death of the most

WATER-RESOURCES

Water is a crucial natural resource, its availability greatly influences the health of the people and development potential of the area. Water as a resource in relation to its needs is becoming increasingly scarce. Proper assessment of the availability of this resource from surface and sub surface sources is crucial for its proper planning, development and efficient management.

About 70% of the global surface is covered with water in the form of oceans, seas, river, lakes, ponds. Total quantity of water available on the earth is 1386 million cubic kilometers. 97.3% of the water available on earth is saline and only 2.7 is available as fresh water. Most of which lies frozen in polar regions or in deep aquifers, not available for use.

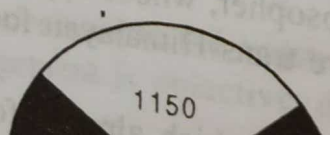
The mean annual rainfall, taking the country as a whole is 1170 mm. This gives an annual precipitation of about 4000 km^3. A significant part of this precipitation returns back to the atmosphere as evaporation. A large part of the remaining precipitation seeps into the ground and the balance flows through streams, rivers and collects in water bodies adding to the surface flow. A part of the water which seeps in to the ground remains as soil moisture in the upper layers and the rest adds to the ground water resource.

INDIA'S WATER RESOURCES

India is a country of vast biological, geographic, and climatic diversity. It has total geographic area of 329 Mha; excluding bodies of water, India's total land area is estimated at 297 Mha.

India is bordered in the north by the 2,500-kilometer long Himalayan Mountains. Melting snow and glaciers provide a continuous flow for numerous rivers running south from the Himalayas into the vast Indo-Gangetic Plain, which is dominated by the Ganges River and its tributaries. Heavy rains are typical in the Himalayas during the monsoon months between June and October, causing frequent floods. Southern India consists largely of the Deccan Plateau, which is flanked by the Western Ghats running along the west coast and the smaller Eastern Ghats on the east coast. The Deccan rivers are rainfed and fluctuate in volume; many of these rivers are not perennial.

India receives average annual precipitation of 4000 km^3, out of which 700 km^3 is immediately lost to the atmosphere, 2150 km^3 soaks into the ground, and 1150 km^3 flows as surface runoff (CGWB 1996, NCA12). See Figure 6.2.



