Africa, where 80 million people were considered to be semi-starving due primarily to environmental factors, seven million people had been obliged to migrate in order to obtain relief food. In early 2000 Sudan featured eight million people who were officially considered at risk of starvation, with another six million in Somalia and three million in Kenya, plus several million others in other countries. While Sub-Saharan remains the prime locus of environmental refugees, there are sizeable numbers in other regions and countries. In China with its 120 million internal migrants, at least six million deserve to be regarded as environmental refugees, having been obliged to abandon their farmlands due to shortages of agricultural plots in the wake of decades of population growth. In Mexico there are one million new environmental refugees each year (Ref. Norman Myers). Environmental Refugees are faced by harsher conditions of malnutrition, landlessness, unemployment, rapid urbanization, pandemic diseases and faulty government policies, together with ethnic strife and conventional conflicts. Thus, there is a great need to protect our environment which in turn would automatically solve the mushrooming of environmental refugees.

Check Your Progress 5

Note: a) Write your answer in about 50 words.

b) Check your answer with possible answers given at the end of the unit.

1) Give two positive and two negative Socio-economic impacts of Industrialization.

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2) What do you understand by the term ‘Environmental Refugees’?

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1.10 LET US SUM UP

After going through this unit you must have got an idea about the concept of industrialisation and also how development and environmental degradation go hand in hand. You have studied how each of the industrial set up (i.e. power plants, mining and excavation industry, manufacturing industry, chemical and pharmaceutical industry, agro based industry etc.) are responsible for the various undesirable consequences such as: air, water and soil pollution, Climate Change, Acid Rain, Natural Resource depletion, deforestation, land degradation, adverse health effects as well as life threatening accidents. Within the boxes were provided some cases of pollution episodes and life threatening Industrial accidents that have occurred in India and abroad in the past. These set an example for all of us to be careful while planning any Industrial/development project in the future and to take into account all possible environmental consequences that a project can have. This would ensure sustainable development for our present and future generation. You have studied about some of the global environmental / impacts the adverse effects of water, air, soil and noise pollution on human health and other living organisms. You have also studied the various socio-economic impacts that Industrialization has brought with it, be it positive and negative ones. By now, you are also familiar with the term ‘Environmental Refugees’ and how this numbers are growing day by day owing to the various environmental catastrophes that are resulting from the disturbed ecological balance which in turn is the consequence of fast paced and un-thoughtful developmental activities.

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1.12 CHECK YOUR PROGRESS – POSSIBLE ANSWERS

Check Your Progress 1

- 1) Displacement of local farmers and acquisition of agriculturally productive land, loss of income generation mainly of farmers.
- 2) Pollution of Air, Water and Soil; Climate change; Acid Rain; Natural resource depletion; Deforestation; Degradation of Land; Production of Hazardous wastes; Adverse Health Effects; Life threatening Accidents

Check Your Progress 2

- 1) CFC's are compounds of carbon, chlorine and fluorine. Free Cl⁻ released by CFC's are capable of destroying the protective stratospheric ozone and are largely responsible for O₃ hole.
- 2) Carbon dioxide, methane, CFC's nitrogen oxides, ozone and water vapors. Refer text for Green House effect.
- 3) Please refer text.

Check Your Progress 3

- 1) i) Biological, ii) Chemical, iii) Physical

Students should give two examples of each from their knowledge of water pollution and explain their adverse effects along with their sources.

- 2) Bioaccumulation occurs when a person is exposed to a substance over a period of time accumulating higher levels of the substance in the body.

Bio-magnification occurs when organisms low on the food chain are consumed by organisms higher on the food chain, increasing the levels of the toxic agent in the predator as a result of concentration in the prey.

Eutrophication is the process of enrichment of water bodies by nutrients. The enrichment leads to population explosion of plants as well as decomposers in the water bodies finally causing the death of the water body due to consumption of the dissolved O_2 .

Check Your Progress 4

- 1) Please refer to Table 3.2
- 2) Irritable behavior, lack of concentration, headaches, lack of sleep, rise in blood pressure, cardio-vascular problems, impaired hearing, neuro-sensory and motor impairment.

Check Your Progress 5

- 1) Positive: Changes in Economy and employment opportunities. Negative: Displacement of local Population, Migration, formation of slums.
- 2) Environmental Refugees is a new class of people who are displaced from their native areas due to certain environmental catastrophes such as rising sea levels, droughts, desertification, deforestation, weather induced flooding and other serious natural disasters due to climate change. These are people who can no longer gain a secure livelihood in their homelands because of environmental problems, together with associated problems of population pressures and profound poverty.



UNIT 3 WATER BODIES, WATER WAYS AND WETLANDS

Structure

- 3.1 Introduction
- 3.2 Water Bodies: Concept, Importance and Benefits
- 3.3 Water Ways: Concept and Significance
- 3.4 Wetlands: Concept and Significance
- 3.5 Economic Value of Wetlands
- 3.6 Ecological and Water Footprints of Urban Area
- 3.7 Revitalisation of Water Bodies
- 3.8 Let Us Sum Up
- 3.9 References and Selected Readings
- 3.10 Check Your Progress – Possible Answers

3.1 INTRODUCTION

India is the second most populated country in the world with a population of 1.21 billion as per 2011 census. Out of this, 377 million which accounts for 31.2 percent of the total population reside in urban areas of the country. The level of urbanisation in terms of the proportion of urban population to total population is low in India But the urban population in absolute terms is very high. Moreover, most of the urban population is concentrated in the Class I cities of India. Population explosion in the cities can be attributed to the large scale rural to urban migration. Urbanisation characterised by extremely high densities of fast-growing populations leads to various adverse social and ecological impact as burgeoning growth of slums and intense pressure on the environment and its resources like water. Several water related problems, such as modification of microclimate stems out of the adverse impact, There is changed environmental conditions for water cycling in landscape, reduced capacity for water retention increasing vulnerability to extreme events like long-lasting droughts and extreme floods and deteriorated quality of water resources are become burning issues and challenges in the new global urbanised world. Rapid development of landscape for housing often results with physical modification of habitats. It often affects resilience of ecosystems to maintain their structures and properties, thus providing ecosystem services. The linkages between water and urban life are crucial. The hypothesis that urbanisation can have direct and indirect impacts on the environment. The wetlands are susceptible to negative change has long been proven. Thus, it is essential for urban areas to adopt a sustainable approach to urbanisation through wetland and water conservation. This approach is essential for countries like India where urban areas are growing at a high rate. The unit delineates the role of water bodies, water ways and wetlands in urban development. After reading this unit, you will be able to:

- Describe the concept and importance of water bodies, water ways and wet lands
- Explain the benefits of water bodies, water ways and wet lands; and
- Discuss the management of urban water bodies

3.2 WATER BODIES: CONCEPT, IMPORTANCE AND BENEFITS

The water cycle, also known as the hydrological cycle, is the continuous exchange of water between land, water bodies, and the atmosphere. When precipitation falls over the land, it follows various routes. Some of it evaporates, returning to the atmosphere, some seeps into the ground, and the remainder becomes surface water, travelling to oceans and lakes by way of rivers and streams that constitute water bodies. A water body is defined as a significant accumulation of water on earth such as oceans, sea, lakes, and smaller pools of water such as ponds, rivers, streams, canals, etc. Moving bodies of water from one place to another are also considered in the category of water bodies for general purposes. Urban water bodies include urban streams, canals, rivers, ponds, impoundments, reservoirs, lakes, etc. Some bodies of water are human-made that include reservoirs or harbours but many are naturally formed. The main characteristics of these water bodies fall into the following five groups:

- a) Flow regime
- b) Physical habitat structure
- c) Chemical variables (water quality)
- d) Energy (food) sources
- e) Biotic interactions

Water bodies play a significant role in sustaining human welfare. Water bodies are estimated to occupy nearly 6.4% of the earth space of those water bodies, nearly 30% is made up of bays, 26% fens, 20% swamps, and 15% flood plains. There are 67,429 water bodies in India, covering about 4.1 million hectares. Out of these, 2,175 water bodies are natural covering 1.5 million hectares and 65,254 are man-made occupying about 206 million hectares.

