

## Lecture 10: Human Ecology

1. Human Ecology: definitions
2. Main ecological problems of mankind
3. Exhaustion and degradation of natural resources
4. Pollution of environment
5. Environmental hazards and Human Impact

### 1. Human Ecology: definitions

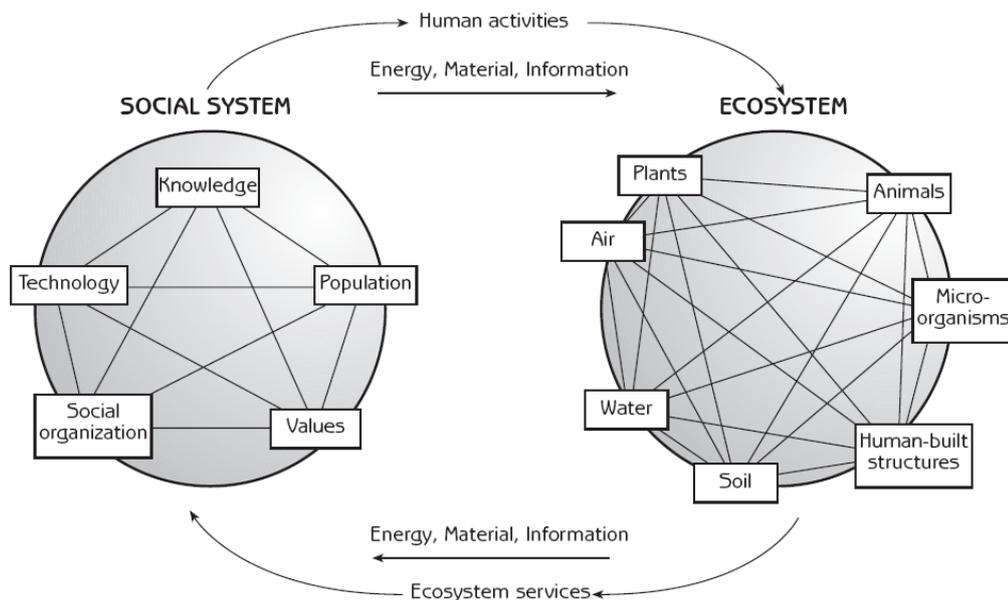
**Ecology** is the science studying how organisms interact with each other and their physical environment. These interactions are often quite complex.

**Human ecology** is a discipline that deals with the relationship between humans, human societies, and their natural, social and created environments.

Human activity frequently disturbs living systems and affects these interactions. Ecological predictions are, of a consequence, often more general than we would like.

#### Interaction of the human social system with the ecosystem

Although humans are part of the ecosystem, it is useful to think of human–environment interaction as interaction between the human **social system** and the rest of the ecosystem (see figure below).



The **social system** is everything about people, their population and the psychology and social organization that shape their behavior. The social system is a central concept in human ecology because human activities that impact on ecosystems are strongly influenced by the society in which people live. Values and knowledge which together form our worldview as individuals and as a society shape the way that we process and interpret information and translate it into action.

Technology defines our repertoire of possible actions. Social organization, and the social institutions that specify socially acceptable behavior, shape the possibilities into what we actually do. Like ecosystems, social systems can be on any scale – from a family to the entire human population of the planet.

The **ecosystem** provides services to the social system by moving materials, energy and information to the social system to meet people's needs. These **ecosystem services** include water, fuel, and food, materials for clothing, construction materials and recreation.

Material, energy and information move from social system to ecosystem as a consequence of human activities that impact the ecosystem:

- people affect ecosystems when they use resources such as water, fish, timber and livestock grazing land;
- after using materials from ecosystems, people return the materials to ecosystems as waste;

- people intentionally modify or reorganize existing ecosystems, or create new ones, to better serve their needs.

