7

Human Communities and the Environment

Learning Objectives

When you have read this unit you will have been introduced to:

- human population growth and distribution;
- theories and components of population change;
- impact of population on environment and human health;
- rehabilitation and resettlement issues;
- various disasters and its management;
- socio-environmental movements;
- environmental education and sustainability;
- environmental ethics;
- environmental public awareness and environmental conservation.

7.1 Human Population Growth

- The population growth or population change refers to the change in number of individuals or inhabitants present in a territory during a specific period of time.
- This change may be positive as well as negative.
- It can be expressed either in terms of absolute numbers or percentage.
- Population change in an area is an important indicator of economic development, social upliftment, historical and cultural background of the region in question.
- Population growth is considered to be one of the driving forces behind current environmental problems, because the growing population demands more (non-renewable) resources for its own use.
- **Population explosion** refers to the sudden and rapid unprecedented growth in size of population, especially human population; mainly as a result of the following:

    - Increased birth rate;
    - Decreased infant mortality rate; and
    - Improved life expectancy.

- The genetic and archaeological records suggest that there was a dramatic collapse in the world human population around 70,000 years

ago.

- Subsequently, numbers recovered coincident with the emergence of food production owing to the development of agriculture during past 10,000 years.
- However, despite localised population collapses brought about by famine, war, and disease, on a global scale the population continued to increase. It is estimated that it took a substantial amount of time (hundreds of years) for the world population to grow to one billion.
- On the contrary, in just 200 years, the population grew sevenfold.
- In 2011, the global population touched the 7 billion mark, and as on today, it stands at about **7.6 billion**. Some of the key reasons behind this dramatic increase in human population are highlighted below.
- Enormous changes in fertility rates and increased life expectancy of women, however, average total fertility for the world has declined to about two children per woman;
- Increase in average global lifespan, from 64.6 years in the early 1990s to 70.8 years today;
- Advances in modern medicines and improved healthcare facilities;
- Improvements in living standards and levels of personal hygiene.
- It is estimated that the world population will continue to grow for decades to come as a result of 'population momentum,' because of improved survival rates and past high fertility levels, there are more women of reproductive age today.
- This will contribute to a relatively large number of births, even if those women have fewer children on average. These trends will have far-reaching implications for generations to come. These would affect economic development, employment, income distribution, poverty, and social protections.

	Population (millions)			
Region	**2017**	**2030**	**2050**	**2100**
World	7550	8551	9772	11184
Africa	1256	1704	2528	4468
Asia	4504	4947	5257	4780
Europe	742	739	716	653
Latin America and the Caribbean	646	718	780	712
Northern America	361	395	435	499
Oceania	41	48	57	72

7.2 Components of Population Change

There are three components of population change: **births, deaths and migration** (emigration and immigration). Following are the components of population change:

- If births exceed deaths, the population grows (↑);
- If deaths exceed births, the population shrinks (↓);
- When births equal deaths, the population stay the same (↔).

- Apart from births and deaths, there is another way by which the population size changes. When people move from one place to another, the place they move from is called the 'place of origin' and the place they move to is called the 'place of destination.'
- Migration may be interpreted as a spontaneous effort to achieve a better balance between population and resources. Migration could be permanent, temporary, or seasonal. It is difficult to measure actual migration; that is why demographers (people who study human population) often estimate migration as a residual value, by calculating the difference between total population change and natural increase.

Putting it all together, we can write a simple equation to show population growth as:

Change in population size = (Births + Immigration) – (Deaths + Emigration)

The net reproductive rate (r) is the percentage growth after accounting for all births and deaths.

Net reproductive rate (r) = (births–deaths)/population size

(to get value in percentage terms, multiply the equation by 100)

Predictions about population (population size and change) had remained an important subject for a long period of time. Early thinkers and philosophers like Confucius (China), Kautilya (India), Ibn Khaldin (Arab), Plato (Greece) had, directly or indirectly, noted observations on population issues. Some of the scientific theories on population change are mentioned below:

7.2.1 Malthusian Theory of Population

Thomas Robert Malthus (1766-1834), an English economist, was the first one

to propose a systematic theory of population. He is considered to be the *Father of Demography* (scientific study of human population). Malthus made observations of England's working class during industrial revolution. He articulated his views in his famous book; *Essay on the Principle of Population* (1798), revised second edition of his book was published in 1803. Malthus argued that world population would grow exponentially (doubling with each cycle) while food production would only increase arithmetically (by the repeated addition of a uniform increment in each uniform interval of time). Thus, in other words, population would soon exceed food stores. This scenario of arithmetic food growth with simultaneous geometric human population growth predicted a future when humans would have no resources to survive on (point of crisis or misery). To avoid such a catastrophe, Malthus urged controls on population growth. He believes, "positive checks;" factors that increases mortality (war, famine, disease, etc.,) and "negative checks;" factors decreasing fertility (moral restraint, contraception, abortion, etc.,) is needed to avoid any "misery."

7.2.2 Karl Marx's Theory of Population

Karl Marx (1818-1883) is regarded as the *Father of Communism*. Although, he did not directly propose any theory of population, however, his surplus population theory has been deduced from his theory of communism. **Marx opposed and criticised the Malthusian theory of population**. According to Marx, population increase must be interpreted in the context of the capitalistic economic system. In a capitalistic model, a laborer gets a very small share of its productivity, and the capitalist takes the lion's share. The capitalist introduces more and more machinery and thus increases the surplus value of labor's productivity, which is pocketed by the capitalist. The surplus is the difference between labor's productivity and the level of wages. A worker is paid less than the value of his productivity. When machinery is introduced, unemployment increases and, consequently, an army of disguised labor is created. Under these situations, the wage level goes down further. Poverty, hunger and other social ills are the result of socially unjust practices associated with capitalism. Population growth, according to Marx, is therefore not related to the alleged ignorance or moral inferiority of the poor, but is a consequence of the capitalist economic system. Marx points out that landlordism, unfavorable and high man-land ratio, uncertainty regarding land tenure system and the like are responsible for low food production in a country. Only in places where the production of food is not adequate does population growth become a problem.

7.2.3 Paul Ehrlich: The Population Bomb

Thomas Malthus and Karl Marx had set the initial stage for the world population debate, however, other population theorists, including: Paul Ehrlich, Julian Simon, Garrett Hardin, and Barry Commoner carried this discussion in the second half of the 20th century. During 1968, the world population was already above 3 billion; Paul Ehrlich authored the popular book; *The Population Bomb*, *that* sold several million copies in the United States alone. Ehrlich, a biologist, maintained that the rate of population growth was surpassing agricultural growth including the capacity for renewal of Earth's resources. Given current rates of natural increase, he predicted "certain" demographic disaster in response to eventual food shortages and diseases. **In his book, Ehrlich wrote: "The battle to feed all of humanity is over**" and later stated that, "**In the 1970s and 1980s hundreds of millions of people will starve to death in spite of any crash programs**."

