Natural Resources Management (NRM)
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Week - 01
Lecture - 02
Introduction to Natural Resource Base: Part 2

Welcome to the MOOC course, Introduction to Natural Resource Management, lecture 2. So, following the last class, where we discussed about the different fundamental theories, concept of natural resources management, and also, we discussed about various other limits, we also talked about the uses of natural resources. Now, today we will discuss about the natural resource bases and we will discuss mainly about the resources that are available in India.

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And these resources that we will cover today will be land, forest, water, power, mineral resources, etc. So, let us now see that one by one; first land resources.

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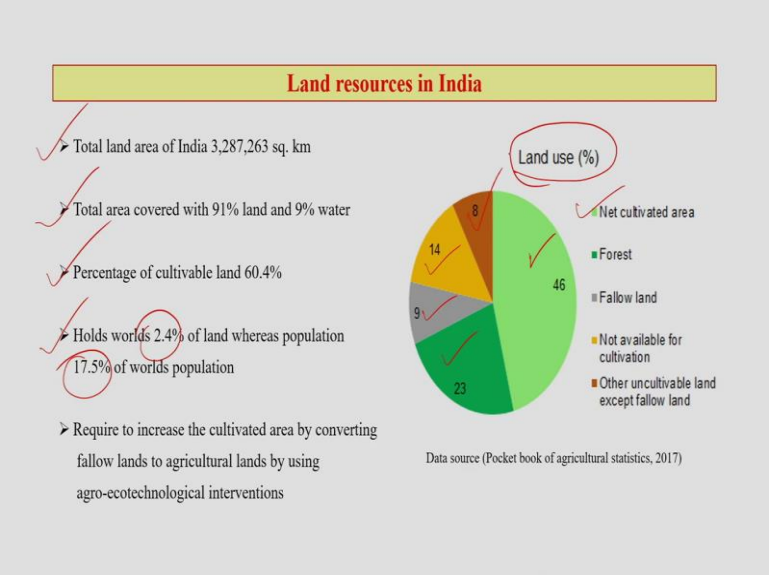

If you look at the total land area that is available in our country, it is almost around 3,287,263 square kilometer and if you look at the total area that is covered with land; 91 percent and with water 9 percent. Percentage of cultivable land that we have in our country is around 60.4 percent. In India, the land also holds world's almost 2.4 percent of the entire landmass whereas, in that 2.4 percent of land, it holds 17.5 percent of world population. So, you can easily imagine the amount of pressure which is coming on the land resources in our country. And that is why it is important to find out the best management practices for natural resources management.

So, we need to actually increase the cultivated area, as you saw that within this small amount of land, we have around almost 18 percent of world population. To feed them, you need to increase the cultivated area by converting some of the fallow lands into agricultural lands by using various agro technological interventions. And that's why it is important today that new innovations should come up in the field of agro technology and agro eco technology as well because the technology which we will be trying to carry out some research and innovation in the field of land use management or agriculture of forest; we must keep in mind that environment has to be taken care of. And that is why agro eco technological approach in the field of agro natural resources management is also very important.

If you look at the different percentage of land use, so, net cultivated area we have around 46 percent, then forest it has increased now, a little bit, then we have around 9 percent fallow land, land which are not available for cultivation is around 14 percent and then other

cultivable land except the fallow land is around 8 percent. So, this is the overall divisions of land uses in our country.

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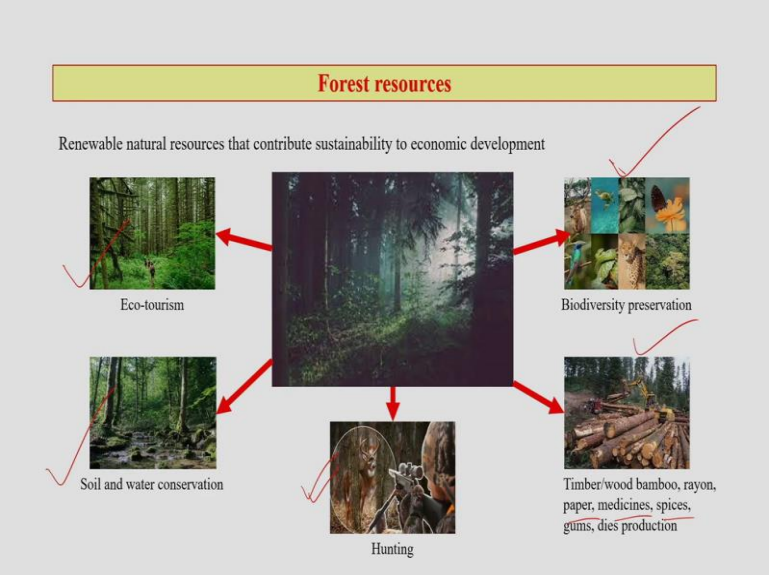

Now, next is the forest resource. If you look at the forest resources, this is another very important natural resources that we need to take care of. What actually forest as a natural resource does to us, especially human civilization, there are various uses. One of the top most uses the forest provides us, enormous amount of biodiversity. If you look at the different renewable natural resources that are contributing to the sustainability of economic development in any countries around the world.

So, what forest can contribute? First ecotourism which is very important for some country across the world, and which is severely impacted because of current COVID pandemic.

Soil and water conservation is another aspect which is very important for forests, natural resource management, biodiversity preservation, timber, wood, different kinds of forest biomass, they are very, very important for various uses and purposes like paper production, medicines, spices, you name it, and then comes to hunting. Now, these all are actually a part of forest resource management and keeping in mind the concept of sustainable natural resource management.