## 2. Main ecological problems of mankind

1. *Population growth*
2. *Exhaustion and degradation of natural resources*
3. *Pollution of environment*

### 1. Population Growth

**Population** a group of individuals of a species living in a particular geographic area and interbreeding in nature

The study of factors that affect growth, stability, and decline of populations is population dynamics. All populations undergo 3 distinct phases of their life cycle:

- i. growth
- ii. stability
- iii. decline

**Population growth** occurs when available resources exceed the number of individuals able to exploit them. Reproduction is rapid, and death rates are low, producing a net increase in the population size.

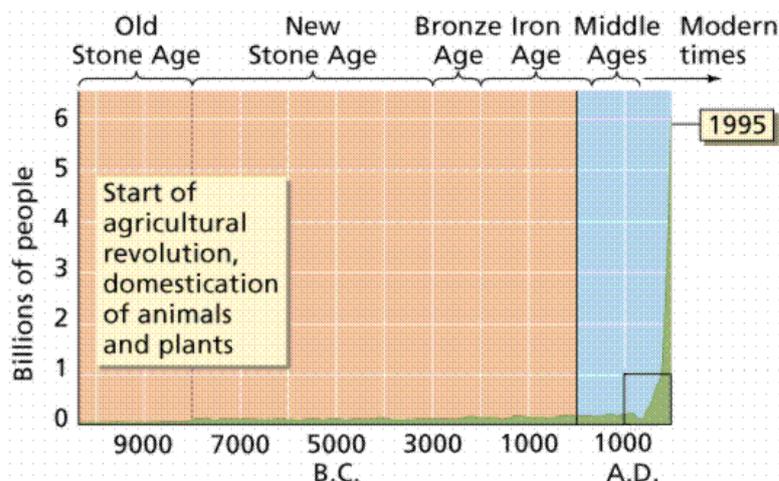
**Population stability** is often preceded by a "crash" since the growing population eventually outstrips its available resources. Stability is usually the longest phase of a population's life cycle.

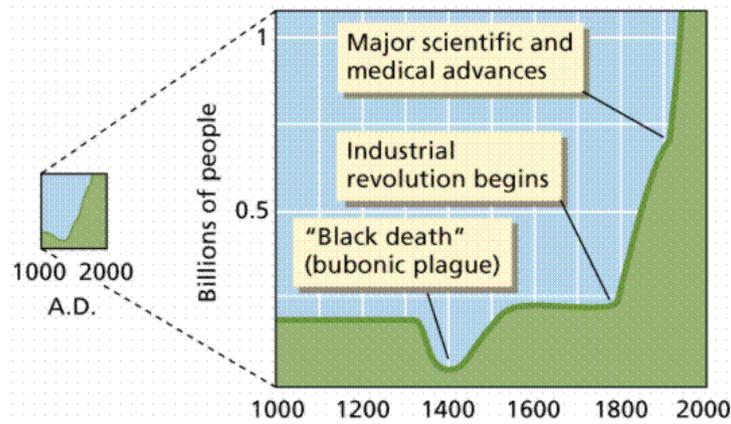
**Decline** is the decrease in the number of individuals in a population, and eventually leads to population extinction.

Human populations are in a growth phase. Since evolving about 200,000 years ago, our species has proliferated and spread over the Earth. Beginning in 1650, the slow population increases of our species exponentially increased. New technologies for hunting and farming have enabled this expansion. It took 1800 years to reach a total population of 1 billion, but only 130 years to reach 2 billion, and a mere 45 years to reach 4 billion.

Despite technological advances, factors influencing population growth will eventually limit expansion of human population. These will involve limitation of physical and biological resources as world population increased to over six billion in 1999. The 1987 population was estimated at a puny 5 billion.

**Human population growth over the past 10,000 years**





Note the effects of worldwide disease (the Black Death) and technological advances on the population size.

### Population projections to 2050

World human population is currently growing by ~72 million people per year.

**Overpopulation** is the condition where an organism's numbers exceed the carrying capacity of its habitat.

Almost all growth takes place and will take place in the less developed regions, where today's 5.3 billion population of underdeveloped countries is expected to increase to 7.8 billion in 2050.

By contrast, the population of the more developed regions will remain mostly unchanged, at 1.2 billion. The world's population is expected to rise by 40% to 9.1 billion.