Ehrlich argued that industrialised regions such that of North America and Europe would be required to undertake "mild" food rationing as starvation spread across the developing worlds of Asia, Latin America, and Africa. He also predicted that during a worst case scenario, the lack of food security in the developing world would set into motion several geopolitical crises that could result in thermo-nuclear war. At its core, Ehrlich's population theory contained three major elements: a rapid rate of change, a limit of some sort, and delays in perceiving the limit.

7.3 Population and Environment

Human population has seen exponential growth over the past few hundred years. It is now well perceived that unchecked population growth will eventually cause an environmental catastrophe. Circumstantial evidence clearly shows the inverse relationship between increasing population and deteriorating environmental quality. The impacts of burgeoning human population on the environment take two major forms:

- Consumption of resources such as land, food, water, air, fossil fuels, minerals; and
- Waste products generated as a result of consumption such as air and water pollutants, toxic materials and greenhouse gases, including contamination of natural resources.

Considering the ever increasing human population and their cumulative impact, has, therefore, resulted in some scientists coining a new term to

describe recent time - the “Anthropocene epoch.” Unlike previous geological epochs, where various geological and climate processes defined the time periods, the proposed Anthropocene period is named amid the dominant influence humans and their activities are having on the environment.

However, while population size is a part of the problem, the issue is much bigger and more complex than just counting heads. There are many factors that play a bigger role, such as: their distribution (density, migration patterns and urbanisation), their composition (age, sex and income levels) and, most importantly, their consumption patterns that are of equal, if not more importance, than just numbers. There is something known as a formula for environmental degradation, popularly known as the “IPAT equation.” The IPAT equation, first devised during 1970s, is a way of determining environmental degradation based on multiple factors. At its simplest, it describes how human impact on the environment (I) is a result of a multiplicative contribution of population (P), affluence (A) and technology (T). The equation is as follows:

$$I = P \times A \times T$$

Environmental impact (I) is considered in terms of resource depletion and waste accumulation; population (P) refers to the size of the human population; affluence (A) refers to the levels of consumption by that population; and technology (T) refers to the processes used to obtain resources and transform them into useful goods and services. The **IPAT equation** thus encouraged people to see that environmental problems are caused by multiple factors that when combined produced a multiplicative and compounding effect. Although, the IPAT equation is not perfect, but it does help to demonstrate that population is not the only (or necessarily the most important) factor relating to environmental damage. According to the Global Footprint Network, “today humanity uses the equivalent of 1.5 planets to provide the resources we use and absorb our waste. This means it now takes the Earth one year and six months to regenerate what we use in a year.”

The influence of the physical environment on human health is increasingly being recognised, although it may not always be easy to measure. Most direct interactions with the environment can be through breathing air, drinking water, or eating food. Any pollutants contained in air, water or food will impact upon human health. For example, certain pollutants intensify the symptoms of respiratory disease, leading to severe illness and in extreme cases, death. There is strong evidence that common air pollutants such as

tobacco smoke, diesel fumes, particulates and nitrogen dioxide aggravate asthma. The relationship between the environment and health can be indirect. The environment influences factors which in turn contribute towards human health for example lifestyle, diet, socio-economic circumstances and even individual susceptibility. These indirect effects are particularly difficult to quantify. The impacts of environmental risk factors on human health are extremely diverse and complex, both in terms of severity and clinical significance. For example, the effects of environmental degradation on human health can range from death caused by cancer due to air pollution to psychological problems resulting from noise pollution. It has been estimated that environmental damage is responsible for around 2-6% of the total burden of disease in many countries. Considering both, the physical and psychological dimensions of human health, environmental factors can impact human health in two ways:

- Through identifiable environmental hazards; and
- Through cumulative effects of the built environment on lifestyles and life circumstances.

7.4 Rehabilitation and Resettlement

Major studies on development-induced displacement or internal displacement of people emerged during mid-fifties and early sixties, mainly in the context of projects such as: the Great Dam of Aswan on the Nile, the Kariba Dam on the Zambezi and the Akosombo Dam on Lake Volta in Ghana, to name a few. The UNEP report "Environmental Refugees," published in 1985 by Professor Essam El-Hinnawi is considered as the first attempt to conceptualise the issue of internal displacement on a more advanced scientific basis. It is pertinent to mention here that the term "environmental refugees" was first used by Sir Edmund Hilary in his book, *Ecology 2000*, published in 1984. The research on environmentally caused forced mobility under the concept of environmental refugees was highly popularised between 1985 and 1995. Development and displacement may appear to be contradictory terms. It is estimated that, in India, during last 50 years more than 60 million people have been displaced from their homes due to major infrastructure or development projects. It is imperative to understand that the terms Rehabilitation and resettlement are different and have different meanings. Rehabilitation, involves a longer process of rebuilding people's physical and economic livelihood, their assets, their cultural and social links, and psychological acceptance of the changed situation; while resettlement is the process of physical relocation.

India, after getting independence in 1947, geared towards the path to development under the leadership of Jawaharlal Nehru (the then Prime Minister), leading to the construction of large multipurpose river valley projects, thermal power, mining, transport linkages etc. According to the UN report, India has the highest number of people displaced due to development projects than any other country in the world, largely the traditional forest dwellers and the Scheduled Tribes. The issue of rehabilitation and resettlement of the people displaced due to development projects, in particularly large multi-purpose river valley projects, came to the limelight with the emergence of the *Narmada Bachao Andolan* (save the Narmada river movement). The Sardar Sarovar project was the first to be taken up (started in 1987), in the government's ambitious plan of creating more than 3000 large and small dams on various tributaries and distributaries of the Narmada river. The project included the construction of one high dam on the Narmada River, the creation of a reservoir submerging land in the states of Gujarat, Maharashtra and Madhya Pradesh, and an extensive canal and irrigation system in Gujarat, that displaced approximately one lakh people residing in 245 villages of the states of said states.