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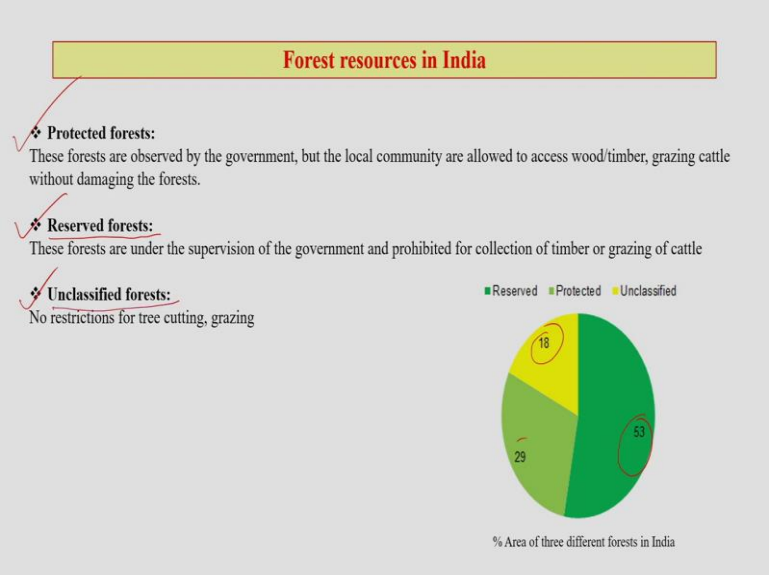

If you look at the forest resources in India, we have around 53 percent of the total area covered for reserved forest around 29 to 30 percent are protected and roughly around 18 percent are unclassified. Now what are these three categories mean for? If you look at protected forest, these forests are basically absorbed by the government, but the local community are allowed to access old timber, they are allowed to graze their cattle without damaging the forest. So, that we call protected forest.

Second category of forest is reserved forests. Now, these forests are under the strict supervision of the government and it prohibits the collection of timber, grazing of animals inside the forest.

The third one is unclassified forest, no restriction for tree cutting, grazing, so these unclassified forest are the forest which are, somehow free for people to use for their different purposes.

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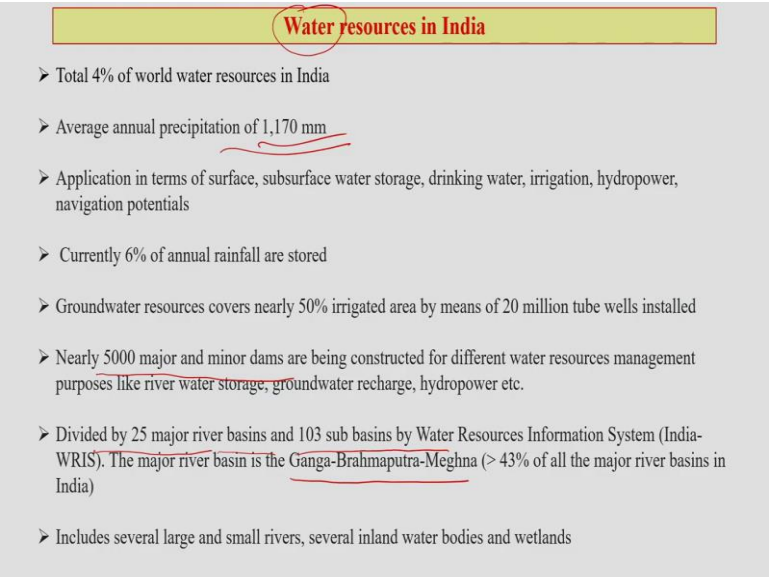

Now, the next resource is water resources of India, a very important natural resources. Total around 4 percent of world water resources are here in India,our country, if you look at the average annual precipitation, it is roughly around 1200 millimeter application in terms of surface, subsurface water storage, drinking water, irrigation, industrial uses hydropower, there are several other, potential uses of these water resources in our country elsewhere as well.

Currently, around 6 percent of the annual rainfall, we are able to store which has to be increased to preserve these natural resources and also the rain that we get. Now, groundwater resources covers nearly around 50 percent irrigated area, which means around 20 million tube wells have been installed across the country.

Nearly 5000 major and minor dams are being constructed for different water resources management purposes like river water storage, groundwater recharge, hydropower, etc. So, our water resources in India is divided by 25 major river basins, out of that 103 sub basins are also divided across the country, by the government and the concerned agency. The major river basins that we have in our country are Ganga, Brahmaputra, Meghna, and these basins occupies almost 43 percent of the total major river basins in India.

Water resource is also important for not only for the uses that just now we have discussed or mentioned, but these water resources also include several large and small rivers, several inland water bodies like pond or tanks as people in southern part of the country they call it wetlands.

So, each one of them has some specific ecological or environmental value, we will discuss about these things in the following classes. Now, the next important natural resources for the use of human civilization are mineral resources. This is one of the most important ingredients of our development priority.

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Now, if you look at what actually we call as minerals, minerals are naturally occurring in organic crystalline solids having distinct physiochemical properties. Now, what are ores? Ores are also naturally occurring or sediment extracted from earth that contains one or more valuable minerals including metals.

Now, if you look at few examples of these minerals, and also the ore especially from the economic point of view, there are different types of minerals example like metallic minerals, like ferrous group where you have iron ore, manganese ore, chromite metallic minerals, a non ferrous group, aluminium, copper, lead; then precious and semiprecious minerals, you have diamond, gold, silver, ruby; then you have strategic minerals like tin, nickel, cobalt, tungsten, molybdenum; fertilizer minerals, which are mainly used for developing fertilizers like potassium, gypsum, rock phosphate, phosphates; refractory minerals, we have fireclay, magnesite, graphite, ceramic and glass minerals feldspar, quartz, silica sand, and other industrial minerals like asbestos, fluoride, limestone, mica. So, huge amount of natural resources like minerals and ores are important for the development of any country.