*Such an increase in population demands more food, water and land!*

During 2005-2050, **9 countries** are expected to account for half of the world's projected population increase: India, Pakistan, Nigeria, Democratic Republic of the Congo, Bangladesh, Uganda, USA, Ethiopia, and China, listed according to the size of their contribution to population growth.

By 2050 (*medium variant*), India will have almost 1.7 billion people, China 1.4 billion, the USA 400 million, Indonesia 297 million, Pakistan 292 million, Nigeria 289 million, Bangladesh 254 million, Brazil 254 million, Democratic Republic of the Congo 187 million, Ethiopia 183 million, Philippines 141 million, Egypt 121 million, Vietnam 120 million, Russia 108 million, Japan 103 million, Iran 100 million, Turkey 99 million, Uganda 93 million, Tanzania 85 million, and Kenya 85 million.

The population of 51 countries or areas, including Germany, Italy, Japan and most of the successor States of the former Soviet Union, is expected to be lower in 2050 than in 2005.

During 2005-2050, the net number of international migrants to more developed regions is projected to be 98 million.

Because deaths are projected to exceed births in the more developed regions by 73 million during 2005-2050, population growth in those regions will largely be due to international migration.

In 2000-2005, net migration in 28 countries either prevented population decline or doubled at least the contribution of natural increase (births minus deaths) to population growth. These countries include Austria, Canada, Croatia, Denmark, Germany, Italy, Portugal, Qatar, Singapore, Spain, Sweden, United Arab Emirates and United Kingdom.

**Fertility rate.** In 2000-2005, fertility at the world level stood at 2.65 children per woman, about half the level in 1950-1955 (5 children per woman). In the medium variant, global fertility is projected to decline further to 2.05 children per woman.

Birth rates are now falling in a small percentage of developing countries, while the actual populations in many developed countries would fall without immigration

Population growth and movement intensifies human interactions with ecological systems which may potentiate biotic disease resulting in the spread of human diseases.

Nearly half the world's people are crowded into urban areas, often without adequate sanitation.

Unsanitary living conditions account for more than 5 million deaths each year, and more than half of those are children.

### Overpopulation: consequences

Human lifestyle transition from a pastoral/agrarian environment to a more sedentary urban environment results in increased population density which may result in increased rates of microbiologically polluted water and communicable infectious diseases (measles, influenza and other

diseases). This transition also results in a change in diet and a more sedentary lifestyle with increased rates of obesity, adult diabetes, hypertension, and cardiac disease

While the population of developed countries suffers from these diseases other part of world suffers from malnutrition. The researches show that 57% of the current world population of about 6.5 billion is malnourished, compared with 20 % of the world population of 2.5 billion in 1950.

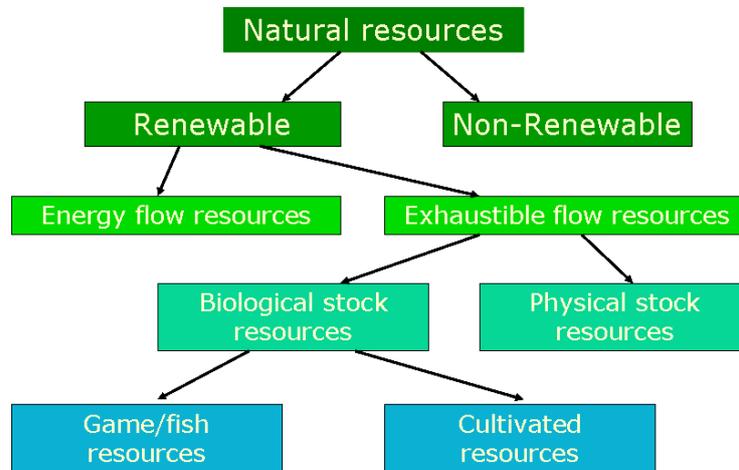
Malnutrition is not only the direct cause of death for 6 million children each year, but also makes millions of people much more susceptible to deadly health problems such as acute respiratory infections, malaria and a host of other life-threatening diseases

### **3. Exhaustion and degradation of natural resources**

**Natural resources** (economically referred to as land or raw materials) are naturally forming substances that are considered valuable in their relatively unmodified (natural) form.