It is valuable to human beings from the point of view of ecology, landscape, recreation, heritage, culture, and drainage. Therefore, finding optimum use of urban water bodies remains an important challenge of urban planning. In many developing countries, water bodies are linked with urban sewerage so it is affected by increased temperatures of effluents, greater discharges of water, pollutants and waste, and changes in water bodies. Impacted water bodies lose their resistance to the escalating stresses as well as the resilience allowing them to adapt to changing conditions. Water stress imposes losses of ecosystem services to different beneficiaries' especially urban human welfare.



Fig. 3.1: Sukhna Lake of Chandigarh

Source: <http://wikimapia.org/10397/Sukhna-Lake>

Water bodies, water ways and wetlands exert tremendous influence on the urban economy and society. The influence and impact of water bodies on economy, society, environment and safety is narrated in Table-1.

Table-1: Importance of Water Bodies Sources, Activities and Description

Sources	Activities	Description
Water Resources	Bathing	A large number of people from lower economic background use them for bathing.
	Washing	Washing of clothes, utensils and other domestic requirements.
	Rainwater Harvesting	Acts as rainwater storage.
Environment	Climate Control	Ponds affect local micro-climate, making it cooler and soothing.
	Open Space	Ponds provide an open space providing room for air movement. Space for recreational use.
	Trees	Generally the pond banks have tree plantations, preserving urban nature.
	Aquatic Ecology	Ponds support many aquatic and other species, a receptacle of biodiversity in urban context.
Economy	Fish Cultivation	Source for local employment and good protein.
Social	Community Gathering	People spend time sitting around these ponds. Many ponds have seats around them and are an important place for local community gathering.
	Clubs	Because of open space, there often exist many clubs by the ponds side. These clubs also manage the ponds.
Culture	Temples	Many ponds have temples by their sides. Temple Authorities also manage some ponds.
	Holy Ponds	Some ponds have a history associated with them and / or are related to some shrines and are considered as holy ones.
	Fair	Due to the presence of temples, fairs are organized in the open spaces in front of many ponds.
	Immersion	Immersion of Idols is an important event in Hindu Festivals. A number of ponds are specifically used for that.
Safety	Fire Extinguishing	In congested urban areas, ponds are very useful as a source of water supply for extinguishing fire.

Sources: www.slideshare.net/ketulmandavia/water-body

The primary factors of water body deterioration are water quality decline and flow alternations, which are particularly pronounced in urban catchments. The broad range of chemicals from point and other sources include toxic substances and carcinogens, fertilisers, pesticides, herbicides, household hazardous wastes, oils, anti-freeze, heavy metals, pet and yard wastes, and pseudo-hormones.

The factors mainly responsible for the degradation of water bodies are follows:

- i) Slums are usually opened up near the water sources. The slum encroachment is degrading many of the water bodies.
- ii) Waste water collection has affected the quality of many water bodies and even many of them have converted into the waste water depository.
- iii) Siltation is also another cause of degradation of lake as lack of importance is attached to water bodies and, disiltation is not taking place.
- iv) Deforestation has led to erosion and degradation of water bodies.
- v) Solid waste disposal in water bodies is also another major cause of degradation
- vi) Ugly landscaping is a responsible factor for degradation of water bodies.
- vii) Many of the water bodies as of lack of attention and even climate change has been eroded.

These are a few important factors responsible for the degradation of water bodies. A list of urban lakes in different cities in India is given below.

Lists of Lakes in India

Names of the Lake	State
Bangalore City Lake	Karnataka
Bhopal's Upper and Lower Lakes	Madhya Pradesh
Bombay (Mumbai) City's Lakes	Maharashtra
Dal & Nagin Lakes	Jammu and Kashmir
Howrah's Urban Water Bodies	West Bengal
Hyderabad City Lakes	Andhra Pradesh
Jalmahal Lake / Mansagar Lake	Rajasthan
Jaisamand Lake or Dhebar Lake	Rajasthan
Kodaikanal Lake & the Ooty Lake	Tamil Nadu
Lakes of Kumaon Hills-Nainital, Bhimtal, Sat-tal, & Naukuchiatal	Uttarakhand
Mirit Lake / Sumendu Lake	West Bengal
Mysore City's five Lakes-Kukkarahalli, Lingambudhi, Karanji, Devanoor and Dalavai	Karnataka
Nangal Lake and Hussainiwala Lake	Punjab
Rabindra Sarovar (Lake) /Dhakuria Lake	West Bengal
Sastamkotta Lake	Kerala
Sukhna Lake	Chandigarh
Udaipur City's five Lakes-Fatehsagar, Rangasagar, Pichola, Swaroopsagar and Dudh Talai	Rajasthan
Wular Lake	Jammu and Kashmir

3.3 WATER WAYS: CONCEPT AND SIGNIFICANCE

Bodies of water that are navigable are known as waterways that includes both natural and human made water ways. Both natural and human made water ways are planned transport systems and integrated with other transport systems like road, rail, etc. Waterways provide valuable contribution to the society by enhancing development values. It was reported in research studies that residential development value in many urban centres uplifted around with water frontage. However, to achieve sustainable waterway regeneration and development, it is crucial to optimise the added value of waterways, there is a need to develop the use of under – utilised waterside and water bodies of urban area, as well as to maximise the use of existing watersides. Waterways are a form of open space performing a variety of functions. Some of them are given below.

- a) Have a strategic function linking metropolitan areas, urban areas, market towns, accessible and remote rural areas and thus provide for recreational needs over most of a region.
- b) Are an important accessible amenity in urban areas.
- c) Accommodate active sports and informal recreational activities, facilities and services. The towing path network provides opportunities for people to walk, cycle or ride, and therefore, can contribute to the promotion of sustainable transport, health and wellbeing.
- d) Are important wildlife corridors often linking towns with the countryside and thus provide important stepping stones from one habitat to another.
- e) Are an important community resource, for example, by providing the context for water festival events including youth events, and providing access to the countryside from urban areas via the towing path network (acting as a recreational route).
- f) Provide an important visual amenity, for example providing an attractive setting for development, particularly residential.
- g) Inland waterways and other water bodies have an important role to play in developing social inclusion, sustainable transport as well as improving the quality of life of both urban and rural communities.

In order to achieve sustainable waterway corridors, it is crucial that development plans protect and enhance as well as encourage the development, regeneration and utilisation of inland waterways as a multi functional space, resource and asset. Security and safety measures are always ensured in water ways through the construction of various structures which are designed on the basis of hydraulic capacity, structural integrity, and safety. The design process consider all six values associated with water bodies: ecology, landscape, recreation, heritage, culture, and drainage. Waterway structures include bridges and culverts, fords, grills and debris traps floodgates and flap valves, pump stations, stop banks, waterway structural linings and waterway fences.

3.4 WET LANDS: CONCEPT AND SIGNIFICANCE

Wetlands are water bodies but also include land. They are freshwater, brackish or saline, inland or coastal, seasonal or permanent, natural or man-made. Ramsar

is a city in Iran where the first World Convention on Wetlands was held on 2nd February 1971. The Ramsar convention defined wetlands as areas of marsh, fen, peat land or water whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish, salt including areas of marine water, the depth of which a low tide does not exceed six metres. The definition talks about the maximum water depth in case of marine areas for these to qualify as wetlands.

However, it does not indicate the same for other aquatic bodies. Therefore, it becomes difficult to classify other aquatic bodies into wetland group. Wetland is a generic term for water bodies of various types, and includes various hydrological entities, namely lakes, marshes, swamps, estuaries, tidal flats, river flood plains and mangroves. Wetlands may be fresh, brackish or saline, and are characterised in their natural state by plants and animals that are adapted to living in wet conditions. Swamps are predominantly and permanently wet from through-flowing waters. The water level may be constant, or vary from season to season. As the water derives from a land source (as opposed to rain-fed systems called bogs), nutrient levels are high (termed eutrophic), and they may accumulate organic silt, but seldom form proper peat. There are different types of wetlands, in which some important types are as follows.