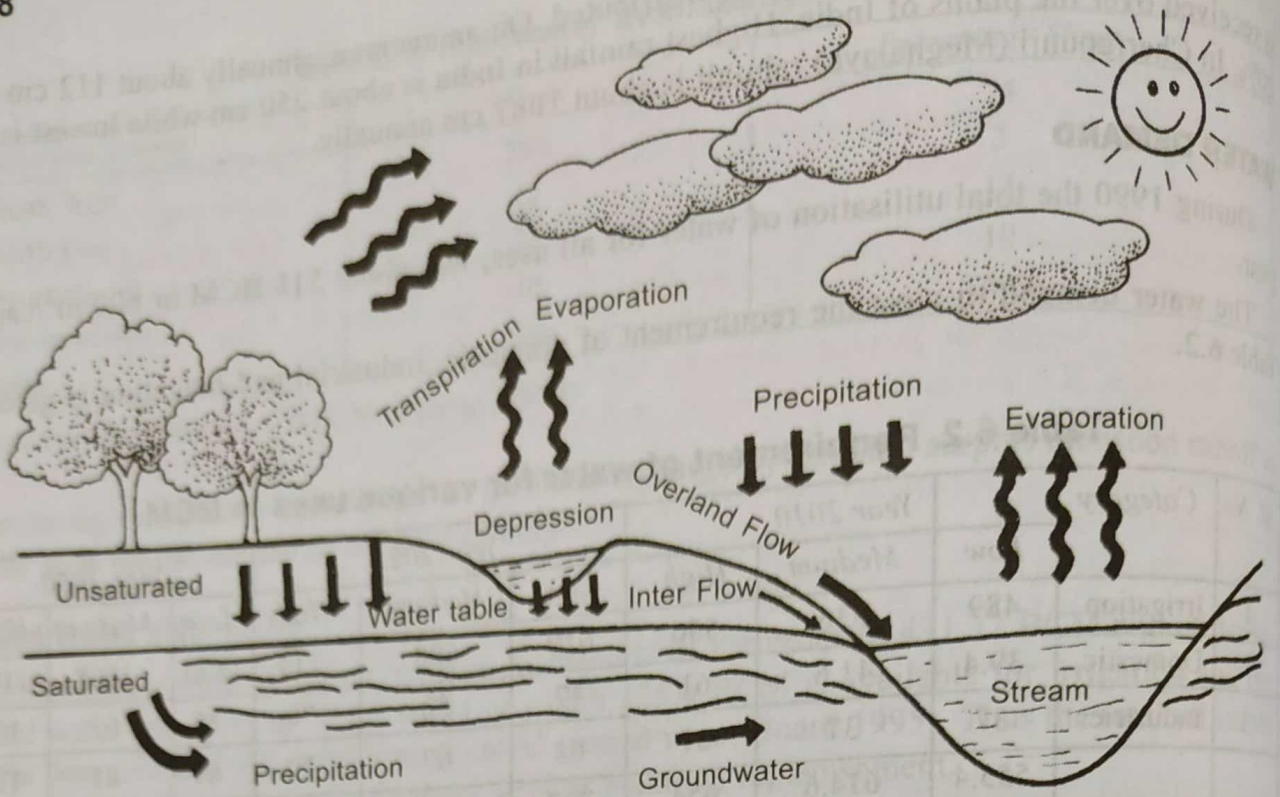


Fig. 6.3. Hydrological Cycle (Water Cycle)

FLOODS

Floods are the most frequent natural calamities faced by India. Floods are more regular and severe in the Brahmaputra Barak basin and Ganga basin in the country. On an average floods are affecting about 33 million persons per year. Total flood prone area in the country is about 40 m.ha. Out of above about 14 m.ha of flood prone area has been provided with reasonable degree of protection.

Floods. Many parts of the country, particularly the areas drained by large river systems, suffer from devastating floods. Widespread floods occurred in 1878, 1892, and 1917 in the then many provinces of India, and again in many states of the country in 1954. Rainfall, exceeding 40–50 cm in 24 hours, occurs occasionally along the west coast, in the coastal districts of Tamil Nadu and in southern Andhra Pradesh in Assam, West Bengal and in the foot-hills of the Himalayas.

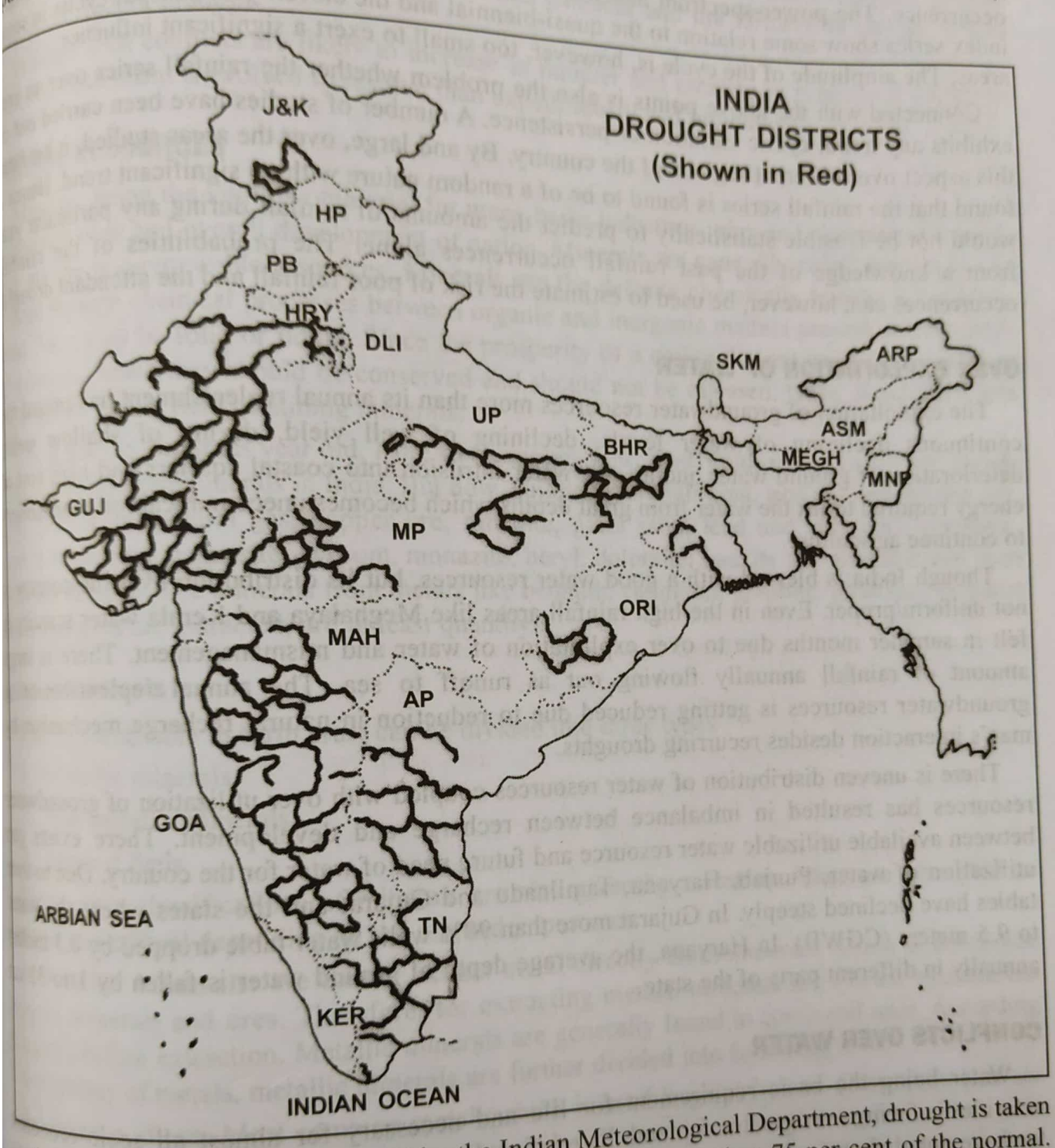
Some of the long-term measures to minimize the damage because of floods consist in the afforestation of the upper catchment areas of the rivers, the construction of river embankments, and the execution of multi-purpose river valley projects. Individual farmers can lessen the damage to their crops owing to heavy rains or floods by making the necessary drainage channels in their fields. Plans are in hand for forecasting floods and for arranging expeditious facilities to take timely action to save the standing crops from devastation by floods. A flood meteorological organization has been drawn up for the country and is under implementation during the current and the subsequent plan periods.

