Environmental Science

Lecture 5

Impact of Dams

A dam is a structure which prevents the flow of water and accumulates it in a reservoir. So these are two typical dams that you would see built in our world. Dams are considered to be world property in certain areas, and in certain areas it comes under the jurisdiction of the country, the central government, in our country, and not irrespective of the state governments.

Needs For Dam Construction:-**Drinking and domestic water supply; Flood Control; Irrigation; Industrial water supply; Hydroelectric energy production; Retention and control of sediments; and inland navigation; improvement of water quality, fish farming and recreation facilities.** So one of the main reasons for dam construction happens is because of agriculture and irrigation. Some areas do not get any water and they do not have sufficient ground water to supply for them. So they are dependent on other levels or other forms of water to irrigate their fields and farms. And because of that dams are constructed, because an artificial reservoir will be created from which channels and canals can take the water to the relevant areas. This can also be used for industrial supply of water because those areas dams usually built obviously not in the heart of an urban area. Its in such an area which is surrounded by forests or middle of nowhere types near a river which is usually prone to flooding, in a particular point. And as a dam is constructed, to make the dam productive, it can be used to produce hydroelectric energy production. So the needs of need not necessarily be exclusive. All these 6 uses can be taken from a particular dam or even just one or two. So it is mutually, it is not mutually exclusive and all of the requirements for having a dam needn't necessarily be a immediate requirement and they do have a lot of benefits. But at the same time there are a lot of bad consequences if the dam is not constructed in the right place or even at the right time with the right materials.

Environmental Impacts of Dams:- It can actually have major impacts are – **River pollution; Erosion; Loss of Aesthetic views; Air pollution; Noise pollution and Dust.** Like we just mentioned, dams are usually built in the middle of forests reserves or near, obviously on the river, at a point of time where at a point or place where the water is excluding creating flooding in an area or a particular region is not getting adequate water for irrigation. So when a dam is built across a river, a lot of problems do occur. Loss of natural habitat for a lot of creatures because the forest area has to be cleared if a dam has to be built. And For the dam to be constructed, a lot of construction material has to go to and fro. Because of that a large road or a pathway has to be laid and which again leads to cutting of trees which will lead to erosion. Loss of aesthetic view- A construction of dam is not an overnight process, it takes a couple of

years at least. And this entire time period, that forest is going to be badly utilized without any jurisdictional power of any body. Construction workers will set up home over there till the work is going on. They will set up home in haphazard fashion, without giving consideration to the forest or the river. So you will have a lot of pollution that is happening in the water, air as well as noise because of the kind of machinery that is used. And noise pollution you might think is only affects human beings, which is not true. Certain birds cannot hear beyond a certain decibel of noise. If that particular decibel of noise is crossed, their brains actually explode and the birds will end up dying. Bees cannot pollinate. SO a lot of plants could become extinct. Bees will get hampered, bees will have devastating effects. The bees might end up dying. So a lot of these problems occur because of a construction of a dam. So the pros of constructing a dam there must heavily be exceeding these cons that will come up.

Effects of Dam to Water Quality:- Main is **change in Temperature; Turbidity** that is the quality of the colour of the water; **Dissolved Gases in Water**- Water discharge from the spill way contains 110-120% saturated nitrogen. This amount may be destructive for fish life. **Eutrophication:-** It means increase in vegetation. If moss and other plants exist in water, quality of water gets worse. Because as the water is running , it is only then that it is healthy and plant and animal life that is fishes and other creatures can survive. Because in running water the level of oxygen will be perfect. But if the water becomes clogged with planktons and different kinds of vegetation, the water becomes sluggish, slow and it will lead to the death of a lot of fishes and under water life.

The Physical and Biological effects of Dams;- Physical Changes downstream-that is flow , temperature regimes and water clarity deep release dams most adverse effects and therefore changes in physical and chemical conditions, resulting in changes in animal and plant life of the river.

Water Quality Changes Downstream- depends on how long the water is kept in a reservoir or if surface or deep water is released from the dam. Dams break natural upstream or downstream connectivity and periodic flow in the rivers. And so because of this, usually how rivers work is, they flow from upstream gradually reach downstream. And as they reach downstream, the soil that is collected there is considered very fertile and that area usually becomes a delta for irrigation which helps a lot in agriculture, because the soil is very fertile. Now along that river, the course of the river, if a dam or even two dams are constructed, the quality of the water that is the fertility of the soil finally is going to be affected, as the nutrients or the fertile soil that the river brings from upstream is tremendously reduced or is trapped in the reservoir that is in the dam.