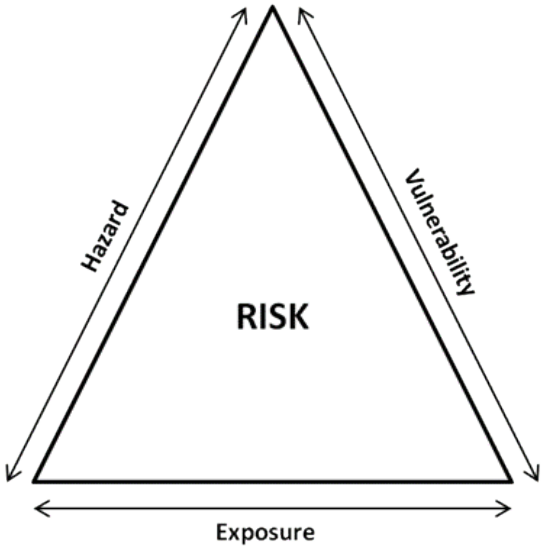
7.6 Disaster Management

The word disaster is derived from middle French *désastre*. The root of the word disaster ("bad star" in Greek) comes from an astrological sense of a calamity blamed on position of the planets. A disaster is a sudden accident or a natural catastrophe that causes great damage or loss of life. Red Cross describes, "a disaster is a serious disruption, occurring over a relatively short time, of the functioning of a community or a society involving widespread human, material, economic or environmental loss and impacts, which exceeds the ability of the affected community or society to cope using its own resources."

The Disaster Management Act, 2005 (Government of India), which provides for the effective management of disasters and for matters connected therewith or incidental thereto, **describes disaster as** "a catastrophe, mishap, calamity, or grave occurrence in any area, arising from natural or man-made cause, or by accident or negligence which results in substantial loss of life or human suffering or damage to, and destruction of property, or damage to, or degradation of, environment, and is of such a nature or magnitude as to be beyond the coping capacity of the community of the affected area." Disasters produce a range of impacts; these include direct, secondary, and indirect effects. Direct effects include deaths, injuries, and physical damage. However,

secondary disaster impacts such as releasing fire or hazardous material that is triggered by disasters. Finally, impacts include the ripple effect resulting from the flow of goods, services, unemployment etc.

The terms hazard, risk, vulnerability and disaster are actually interconnected to each other. In order to understand the relation, we need to understand the said terms individually. Hazard is any substance, phenomenon, or situation, which has the potential to cause disruption or damage to people, their property, their services, and their environment. Vulnerability is a concept which describes factors or constraints of an economic, social, physical or geographic nature, which reduce the ability to prepare for and cope with the impact of hazards. Risk is the probability that negative consequences may arise when hazards interact with vulnerable areas, people, property, and environment. Risk is a concept which describes a potential set of consequences that may arise from a given set of circumstances. In other words, risk is a combination of the interaction of hazard, vulnerability, and exposure, which can be represented by the three sides of a triangle (Figure 7.2).



It is clear from the figure that if any one of these sides increases, the area of the triangle increases, hence the amount of risk also increases. If any one of the sides reduces, the risk reduces. If we can eliminate one side there would not be any risk. The risk equation is presented below.

$$\text{Risk} = \text{Hazard} \times \text{Vulnerability} \times \text{Exposure}$$

There are many books and internet sources that classify disaster into (i) natural; and (ii) human-instigated disasters. Invariably, all the studies of disasters reflects a common opinion that all disasters can be seen as human-instigated, because human endeavours before the strike of the hazard can

actually prevent it developing into a disaster. Therefore, all disasters, hence, are the result of human failure to introduce appropriate disaster management measures. So, there is no such thing as a natural' disaster, and only natural hazards are present. Hazards are routinely divided into natural or human-instigated. A disaster's severity depends on how much impact a hazard has on society and the environment. The scale of the impact, in turn, depends on the choices we make about our life and environment. These choices relate to our activities, such as: how we practice our agriculture, where and how we build our homes, how our financial system works and even what we teach in schools. Each decision and action makes us more vulnerable to disasters or more resilient to them. A list of various disasters is presented in Table.

Family	Primary event
Geological	• Avalanche • Earthquake/mass movement of earth materials • Landslide • Mudflow
Hydrological	• Flood • Landslide
Meteorological	• Cold wave • Cyclone • Drought • Thunderstorm • Hailstorm • Heat wave • Sand storm • Storm surge • Subsidence • Tornado
Biological	• Cattle or bird epidemics • Epidemic • Food poisoning • Pest attack
Accidental	• Air, rail, and road accidents • Bomb blast • Building collapse • Chemical and industrial disaster • Dam burst • Mine flooding • Nuclear disaster • Oil spills

Disaster risk reduction (DRR) aims to reduce the damage caused by natural hazards like earthquakes, floods, droughts, and cyclones, through an ethic of prevention. DRR is therefore, the concept and practice of reducing disaster risks through systematic efforts to analyse and reduce the causal factors of disasters. Reducing exposure to hazards, lessening vulnerability of people and property, wise management of land and the environment, and improving preparedness and early warning for adverse events are examples of DRR. It includes disciplines like disaster management, disaster mitigation, and disaster preparedness, but DRR is also part of sustainable development. The first and foremost step towards DRR is understanding 'risk.'

As per the Disaster Management Act, 2005, "disaster management" means a continuous and integrated process of planning, organising, coordinating, and implementing measures which are necessary or expedient for:

- Prevention of danger or threat of any disaster;
- Mitigation or reduction of risk of any disaster or its severity or consequences; Capacity-building;
- Preparedness to deal with any disaster;
- Prompt response to any threatening disaster situation or disaster;
- Assessing the severity or magnitude of effects of any disaster: evacuation, rescue and relief;
- Rehabilitation and reconstruction.

Disaster Management can be defined as the organisation and management of resources and responsibilities for dealing with all humanitarian aspects of emergencies, in particular preparedness, response and recovery in order to lessen the impact of disasters. Disaster management aims to reduce, or avoid, the potential losses from hazards, assure prompt, and appropriate assistance to victims of disaster, and achieve rapid and effective recovery.

Disaster risks are increasing due to negative environmental impacts like that of climate change. Disasters also negatively impact development achievements and reduce economic growth. The Sendai Framework is a 15-year (2015-2030), voluntary, non-binding agreement which recognises that the State has the primary role to reduce disaster risk but that responsibility should be shared with other stakeholders including local government, the private sector and other stakeholders. It aims for the following outcome: "The substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural, and environmental

assets of persons, businesses, communities, and countries." The four priorities for action under the Sendai Framework are:

- Understanding disaster risk;
- Strengthening disaster risk governance to manage disaster risk;
- Investing in disaster risk reduction for resilience;
- Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation, and reconstruction.

The UNISDR coordinates international efforts in disaster risk reduction, and guides, monitors, and reports on the progress of the implementation of the Sendai Framework for disaster risk reduction.