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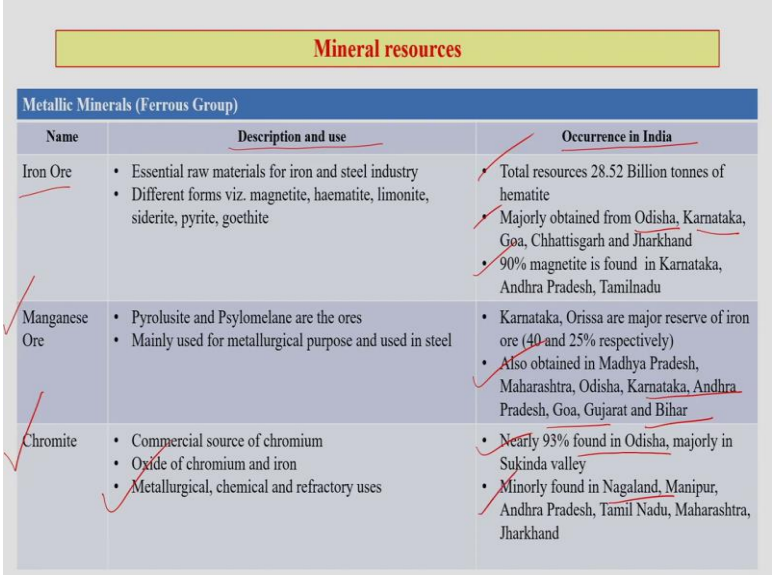

Now, we will go a little bit in detail. Now, if you look at the iron ore, and their uses, and where they appear, and where they are found in India in our country. Now, iron ores these are essential raw materials for steel industry and different type and forms of iron ores like magnetite, hematite, limonite, siderite, pyrite, goethite, these are all available and being used for iron and steel industry. And they are found largely around almost 28-29 billion tonnes of hematite are available in our country. Majorly obtained from Odisha, Karnataka, Goa, Chhattisgarh, and Jharkhand. Almost 90 percent of magnetite is found in Karnataka, Andhra Pradesh, and Tamil Nadu. So, that means, more or less dominated by the southern part of country in case of magnetite.

Let us come to the next mineral manganese ore. The manganese ore are also used for various purposes and they are like pyrolusite and psylomelane are the major ores mainly used for metallurgical purpose and also for steel industry. They are found largely in Karnataka, Orissa which are the major region for manganese ore almost around 65 percent of the total manganese ore are available coming from these two states. Manganese ore are also available in Madhya Pradesh, Maharashtra, Orissa, Karnataka, Andhra Pradesh, Goa, Gujarat and Bihar.

Next mineral is chromite. Chromite is the commercial source of chromium and oxide of chromium and iron is also known as this chromite group of mineral which are used for metallurgical purpose, chemical or refractory purposes. Nearly 93 percent are found in Orissa

and mostly in the Sukinda valley. Some amount are also found in Nagaland, Manipur, Andhra Pradesh, Tamil Nadu, Maharashtra and Jharkhand.

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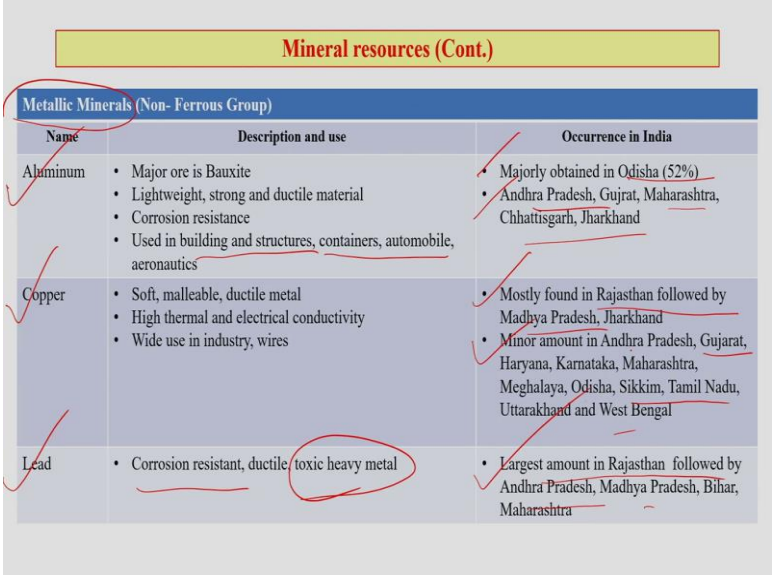

Metallic minerals, non-ferrous group first aluminium, majorly aluminium bodies, bauxite; it is lightweight, strong and used for building different structures, containers, automobile, aeronautics. Now they are found mostly in Odisha. So, Odisha is one state as you are finding that lot of important minerals are coming from this state. Andhra Pradesh, Gujarat, Maharashtra, Chhattisgarh also provides aluminium.

Next copper, it is very important, it has a high thermal and electrical conductivity widely used for industry to produce wires for electrical uses mostly found in Rajasthan, followed by Madhya Pradesh, Jharkhand, some amount are found in the southern part like Andhra Pradesh, Karnataka and also Gujarat, Haryana, Meghalaya, Sikkim, Odisha, Tamil Nadu and also West Bengal. So, we need to know that how reach as far as mineral resources is concerned is our country and where they are found and used for different purposes.

Next is lead, which is an anti corrosive material ductile, but it has another issue is very toxic for environment, largest amount are found in Rajasthan followed by Andhra Pradesh, Madhya Pradesh, Bihar and Maharashtra.