Presence of Reservoir / dams affects the flow regime of the river and hence transport of fine sediments and fine particles on the stream bed is altered. Inflowing sediments settle out in the

reservoir depleting storage capacity. High discharge dams cause scouring of fine particles and armouring of steam bed, that is surface substances become tightly compacted as well as changes in the channel form. That is you have bank erosion, cutting down of stream beds, elimination of plants and fauna. So once the effect is felt on biological life, it can have a lot of other extrinsic and intrinsic effects caused due to it. And it cannot be measured at a particular point of time. Now when you know that the water quality is changing, that can be quantified. But when it starts affecting flora and fauna that becomes beyond being getting quantified and it can lead to a lot of other changes. Low discharge dams, they actually have a reduced flow. So they actually end up having increased algae or Phytoplanktons which blooms and develops greater abundance of higher plants that is aquatic moss. These favours midges and oligochactes, these mayflies' shifts and all of this lead to a lot of problems in the aquatic life. Reservoirs and dams impede the upstream or downstream migration of fish, that is example Salmon and eels. Damage of fish by water pressure and turbines. So when a reservoir is built, and the reservoir is quite large for it to actually have a lot of under sea water , under river water life amongst itself. But whence the reservoirs are opened without any, because the fish cannot be intimated ok we are going to open the reservoirs, because there is sudden change in pressure, the fish get crushed, they die and even the other supporting life also ends up dying . And because of that there are other intrinsic factors that are leading to this and this effect the biological cycle of water life in the dam. Decrease in species richness of benthic invertebrates but an increase in abundance, due to altered physical chemical environment below impoundment and a reduction in habitat heterogeneity. So what happens is the different types of creatures reduce, but individually one specie could become over prolific. That is one particular specie which is suitable for that temperature, that climate will end up growing in abundance, but other heterogeneous species or other indigenous species to that area will get affected.

Dams and other form of river regulation have many negative effects on rivers and streams causing changes in community structure as well as the function of the ecosystem. The naturally free flowing and continuous river course is transformed into an unnatural, uniform river segment. The argument in favour of dams and many river regulation schemes is that it brings huge human economic benefits.

Mineral Resources

A mineral resource is defined as an occurrence of natural, solid, inorganic or fossilized organic material in or on the earth's crust in such a form and quantity and of such a grade or quality that it has reasonable prospects for economic extraction.

Now if you look at the **National Mineral Scenario** in our country, our country produces as much as 87 minerals, which includes 4 fuel, 10 metallic, and 47 non metallic, 3 atomic and 23 minor

minerals which includes building and other materials that are related like mica. India possesses a large variety of mineral ores in fairly huge quantities. India is rich in coal, manganese, iron, chromites and mica. It is deficient in gold, silver, nickel, etc. So if you look at the estimated expiry of minerals, it depends on two things- number 1 the size of the reserve, and the rate at which we are using it up. So if you actually look at our coal reserve, its estimated life is 200 -300 years and are main use is electricity. But if you look at it there are some which are going, tin for example has an estimated expiry in about 31 years, lead in about 25 years, and oil, which is most depressing is 50 years, which is are main consumption. An ore is a mineral or combination of minerals from which a useful substance, such as a metal can be extracted and then further used to manufacture a useful product. This is a sample of a gold ore that you see here. Minerals are formed over a period of millions of years in the earth's crust.

Use and Exploitation:- The **main uses of minerals** are as follows- first you have the **development of industrial plants and machinery**. Second **generation of energy**, that is could be coal, lignite or nuclear uranium energy. **Construction , housing , settlements, Defense equipments, weapons, armaments**. So these are the main uses of minerals. Then you have the **bi-ancillary things are transportation, communication, like telephone wires, cables, electronic devices, medicinal system particularly in the ayurvedic system, formation of alloys for various purposes** eg.- phosphorite. **Agriculture** such as fertilizers, seed dressings, fungicides like zineb containing zinc and maneb containing manganese etc. **Jewelry** – gold , silver, platinum and diamond.

Based on their **properties,** minerals are basically of two types:- **Non metallic minerals** that is graphite, diamond, quartz, feldspar. **Metallic minerals** are bauxite, laterite, haematite,etc.