7.6.1 Cyclone

A tropical cyclone is a generic term used to describe a rotating, organised system of clouds that originates over tropical or subtropical waters having closed, low-level circulation. Once a tropical cyclone reaches maximum sustained winds of 120 km/hr or higher, it is then classified as a hurricane, cyclone, or typhoon depending upon where the storm originates in the world. Hurricanes, cyclones, and typhoons are all the same weather phenomenon; the only difference between these three is the location where the storm occurs. In the Atlantic and Northeast Pacific, the term "hurricane" is used. The same type of disturbance in the Northwest Pacific is called a "typhoon" and "cyclones" occur in the South Pacific and Indian Ocean. Henry Piddington coined the term cyclone, meaning the coil of a snake. Cyclones are named to provide ease of communication between forecasters and the general public regarding forecasts and warnings. Storms can often last a week or even longer and more than one cyclone can be occurring in the same region at the same time, names can reduce the confusion about what storm is being described. Post 1979, storms are given short, distinctive names to avoid confusion and streamline communications. Following conditions are required for a cyclone to form:

- A source of warm, moist air derived from tropical oceans with sea surface temperature in excess of 27 °C;
- Winds near the ocean surface blowing from different directions converging and causing air to rise and storm clouds to form;
- Winds which do not vary greatly with height allow the storm clouds to rise vertically to high levels;
- Coriolis force/ spin induced by the rotation of the Earth.

The formation mechanisms vary across the world, but once a cluster of storm clouds starts to rotate, it becomes a tropical depression. If it continues to develop it becomes a tropical storm, and later a cyclone/ super cyclone. However, an anticyclone (opposite to a cyclone) is a weather phenomenon defined by the United States National Weather Service's glossary as "a large-scale circulation of winds around a central region of high atmospheric pressure, clockwise in the Northern Hemisphere, counter-clockwise in the Southern Hemisphere." In simple words, areas of sinking air which result in high pressure are called anticyclones.

7.6.2 Earthquake

An earthquake occurs when Earth's surface shakes because of the release of seismic energy following the rapid movement of large blocks of the crust along a fault. Faults are breaks in the crust that may be hundreds of kilo-meters long and extend downward 10 to 20 km into the crust. Seismic waves radiate outward in all directions from the focus. An epicenter of an earthquake is the place on the Earth's surface directly above the focus (or hypocenter), the place inside the Earth where an earthquake originates. The focus is the source of the earthquake and the epicenter is the point on the surface directly above the focus. Earthquake foci (plural of focus) occur at a range of depths. The majority of earthquakes occur at shallow depths that range from the surface down to 100 km in depth. In some areas, however, foci may be as deep as 700 km. Even a glance at an earthquake epicenter map shows that most earthquakes have occurred in certain well defined regions of the Earth. Because these regions tend to be relatively long and narrow, they are sometimes referred to as "earthquake belts."

As mentioned earlier, seismic waves represent the energy released from the earthquake focus. There are two types of seismic waves:

- Surface waves (travel on Earth's surface); and
- Body waves (travel through Earth's interior).

Surface waves travel on Earth's surface and cause much of the destruction associated with earthquakes. Undulations of the land surface during an earthquake are a representation of surface waves. Further, surface waves may result in vertical motions (Rayleigh waves), much like waves travelling through water, or sideways motions (Love waves) with no vertical component of movement. Body waves travel through Earth's interior are further subdivided into P (primary) waves and S (secondary) waves based upon their

vibration direction and velocity. Variations in seismic wave velocity are used to infer the properties of Earth's interior.

Both P and S waves are generated (at the same time) at an earthquake focus as a result of movement on a fault. However, P waves will arrive at a recording station (seismograph station) early than S waves because of the greater velocity of P waves. Surface waves are the last to arrive because P and S waves travel a more direct route through the earth. Seismogram is an instrument that records magnitude of an earthquake. The principal elements of a seismogram that interest seismologists (scientists who study earthquakes) are the relative size of the recorded waves and the difference in time that the first P and S waves were recorded.

There are three principal methods of measuring the effects of earthquakes.

- Richter magnitude scale (measures the size of the seismic waves recorded at a seismogram);
- Modified Mercalli intensity scale (measures damage and human perception of an earthquake); and
- Moment-magnitude scale (gives more accurate interpretation of the amount of energy released by an earthquake).

The Richter scale measures magnitude of an earthquake. Magnitude is the amplitude of seismic waves recorded on a seismograph following an earthquake. Charles Richter developed the scale in the 1930s. The measurements of magnitude relied on using two factors (the difference in P- and S-wave arrival times and S-wave amplitude). The measured earthquakes were less than 600 km from the seismograph stations and occurred at similar depths in the crust. Unlike the Mercalli scale (explained below), the Richter scale does not have a maximum value. Hence it is open-ended. The largest earthquakes measured with the Richter scale have magnitudes between 8 and 9. It is probable that rocks in Earth's crust are unable to withstand stresses necessary to generate earthquakes of magnitude 9 or more.

The moment-magnitude scale measures the energy released by an earthquake more accurately than the Richter scale. The amount of energy released is related to rock properties such as the rock rigidity, area of the fault surface and amount of movement on the fault. It provides the most accurate means of comparison of large earthquakes.

7.6.3 Flood

Floods have been recurrent in many parts of the world. Almost every year floods of varying magnitude affect some parts of the world or the other. Different regions have different climates and, therefore, while some parts face devastating floods, other parts may, at the same time, experience drought conditions. The monsoon regime, especially in tropical and sub-tropical areas is a regular phenomenon. Rainfall happens to be the most important factor in creating a flood. However, there are many other contributing factors, as well. When rain falls on a catchment (drainage basin) of a river, the amount of rainwater that reaches the waterways depends on the characteristics of the catchment, particularly its size, shape, and land use. Some rainfall is 'captured' by soil and vegetation, and remaining enters waterways as flow. River characteristics such as size and shape, the vegetation in and around the river, and the presence of structures in and adjacent to the waterway all affect the level of water in the waterway.

Flood, in other words can be defined as an excess of water (or mud) on land (normally dry) and is a situation wherein the inundation is caused by high flow, or overflow of water in a flood plain, such as a river, stream, or drainage ditch; or near the point where the rain fell. This happens to be a duration type event. Inadequate capacity of the rivers to contain water within their banks the high flows brought down from the upper catchment (drainage basin) areas following heavy rainfall, leads to flooding. The tendency to occupy the flood plains has been a serious concern over the years. Because of the varying rainfall distribution, many a time, areas which are not traditionally prone to floods also experience severe inundation. Areas with poor drainage facilities get flooded by accumulation of water from heavy rainfall.

A flood can strike anywhere without warning, occurs when a large volume of rain falls within a short time (flash flood). A flash flood is a rapid rise of water along a stream or low-lying urban area. Flash flood damage and most fatalities tend to occur in areas immediately adjacent to a stream or arroyo, due to a combination of heavy rain, dam break, levee failure, rapid snowmelt, and ice jams. Additionally, heavy rain falling on steep terrain can weaken soil and cause debris flow, damaging homes, roads, and property. Flash floods can be produced when slow moving or multiple thunderstorms occur over the same area. When storms move faster, flash flooding is less likely since the rain is distributed over a broader area.