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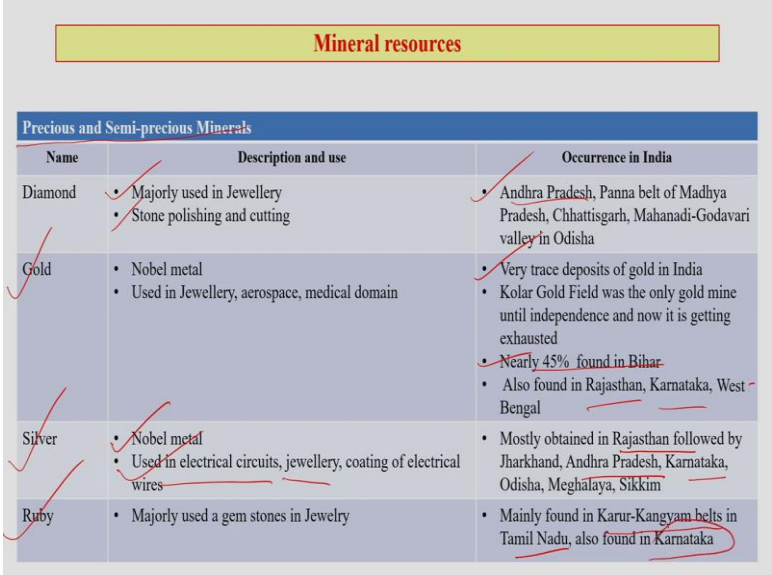

Then next group of minerals; precious and semi precious minerals; first diamond. Diamond majorly used for jewellery industry, stone polishing, cutting. Where do we get them, Andhra Pradesh, then Panna belt of Madhya Pradesh, Chhattisgarh, Mahanadi-Godavari valley in Odisha.

Next is gold. Of course, we all know that gold is one of the most sought after mineral for the jewellery industry, but its also used for medical purposes, aerospace. Now, they are found in very trace amounts in India. So, some amount are found in Bihar, whatever the total amount that we have available in India 45 percent are found in Bihar, also in Rajasthan, Karnataka and West Bengal.

Next silver, it is known as a noble metal and used for electical circuits, jewellery, coating of electrical wires as well. We find them mostly available in Rajasthan, Jharkhand, Andhra Pradesh, Karnataka, Odisha, Meghalaya, and Sikkim.

Ruby majorly used as a gemstone in jewellery, mainly found in Karur-Kangyam belts in Tamil Nadu and also found in Karnataka.

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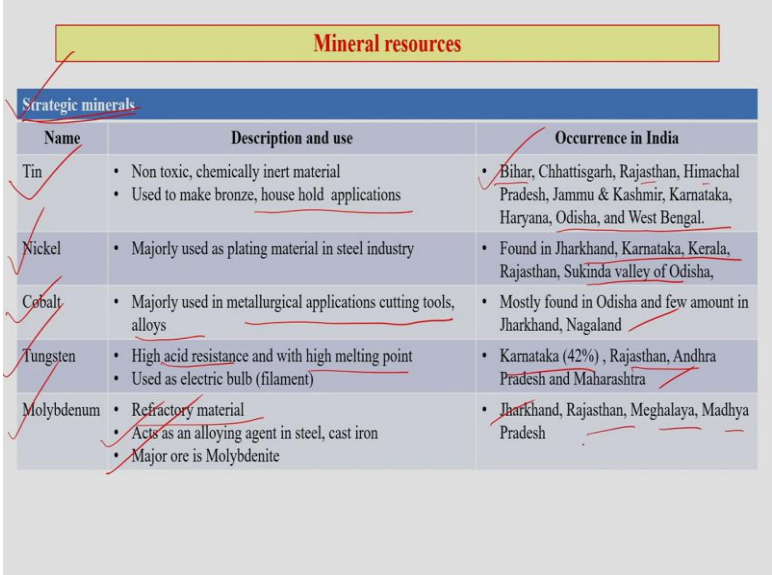

Next group of mineral are strategic minerals, they are used for various important purposes and largely used for, household application, plating material; sometimes steel industry. So, if you look at the first one tin. Tin is largely used for household applications and also some time used to make bronze available in Bihar, Chhattisgarh, Rajasthan, Madhya Pradesh, Jammu Kashmir, Karnataka, Haryana, Odisha and West Bengal.

Nickel is majorly used in in a plating material in steel industry and they are found in Jharkhand, Karnataka, Kerala, Rajasthan and Sukinda valley of Odisha. Cobalt majorly used for metallurgical applications, cutting tools alloy and is found in Odisha and few amount found in Nagaland and Jharkhand.

Tungsten is a high acid resistance mineral with high melting point used as filament in electrical bulb and various other electrical uses. Tungsten are found in Karnataka mainly followed by Rajasthan, Andhra Pradesh and Maharashtra.

Molybdenum is used as refractory material. It acts as an alloy agent in steel and also in cast iron. Its major ore is molybdenite. We find them in India in Jharkhand, Rajasthan, Meghalaya, and Madhya Pradesh.

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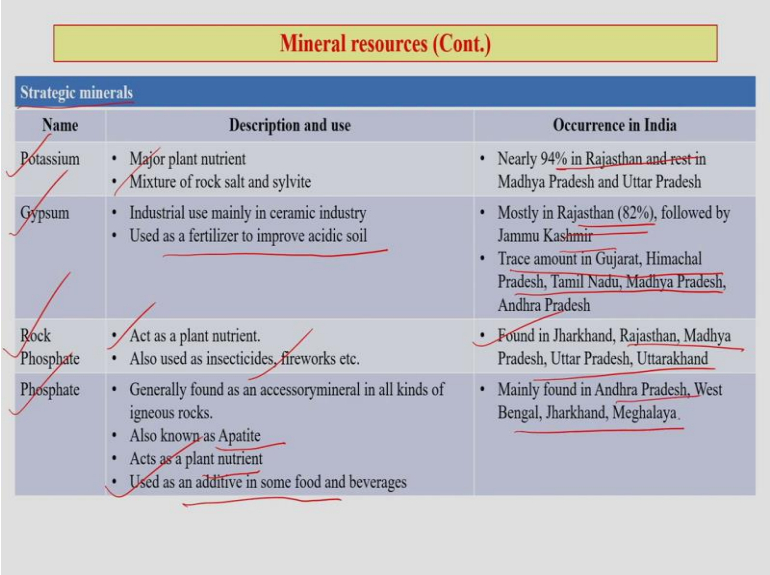

Strategic minerals to continue with; Potassium is largely used for fertilizer industries, major plant nutrient, it is used as a mixture of salt and sylvite found in Rajasthan and a little bit about in Madhya Pradesh and Uttar Pradesh.