Lagoons are one type of wetland that occur in coastal enclosures that are shallow and separated from the sea by a sand bar or strip of land. Occasionally they may receive sea water, but do not experience typical tidal fluctuations of an estuary. Waters are brackish as a result, and the water level fluctuates somewhat unpredictably.

Estuaries are different from Lagoons that are partially enclosed by land, but that are open to the sea and subject to regular fluctuations of the tide. The salinity regime depends on the mixing of sea and freshwater from rivers and the nature of the vegetation reflects this balance.

Ephemeral are wetlands that appear only at certain times of the year, especially winter. The plants occupying such situations when wet are short-lived and tolerant of the wetness, while normal dry land plants occupy the site in drier conditions. Sometimes wetlands occur at the interface between land and water bodies that may be flowing (rivers) or stationary (lakes). The characteristic of vegetation is the same as swamps, unless the fluctuations in water level are highly predictable.

Dune slacks are also wetlands that occur in hollows between sand dunes. The water may be above the sand surface (dune lake) or below it (dune slacks). These are typically brackish, and subject to changing water table levels.

Marshes are also wetlands that undergo fluctuations in water level that are considerable and seasonal.

Wetland ecosystems provide many services that contribute to human well-being of human beings. The millennium ecosystem assessment 2005 provides a comprehensive understanding of various services provided by the wetlands. Two of the most important wetland ecosystem services affecting human well-being involve fish supply and water availability. Wetlands are considered as the principal source of renewable fresh water for human use. It also play an important role in climate regulation, water purification, etc. It also provides cultural and aesthetic value to the human population (Table 2).

Table 2: Ecosystem Services Provided by or Derived From Wetlands

Services	Comments & Examples
PROVISIONING	
Food	Production of fish , wild game , fruits , and grains
Fresh Water ^a	Storage and retention of water for domestic , industrial and agriculture use
Fibre and Fuel	Production of logs , fuel wood, peat, fodder
Biochemical	Extraction of medicines and other materials from biota
Genetic Materials	Genes for resistance to plant pathogens, ornamental species, and so on.
REGULATING	
Climate Regulation	Source of and sink for greenhouse gases; influence local and regional temperature, precipitation, and other climatic processes
Water Regulation (Hydrological flows)	Groundwater recharge/Discharge
Water purification and waste treatment	Retention, recovery , and removal of excess nutrients and other pollutants
Erosion Regulation	Retention of soils and sediments
Natural hazard regulation	Flood control, storm protection
Pollination	Habitat for Pollinators
CULTURAL	
Spiritual & Inspirational	Source of Inspiration; many religions attach spiritual and religious values to aspects of wetland ecosystems
Recreational	Opportunities for recreational activities
Aesthetic	Many people find beauty or aesthetic value in aspects of wetland ecosystems
Educational	Opportunities for formal and informal education and training
SUPPORTING	
Soil Formation	Sediment retention and accumulation of organic matter
Nutrient cycling	Storage, Recycling, Processing, and acquisition of Nutrients
^a = While fresh water was treated as a provisioning service within the MA, it is also regarded as a regulating service by various sectors.	

Source: Millennium Ecosystem Assessment (2005)

In India, we have many Ramsar wetlands since it is a signatory to Ramsar Convention. Ramsar Convention on wetlands is an intergovernmental treaty which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. Twenty five sites from India have been designated as Ramsar sites of International importance. The names of the sites, area and the date of declaration of these sites across the states of India are presented in Table 3.

Table 3: List of Wetlands of International Importance in India under Ramsar Convention

State	Name of Ramsar Site	Area in Hectares	Date of Declaration
Andhra Pradesh	Kolleru	90100	19/08/02
Assam	Deepor Beel	4000	19/08/02
Himachal Pradesh	Pong Dam Lake	15662	19/08/02
	Renuka Wetland	20	8/11/05
	Chandertal Wetland	49	8/11/05
Jammu & Kashmir	Wular Lake	18900	23/3/90
	Tsomoriri	12000	19/8/02
	Hokera Wetland	1375	8/11/05
	Surinsar-Mansar Lakes	350	8/11/05
Kerala	Ashtamudi Wetland	61400	19/08/02
	Sasthamkotta Lake	373	19/8/02
	Vembanad-Kol Wetland	151250	19/8/02
Madhya Pradesh	Bhoj Wetland	3201	19/8/02
Manipur	Loktak Lake	26600	23/3/1990
Orissa	Chilika Lake	116500	1/10/1981
	Bhitarkanika Mangroves	65000	19/8/02
Punjab	Harike Lake	4100	23/3/1990
	Kanjli	183	22/1/02
	Ropar	1365	22/1/02
Rajasthan	Sambhar Lake	24000	23/3/1990
	Keoladeo National Park	2873	1/10/1983
Tamil Nadu	Point Calimere Wildlife and Bird Sanctuary	38500	19/8/02
Tripura	Rudrasar Lake	240	8/11/05
Uttar Pradesh	Upper Ganga River (Brijghat to Narora Stretch)	26590	8/11/05
West Bengal	East Kolkata Wetland	12500	19/8/02
Total Sites	25	677131	

In these sessions you have read about the importance of water bodies, water ways and wet lands and now answer the questions given in *Check Your Progress 1*

Check Your Progress 1

Note: a) Write your answer in about 50 words

b) Check your answer with possible answers given at the end of the unit.

1) Define water bodies.

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2) What is a wetland and what are different types of wetlands?

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3.5 ECONOMIC VALUE OF WETLANDS

Wetlands are often located between dry terrestrial systems and permanent deep water systems like rivers, lakes, or oceans. It has been pointed out that because of their niche in the landscape, the wetlands are important exporters or importers of organic and inorganic nutrients respectively. Its regarded as one of the most productive ecosystems. Besides these the wetland helps to reduce the effects of floods, regeneration of groundwater and provides recreational opportunities. The climatic function of some wetlands is also important as it affects the mesoclimate of nearby land by increasing evaporation and absorbing heat during periods of drought. It also acts as barriers against strong winds. In short, the services provided by the wetlands are many. It is considered as open systems which receives inputs from other ecosystems and also from the sun. The outputs or environmental services of the wetlands can be exported to human society and /or to other ecosystems. It is important to note that human interventions can result in the improvement or degradation of the services provided by the wetlands. Following the realisation amongst natural and social scientists that one of the major causes for the loss of wetlands all over the world has been the lack of appreciation of its value, attempts have been made to understand the value of this ecosystem. Although wetlands are generally considered as dynamic ecosystems where the natural fluctuations are part of the system, human activities can change or affect its ecological functions.