Natural resources are mostly classified into renewable and non-renewable resources.

!!! Sometimes resources are classified as non-renewable even if they are technically renewable, just not easily renewed within a reasonable amount of time, such as fossil fuels



**Renewable resources** are sometimes living resources (*trees and soil, for example*), which can restock (renew) themselves if they are not over-harvested and used sustainably.

There are also non-living resources that are renewable, such as hydroelectric power, solar power, biomass fuel, and wind power.

If renewable resources are consumed at a rate above their natural rate of replacement, the standing stock will diminish and eventually run out.

The rate of sustainable use of these resources is determined by the replacement rate and amount of standing stock of that particular resource.

Non-living renewable natural resources include dirt and water.

Resources can also be classified on the basis of their origin as

1. biotic
2. abiotic

**Biotic resources** are derived from living organisms.

**Abiotic resources** are derived from the non-living world (e.g., land, water, and air). Mineral and power resources can be abiotic natural resources.

Resources such as timber (when harvested sustainably) or metals (which can be recycled) are considered renewable resources

A **non-renewable resource** is a natural resource that cannot be produced, re-grown, regenerated, or reused on a scale which can sustain its consumption rate.

These resources often exist in a fixed amount, or are consumed much faster than nature can recreate them.

*Examples:* Fossil fuels (such as coal, petroleum and natural gas) and nuclear fuel.

Over-exploitation of natural resources in some cases lead to exhaustion, particularly by excessive forestry, fishing and hunting. This over-exploitation may be explained in part by human overpopulation in some areas of the planet, ever-increasing world demand for these resources and the development of international trade.

Industrial-scale logging, for wood products and timber, destroys or fragments millions of acres of forests each year, along with the habitat they provide to many uniquely adapted species. Over-harvesting of fisheries has driven several fish species to the brink of extinction and reduced the overall diversity of marine life. Over-hunting and illegal trade in endangered species are a prime threat to their survival. This occurs even in the well-developed countries such as the US. For example, box turtles in the US are illegally collected and exported as pets, and, they die in the tens of thousands each year. These species are very slow to reproduce, and, in some populations, poaching has resulted in too few hatchlings surviving to offset adult mortality.

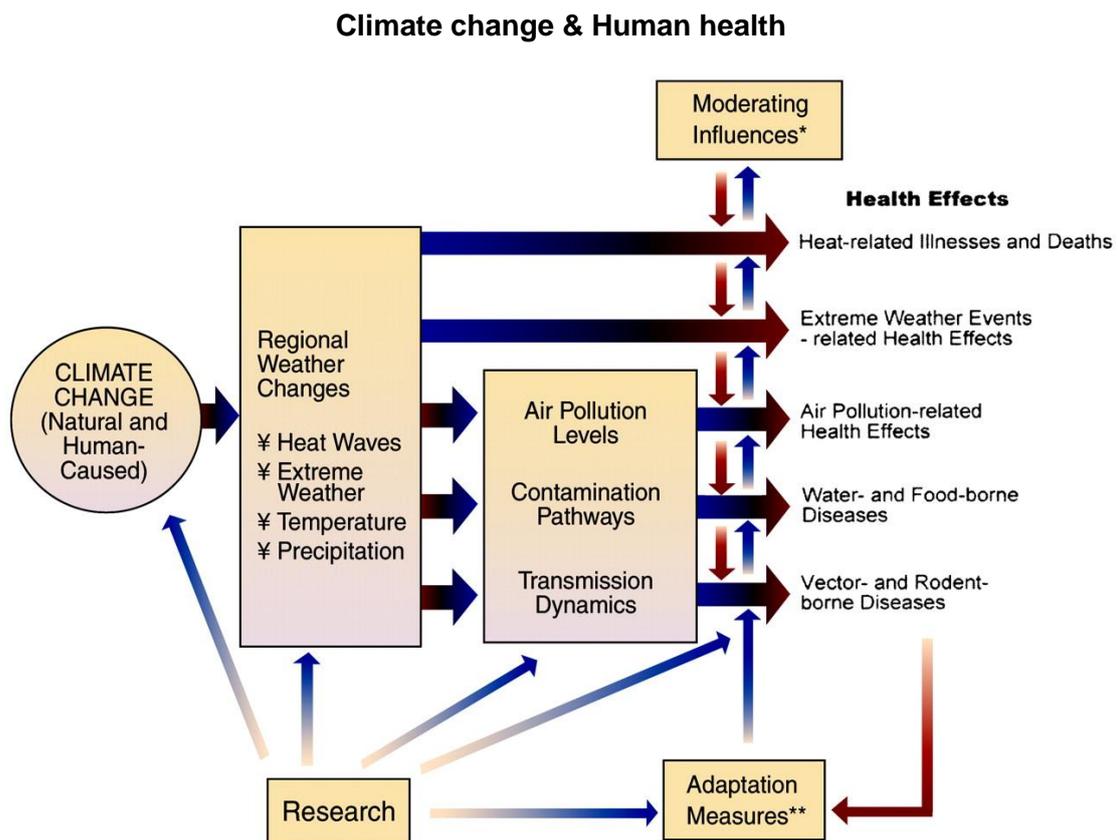
To the moment, a dozen of species that were most popular fishes during the hundreds of years became rare and endangered species. Like god-fish, in many areas herring, wild salmon and few more species now have almost no economic value in the North Atlantic seas. Even if there are still some quotas for fishery of these species, the volume of quotas decreased annually.