So if you look at the **classification, distribution of major non metallic and minerals** are given below;- here you have aluminum. This is completely some of the major metallic ores that we have. Aluminum, chromium, copper, iron, lead, manganese, the platinum group you have gold, silver and nickel. And unfortunately we are lacking in most of these except aluminum. These you have the non metal minerals silicate, limestone, gypsum, potash, phosphorite which is mainly used for fertilizers and sulphur pyrites used as medicine, car battery and in industries. So in silicate and limestone we are quite well. We have good distribution of silicate and limestone materials.

Some **major minerals of India** – **the energy generating minerals** – we have **coal and lignite** in the west, in Bengal, Jharkhand, Orissa, Madhya Pradesh and Andhra Pradesh. **Uranium** that is pitchblende or a uranite ore. Again you have this in Jharkhand, Andhra Pradesh, in Meghalaya, Rajasthan. **Other commercially used materials- aluminum** is the Bauxite ore, we have this in Jharkhand, West Bengal, Maharashtra, Madhya Pradesh as well as Tamilnadu**. Iron** that is Hematite and Magnetite ore, you have Jharkhand, Orissa, Madhya Pradesh, Andhra Pradesh,

Tamilnadu, Karnataka, Maharashtra and Goa. **Copper and Copper pyrites** that is the ore is copper pyrites we find in Rajasthan, Bihar, Jharkhand, Karnataka, Madhya Pradesh, West Bengal, Andhra Pradesh and Uttaranchal.

Moving on to **the Environmental impacts of mineral extraction and Use**;- The issue related to the limits of the mineral resources in our earth's crust or in the Ocean is not so significant. More important environmental concern arises from the impacts of extraction and processing of these minerals during mining, smelting etc.

Indian Scenario;- India is the producer of 84 minerals, the annual value of which is about Rs. 50,000 crores. At least 60 major mines need a mention here which are known for causing severe problems.- **Jaduguda Uranium mine in Jharkhand,** it has been exposing local people to radioactive hazards for many years,.

The Jharia Coal mines in Jharkhand again underground fire leading to land subsidence and forced displacement of people, because once a mine comes in that area, that land becomes very useful and goes beyond value. All mines belong to the government in our country and because of that they can sell the land to the government. And once they discover a mineral or a mineral ore in that area, people are forcefully displaced by giving them pittance because the mineral is going to give them so much more money. So it leads to a lot of social issues as well as a result of this.

The Sukinda Chromite Mines in Orissa, this has been seeping hexavalent chromium into the river posing serious health hazards. Cr6+ is highly toxic and very carcinogenic, and this affects the groundwater completely**.**

Kudremukh Iron ore Mine in Karanataka, this has been causing river pollution and it has been a threat to bio-diversity for a very long time.

East Coast Bauxite mine in Orissa again, land encroachment and issue of rehabilitation unsettled**.**

North Eastern Coal Fields in Assam, very high sulphur contamination. This again affects the land as well as the water.

Impacts of mining as such:- Mining is done to extract minerals, or fossil fuels from deep deposits in the soil by using sub- surface mining or from shallow deposits by surface mining. The former method is more destructive, dangerous and expensive, includes risks of occupational hazards and accidents.

Effects of Mining on the Environment

Deforestation and loss of bio-diversity are major effects of mining. It destroys the forest and the wetlands. We saw the effect it had and went through forest resources and the impact it had on forest resources. Many mines require tailing dams to prevent waste being washed into the rivers. Unethical miners can dispense with the dams, to save costs, resulting in massive pollution downstream. And this downstream water is what is used for irrigation and if polluted water that is chemical polluted water is going to be used for irrigation. It is not only the soil that gets contaminated but also the crops that get contaminated which are going to be consumed by people. In other cases the tailing dams can overflow and even breach during periods of heavy rain.

Underground coal mining can require the removal of almost an entire layer of material deep under the surface. So this leads to even disposition of soil and makes the soil or the land weak in that area. Some mining involves inadvertent disposal of heavy metals such as lead into the atmosphere. This can lead to serious health effects including mental retardation in children. And there are recorded cases; increased cases were people actually settle down near mine fields, workers that is children of workers who are exposed to this dust in the air.

Asbestos mining cause the dispersal of asbestos into the environment. This causes deaths among local residents and workers often several decades later. Asbestos poisoning is felt very gradually not immediate but it has dire consequences as well. We did not even realize about the negative aspects of asbestos till recently. Asbestos completely corrode the lining of the lungs and actually distresses lung syndrome, its one of the main causes and as a result of this people actually have constant breathing issues, asthma related issues and especially in children. So we have to see how the environment protection forms as a part of planning and design for obtaining approvals and lease of contemporary Indian mines, thereby benefitting both the mining industry as well as a community as a whole.