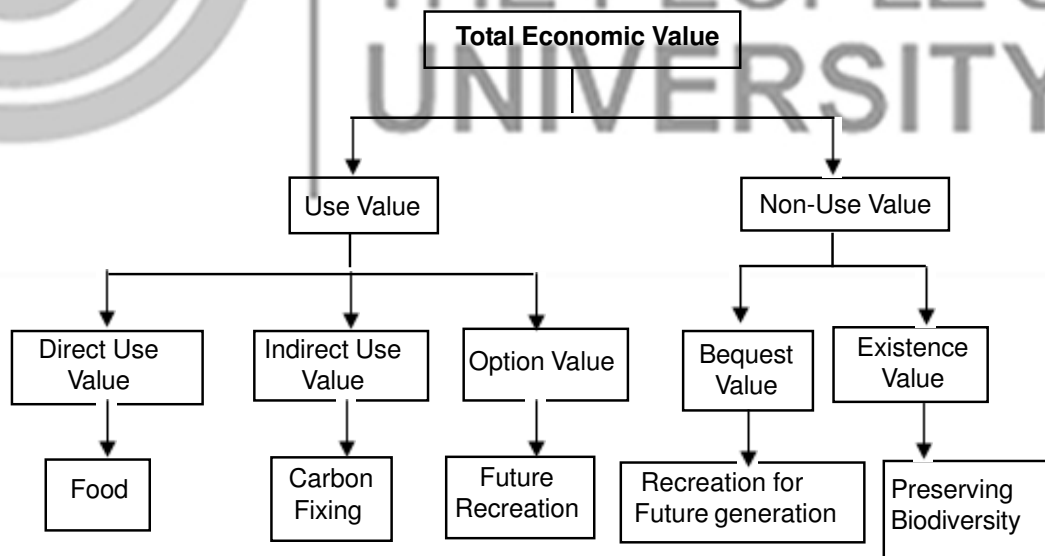


Figure 1. Total Economic Value of Wetlands

Therefore, attempts have been made not only to assess the value of the wetland ecosystem to human society but also the impact of human activities on it. A

conceptual frame work of the total economic value of wetland can be explained with help of figure 1. Use value has been derived from the actual and present use of the ecosystem or species. It is differentiated into productive and consumptive values. This classification of use value follows a sequence based on the tangibility of the biological goods and services. The non-use values are the residual between the total economic value and the use value. The non-use values of ecosystems and species have been classified into existence value, option value and quasi-option value. The concept of existence value suggests that people might value a resource even if they don't use it. Existence value arises from the knowledge that the species exist and will continue to exist, independent of any actual or possible future use by the individual. It is also important to know that some form of altruism motivates existence value. There are three altruistic motives behind existence value. Firstly, philanthropic motive, which says the resource, is valued because contemporaries may wish to use it. The bequest motive that means the current generation may wish to provide an opportunity for future generations to enjoy or use some resource. Finally, intrinsic motive, that implies individuals care about non-human components of the ecosystem.

3.6 ECOLOGICAL AND WATER FOOTPRINTS OF URBAN AREA

Today more than half of the world's population resides in the urban environment, and hence the demand on natural resource consumption also increasing. The measure of increasing human demand on the Earth's ecosystems is referred as the 'ecological footprint'. Comparisons between the demands human beings places on nature and its ability to regenerate resources and provide services have demonstrated in various studies. A study of the ecological footprint of Vancouver of Canada shows that city required an area some 200 times larger than the geographic area of the city to support its population. A more extreme picture emerges for London. The ecological footprint of Londoners has been estimated at 49 million global hectares, which is 293 times its geographical area. It is reported that it is approximately twice the size of the UK, and roughly the same size as Spain. Ecological footprint is a perspective that cities can be considered as organisms with their own metabolic processes. The concept of the metabolism of cities was first suggested by Wolman in 1965 as an approach to overcome shortages of water and pollution of water and air. This allowed an examination of the complex interactions that take place within cities to be understood rather than studying specific problems in isolation. The metabolism of an ecosystem has been defined by ecologists as the production (via photosynthesis) and consumption (by respiration) of organic matter and is typically expressed in terms of energy. In this broader context, urban metabolism might be defined as the sum total of the technical and socio-economic processes that occur in cities, resulting in growth, production of energy, and elimination of waste. In the early stage of urbanisation, water supply often exploits good quality shallow groundwater, with wastewater and drainage waters discharged back to the ground or to a watercourse. With increasing urbanization a lowering of the water table occurs with localised pollution of groundwater resources resulting from wastewater discharges and other urban activities. Similar to ecological footprints, 'water footprint' indicates the volume of water required to sustain a population. The water footprint of a city is defined as the total volume of freshwater that is used to produce the goods and services consumed by the urban people. In terms

of water, it indicates the volume of water required to sustain a population. It is defined as the total volume of freshwater that is used to produce the goods and services consumed by the people occupying the city. Since, not all goods consumed in one particular city are necessarily produced in that city, the water footprint consists of two parts: use of municipal water resources and use of water from beyond the geographical area of a city. Water footprints will reflect consumption patterns, economic prosperity, climate and food demand. Unplanned urbanisation can lead to degradation of important water bodies and wetlands of a city that in turn make the city more dependent on water sources outside the geographical area. Urbanization affects water bodies and wetlands via hydrological cycle through the modification of landscapes. The main changes in landscape due to urbanisation include:

- a) Removal of natural vegetation;
- b) Loss of natural depressions which temporarily store surface water;
- c) Loss of rainfall absorbing capacity of soil;
- d) Creation of impervious areas (e.g., rooftops, roads, parking lots, sidewalks, driveways) and provision of man-made drainage systems (e.g., storm sewers, channels, detention ponds).

Impervious surfaces associated with urbanisation alter the natural amount of water that takes different routes. The consequences of this change are a decrease in the volume of water that percolates into the ground, and a resulting increase in volume and decrease in quality of surface water. These hydrological changes have significant implications for the quantity of fresh, clean water that is available for urban use. The Millennium Ecosystem Assessment of 2005 reported that the degradation and loss of wetlands, and the deterioration of freshwater and coastal wetland species, are more rapid than that of other ecosystems. It is apparent that we continue to mismanage wetlands in urban context.

3.7 REVITALISATION OF WATER BODIES

A study shows that build up area of Delhi witnessed an overall increment of 17% and a whopping 52.19% reduction in area under water bodies (Nandi, 2012). The government of India has taken a series of measures for the management and restoration of the glory of water bodies. The measures taken at different points of time are given below:

- i) **Special Purpose Vehicles (SPVs)**- The SPVs measures taken by different state governments are Bhoj Wetland Authority in Bhopal, Madhya Pradesh; the Chilika Development Authority (CDA) in Orissa; the Loktak Development Authority (LDA) in Manipur; J&K Lakes and Waterways Development Authority in J&K and Jai Vikas Samiti in Udaipur, Rajasthan are a few of them.
- ii) **Restoration Plans**- Treatment of watershed or catchment of lakes, soil conservation measures, afforestation, tiny drainage improvements are in vogue by different state governments for the restoration of water bodies. Besides de-silting, de-weeding and bio-remediation measures being done in various cases. The people participation has been ensured in a few places for the effective management of water bodies. The state governments have also

launched environmental education and awareness programme regarding importance of bio-diversity and dependence of local community on natural resources.

- iii) **Institutional Mechanism-** Several organizations, both government and Non-Government and at community levels are participating in restoration of water bodies. The National Lake Conservation Plan (NLCP) is an illustrious example which is involved in preparing comprehensive plan for restoration of water bodies. A few of them are prevention of pollution, catchment areas treatment, desilting and weed control, research and development studies.
- iv) **Role of International Institutions-** International Institutions such as the WWF, UNDP, UNEP, ADB and World Bank are providing technical and financial assistance for the restoration of water bodies.
- v) **Role of Judiciary and Legal Interventions to stop Degradation-** A major development in stopping the continuing degradation of lakes is the involvement of judiciary. The Indian judiciary system have been extremely proactive on the issue of environmental protection. As the Supreme Court of India in a PIL in the case of Badal Khol and Surajkund Lakes has made it mandatory for Haryana State to protect the two lakes from environmental degradation and pollution.
- vi) **Policy Interventions-** The National Water Policy revised in 2002 gives importance to institutional mechanism which creates planning and management of water resources on a hydrological unit basis. It also emphasises on the multi-sectoral, multidisciplinary and participatory approach for management of water bodies. It emphasis that the existing institutions at various levels under the water resources sector will have to be appropriately reoriented/reorganised and even created.

In these sessions you have read about the importance of water bodies, water ways and wet lands and now answer the questions given in *Check Your Progress 2*.

Check Your Progress 2

Note: a) Write your answer in about 50 words

b) Check your answer with possible answers given at the end of the unit

- 1) What are different Special Purpose Vehicle (SPVs) measures taken by various state governments of India?

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- 2) Discuss the role of Water Policy in the management of Water Bodies.