DROUGHT

Due to deficient rainfall 150 districts are drought prone in India. Out of above 7 districts of Punjab, Haryana, Rajasthan, Gujarat, Tamil Nadu, Uttar Pradesh, Maharashtra, Karnataka and

Andhra Pradesh are provided with irrigation. Among states West Bengal, Madhya Pradesh, Andhra Pradesh, Bihar, Jharkhand and Orissa are suffering from high frequency of droughts.

Food production in India being marginal, drought poses many problems. Irrigation facilities available in this country are also limited and, therefore, when droughts occur, they cause partial or complete crop failure. If failures occur in consecutive years, it becomes a national calamity, putting great strain on the economy of the country.



According to the practice followed by the Indian Meteorological Department, drought is taken to have occurred over an area where the annual rainfall is less than 75 per cent of the normal. When the annual rainfall is less than 50 per cent of the normal, it is called severe drought. Drought can occur anywhere in India, depending upon the distribution of rainfall.

Attempts to quantify drought in the form of an index have been made by using various techniques. Pilot studies have been conducted in India, with special reference to Bihar State, in order to arrive at a rational definition. The Palmer drought index, which takes into account rainfall, evapo-transpiration and soil moisture is considered a comprehensive approach to this

problem. The computation of the Palmer drought index have been carried out for the different sub-divisions of the country. The computations show that, on the average, drought is experienced on 20-25 per cent of the days in each of the months of the *kharif* season over large areas of the country.

Another aspect of great interest in respect of drought is whether there is any periodicity in its occurrence. The power-spectrum analysis of the rainfall series and that of the Palmer drought index series show some relation to the quasi-biennial and the eleven-year sunspot cycles in some areas. The amplitude of the cycle is, however, too small to exert a significant influence.

Connected with the above points is also the problem whether the rainfall series over an area exhibits any trend, cyclic variation or persistence. A number of studies have been carried out on this aspect over different regions of the country. By and large, over the areas studied, it has been found that the rainfall series is found to be of a random nature with no significant trend. Hence it would not be feasible statistically to predict the amounts of rainfall during any particular year from a knowledge of the past rainfall occurrences alone. The probabilities of the rainfall occurrences can, however, be used to estimate the risk of poor rainfall and the attendant drought.