Gypsum mainly in ceramic industry it is used and also used as fertilizer to improve the acidic soil and we find it mostly in Rajasthan. So, Rajasthan state is also another important state as far as mineral deposit is concerned, followed by Jammu Kashmir, a very trace amount found in Gujarat, Himachal Pradesh, Tamil Nadu, Madhya Pradesh and Andhra Pradesh.

Rock phosphate; another important mineral used for fertilizers development or fertilizer production act as a plant nutrient also used as insecticides and fireworks industry. It is found in Jharkhand, Rajasthan, Madhya Pradesh, Uttar Pradesh and Uttarakhand.

Phosphate is found in different rock deposit also it is known as apatite acts as a plant nutrient. It is also used as an additive in some food and beverages mainly found in Andhra Pradesh, West Bengal, Jharkhand and Meghalaya.

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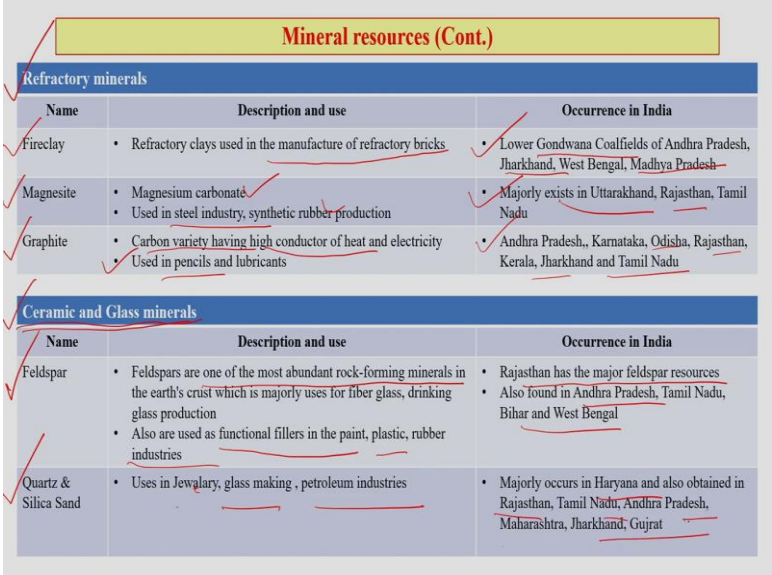

Mineral resources (Cont.)

Refractory minerals

Name	Description and use	Occurrence in India
Fireclay	• Refractory clays used in the manufacture of refractory bricks	• Lower Gondwana Coalfields of Andhra Pradesh, Jharkhand, West Bengal, Madhya Pradesh
Magnesite	• Magnesium carbonate • Used in steel industry, synthetic rubber production	• Majorly exists in Uttarakhand, Rajasthan, Tamil Nadu
Graphite	• Carbon variety having high conductor of heat and electricity • Used in pencils and lubricants	• Andhra Pradesh., Karnataka, Odisha, Rajasthan, Kerala, Jharkhand and Tamil Nadu

Ceramic and Glass minerals

Name	Description and use	Occurrence in India
Feldspar	• Feldspars are one of the most abundant rock-forming minerals in the earth's crust which is majorly uses for fiber glass, drinking glass production • Also are used as functional fillers in the paint, plastic, rubber industries	• Rajasthan has the major feldspar resources • Also found in Andhra Pradesh, Tamil Nadu, Bihar and West Bengal
Quartz & Silica Sand	• Uses in Jewelary, glass making , petroleum industries	• Majorly occurs in Haryana and also obtained in Rajasthan, Tamil Nadu, Andhra Pradesh, Maharashtra, Jharkhand, Gujrat

The next group of minerals are refractory minerals; the three major refractory minerals are fireclay, magnesite and graphite. So, fireclay is used in the manufacturing of refractory bricks, which you might have seen in the chimneys of various industries. It is available in lower Gondwana coal fields of Andhra Pradesh, Jharkhand, West Bengal and Madhya Pradesh.

Magnesites is used as in steel industry and also in synthetic rubber production, largely found in Uttarakhand, Rajasthan, and Tamil Nadu.

Graphite, as we know that it is a type of variety of carbon mineral, high conducting of heat and electricity, largely used for production of pencil and lubricants. Where do we get them? Andhra Pradesh, Karnataka, Odisha, Rajasthan Kerala, Jharkhand and Tamil Nadu.

The next group of a mineral; ceramic and glass minerals. These also have very important use in our daily life. The first one is feldspar. Now feldspar is one of the most abundant rock forming minerals in earth’s crust, these are used as functional filters for paint, plastic and rubber industry. We get them in Rajasthan which has the largest amount of feldspar deposit, we get little bit amount also in Andhra Pradesh, Tamil Nadu Bihar and West Bengal.

Quartz and silica sand largely used for in a jewellery industry, glass making, petroleum industry. We find them in Haryana, Rajasthan, Tamil Nadu, Andhra Pradesh, Maharashtra, Jharkhand and also in Gujarat.