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3.8 LET US SUM UP

Water bodies and wet land plays an important role in the urban area landscape. They are not only important sources of environmental protection to the city but also a source of revenue earning for the municipal government. The international and the national government of different countries have emphasised on the protection of the urban water bodies. Many municipal governments have initiated commendable steps for the management of water bodies. This unit covers in detail various aspects of water bodies, water ways and wet lands.

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3.10 CHECK YOUR PROGRESS– POSSIBLE ANSWERS

Check Your Progress 1

- 1) Define water bodies.

A water body is defined as a significant accumulation of water on earth such as oceans, seas, lakes, and smaller pools of water such as ponds, rivers, streams, canals etc. Moving bodies of water from one place to another are also considered in the category of water bodies for general purposes. Urban water bodies include urban streams, canals, rivers, ponds, impoundments, reservoirs, lakes etc. Some bodies of water are human-made that include reservoirs or harbours, but many are naturally formed.

- 2) What is a wetland and what are different types of wetlands?

Wetland is a generic term for water bodies of various types, and includes various hydrological entities, namely lakes, marshes, swamps, estuaries, tidal flats, river flood plains and mangroves. Wetlands may be fresh, brackish or saline, and are characterised in their natural state by plants and animals

that are adapted to living in wet conditions. Swamps are predominantly and permanently wet from through-flowing waters. The water level may be constant, or vary from season to season. Because the water derives from a land source (as opposed to rain-fed systems called bogs), nutrient levels are high (termed eutrophic), and they may accumulate organic silt, but seldom form proper peat. There are different types of wetlands such as lagoons, estuaries, ephemeral, dune slacks and marshes.

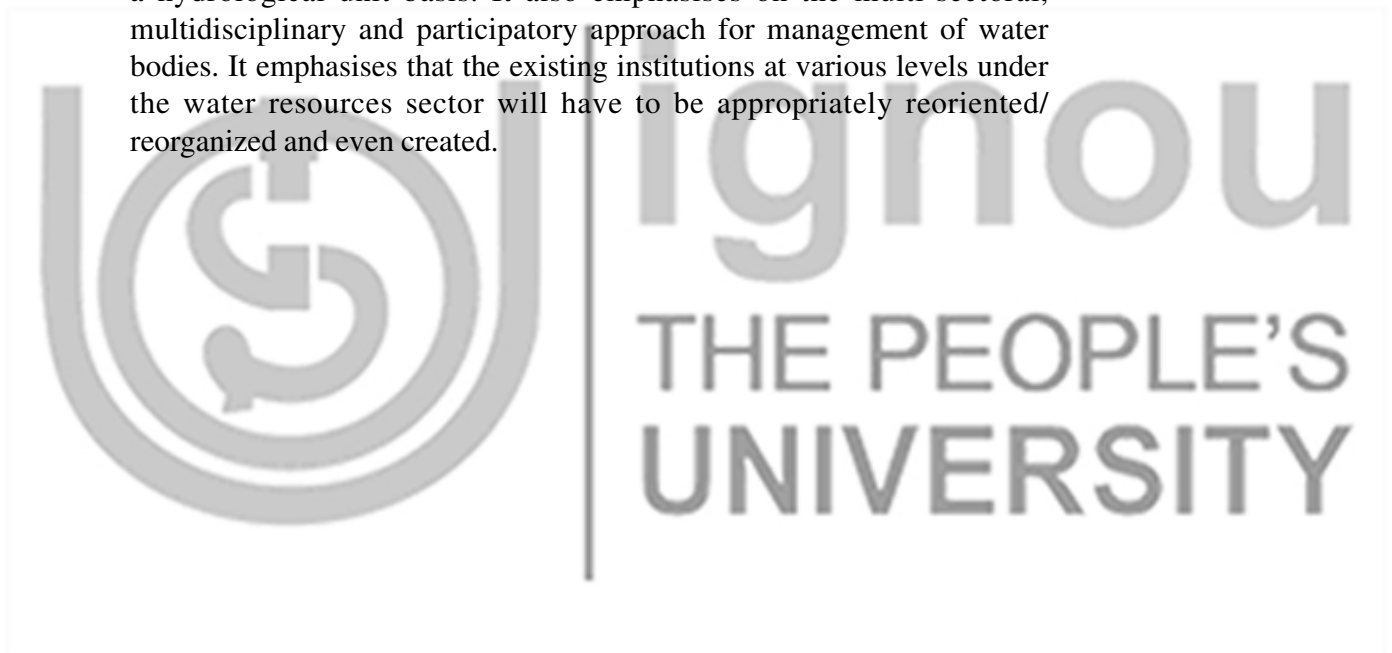
Check Your Progress 2

- 1) What are different Special Purpose Vehicle (SPVs) measures taken by various state governments of India?

The SPVs measures taken by different state governments are Bhoj Wetland Authority in Bhopal, Madhya Pradesh; the Chilika Development Authority (CDA) in Orissa; the Loktak Development Authority (LDA) in Manipur; J&K Lakes and Waterways Development Authority in J&K and Jai Vikas Samiti in Udaipur, Rajasthan are a few of them

- 2) Discuss the role of Water Policy in the management of Water Bodies.

The National Water Policy revised in 2002 gives importance to institutional mechanism which creates planning and management of water resources on a hydrological unit basis. It also emphasises on the multi-sectoral, multidisciplinary and participatory approach for management of water bodies. It emphasises that the existing institutions at various levels under the water resources sector will have to be appropriately reoriented/reorganized and even created.



UNIT 4 OPEN SPACES

Structure

- 4.1 Introduction
- 4.2 Open Spaces: Meaning and Significance
- 4.3 Types of Open Space
- 4.4 Status of Open Spaces in Indian Cities
- 4.5 Causes of Deterioration of Open Spaces
- 4.6 Parameters and approaches for revitalization of Open Spaces
- 4.7 Let us sum up
- 4.8 References and Selected readings
- 4.9 Check Your Progress: Possible Answers

4.1 INTRODUCTION

Open spaces are an aspect of city management that has emerged as one of the most important aspects of maintaining city vitality. The quantity and the quality of open spaces in Indian cities have been deteriorating over the years and there is an urgent need to deal with the same. This unit introduces the meaning, concept of open spaces, how have they been planned traditionally, the status of open spaces in Indian cities. It also outlines the emerging approaches to open spaces across the world and the lessons that they offer.

After studying this unit, you will be able to:

- Explain meaning and significance of open space
- Describe types of open spaces
- Explain the causes of deterioration of open spaces
- Outline parameters for vital open space

4.2 OPEN SPACES: MEANING AND SIGNIFICANCE

4.2.1 Meaning

Open Spaces are lands that are not intensively developed for residential, commercial or institutional use. Over the years, their meaning has been expanded to include not just urban parks and preserves but also non-park and non-natural places such as public squares, outdoor sports complexes, amphitheatres, or even cemeteries, school yards, etc which are available to the use of a full spectrum of city residents. Open space may also be thought of as the undeveloped land which results from our efforts to conserve natural resources and scenic areas, to avoid development in hazard areas and to provide recreational opportunities. According to Nelson and Whitney (2008) open space consists of under developed lands with significant natural, cultural and visual resources that are integral to the country's quality of life.