OVER EXPLOITATION OF WATER

The exploitation of groundwater resources more than its annual replenishment has caused the continuous declining of water levels, declining of well yield, drying of shallow wells, deterioration of ground water quality, sea water intrusion into coastal aquifers and high cost of energy required to lift the water from great depths which becomes uneconomical for poor farmers to continue agriculture.

Though India is blessed with a good water resources, but its distribution over the country is not uniform/proper. Even in the high rainfall areas like Meghalaya and Kerala water scarcity is felt in summer months due to over exploitation of water and mismanagement. There is large amount of rainfall annually flowing out as runoff to sea. The annual replenishment to groundwater resources is getting reduced due to reduction in natural recharge mechanism by man's interaction desides recurring droughts.

There is uneven distribution of water resources coupled with over utilization of groundwater resources has resulted in imbalance between recharge and development. There exists gap between available utilizable water resource and future need of water for the country. Due to over utilization of water, Punjab, Haryana, Tamilnadu and Gujarat and the states where the water tables have declined steeply. In Gujarat more than 90% wells water table dropped by 0.5 meters to 9.5 meters (CGWB). In Haryana, the average depth of ground water is fallen by 1 to 33 cm annually in different parts of the state.

CONFLICTS OVER WATER

Water being the basic requirement for life and necessary for almost all socio-economic activities is facing ever greater demand. Its relative demand increases with degree of scarcity. As we have noted above, a large part of the country already faces water scarcity conditions and it is expected that by the middle of the next century most regions of the country would face some degree of scarcity. These conditions have already created a number of inter state water dispute. If the such conditions continue, we can also expect the next world war will be on water. Bitterness over these disputes is increasing with passage of time. These water disputes have multiple facets, examples of two such instances are as :

1. Urban water demands are concentrated in space, therefore, pose serious problems at local levels. Water demands in mega cities are growing much faster than envisaged and are putting

heavy strain on water resources. It is creating difficult problem for the surrounding rural areas, leading to serious conflicts.

2. Since the urban water supply are met from surface (river) flows, there will be conflict with upstream users, specially farmers, over the quantum of withdrawls, while the down stream users will be affected by the polluted waste waters released by urban areas. Such conflicts already exists : between Delhi and Haryana, and between Chennai and the farmers in drought prone districts of Andhra Pradesh.

In future such conflicts are likely to increase in number and escalate in magnitude unless an effective mechanism is evolved to resolve than expeditiously and judiciously.

MINERAL RESOURCES

Minerals, being the vital raw material for many basic industries, play an important role in the industrialisation and overall development of nation. Minerals are generally called the "stock" as they are the non-renewable resources. Minerals are the definite chemically bonded substances, created through chemical processes between organic and inorganic matters present in the earth's crust. They may be solid or liquid. Since the prosperity of a nation depend upon the proper use of minerals, hence they should be conserved and should not be misused. Govt. should promote the research in this field of mining minerals.

The history is hundreds year old. Iron, steel, copper, zinc, lead, gold, silver, cobalt etc. metals were extracted from minerals in India. But now, building materials coal, iron ore, mangenese ore, gold, petroleum, natural gas, copper ore, ilmenite, glass sand, lead and zinc ores, chromite, raynite, silmenite, magnesite, gypsom, monazite, beryl, dolomite, bauxite etc. are produced from minerals in India. The minerals from metals like bismuth, cadmium, graphite, platinum, tungsten tin, silver, gold are extracted, are in least quantity.

Types of minerals

Minerals available in earth crust can be divided into three types

1. Metallic minerals
2. Non-metallic minerals
3. Mineral fuels

Some other classifications of minerals are also given by scientists. They are classified as strategic and critical depending on the use and importance.

1. **Metallic Minerals:** We cannot extract metal directly from minerals. There is difference between minerals and ores. Therefore, for extracting metals, minerals are treated by different processes before extraction. Metallic minerals are generally found in combined state. According to availability of metals, metallic minerals are further divided into following :—

(*a*) Ferrous alloys: Most common metal (which is used largely) is iron. Other than iron are aluminium, lead, zinc, copper etc. All are found in rich quantities, found in native as well as in combined state. Iron pyrite, Lynonite, Haematite, Magnetite are examples of ferro alloys. Certain other metals, non-metals are contaminated with these as impurities.

(*b*) Non-ferrous alloys: The minerals/alloys of this type contain the metals like titanium, antimony, arsenic, beryllium, copper, zirconium, cerium, lithium etc. These metals are costlier than proceeding metals. Here the iron found as an impurities.