Not only fishes, but also invertebrates and macro algae are under pressure of human beings. In many countries inhabitants collect invertebrates along the tidal. In vicinities of cities and settlements the tidal communities could be really "eaten away".

#### 4. Pollution of environment

**Pollution** is the introduction of contaminants into an environment that causes instability, disorder, harm or discomfort to the physical systems or living organisms they are in

About 40 % of human deaths worldwide are caused by water, air and soil pollution (*David Pimentel, professor of ecology and agricultural sciences at Cornell University, USA*)



#### Air pollution of environment

Air pollution is one of the greatest environmental evils. The air we breathe has not only life-supporting properties but also life-damaging properties. Air pollution from smoke and various chemicals kills 3 million people a year.

In the United States alone, about 3 million tons of toxic chemicals are released into the environment each year - contributing to cancer, birth defects, immune system defects and many other serious health problems

### **Health effects of pollutants**

- **Sulphur dioxide** is an irritant gas which affects mucous membranes when inhaled.
- **Sulphur trioxide** is a very strong irritant, much stronger than sulphur dioxide, causing severe bronchospasms at relatively low levels of concentration.
- **Carbon monoxide** has a strong affinity for combining with the haemoglobin of the blood to form carboxyhaemoglobin COHB. This reduces the ability of the haemoglobin to carry oxygen to the body tissues. Carbon monoxide also affects the central nervous system. It is also responsible for heart attacks and a high mortality rate.
- **Ozone** is a gas that has an irritant action in the respiratory tract, reaching much deeper into the lungs than the oxides or sulphur.
- **Fluorine** is a cumulative poison even in sub-acute concentrations under conditions of prolonged exposure.
- **Lead** is a highly toxic and cumulative poison. Lead poisoning can cause severe mental retardation or death. The effects include gastro-intestinal damage, liver and kidney damage, abnormalities in fertility and pregnancy, and mental development of children.
- **Insecticides** are not only harmful for insects but also poisonous for man. e.g., DDT [Dichloro Diphenyl Trichloroethane]. They can affect the central nervous system and may attack other vital organs. In fact, DDT has been found in mother's milk in western countries
- **Radioactive Isotopes:** serious health effects are anaemia, leukaemia and cancer. Radioactive isotopes also cause genetic defects and sterility.

### **Water pollution**

Water pollution is a phenomenon that is characterized by the deterioration of the quality of land water (rivers, lakes, marshes and ground water) or seawater as a result of various human activities. Man has polluted much of this limited quantity of water with sewage, industrial waste and a wide array of synthetic chemicals.