4.2.2 Significance of Open Space

Open spaces of all these types have an extremely significant role to play in the urban landscape. Some of the important functions that they perform are:

- **Open Spaces have important environmental benefits** – A city is an artificial environment. It is created through the intense exploitation of land and thus also impacts other features of the ecosystem such as natural contours – hills, marshes; water bodies such as lakes, rivers and specific components such as forests, trees, bird and animal life etc. It is being realized today that an indiscriminate damage to environment ultimately impacts human life and security. Pollution has thus become a reality of most cities. Several cities in India face issues of water scarcity while also being threatened with floods in the monsoons. Open spaces, if provided adequately, play an important role in managing the environmental landscape of the city. Some clear areas of such benefits are: a) trees and parks in urban settings reduce noise, lower temperatures in the summer; b) forested areas remove carbon dioxide from the atmosphere, thereby mitigating the threat of global warming; c) tidal lands and wetlands absorb polluted water, and buffer developed areas from flooding; d) forests are a primary source of clean water; and e) conserving open spaces and related natural resources allows important biological resources and natural habitats to remain intact and ecologically healthy.
- **Open spaces have important social and psychological functions** – Chiesura(2004) maintains that open spaces are critical for the livability of the city and well being of urbanites. In a world, in which everyday's life is often filled with tension and uncertainty, parks and preserves can provide the opportunity for escape and relaxation for every urban citizen. Interesting and diverse recreation areas and scenic open spaces have a special ambiance and attractive qualities. These attributes help to define communities and they lead residents to a strong identification with their neighborhoods. By becoming partners, or “stakeholders,” in making their community attractive, people develop a strong sense of community. A community sports program provides an alternative for at-risk youths by providing places for children to play and for young people to participate in athletics. Community conservation programs can also provide young people with an opportunity to focus their energy in a positive way and build self-esteem. In order to have successful programs for children, communities must plan for well-maintained parks and open spaces for them to use. Finally, open spaces provide a place for recreation and maintenance of physical health as well as a place for spiritual revitalization.
- **Open Spaces are spaces to celebrate cultural diversity** – A city is made of diverse ethnicities. Such diversity is core to the nature of a city; however, it makes for extremely tenuous social relations among groups with diverse customs and practices. Open spaces potentially offer a platform for interaction between such diverse groups, paving the way for greater intermingling. It marks the beginning of bonds with a new place and thereby forges communities over the long run. Open spaces, thus, contribute to the quality of life in many ways (Burke and Ewan, 1999).

4.3 TYPES OF OPEN SPACE

The open space would be broadly categorized in to two types: (i) Traditional Open Space and (ii) Innovative Open Space. (Mark Frances)

i) Traditional Open Space: Types and Meaning

The meaning and types of traditional open spaces is given in a tabular form below in Table 1.

Table1: Traditional Open Space: Types and Meaning

Type	Meaning
Public Parks	A public open space; developed and managed by Parks Department as part of zoned open-space system of city; often located near center of city; often larger than neighborhood parks.
Neighborhood Parks	Open space developed in residential areas; managed by Parks Department as part of zoned open space of cities; may include playground, sport facilities, and so forth.
Playgrounds	Playground areas are located in neighborhood; frequently includes traditional play equipment such as slides and swings; sometimes include amenities for adults, such as benches, and so forth.
Pedestrian Mails	Street closed to auto traffic; pedestrian amenities provided such as benches, planting; often located on the main street in downtown area.
Plazas	Open space developed as part of new building in down town area; built and managed by building owners; typically privately developed and managed.

ii) Innovative Open Space: Types and Meaning

The meaning and types of innovative open spaces is given in a tabular form below in Table 2.

Table 2: Innovative Open Space: Types and Meaning

Type	Meaning
Community Open Space	Neighborhood spaces designed, developed, owned, and or managed by local residents on vacant land; may include viewing gardens, play areas, and community gardens; often developed on private land; not officially viewed as part of open-space system of cities; highly vulnerable to displacement by other uses such as housing.
Neighborhood Open Space	Space located in neighborhood often near private open space, often heavily used by children and teenagers; important setting for environmental learning and socializing.
Schoolyards	Not normally considered part of open space system of cities; increased awareness as place for environmental learning; some schoolyards redeveloped as environmental centers.

Streets	Much of the publicly accessible open space of cities; increased awareness of importance of street use and traffic impacts on children; changes of streets include pedestrian improvements and sidewalk widening, street tree planting, and so forth.
Transit Malls	Development of improved transit access to downtown areas, may replace a traditional pedestrian mall with a bus and “light rail” mall.
Farmers’ Markets	Open space used for farmers’ markets of flea markets; often temporary or held only during certain times in existing space such as parks, downtown streets, or parking lots.
Town Trails	Connects parts of cities through integrated urban trails: use of street and open spaces as setting for environmental learning.
Vacant/Undeveloped Open Space	Still much of the open space in cities, found in redevelopment areas, where abandonment has occurred, or in undeveloped areas; increased awareness as potential open space; interest in vacant land being used to develop urban forests of natural areas in cities.
Waterfronts	Increased awareness of waterfronts as urban open space many cities working to increase public access to water front areas by developing waterfront parks.
Found Spaces	Informal open spaces of cities where social life takes place; include street corners, sidewalks, paths connecting building, bus stops, steps to public buildings, and so forth.

In the above sections you read about the meaning, importance, and types of open space. Now answer the questions given in *Check Your Progress 1*.

Check Your Progress 1

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

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

1) Write a short note on Open Space.

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2) Explain how open spaces contribute to the livability of cities.

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4.4 STATUS OF OPEN SPACES IN INDIAN CITIES

The cities in India are facing a very real challenge of deteriorating quality and quantum of open spaces. Rivers, lakes, forests, parks, hills, maidans and play spaces, wet lands, mangroves, beaches and coast lines are all facing the brunt of unchecked urbanization. Environmentalism in urban areas has just made a beginning in the country and its incorporation in planning is still a long way in coming. The current provisioning for open spaces is in the form of a standard percentile of total developed area or as legislations which place restrictions on development. Both these are top down, non participatory processes, where decisions are made without consulting relevant stakeholders. Its potential as a strategic aspect of development or as a value within itself is therefore not being realized.

While the above is true as a general scenario, the status of open spaces also varies across cities. Delhi with an open space of above 3 acres per 1000 persons ranks the highest, while Mumbai with 0.03 acres per 1000 persons ranks the lowest. The international norm for open spaces is about 4 acres per 1000 persons. These quantitative indicators are however not adequate by themselves to indicate how the open spaces in the city contribute to the quality of life in the cities.

The following extracts of a report on the status of open spaces in Mumbai by a NGO called Urban Design Research Institute (UDRI) are extremely revealing.

Mumbai has the lowest ratio of open space per person ie 0.03 acres per 1000 persons as compared to other cities. This means an area of barely 3+3 ft per person. In a city bereft of public space, the Corporation of Mumbai even terms counts the traffic islands as public spaces.

Further, the quality of these available spaces is even more appalling. 18% of the open space available is partially or fully occupied. The city's rich bio-reserves- the 37.5 sq km of mangroves, 10.68 sq km of salt pan land, 13.35 sq km of marshy land and 46.5 sq km of the Sanjay Gandhi National Park are depleting fast. The lack of geographically mapped and surveyed data accompanied by the control of real estate and developer lobby over land use and development planning has meant that several public spaces are making way for developments- legal and illegal.

The maintenance of those open spaces and parks that exist is another vexed issue. Thus Dyaneshwar Udyan, in Dadar has been closed to the public for years now. Veer Kotwal Udyan also in Dadar, has become a shelter for drug addicts, through day and night. 'Our children can no longer play there', say local residents. Same is the case with many others. "Maintenance of municipal gardens is zero", claim some of the local residents. This is in spite of the fact that the Municipal Corporation of Greater Mumbai provides for a budget of Rs 150-200 crore for the maintenance of municipal gardens.

The tale of Mumbai is repeated in several cities. Each of the metros in the country has been subjected to the deterioration of open spaces. Natural features such as water bodies, coasts and hills have taken the worst hit. To cite a few examples, the lakes and tanks in Bangalore, the Yamuna and the ridge in Delhi, the Musi River in Hyderabad, the hills in Pune are all stories of rapid deterioration. Chennai

has a green cover of a meagre 4.2% (last estimation by FSI in 2005). While the Chennai corporation states that it maintains 230 parks, residents estimate that the number of parks large enough for morning walks is only around 50. Further, these stories are not limited to large cities. Thus even a medium sized city like Udaipur which was called a lake city and which was water reliant till the 60s has now been forced to not only depend on external water resources but also to undertake programmes for lake rejuvenation.

It is obvious from these stories that there is a need to drastically alter the approach towards recognition of issues as well as action.