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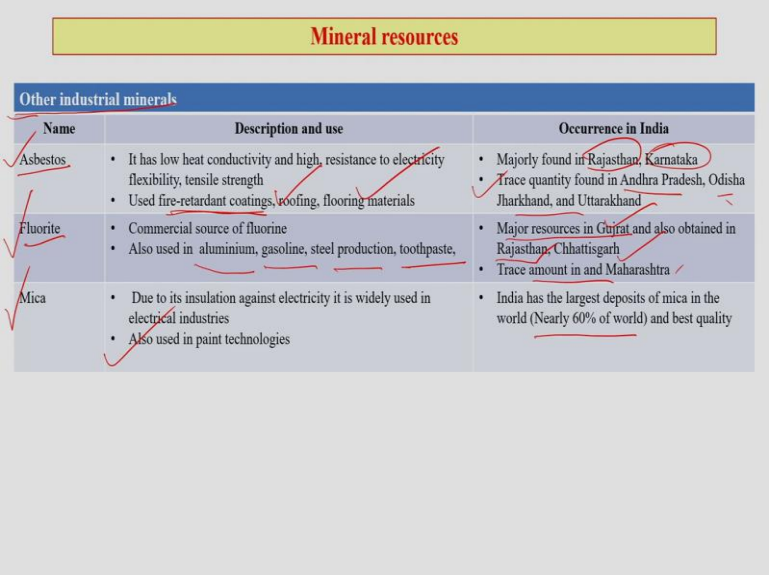

Finally, the last group of minerals; other industrial minerals. These three are very, very important. Asbestos, it has low heat conductivity and very high resistance to electricity, it is flexible, it has a high tensile strength and largely used for fire retardant coatings.In some melting or using fire to produce glass or something, you will find that asbestos are used as a fire retardant coatings in those areas. Also, in roofing and flooring material. Majorly found in Rajasthan and Karnataka; little bit amount also are available in Andhra Pradesh, Orissa, Jharkhand and Uttarakhand.

Next fluorite; commercial source of fluorine is fluorite and also used in aluminium, gasoline steel production and toothpaste production. So, major sources of fluoride are Gujarat and it will be found in Rajasthan state Chhattisgarh as well, very less amount found in Maharashtra.

Mica, another important industrial mineral. Due to its, insulating behaviour mica is largely used in electrical industry, it is also sometimes used in iron and steel industry used for paint industry. Almost around 60 percent of the world mica deposits are available in India and one of the best quality of mica is available in our country. So, of course, it appears that a good amount of mica is getting exported from our country.

Now, the next resource we will talk about after mineral resource is the power resources in India.

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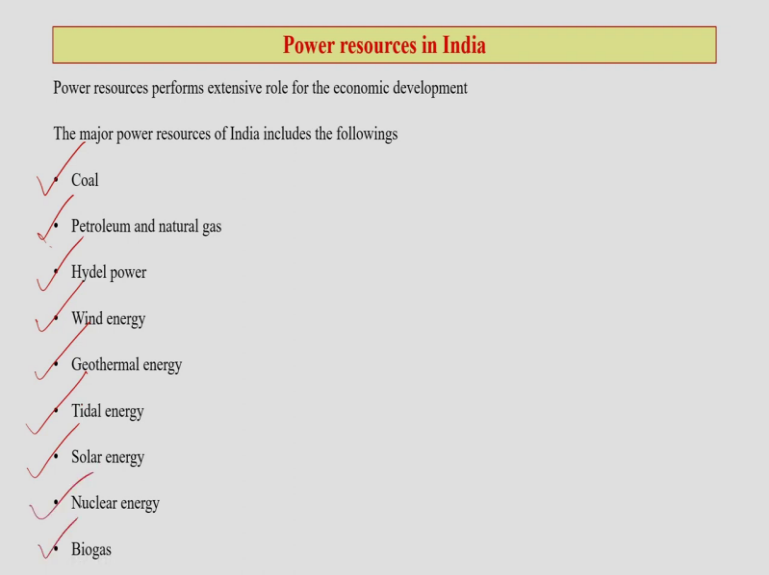

So, power resources, if you look at the major ones, that includes of course, coal, then petroleum and natural gas, hydel power, wind energy, geothermal energy, tidal energy, solar energy, nuclear energy, and finally biogas. So, these are the major power resources that are being used; explored in India.

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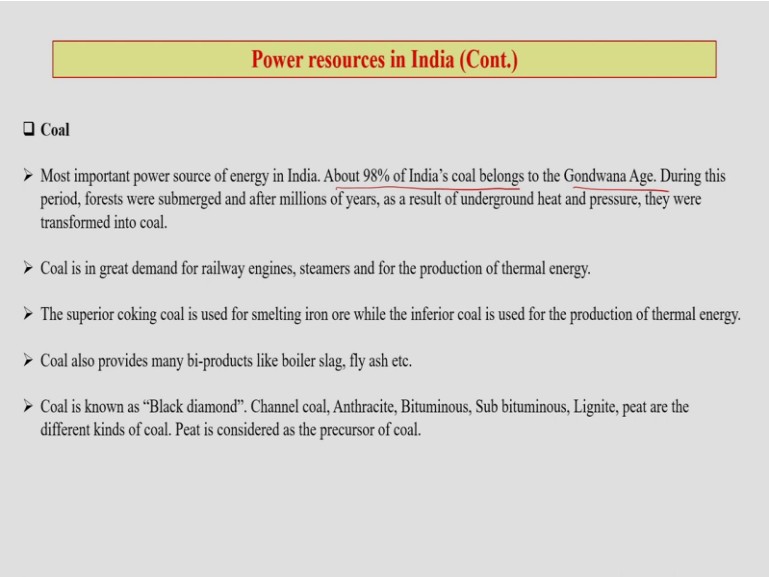

Now, coal, as we know that coals are being used for the thermal power industry and around 98 percent of coal belongs to the Gondwana Age. So, coal is used for various purposes apart from the thermal power industry. And the natural resource base of coal is getting diminished in a very faster rate, because of large amount of uses for various purposes. Coal is also used in India for railway sector steel and industry. It also provides some bi-products like boiler

slag, fly ash. So, all in all, coal is one of the power resources in India, which is utilized for many purposes.