More than the loss of life and damage to property, the sense of insecurity and fear in the minds of people living in the flood plains is a cause of great concern. The after effects of floods such as the agony of survivors, spread of

epidemics, non availability of drinking water, essential commodities and medicines, loss of the dwellings etc. make floods the most feared natural disasters faced by humans.

7.6.4 Landslide

A landslide is the movement of rock, debris, or earth down a slope. Debris and mud flows are rivers of rock and earth saturated with water. They develop when water rapidly accumulates in the ground, during heavy rainfall that changes the earth into a flowing river of mud or "slurry." They can flow rapidly, striking with little or no warning. Landslides can be classified into different types on the basis of the type of movement and the type of material involved. If material in a landslide mass is either rock or soil (or both); the latter is described as earth if mainly composed of sand-sized or finer particles and debris if composed of coarser fragments. The movement of landslide material can vary from abrupt collapses to slow gradual slides and at rates which range from almost undetectable to extremely rapid. Sudden and rapid events are the most dangerous because of a lack of warning and the speed at which material can travel down the slope as well as the force of its resulting impact. Extremely slow landslides might move only few centimeters a year and can be active over many years.

Although this type of landslide is not a threat to people they can cause considerable damage to property. They also can travel several miles from their source, growing in size as they pick up trees, boulders, cars, houses, and other materials. They result from the failure of the materials which make up the hill slope and are driven by the force of gravity. Landslides are also known also as landslips, slumps or slope failure. Landslides could be triggered by natural as well as by human activities. They range from a single boulder in a rock fall or topple to huge volume of material in a debris flow. Landslides have and could cause fatalities, environmental degradation and severe damage to buildings, roads, railways, gas pipelines, communication networks, and agricultural land. Different types of movement describes the actual internal mechanics of how the landslide mass is displaced; some of the types includes: fall, topple, slide, spread, or flow.

7.6.5 Tsunami

The word tsunami is derived from a Japanese word meaning "harbour wave." Tsunamis, also known as seismic sea waves (mistakenly called "tidal waves"), are a series of enormous waves in a water body caused by the displacement of a large volume of water, generally in an ocean; created by underwater

disturbances, such as an earthquake or under sea volcanic eruption. In the deep ocean, tsunami waves do not dramatically increase in height, rather as the waves travel towards inland or an island, they build up to higher heights as the depth of the ocean decreases, due to low depth of the continental shelf. The speed of tsunami waves depends on ocean depth rather than the distance from the source of the wave. Tsunami waves may travel at very high speed over deep waters, only slowing down when reaching shallow waters. While tsunamis are mistakenly referred to as tidal waves, this name is discouraged by oceanographers because tides have little to do with these gigantic waves.

Tsunami events become disasters when they harm people and damage property beyond the ability of the community to cope. When a tsunami wave inundates a low-lying coastal area, it creates strong landward currents which exert potentially destructive forces on anything in their pathway. Anything moveable may become entrained. Following the peak of an inundation, draining waters form strong seaward currents charged with debris of all sorts that may be carried out to sea. The arrival of a tsunami at the coast may be presaged by a drawdown of sea level, causing an unusual recession of the shoreline and exposure of the seabed. Other hazards of tsunami includes flooding, contamination of drinking water, and fires from gas lines or ruptured tanks.

7.7 Socio-Environmental Movements

The term "social movement" was used for the first time during early nineteenth century. According to International Encyclopaedia of Sociology, "a social movement is an organised attempt by a number of people united by a shared belief to effect or resist changes in the existing social order by non-institutionalised means. The ultimate objective of any social movement is what its members see as the betterment of society." Accordingly, International Encyclopaedia of the Social Sciences defines social movements as "socially shared demands for change in some aspect of the social order." The social movement contributes to the formation of public opinion by providing for the discussion of social and political problems and through the eventual incorporation of the movement's ideas into central public opinion. It may also provide training of leaders who eventually joins politics and may eventually rise to the positions of leading statesmen.

There are two kinds of social movements; 'old social movements' and 'new social movements.' Old and new social movements are often distinguished on the basis of their location, aims, organization, and medium of change. Old

social movements tend to be located in the polity, whereas new social movements are autonomous movements outside conventional political establishments. Old social movements aim at securing political representation, legislative political reform and rights associated with citizenship in the political community, whereas the new social movements defend civil society against political power rather than pursuing legislative change through the state. Old social movement organizations are characterized by formal and hierarchical internal forms of organization, whereas new social movements go for informal or unstructured organization rather than structures of authority. Old social movements are oriented towards political institutions through which change can be achieved. The new social movements on the other hand go for newer and more innovative forms of direct action. They work on new redefinition of meaning and symbolic representation in culture rather than change trough political apparatus.

Environmental movement is also a kind of social movement that involves individuals, groups, and coalitions that perceive a shared interest towards environmental protection and, therefore, act collectively to bring about changes in environmental policies and practices. Although throughout the world, environmental movements are characterized by the features of both old and new social movements. The genesis of concern for environmental protection in India can be traced back to the early twentieth century when people protested against the commercialisation of forest resources during the British colonial period. More recently, a large number of environmental movements emerged especially during last few decades, falls under new social movements. These movements have grown out of a series of independent responses to local issues in different places at different times. Such movements played a pivotal role in creating public awareness about the importance of bringing about a balance between development and the environment. Also, major reasons for the emergence of environmental movements in India includes: control over natural resources; erroneous developmental policies of the government; socio-economic concern; prevailing environmental degradation/ destruction; and spread of environmental awareness through mass-communication media. Some of the popular environmental movements in India are: Bishnoi movement in Rajasthan; Chipko and Tehri dam movements of Himalayas; save the Narmada movement in central India; Koel Karo movement in eastern India; and the Silent Valley movement in the Malabar region of southern India (Figure 7.4).

[Figure 7.4 about here]

7.7.1 Bishnoi Movement

Bishnoi sect is said to have created during 1485 AD by Saint *Guru Jambheshwar* in western part of Rajasthan, India. According to local traditions, and vernacular literatures, *Jambaji* (as he is popularly known) had special attachment towards nature. He articulated 29 principles of morality and conduct, and the sect of Bishnoi (*Bish*=twenty; *noi*=nine) takes its name from those principles. Out of these 29 principles; 6 principles are exclusively dedicated towards environmental protection and compassion towards all living beings. Long before the world came to know about the environmental crises, Bishnois' were cognizant of the importance of maintaining a delicate balance between nature and humans. Moreover, the customs of the Bishnoi point to an attempt to forge a more syncretic movement by adopting the practice of burial of the dead, as *Jambaji*, could not endure the idea of felling trees to obtain wood for the funeral pyre.