We have a certain **perception about mining**. So we have to deal with those perceptions first before we go about discussing how we go about solving the problems. Overlapping of interest amongst the three that is mineral reserves, forest cover and tribal zones. Economic and social benefits of mining are not apparent. There is social dissatisfaction and unrest among the people towards the mining. The legal and regulatory policies regarding mining and the environment are inadequately factored focusing majorly on long term impacts. Too much pressure on land, air, water, forests and bio-diversity due to excessive demand. Overall life quality of people gets damaged. Lack of enforcement and successful implementation of existing sustainable mining policies. So when you look about, go about looking at mining as an occupation, number 1 the main reason is even the people working in the industry are getting affected by it. They are not made aware of the consequences of working in such a mine. They end up being uneducated people, who just know, that they are getting paid X amount of money at the end of the day,

without realizing that, without following certain precautions, they can actually be endangering ,not only themselves but also their family ,especially children. So if you actually look about it we have discussed, yes we get about 50,000 crores from different minerals and mines in our country. And for a developing country like India that amount is definitely not negligible. But the social benefits of mining are definitely not obvious. On the other extreme, there are lot of negative impacts not only on health but also on the social community structure, because people are forced to be displaced from that area. And because all mines and mineral ores are owned by the government, the land which people live on is bought for pittance, literally nothing and they are forced to evacuate those places.

Impacts of mining Coal:-It causes **scaring and disruption** of the area, makes the area very ugly. **Erosion increases if reclamation is not done properly. Subsidence** that is sinkholes are created. **Toxins are released** like dust, gas, drainage, possible pollution elements air, water as well as soil. **Acid mine drainage especially sulphur. Slurry that is coal waste, pond overflow.** So this coal waste has a huge thing that is collected in a pond that refers to as a slurry pond and some most of the time this pond overflows affecting the river as well as the land.

Water Loss and Pollution;- **Altered hydrological and hydro geological regimes** that is decrease of water level; **increased heavy metals, acidity or pollution, increased turbidity** that is the water gets more turbid in the sense that is more suspended solids are there in it and no longer remains clear, **Risk of Ground Water contamination** and that is the worst kind of contamination, because ground water cannot be tested easily, it cannot be studied very easily, and once it is used for irrigation, we do not know the consequences of it till we actually face the consequences.

Air pollution;-**Increased ambient particulates** that is dust; **Increased ambient sulphur di oxide** that is SO2; **Increased ambient oxides of nitrogen** NOX which is very very bad for agriculture and produce; **Increased ambient heavy metals**.

Species and Habitat Loss;- **Loss of entire eco systems, habitats and functions related to them; Loss of endemic and/or threatened species; Loss of important plant species with potential to cure other illnesses , diseases like AIDS or Cancer.**

Impacts on Service Values:- **Loss of access to timber and other plants that is other plants that are growing around there, medicinal plants , fuel wood etc.; loss of access to grazing for livestock; Impaired eco system services that is soil and flood protection, watershed protection, climate modification**. So when you look at an area or a mine, it is not only that particular area that is going to get affected but quite a large surrounding area that is going to be impacted .

So what are the **main needs for sustainable development of mines**? Again this is like something we cannot ignore and say we do not mean mines, we do not mean ores. Without basic minerals and ores we will not be able to function in a suitable way. Let it be right from our electricity, to the gas that we consume for cooking, everything we require in some kind of ore or mineral. So we actually have to make sure that lets do about it in a sustainable manner. Yes money and economics play a very important role but we shouldn't be paying a heavier price in terms of sacrificing the environment or the lives of people. So we have to have a joint study, we need to integrate the economic activity along with the environmental integrity, and this practiced has to be recognized. This integration will recognize sustainable development. It should be financially profitable, technically appropriate, environmentally sound, and socially responsible. Sustainability principles have application for all stages of mine cycle- exploration, mine planning, construction, mineral extraction, mine closure, post closure, reclamation and rehabilitation. So sustainability has to go from every phase of mining, let it be choosing the site for mining to the very end of rehabilitation.

The **Environmental Damage Caused By Mining Activities** are as follows;-**Devegetation and Defacing of landscape; Subsidence on lands that is you have these sinkholes that are created ; Ground Water** Contamination.