4.5 CAUSES OF DETERIORATION OF OPEN SPACES

The various reasons for the deterioration of urban open spaces are described below:

- i) **Techno legal Planning Approach:** The solution to conservation, creation and maintenance of open spaces has been conventionally sought through the urban planning framework. Urban planning itself has multiple goals – balancing the goals of efficiency, equity and sustainability. Often these goals present themselves as conflictual objectives and the priority inevitably goes to efficiency with sustainability of which open spaces are seen to be a part of an inevitable cost of economic growth.

Further, the planning approach is an intrinsically anthropocentric approach (keeps human beings at the centre) and thus, gives a secondary importance to considerations of nature. It sees open spaces in terms of their functionality to human beings and thus, norms such as ‘x’ acres of open space per person are drawn up. There is thus a disjunctive between natural features of the city landscape and the open spaces that is created by this techno legal approach.

Another drawback of the techno legal approach is that decisions on spaces to be developed as open spaces are made without the involvement of relevant stakeholders and they are alienated from the creation, maintenance and development of such spaces. They thus become a prime example of a common tragedy where the space is ‘public’ enough for use by everyone and maintenance by no one. Many a times, the area earmarked for parks is misused for another purpose of commercial value. Open spaces that are left undeveloped due to lack of funds or attention by concerned authorities end up being illegally encroached or being used as parking lots.

The Limoni bag is a plot reserved for a municipal garden in the middle of a slum called by the same name in Mumbai. In the congested environment of the slum, the garden would have been a much needed space to interact and play. However, the residents of Limoni Bag used the plot as a garbage dump and as a site for defecation.

The roots for this indifference and apathy lay in the fact that the Municipality had evicted a few households to create the garden. It was thus the Corporations’ garden – owned and therefore to be maintained by them too. It had nothing to do with the residents of the community.

- ii) **Fragmented approach:** Fragmentation occurs when a large habitat is transformed into a number of smaller patches of smaller total area. Isolation is the typical outcome of habitat fragmentation. The more isolated the system, the lower the ecological value and higher the loss of its structure and function (Esbah and Cook). In many urban landscapes, the degree of fragmentation is so high and land is transformed so much that the open spaces no longer possess natural attributes. The ability of nature to reinvigorate itself is thus lost. The conventional planned approach to open spaces is one that fragments open spaces and creates patches deficient in ecological value. Such spaces need continual maintenance and upkeep. Any default in the same results in a deterioration of these spaces.

The Pichola Lake is the centre piece of tourist interest in Udaipur. Currently the lake is in an extremely bad shape with filth strewn all around. A special Lake Development Authority has been formed in the city to rejuvenate the lake.

Analysts however point out that the causes of the deterioration of the lake lie in the destruction of the lake eco system of which Pichola is a part. There were about 100 lakes in this eco system, most of them up stream which fed Pichola with fresh water and two lakes downstream that drained excess water. Today almost all of the upstream lakes have been filled up to create developable land while the ones downstream have been polluted with industrial waste and sewage. Isolated from its ecosystem, pichola is bound to deteriorate.

- iii) **Non Strategic Planning:** The discussion above reveals that the planning of open spaces is not based on environmental values. However, it is often non strategic too. The open space plan can play an important role in overall community development. Its implementation can ensure community access to specific open space uses, as well as provide a framework for more intensive use of other parcels of land for residential, commercial, industrial, transportation and community facility purposes. A case in point would be how recent real estate developments have been able to capture the value of open spaces in the built up areas.

The lack of such planning pushes open spaces to the earlier discussed category of neglected commons and creates disincentives for investment in such spaces. This is how the case like Mumbai where there is 'zero maintenance' of municipal parks can emerge.

- iv) **Alienation of Public:** Human societies have evolved in close relationship with nature. In India, nature is celebrated and revered through rituals. Recent developments have sought to reduce the public access to nature and seen it as the primary cause of deterioration of the environment. However, experience shows that reduction in public access results in furthering the distance from nature, absolving one from the sense of responsibility towards it and thereby encouraging practices and behaviours that pollute it. It also often generates exclusive 'access' for certain groups who further undermine natural attributes. Blocking river fronts, beaches, lakes and forests does not improve the quality of these natural resources but further undermines it.

- v) **Lack of Data:** The understanding that urban planning with nature is an imperative has only recently begun to emerge. Consequently, there is a generalized absence of data with respect to several aspects of open spaces and annual features. The exact boundaries of forests, fold lines of rivers and tidal lines of coasts, number and slopes of hills, the mangrove lines, the biodiversity of the city region, the nature, quantum and parameters of fringe spaces are not known.

Lack of such data makes all of these features vulnerable to manipulation and greed. Thus, the lack of adequate data is a key cause for the deterioration of open spaces.

- vi) **Lack of Good Governance:** Governance structures of cities shape the status of open spaces in many ways. A lack of decentralization delays decision making processes which are crucial for timely inputs and investments in open spaces. Further they also result in dimming of prospects of citizen action in terms of bringing problems to the notice of the administration. It creates an atmosphere where open spaces are misused. The irresponsible attitude of respective civic authorities has been brought to light by a recent case (March 2009) where the high court pulled up DDA for violating the zonal plan by converting a park into a commercial complex at Loha Mandi of Naraina area. The plot was marked as 'P' but the plan did not clarify whether 'P' denoted plot, park or parking.

Further, the environmental response is highly fragmented in Indian cities. To cite an example, in the Mumbai Municipal Corporation there are nine different departments which have an interface with open spaces – a gardens department, a tree authority, water supply department, sewage department, etc. In this institutionalised fragmentation, concern for open spaces is devalued and never synchronized. As a result, both the quality of open spaces and their maintenance takes a toll.

4.6 PARAMETERS AND APPROACHES FOR REVITALIZATION OF OPEN SPACES

4.6.1 Parameters of Vitalization of Open Spaces

The above discussions on the deterioration of open spaces in Indian cities and the causes for the same bring us to a consideration of those parameters which create vital and dynamic open spaces. Some of these key parameters are –

i) Functional

- 1) Accessibility – visual and physical for all age groups and gender
- 2) Connectivity to the other areas of the city and to the other open spaces
- 3) Proximity to improve access and visibility
- 4) Safety as an essential precondition for use
- 5) Climatic comfort to encourage access
- 6) Flexibility of use across age groups and gender
- 7) Need and aspiration based evolution of the place
- 8) Flexibility to evolve with time- open ended character

ii) Ecological

- 1) Availability of fresh air, water, land and vegetation
- 2) Opportunity to experience nature in cities
- 3) Awareness of the natural landscape parameters of land, water and vegetation
- 4) Connected and Networked for better ecological values

iii) Cultural

- 1) Presence of cultural association
- 2) Sense of place to give a distinct character
- 3) Sense of belonging
- 4) Opportunity for social interaction
- 5) Opportunity for participation in the making and maintaining the space
- 6) Readable vocabulary of the spaces

The new approaches to management of open spaces thus try to base themselves on the above parameters.