It is documented that in 1730 AD, 363 people including Amrita Devi, a Bishnoi woman leader, who steered this movement further, sacrificed their lives in an effort to prevent the felling of *Khejri* (*Prosopis cineraria*) trees, which in Rajasthan are treated with reverence. This movement was the first of its kind to have developed the strategy of hugging or embracing the trees for their protection spontaneously. The Bishnoi's embrace of trees can be found the precedence for the famous '*Chipko*' movement (of 1973) in northern Himalayas of India, where again women hugged the trees to resist the depredations of loggers and contractors. The Bishnois are rightfully known to be the foremost environmentalists' of India.

7.7.2 Chipko Movement

The word '*Chipko*' in Hindi means 'to embrace' or 'to hug,' as villagers during the movement hugged the trees preventing their chopping. In local vernacular it is popularly known as *Angwal*. The movement is best known for its tactic of hugging trees to prevent them being cut down in order to prevent commercial timber harvesting. The Chipko movement is considered to be one of the environmental movements of grassroots origin in India. This movement focused world's attention on the environmental problems of the Alaknanda catchment area in the northern Himalayan region.

Post Indo-Chinese border issues during 1960s; extensive networks of roads were built throughout the lower Himalayan region as a strategic move. This resulted in opening of the region's natural resources to entrepreneurs from various regions of India. During March 1973, confrontation occurred in Chamoli district of Uttar Pradesh (now under Uttarakhand state), where a

group of women, led by Gaura Devi (an elderly woman) blocked an army of lumberjacks, against cutting of natural forests trees by private contractors hired by a sports good manufacturing company. Local residents hugged the earmarked trees when the treed were about to be axed. Later, the same tactic was used by the villagers in some other areas of the state to save trees.

The movement later became popular under the leadership of Chandi Prasad Bhatt, a Marxist and Sunderlal Bahuguna, a Gandhian. Later Chipco activists' undertook afforestation programmes in nearby villages with the help of some voluntary organizations. Chipko's appeal was uniquely wide-ranging. Thus the movement was co-opted, shaped, and popularized by groups as diverse as local and global journalists, environment activists, Gandhians, spiritual leaders, politicians, and feminists. The feminist movement popularized Chipko, pointing out that poor rural women walk long distances to collect fuel and fodder, and thus were the frontline victims of forest destruction.

7.7.3 Appiko Movement

The Appiko movement, a movement similar to the Chipko movement of north-India, was launched during 1983 by the activists' to save the Western Ghats in Karnataka state. Appiko movement created a wider consciousness about conservation of trees in Western Ghats (a biodiversity hotspot). The objective of the Appiko movement was three-fold: to protect the existing forest cover, to regenerate trees in denuded lands and, to utilize forest wealth with due consideration to conservation. All these objectives were implemented through established *Parisara Samrakshna Kendras* (environment conservation centre).

The regions rainforests have been undermined by logging for the plywood and paper industry, conversion of forest to monoculture plantations and the construction of large hydro-electric dams for power generation. This has also resulted in the destruction of livelihood of forest dwellers. The movement forced the Forest Department to reduce felling of marked trees in some areas and to completely halt the logging work in some other parts. Some specific changes included; ban on clear felling, no further issuing of concessions to logging companies, and moratorium on felling of green trees in the tropical rainforest of the Western Ghats.

7.7.4 Silent Valley Movement

Silent Valley, is a pristine environment located in Palakkad district of Kerala having vast expanse of tropical forests of the Western Ghats. During 1980s, a

200 MW hydroelectric dam on the river Kunthipuzha was to come up. The proposed project was not ecologically viable, as it would drown nearly 8952 hectares of the valuable rainforest of the valley and threaten the life of a host of endangered species of both flora and fauna. Environmentalists opined that the deforestation and submergence of virgin rain forests of Silent Valley could danger the eco-balance and would change the climate of the Kerala by way of diminishing rainfall.

Considering this, a voluntary organization *Kerala Satya Sahitya Parishad* conducted demonstrations and protests against the decision of the state government. The movement acknowledged the obvious economic needs of the people of Malabar region but concluded that the project would make only a marginal contribution to regional development. Thus, the group opposed the project with a campaign that brought into sharp focus the ecological consequences, specifically the possibility of extinction of species. The movement began to challenge the idea that energy generated by the dam would benefit the rural people of that region. Most of the energy from the project was to be exported to industrialized areas of Kerala and surrounding states. The uproar created by the public concerning the Silent Valley was so high that the Government of Kerala promulgated an ordinance, which was followed by an Act to protect the ecosystem of that area. Later, the project was completely dropped and Silent Valley was declared as a National Park in 1985.

7.7.5 Koel Karo Movement

The South Koel river runs across Jharkhand and Odisha states in India. The river has three tributaries, namely: North Karo, South Karo, and Koina. The Koel Karo hydroelectric project was conceptualized during 1950s in Jharkhand area (now a state) of Bihar. The project aimed at generating 710 MW of electricity by construction of two dams at South Koel and North Karo rivers. The two reservoirs were to be connected through a 35 km inter-basin channel. It was estimated that around 120 villages would be affected, displacing over one lakh people and 22,000 hectare of land would get submerged. Serious opposition of the proposed project was marked by tribal and local population considering their large scale displacement. Opposition of the project reached its peak in 1984 when around 70,000 people organized strong protest to move from the area marked for submergence. Due to sustained opposition and pressure by the people, the government of Jharkhand abandoned the project.

7.7.6 Tehri Dam Movement

One of the most protracted environmental movements is the movement against the construction of the Tehri Dam. Serious controversies arose when the provincial government decided to construct a dam at the confluence of rivers, Bhagirathi and Bhilangana close to Tehri Town of Uttar Pradesh (now in Uttarakhand). Environmentalist including local inhabitants opposed this project as the area chosen for construction of dam was vulnerable to earthquakes and fear of submergence of major portions of Tehri town in the event when the dam would burst. They also opposed the dam due to the fear of displacement, deforestation, earthquakes, and other associated environmental hazards. *Tehri Baandh Virodhi Sangahrsha Samithi*, a committee founded by veteran freedom fighter Veerendra Datta Saklani opposed the construction for almost more than a decade.