(*c*) The minerals/alloys containing very least quantity of metals whose extraction is costlier. These metals are generally used in jewellary eg. gold, platinum, silver, irridium etc.

2. Non-metallic minerals : Minerals, whose yield products are other than metals comes in this head. They are called the non-metals. They are further divided on the basis of physical and chemical properties. Graphite, pyrolusite, dolomite quartz, kaoline, fire clay, felspar, mica, asbestos, gypsom fluorite, chrome/red ochre, lime stone, borax, phosphorite, ilmanite, flint, dymond, calcite, sand stone, stones like phylite, cyanite, lime stone, ruby, sapphire. Emarald, amber, spodumene etc. are the examples of non-metallic minerals.

3. Mineral fuels : These include the materials used to provide energy, for example coal, natural gas, fossil fuels and petroleum etc. These are the important source of energy, hence they have tremendous importance for mankind.

Coal is the most commonly available fuel which is used as domestic as well as industrial fuel. It is of different type i.e. Anthracite, Bituminous, Lignite etc. The type and quality of the coal depend upon the percentage of carbon present in them. It is the principal source of energy in world. It is used in various ways in different industries like cement, glass, railways, textile, sugar, paper, steel etc. It is also largely used in domestic way. USA, China, Britain, Germany, South Africa, Australia are richest coal containing countries in world.

Petroleum is used in the manufacture of large number of petro-chemicals. It is drilled out from the sources as crude oil. Crude oil is refined before use as petrol, diesel, kerosine etc.

Minerals in nature : The man is using minerals since long. From lacs of year back primitive man was using flint, quartiz etc. for preparation of their tools. This was called "stone age". Later they use metals therefore, the period was named after as "copper age", "bronze age", and "iron age". Now present age is "machine age" because machines are prepared from minerals and they run by mineral fuels.

The formation of mineral deposits is a very slow geo-chemical or biological process, which takes millions of years to develop mineral deposits. Most of the minerals are widely distributed in earth's crust. Studies shows that, there are number of ways by which mineral deposits are formed. They are

1. Molten rock materials, which is a complex collection of a number of substances, when cooled, the crystallization of different minerals takes at different temperatures. These are settled in different bands, giving the mineral deposits.

2. Sodium chloride, gypsom, salt peter etc. Water soluble minerals are obtained by evaporation of lake/sea water. The compounds of iron and manganese as chemical sediments are also formed by precipitation from lake or sea water.

3. Deposits of minerals like asbestos, talc, graphite etc. are formed intense heat and pressures inside earth's crust.

4. When the pH, temperature, solubilities are changes, the rock materials in solution/ suspension are deposited in sufficient amounts to form mineral deposits as water current slow down.

5. Mineral deposits are also formed by oxidation and reduction reactions.

6. Formation of mineral deposits are also take place by micro-organisms. It is mainly autotrophic bacteria which are involved in mineralization reactions.

There are also other views for formation of mineral deposits. When the plants, dead animals, wild life & other ecosystems are accumulated below in earth. Biological process convert them in to mineral deposits.

Mineral resources of India : India has sufficient quantities of iron, aluminium, titanium, copper, lead, zinc ores. India is fairly rich in mineral resources. We possess good deposits of most of mineral elements which we needed in large quantities. However, other economically important minerals are not present in sufficient quantities. Iron minerals, which are most

Silimanite reserves are in Sonapahar of Meghalaya and in Pipra in M.P. **Copper ore** bearing areas are Agnigundala in Andhra, Singhbhum in Bihar, Khetri and Dartiba in Rajasthan and parts of Sikkim and Karnataka.

The Ramagiri field in Andhra, Kolar and Hutti in Karnataka are the important **gold mines.**

The Panna **diamond belt** is the only diamond producing area in the country, which covers the districts of Panna, Chhatarpur and Satna in Madhya Pradesh, as well as some parts of Banda in Uttar Pradesh.

Petroleum deposits are found in Assam and Gujarat. Fresh reserves were located off Mumbai. The potential oil bearing areas are Assam, Tripura, Manipur, West Bengal, Punjab, Himachal, Kutch and the Andamans.