With 1.2 billion people lacking clean water, **waterborne infections** account for 80% of all infectious diseases. Increased water pollution creates breeding grounds for malaria-carrying mosquitoes, which kill 1.2 million to 2.7 million people every year

Many human activities impact the environment in ways that are subtle or inconspicuous or involve changes that are so slow that people do not notice what is happening until the problem is serious. Problems may appear suddenly, and sometimes at a considerable distance from the human actions that cause them.

**Example: Minamata disease** is a typical example of an unintended consequence. Until the 1960s, *mercury* was widely used for industrial processes such as paper and plastics production. Plastic factories in *Japan's Minamata region* routinely dumped mercury waste into the adjacent coastal waters. Though mercury was known to be highly toxic, no one worried because the ocean was so large. However, bacteria around factory outlets were transforming the mercury into even more toxic methane mercury, which accumulated year after year in the coastal ecosystem. The mercury was biologically concentrated as it passed along each step of the food chain from phytoplankton (microscopic plants) to zooplankton (tiny animals), small fish and finally fish large enough for people to eat. No one realized that the mercury concentration in fish was more than a million times the concentration in the surrounding ocean water.

During the 1950s more than 1000 people in the Minamata region were afflicted with an illness that killed several hundred, left survivors with devastating neurological damage and produced severe deformities in babies. Once mercury-contaminated fish were identified as the cause of the problem, the local people mounted a campaign for the factories to do something about it. After several years the government finally ordered the factories to stop dumping mercury; but the large quantity of mercury already in the coastal ecosystem continued to circulate through the food web. It was nearly 50 years before fish in the Minamata region were safe to eat again. This dramatic incident eventually led to worldwide elimination of mercury from large-scale industrial processes, though mercury is unfortunately still in use for gold mining in parts of Africa, Latin America and Asia.

### **Soil pollution**

Soil is contaminated by many chemicals and pathogens, which are passed on to humans through direct contact or in their food and water.

Increased **soil erosion** worldwide not only results in more soil being displaced, but also contributes to the spread of disease microbes and various toxins

World Health Organization (WHO) has reported that such environmental degradation, combined with the growth in world population, is a major cause of the rapid increase in human diseases.

### **Noise Pollution**

Noise pollution can change man's physiological state by speeding up pulse and respiratory rates. It can impair hearing either permanently or temporarily; millions of industrial workers are threatened with hearing damage.

Medical evidence suggests that noises can cause heart attacks in individuals with existing cardiac injury, and that continued exposure to long noise could cause chronic effects such as hypertension or ulcers, and of course deafness. Audiograms of pop musicians show typical hearing loss in both the ears.

Some empirical research conducted on pregnant female mice reveals that aircraft taking off which bring in 120-to-160 decibels caused miscarriages in them.

Prolonged chronic noise can also produce stomach ulcers as it may reduce the flow of gastric juice and change its acidity.

### **5. Environmental hazards and human impact**

Human is subjected to a variety of environmental hazards. Sometimes, human-made hazards are direct in their impact.

The following factors can be used in categorizing environmental hazards:

1. biological
2. chemical
3. physical
4. psychological
5. sociological

### **Biological hazards**

Biological hazards are concerned primarily with the entry of disease producing infectious agents into man's body.

Diseases are also transmitted from person to person or from animals to humans by biological agents or some other means. In such cases, these agents are disease vectors. Among such disease vectors are *flies, mosquitos, fleas, ticks, mites, cockroaches*, etc.

Vector-borne diseases constitute threats throughout the World.

Examples are malaria, murine typhus fever, yellow fever, and dengue and filariasis.

**Global climate change** is likely to aggravate climate-sensitive diseases in unpredictable ways.

At the same time, more microbes are becoming increasingly drug-resistant. And global warming, together with changes in biological diversity, influence parasite evolution and the ability of exotic species to invade new areas.

As a result, diseases such as tuberculosis and influenza are re-emerging as major threats while new threats - including West Nile virus and Lyme disease - have developed or spread.