7.7.7 Save the Narmada Movement

In 1978, the Government of India sought the World Bank's assistance to build a complex of dams along the Narmada and its tributaries as part of the Narmada Valley Development Project (Narmada Project). River Narmada is the largest west-flowing river on the Indian peninsula and flows through states of Madhya Pradesh, Maharashtra, and Gujarat. The river winds its 1,300 km long course into the Gulf of Cambay. The Narmada valley is the site of one of the world's largest multipurpose water projects, which involves construction of thirty large dams, 135 medium dams, and 3,000 small dams on the river fifty-one main tributaries. The project was conceptualized with a view to transform lives of residents by increasing food production and hydropower generation in Gujarat, Madhya Pradesh, and Maharashtra.

Narmada Bachao Andolan (save the Narmada Movement) began during 1980s was started as a social movement for rehabilitation and resettlement of people being displaced by large dams being built across the Narmada river, but later the focus shifted to preserving the environmental integrity and natural ecosystems of the entire valley. Sardar Sarovar Dam in Gujarat is one of the biggest dams on the river and was one of the first focal points of the movement. The movement has used the project as a symbol of Indian development planners' fascination with costly projects at the expense of the environment and the poor. The withdrawal of World Bank funding was a moral victory for the movement. The movement, however, gained wider public attention with mobilization and organization of local tribes, farmers, environmentalists, human rights activists and the joining of the eminent social workers like Baba Amte, Sunderlal Bahuguna and Medha Patkar. The

movement, with its leading activists; Medha Patkar and Baba Amte, later, for their exemplary work received the Right Livelihood Award in 1991.

7.8 Environmental Education and Sustainability

During 1960s, awareness about detrimental impacts of development on mankind and natural environment was on rise. In order to tackle this situation, environmental policies and programmes were started being developed worldwide. People became more aware of their own impact on the environment in their everyday life. The idea emerged that an individual could influence public decisions that impact ones quality of life (at least in democratic countries). That was the time when the need for environmental education emerged. It covered two aspects: to inform people of environmental systems and to educate them so that they adopt a more responsible attitude towards the environment. The idea was not to dictate how to behave but to help people take informed choices and decisions.

During 1970s, great efforts were taken by the UNESCO and the UNEP to put environmental education higher on the agenda, to define its scope, to state clearly some quality measures and guidelines, and by all this to promote environmental education as an essential part of the multi-faceted solutions to environmental problems produced by humans. With the Belgrade Charter of 1975 and the Tbilisi Declaration of 1977, environmental education was, for the first time, clearly defined. Environmental education can be described as formal and informal education, aiming to raise the awareness of people for ecological dynamics, their natural surroundings, environmental problems, and interdependencies with economic, social and cultural development. As a consequence, people should be able to understand natural dynamics in a holistic way and be able to take action for improving the environmental situation.

Environmental education is a central aspect in the process of change towards sustainable development. The United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in 1992 first brought the issue of sustainable development to the attention of the world. Following the 1987 report of the Brundtland Commission to the World Commission on Environment and Development, more than 170 nations approved the Agenda 21, a far-reaching platform to achieve sustainable development. The commission was headed by the then Norwegian Prime Minister, Gro Harlem Brundtland and the report (Brundtland Commission report) was published in the form of a book, *Our Common Future*. The Commission defined sustainable

development as a type of development which fulfils the needs of the present generation without compromising the ability of the future generation to meet their own needs. The principle of sustainability is based on three equally important dimensions (sustainability triangle): economic efficiency, environmental sustainability and social equitability. Any consideration of one of the three dimensions in isolation jeopardises sustainable development.

At the Johannesburg Summit in 2002, it was agreed to assess new forms of education and educational programme content to ensure communication of the concept of sustainability to the forthcoming generation. The objective was to provide all kinds of people with educational opportunities that enable them to acquire knowledge and values, as well as to adopt the behaviour and lifestyles that are essential to make the future worth living and to bring about positive social change. Education for sustainable development comprises the subjects of environmental protection, the efficient utilisation of natural resources, the maintenance of the ecosystem and responsible attitudes among members of society and the business community. Environmental education is thus an integral aspect for sustainable development. It deals with the subject of environmental problems, why they occur and what behavioural modifications could be made in order to eliminate them. Environmental education, like education for sustainable development, is based on building awareness and identification with personal living environments. It is therefore not merely the conveyance of knowledge, but a process of learning about the concept of political action.

Education for sustainable development became more and more important at the beginning of the 21st century and can be viewed as a broadening and strengthening of environmental education. However, one cannot rely only on a top-down approach. Sustainable development is a process of social change that must be experienced by all members of society. In order to realise it, society must be willing to both accept and implement a policy of transition to sustainable management practices. Learning to play an active role in the creation of an ecologically compatible and economically efficient world in which social equality prevails is not an automatic process. This is why education is a vital prerequisite for the worldwide promotion of sustainable development. In 2002, the United Nations designated the period, 2005 to 2014 as the decade of “Education for Sustainable Development.” The objective was to integrate the concept of sustainable development in education processes across the world and to promote the value of respect to others as a basis of sustainable development.

Case Study

Tsunami early warning system for the Indian Ocean region

On 26 December 2004 (Sunday), an earthquake of magnitude nine occurred off the West Coast of Northern Sumatra (Indonesia) in the Indian Ocean. This caused the Indian Ocean tsunami that affected 13 countries and killed approximately 3,00,000 people (more casualties than any other tsunami ever recorded). According to estimation nearly 1.7 million (17 lakh) people became homeless. It was the largest trans-oceanic tsunami in over 40 years. This was followed by a second earthquake, only three months later of magnitude 8.7 instilled more fear in the survivors of the first disaster. As a result of this tragedy, a strong interest and requirement of a system at global level was felt that could warn of a potential tsunami. Prior to 2004, tsunamis were never considered a high-risk hazard. Tsunami science was a niche scientific field, with little translation of knowledge into practice, even though scientists published work on a possible ocean-wide tsunami in the Indian Ocean just few months before the 2004 event.

Although tsunamis cannot be prevented, however, an early warning of its approach, combined with physical defenses and well-practiced evacuation procedures could save many lives. On request by the George Bush, the then President of the United States, National Oceanic and Atmospheric Administration's (NOAA) Pacific Marine Environmental Laboratory (PMEL) developed an innovative Deep-ocean Assessment and Reporting of Tsunami (DART) system, in which a sensor on the ocean floor detects tsunami waves and communicates these to a surface buoy with satellite telecommunications capability. The DART system was an effort to maintain and improve the capability for the early detection and real-time reporting of tsunamis in the open ocean. DART is a critical element of the NOAA "Tsunami Program" as a cooperative effort to save lives and protect property through hazard assessment, warning guidance, mitigation, research capabilities, and international coordination. Computer models were developed that could simulate tsunami impacts on communities and satellites could now transmit signals to high-speed computers, empowering humans to issue local and pan-oceanic tsunami warnings in a matter of minutes.