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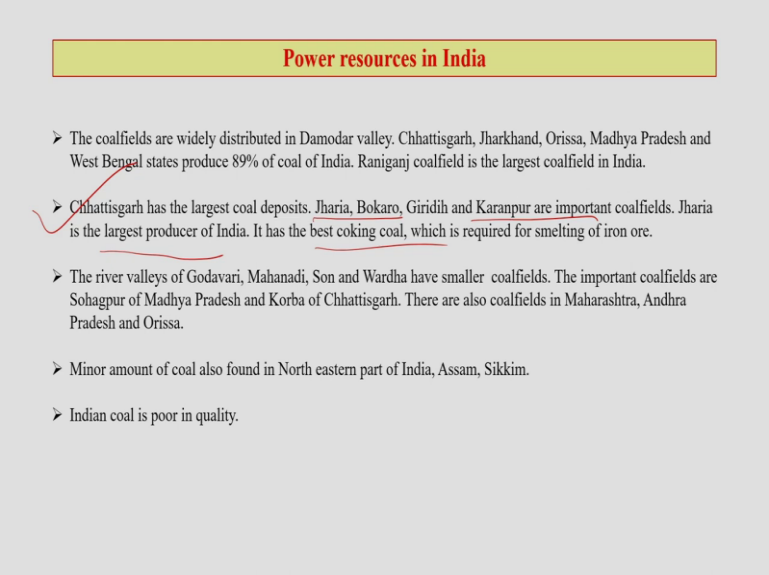

So, it is important now, for us to look at these resources very carefully and estimate it, stock and use it in a very sustainable and planned manner. So, if you see that the quality of Indian coal that we have at present, they are not a very high-quality coal, Chhattisgarh has the largest coal deposits. Then we have Jharia, Bokaro, Giridih, Karanpur are some of the important coal fields. Jharia is the largest producer of coal in India and it has the best coking coal which is required for smelting of iron ore.

So, in West Bengal also we have some coal field like Raniganj. overall we are actually having some coal resources, which are extremely utilized and some other coal mines or coal fields, which are not used in that intensity like the other ones. So, a balanced and cautious approach is required for this very important power natural resource.

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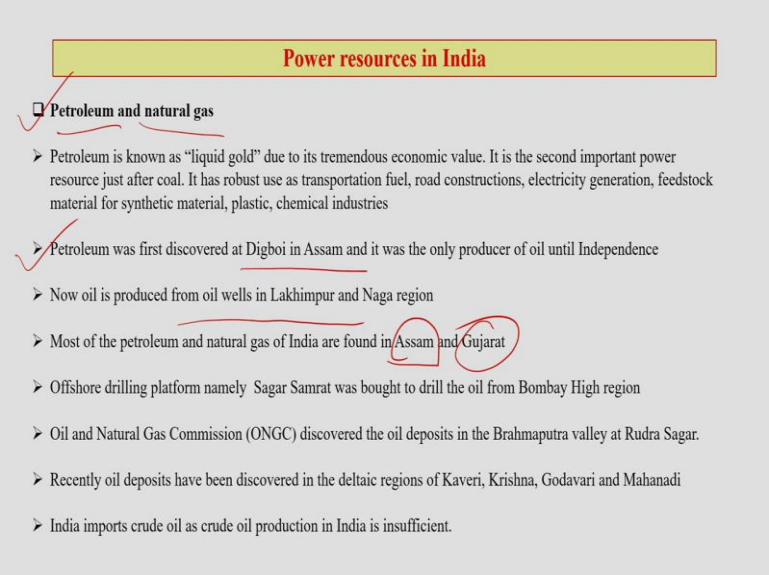

Now, next is petroleum and natural gas. Petroleum is also known as liquid gold, because of its value, we are all aware that how important is petroleum and natural gas for any country's development. So, petroleum in India was first discovered here in Assam and it was the only producer of oil until our independence. So, Digboi in Assam is one of the most important place as far as petroleum and natural gas is concerned.

Now, oil is produced also in Assam in Lakhimpur and Naga region most of the petroleum and natural gas of India are found in two state largely Assam and Gujarat. There are some offshore drilling also being performed to extract petroleum and natural gas. Recently, India has started importing crude oil as crude oil production in India has gone down quite significantly. So, yes petroleum and natural gas as I say are very important for the development of any country and of course, for our country as well. Again, a very sustainable approach is required for this important natural resource.