4.6.2 Approaches to Retaining Vitality of Open Spaces

Some of the approaches to retaining for vitalization of open spaces are:

- i) Synthesis of GIS based Data:** It has been discussed earlier how the lack of data adds to the vulnerability of open spaces to manipulation. Therefore, creation of comprehensive data systems can go a long way in conservation of such spaces. GIS based data can add in new dimensions to the understanding of attributes of open spaces. Esbah and Cook have demonstrated in their study of open spaces in Phoenix, U.S.A and Aydin, Turkey that the utilisation of GIS based systems can vastly improve the understanding of intricate details of open spaces and thereby help to create a variety of open spaces that enhance livability of cities.
- ii) Holistic and Networked Approach:** The overall transformation of land uses in urban areas basically results in a loss of ecological values. However, an emphasis on diversity in the kinds of open spaces provided and the establishment of connectivity among them can counter the isolation trend in open spaces, give the cities some layer of environmental resilience and enhance livability of cities. Esbah and Cook illustrate the wide variety of spaces that have a potential for being conserved as open spaces as opposed to the conventional notion that open space is equivalent to a neighbourhood park. Some typology of the patches that they list in Phoenix are -Agriculture ,Airport ,Commercial ,Natural Drainage , Golf ,Military ,Natural Preserves, Open patches, Park ,Public spaces, School yards, Sport grounds, Transportation and Vacant lots. This illustrates that open spaces include a variety of uses, non uses, reserve for future uses, access and governance structures. Such diversity greatly enhances the adequacy of open space besides introducing a functional diversity, thereby reducing the pressure on development too. In Chennai, for example, a lot of large open spaces, which were earlier wasteland, and are now being developed, into Parks. Open space near Napier bridges, along the Marina Beach adjacent to the foot paths;

open space near the Turnbolls road junction; open space in Chitra Nagar, Kotturpuram; and Open space in Gandhimandapam are examples of such conversion.

iii) Strategic Planning: An open space plan is the flip side of a development plan. After identifying important open spaces, it will be much more apparent where development should occur. It is essential, therefore, that open space planning be fully coordinated and integrated with physical, social and economic planning for the community. Local authorities should undertake audits of existing open space, sports and recreational facilities, the use of existing facilities, access in terms of location and costs and opportunities for new open space and facilities. Such assessments and audits will allow local authorities to identify specific needs and quantitative or qualitative deficits or surpluses of open space, sports and recreational facilities in their areas. They form the starting point for establishing an effective strategy for open space, sport and recreation at the local level and for effective planning. A research was undertaken by Heriot Watt University with funding from the RICS Education Trust to explore the effects that urban parks and open spaces have on residential property values within the UK. Using Aberdeen as a case study area, the effect on residential property values of proximity to the city's urban parks and amenity green spaces was measured. The Aberdeen case study provides evidence that its residents attach a marginal value to open green spaces - this is reflected in the premium they are prepared to pay to secure a dwelling that has this advantage.

iv) Participatory Approach: Open spaces are an expression of the prevalent social relations and knowledge and as such constitute a territory of contestation. Such contestations begin with establishing the legitimacy of the area as an open space but also extend to establishing modes of access, and control. Conventional approach attempts to negate conflict by lending the planning process, the sanctity of law. However, experience shows that this is not adequate. It is therefore necessary to recognize the conflicts at the core of creation and management of open spaces. Such recognition then paves way for creating forums where such conflicts are brought to the fore by involving relevant stakeholders in the planning as well as in decisions pertaining to access and management of open spaces. A participatory approach creates more dynamic open spaces that have an organic relationship with the communities that they are embedded in. With the incorporation of such an approach, Resident Welfare Associations (RWAs) have been forthcoming to take ownership of maintaining their local open spaces. Over the recent past, Municipal Corporation of Delhi has signed MoUs with RWAs and transferred maintenance of 173 parks (as last reported). Another 212 redeveloped parks were ready to be given out, upon interest from RWA or private firm. The Haryana Urban Development Authority (HUDA) has also recently announced handing over the maintenance of parks, green belts and open spaces to the respective RWAs. Under this deal, HUDA will pay Re 1 per square meter per month for the area maintained by RWAs. In a similar arrangement, struggling with manpower shortage, the Municipal Corporation of Chandigarh has handed over many parks and green belts (with less than 1 acre of area) to residents' welfare associations for development and further maintenance for which the corporation would pay a onetime development cost and monthly maintenance cost.

v) **Appropriate Governance:** Centralized governance systems perpetuate apathy towards open spaces. Their requirement is however often of systems where an involved and close management is essential. Hence, the creation of institutional structures that are integrated, have an understanding of natural systems and are empowered to take decisions and are located in proximate distance to the spaces in question is a clear necessity. Institution of appropriate governance structures can result in not only better maintained open spaces but also ones that have been literally created from waste lands. Delhi *Haat* is an example where an abandoned sewerage drain was filled over and reincarnated into a vibrant public domain. In his design Pradeep Sachadev integrated modern hygiene and space standards with footpath vending, window shopping, browsing, traditional fast foods, and places to just hang out. A similar example is that of Maharashtra Nature Park in Mumbai. Conceived by the WWF-India in the late 1970s, an area of about 37 acres in the “H” Block of Bandra-Kurla Complex, which was earlier a garbage dump or land fill, was decided to be ecologically restored and developed as a Nature Park by MMRDA. It is located on Bandra-Sion Link Road at the Southern bank of Mithi River. Managed by the Maharashtra Nature Park Society, the park is home to diverse tree species, birds but has also emerged as a centre for environmental education and conservation.

In the above sections you read about the causes of deterioration of open space and measures for revitalization. Now answer the questions given in *Check Your Progress 2*.

Check Your Progress 2

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

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

1) What are the key factors behind deterioration of open spaces in the cities in India?

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2) Discuss briefly the Importance of Involving Stakeholders in planning of Open Spaces.

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4.7 LET US SUM UP

Open Spaces are lands that are not intensively developed for residential, commercial or institutional use. Over the years, their meaning has been expanded to include not just urban parks and preserves but also non-park and non-natural places such as public squares, outdoor sports complexes, amphitheatres, or even cemeteries, school yards etc which are available to the use of a full spectrum of city residents. Open spaces of all these types have an extremely significant role to play in the urban landscape. They have important environmental benefits. They also enhance the physical, social and psychological well being of the city residents. They also provide forums for interface and thus build communities. The status of open spaces in almost all Indian cities is poor; moreover the ecological features of these cities are fast depleting too.

The conventional approach to management of open spaces has been techno-legal, using master plans as a tool for planning of open spaces. Experience shows that such an approach lacks ecological as well as strategic and social values. This is identified as the key cause of deterioration of open spaces in the cities. There is therefore a need to adopt a new approach to planning of open spaces based on GIS mapped data, participatory and strategic planning and use of a diversity of spaces that are connected. The management of open spaces needs to also follow the principles of good governance. Such an approach would lead to dynamic and vital open spaces that enhance the livability of cities.

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4.9 CHECK YOUR PROGRESS: POSSIBLE ANSWERS

Check Your Progress 1

- 1) Write a short note on Open Space.

Open spaces are defined as lands that are not intensively developed for residential, commercial or institutional use. Over the years, their meaning has been expanded to include not just urban parks and preserves but also non-park and non-natural places such as public squares, outdoor sports complexes, amphitheatres, or even cemeteries, school yards etc which are available to the use of a full spectrum of city residents. Open space may also be thought of as the undeveloped land which results from our efforts to conserve natural resources and scenic areas, to avoid development in hazard areas and to provide recreational opportunities.

- 2) Explain how open spaces contribute to the livability of cities.

Cities are starved of natural features over the years. This causes a burden on city infrastructure that faces impact of environmental deterioration. City life is stressful for its residents, though it offers economic opportunities. Open spaces offer buffers to all the above aspects of urban landscape. a) They provide important environmental benefits b) They offer important physical, social and psychological benefits too c) Open spaces facilitate social interaction and build communities.

Check Your Progress -2

- 1) What are the key factors behind deterioration of open spaces in the cities in India?

The open spaces in Indian cities are still planned and managed in a conventional manner. This conventional manner is characterized by a techno legal approach that undermines both ecological values as well as social values. Open spaces are then planned in an isolated manner, without involving relevant stakeholders and governed in a fragmented and centralized manner. The lack of strategy makes open space an ongoing investment for local bodies. All of these factors cumulatively result in the deterioration in quantity and quality of open spaces in Indian cities.

- 2) Discuss briefly the Importance of Involving Stakeholders in planning of Open Spaces.

Open spaces are an expression of societal culture and social relations. The existence of open spaces that have been planned and managed through the active involvement of relevant stakeholders indicates a vibrant society in active interface with a governance system. Involving stakeholders in planning of open spaces helps to make decisions of location, nature, size of open spaces closer to the lives of people who are potential users and makes them more accessible and functional. It also contributes to enhancement of the strategic value of the open space which further strengthens the prospects for sustainability.