India also possesses the all-too valuable nuclear **uranium** as well as some varieties of **rare earths.**

A quarter of all mining is carried out in the southern part of Orissa. Gold, silver and diamonds make up a small part of other natural resources available in India. The gemstones are found in Rajasthan. Major portion of the energy in India is generated from coal. It is estimated that India has around 120 billion tons of coal in reserve, enough to last for around 120 years. Huge reserves of the petroleum have been found off the coast of Maharashtra and Gujarat and M.P. Electrical energy generated by hydroelectric power, coal and nuclear energy. Half of the hydroelectric power is generated by snow field reservoirs high up in the Himalayas. In Madhya Pradesh important minerals like diamond, tin ore, coal, copper ore, alexandrite, iron ore, dolomite, rock phosphate, manganese ore, lime stone, granite, marble, corumdum, pyrophylite, diaspore, Bauxite etc. are found in different quantities. Chhatisgarh (new state of M.P.) is rich in minerals and forest products.

Environmental effects of extracting and using mineral resources

Mining, minerals and mineral based industry indeed play an extremely important role in the development of mankind. The total geographical area of India i.e. 329 million hectares constitute 2.4% of the world land area. Out of this about 82500 hectares is sustaining mining activities of some kind or the other. As the mining activity grows, the per capita availability of land is declining at a very high rate. The extra emphasis on mining and minerals is directly related to growing population and better standard of living.

The environment means the surroundings. The components of environment include soil, water, air, land, landscape, and living creatures. The environment is more damaging by open cast mining than underground mining. Not only environment, mining also effects human health. Over exploitation causes the wastage of mineral wealth and derelict of land. Mineral deposits should not be over exploited because they are non-renewable. Derelict land is that land which has been abandoned as useless. Dereliction is the result of thoughtless, uncontrolled ruthless exploitation

of natural resources. This land is the permanent damage not usable for agriculture. There are following environmental effects of mining—

(i) Land degradation due to lowering of the surface levels at some places and creation of large mounds at other places;

(ii) Deforestation in the mining areas, i.e., the loss of valuable cover resulting in the possibility of enhancement of soil-erosion;

(iii) The loss of top and sub-soil;

(iv) Adverse effect on ground water table. The local water table is lowered as a result of opencast mining. The replenishment of acquifers is adversely affected as the mined out terrains are completely dismembered of acquiducts leading to acquifers. As a result the affluent discharge of rain water is increased leaving the water-table completely or partly unrecharged. This also increases the salinity of remaining ground water;

(v) Due to increased discharge of rain water passing through the terrains, disturbed by surface mining, the local drainage system is polluted, which on joining the main drainage feature. affects it also;

(vi) The frequency of land slides increases substantially as a combined result of factors as stated above;

(vii) The erosion of soil is enhanced;

(viii) The agricultural lands are affected by silt and the fine material mined but not recovered. It also clogs the surface water channels;

(ix) The disturbance caused adversely affects the well-balanced pH and diminishes the regenerative qualities of soil, etc.;

(x) The disturbance caused to the floral and faunal population is immense;

(xi) The heavy earth-moving machinery and blasting cause problems of noise, vibration and the release of noxious gases in the atmosphere;

(xii) The aesthetic damage caused to the landscape reduces its recreational value;

(xiii) Mine drainage has polluted streams, rivers, lakes even seas;

(xiv) Fumes from smelters damage forests and spread pollution over large area (air pollution);

(xv) Mining and mineral based industries with their effluents create pollution problems. Asbestos, cement and other chemical industries are very hazardous. People are not supposed to live in surrounding areas;

(xvi) Mining causes the reduction of forests i.e. deforestation. Thus flora and fauna are also destroyed. Wild life also effected. Land becomes barren and this results in increased incidents of land slides;

(xvii) The people related with mining and extraction effected by polluted environment (Dust & poisonous gases) lead to skin and lung diseases;

(xviii) Mining affects the sub segments of the environment like forests, vegetation, soil cover, humus and ground water. Dust and toxic gases indirectly affects air, humidity, temperature;

(xix) Deforestation and climatic change results poor rainfall and affects flora & fauna.

WORLD FOOD PROBLEM

Before the 21st century, it was felt that world food production is not sufficient for the present population. Food production was less because people were using the old techniques, seed etc. Later on when population pressure starts, the new ways of food production, using fertilizers, pesticides, insecticides etc. are discovered to increase the yield. In 1999 International Food Policy Research Institute (IFPRI) reported the increase in world food consumption by 2020, discussing the impact of this on both developed and developing countries. The report considers