In less than three months following the devastating Indian Ocean tsunami, scientists worked together with policymakers to form an international commitment to develop an Indian Ocean Tsunami Warning & Mitigation System (IOTWS). The IOTWS is now fully operational; comprising a set of regional tsunami service providers located in India, Australia, and Indonesia.

They issue tsunami advisories to all national tsunami warning centers of the Indian Ocean rim countries. The IOTWS also developed the first international guidelines for tsunami hazard and risk assessment.

Case Study

Earthquake, Tsunami, Meltdown: triple disasters of Japan

During March, 2011, a devastating earthquake (Tohoku earthquake) of magnitude nine struck the Japan's east coast. Damage from the earthquake itself was just the start. The tremendous up-thrust from the seafloor thus generated a series of enormous tsunami with 100 foot waves, the first of which struck the coast within an hour. Due Japan's exemplary investment in earthquake-resistant design, only about 100 people died during the earthquake. However, almost 20,000 people lost their lives in the tsunami. Almost 160 km north of Tokyo, a nuclear power plant (Fukushima Dai-ichi), established in 1971 started to overheat as a result of the buildup of hydrogen gas generated by melting nuclear fuel resulted in colossal explosions in these three units and damage to the containment structure of a fourth reactor amid double blow from the earthquake followed by tsunami.

The economic destruction of the "Triple Disaster" (earthquake, tsunami, and meltdown) was massive. Almost 1,38,000 buildings were destroyed and 360 billion USD in economic losses were incurred. This made the Japan's 2011 disaster as one of the most expensive disaster reported in the human history.. Some 4,65,000 people were evacuated after the disaster. But it was the meltdowns at the Fukushima nuclear plant, the world's worst nuclear crisis since Chernobyl in 1986, which caused massive fear and aggravated the greatest criticism of the Japanese government's disaster response.

The economic, political, and social consequences of the triple disaster changed Japan in fundamental ways. The uprooting of entire communities and the large infrastructural losses produced immediate disruptions in Japan's extensive supply networks. This triggered dramatic drops in industrial production that imposed a toll, not only on Japan's economy, but also on the many other countries linked through these production networks. While Japanese companies restored the supply chains in relatively less time, the shutdown of the nuclear reactors has had far more damaging long-term economic consequences. Amid this, the Japanese government has had to resort to large increases in oil imports to make for the gap in electricity supply.

The after-effects of the Japanese disaster went far beyond Japan. It gave a direct warning that even developed, well-prepared countries are not immune from disasters of such scale and enormity. It also illustrated the enormously high economic costs of disasters occurring in developed countries and the vulnerabilities of urbanisation and coastal settlement. It served as a wakeup

call to the world that unanticipated disasters (or "black swans") could struck any time and that those engaged in contingency planning need to be prepared for much more devastating disasters. Internationally, the fallout of the Fukushima meltdowns for the future of nuclear energy has been mixed. A large citizen movement for the abolition of the nuclear power plants began to develop, as a consequence of the disaster. While immediately after the accident some governments announced plans to phase out of nuclear energy, others have continued their nuclear planning.

In October 2012, the Japanese government and the World Bank co-hosted the *Sendai Dialogue* (a special event on managing disaster risk) to highlight the lessons learned from the disasters and to adopt comprehensive guidance for reducing risk in other parts of the world.

Case Study

Public participation in environmental impact assessment: a decision making tool

Environment Impact Assessment (EIA) can be defined as the study to predict the possible effects of a proposed activity/project on the environment. EIA, a decision making tool, compares various alternatives for a project and seeks to identify the one which represents the best combination of economic and environmental costs and benefits. EIA systematically examines both beneficial and adverse consequences of the project in question and ensures that these effects are addressed and must be taken into account during project design. In other words, EIA helps to identify possible environmental effects of the proposed project, proposes measures to mitigate adverse effects, and predicts whether there will be significant adverse environmental effects, even after the mitigation is implemented. The purpose of EIA is not just to assess impacts and complete an environmental impact statement (EIS), rather to improve the quality of decisions. By way of thoroughly informing the stake holders (affected people) the project proponent could make environmentally sensitive decision by being aware of a project's potential adverse impacts on the environment. Another important purpose of EIA is to inform the concerned people about the proposed project and its impacts on them and environment. In this context public participation provides crucial information.

EIA happens to be one of the successful policy innovations of the 20th century for environmental conservation. Almost four decades ago, there was no EIA but today, it is a formal process in many countries and is currently practiced in more than 100 countries. The EIA process really took off after the mid-1980s. In 1989, the World Bank adopted EIA for major development projects, in which a borrower country had to undertake an EIA under the Bank's supervision. There is a need to increase public sensitivity to environment and development problems to find out solutions and foster a sense of personal environmental responsibility and greater motivation and commitment towards sustainable development.

The Indian experience with Environmental Impact Assessment began almost 20 years back. It started during 1976-77, when the Planning Commission asked the Department of Science and Technology to examine the river-valley projects from an environmental angle. This was subsequently extended to cover those projects, which required the approval of the Public Investment Board. Till 1994, environmental clearance from the Central Government was an administrative decision and lacked legislative support. On 27 January

1994, the Union Ministry of Environment and Forests (MoEF), Government of India, under the Environmental (Protection) Act 1986, promulgated an EIA notification making Environmental Clearance (EC) mandatory for expansion or modernisation of any activity or for setting up new projects listed in Schedule 1 of the notification. A law on EIA is important for environmental management and it has been gradually developed since 1994. Public participation provisions in EIA legal system have also experienced continuous developments in India.

Under the original 1994 notification, the MoEF had the discretion over whether to hold public hearings to solicit comments about the project application. Typically, public hearings were called for in projects involving a large displacement of local inhabitants or having severe environmental impacts. However, prior to 1997, public involvement was very limited since many specific operational provisions were unclear and this influences the implementation of public participation in practice. As a result, public right to participate were, many a times, weakened. Considering the importance of public awareness and involvement of key stakeholders in decision making process, the public hearing provisions of the EIA Notification were introduced in 1997, by way of amendments. The gist of the public hearing notifications is that hearings are now mandatory for all projects to which the EIA notification applies.

The notification of 1997 is considered a significant advance on the EIA notification of 1994, since the provisions for public participation, are more specific. The process of conducting public hearing is outlined including the submission of EIA report to State Pollution Control Board (SPCB), the specification for public hearing notice, the member composition of the hearing panel and time period for completing public hearing process. In addition, the notification 1997 emphasises the fairness and representativeness of the public as states that: “All persons including bona fide residents, environmental groups and others located at the projects site/sites of displacement/sites likely to be affected can participate in the public hearing” (Public Hearing Notifications, 1997).

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