#### ***The vector-transmitted parasitic diseases may have major importance locally***

<i>Malaria</i>	<i>Global, but between 80-90% of cases in Africa, between 100 and 200 million people infected; between 1 and 2 million deaths a year.</i>
<i>Schistosomiasis (bilharzia)</i>	<i>Global, but to the largest extent in Africa; a debilitating disease; an estimated 200 million people are infected.</i>
<i>Japanese encephalitis (brain fever)</i>	<i>South, South-East and East Asia, closely linked to irrigated rice production; occurs in epidemic outbreaks with high mortality rates among children.</i>
<i>Lymphatic filariasis (elephantiasis)</i>	<i>Global, and mainly urban, with the exception of Central Africa where it is linked to irrigation and South/South-East Asia where it is linked to weed-infested reservoirs and to latrines either in the field or in nearby communities.</i>
<i>River blindness (onchocerciasis)</i>	<i>West and Central Africa and foci in Central America; the Onchocerciasis Control Programme has eliminated the disease as a public health problem in a large part of West Africa.</i>

There are other diseases which generally involve close person-to-person contact. Among these are infections of the upper respiratory tract, such as pneumonia, tuberculosis, and common colds.

Since many of the water-borne illnesses are of human rather than animal origin, the improper disposal of human waste is the chief cause of contamination of water. Water-borne illnesses including typhoid and paratyphoid fevers, cholera, bacillary dysentery, amoebic dysentery, and infectious hepatitis.

### **Food borne infections**

Food borne infections include such diseases as diphtheria and tuberculosis, as well as intestinal diseases like typhoid fever, dysentery, Q fever, infectious hepatitis, leptospirosis and botulism. Salmonella increase in such numbers after contamination of the food that gastrointestinal symptoms start appearing following ingestion -

1) *Food infection* – Such food borne infections are sometimes referred to as food poisoning.

2) *Parasitic infections* - may be transmitted by foods, which have been contaminated. Diseased animals may be the source of such infections if the meat is not thoroughly cooked, e.g., tapeworm and trichinosis.

There are a number of diseases from animals which may be transmitted to man such as: rabies (animal bites), bovine tuberculosis, various tapeworms (beef, pork, fish), parrot fever (or psittacosis), anthrax, plague, murine typhus, fever, relapsing fever, and tularemia.

### **Chemical hazards**

Man's reaction to a chemical depends upon its toxicity and the individual's susceptibility, the duration of exposure, and the concentration of the chemical.

The effect may be related to body weight and the form (solid, liquid, gas) of the chemical at the time of exposure. There are hundreds of new chemicals developed each year. For many of these, the toxicity may not be known in the development stages or production, resulting in occupational hazards.

For example, high concentrations of nitrates may cause methemoglobinemia – "blue babies", and fluoride may cause mottled teeth enamel.

An association between the occurrence of lung cancer and cigarette smoking has been observed, but it has also been noted that urban inhabitants have lung cancer more frequently than rural residents.

### **Physical hazards**

Physical hazards in the environment may cause death, disease or disability. These concerns include a wide range of factors such as dust, humidity, equipment and environmental design and radiation.

Temperature and humidity are important to the efficiency of human performances. The critical air temperature for man ranges from 1C-to-32C.

Metabolic rate, oxygen consumption, respiration, heartbeat, and blood pressure are affected by temperature.

Electromagnetic radiation includes X-rays, ultraviolet, infrared and microwaves. Prolonged exposure may induce skin burns.

Mechanical vibration as well as noise can cause hearing loss and produce other psychological and physical disturbances.

### **Psychological and Sociological hazards**

Psychological and sociological parameters of environmental design are not as well delineated as biological, chemical and physical factors. A total consideration of the environment of man must consider sociological and psychological influences.

Noise, overcrowding, lack of privacy, lack of opportunity for social interaction, lack of open space, boredom, compulsory leisure, traffic, and estrangement from the conditions and natural cycles under which human evolution took place are environmental factors which have been identified as having possible social and psychological consequences.