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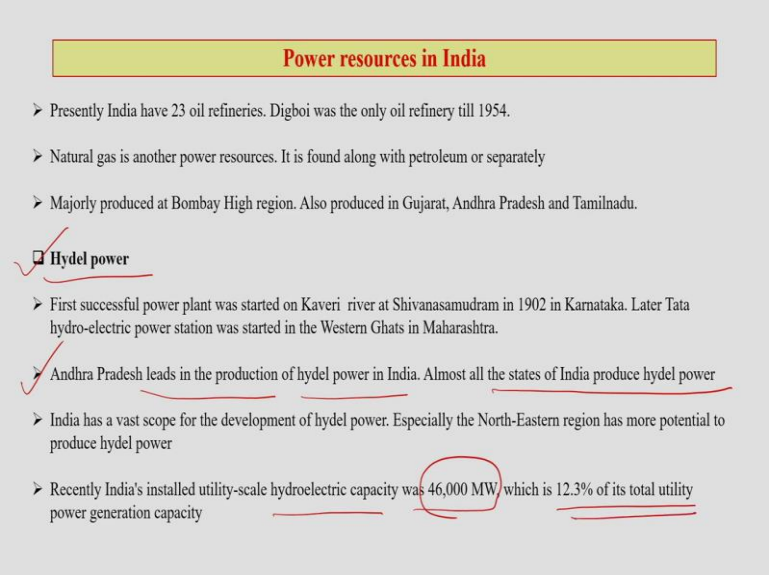

Presently, if you look at that we have around 20 plus oil refineries in our country and natural gas is also again another power resources, which is being explored at a very faster rate, because increasingly the prices of petroleum is going higher and higher. So, we need to look at this resource in a very sustainable manner.

Next is hydel power. The first successful power plant in India was started in Kaveri river at Shivanasamundram in 1902 in Karnataka. Later Tata hydroelectric power station was started in the western ghats in Maharashtra and Andhra Pradesh actually is leading in the production of hydel power in India. Almost all the states of India produce hydel power and our country also has a vast scope for the development of hydel power especially in the northeastern region which has more potential to produce hydro power as far as various research and reports are concerned. Recently India’s installed utility scale hydraulic electric capacity was around 46,000 megawatt, which is almost 12.13 percent of its total utility power generation capacity.

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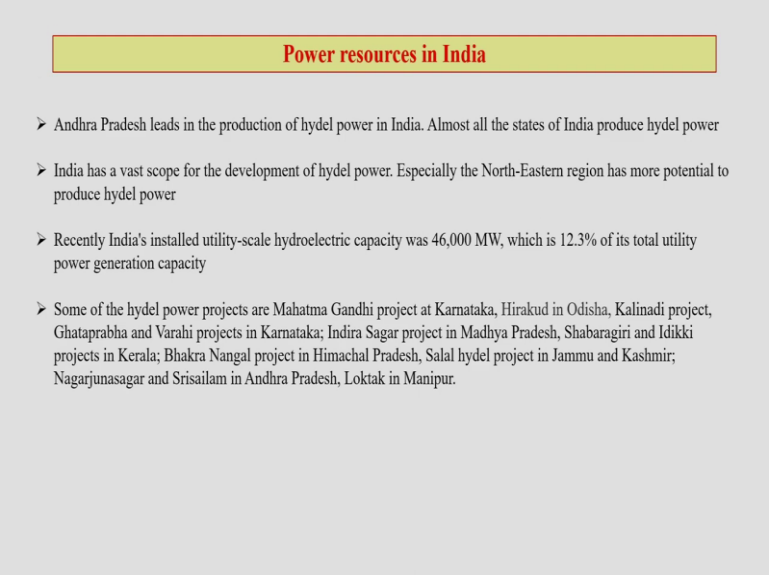

So, yes, there are certain technological intervention and improvement can be carried out. So, India also has as we all know, a vast scope for development of hydel power, especially in the north-eastern region. And recently some of the hydel power projects like Mahatma Gandhi project at Karnataka, Hirakud in Odisha, Kalinadi project, then Ghataprabha there are several other projects which are working in various parts of the country. So, these power resources, hydel power resources could be another very important resources that can be utilized for the development of the nation.

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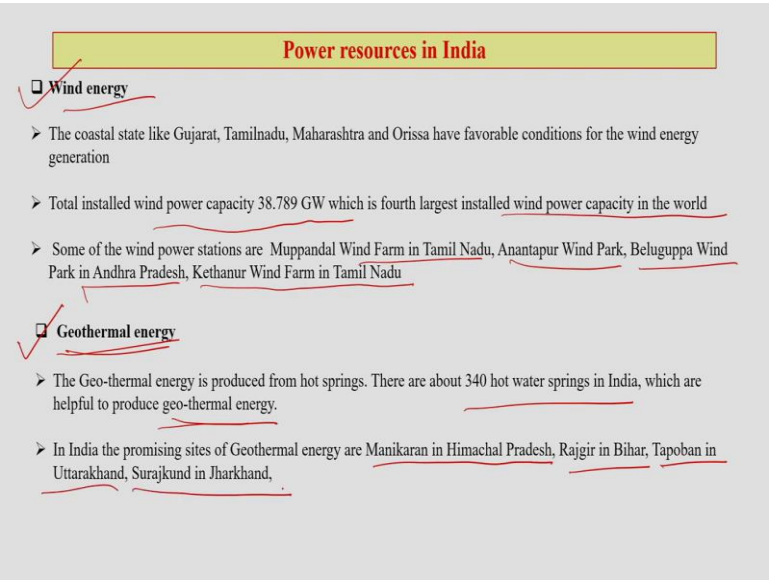

Wind energy; coastal states like Gujarat, Tamil Nadu, Maharashtra, Odisha are some of the favourable places where wind energy can be another scope of energy utilization and energy

exploration. Total installed wind power capacity as of today in our country is around 38.7 gigawatt, which is fourth largest installed wind power capacity in the world. Some of the wind power stations to name a few; Muppandal wind farm in Tamil Nadu, Anantapur wind park, Beluguppa wind park in Andhra Pradesh, Kethanur wind farm in Tamil Nadu.

Next comes geothermal energy. Geothermal energy mainly produced from Hot Springs. There are about 340 hot springs in India which are helpful to produce geothermal energy. Geothermal energy, some example we can give like Manikaran in Himachal Pradesh, Rajgir in Bihar, Tapoban in Uttarakhand, and Surajkund in Jharkhand, these are some areas where geothermal energy is being explored.

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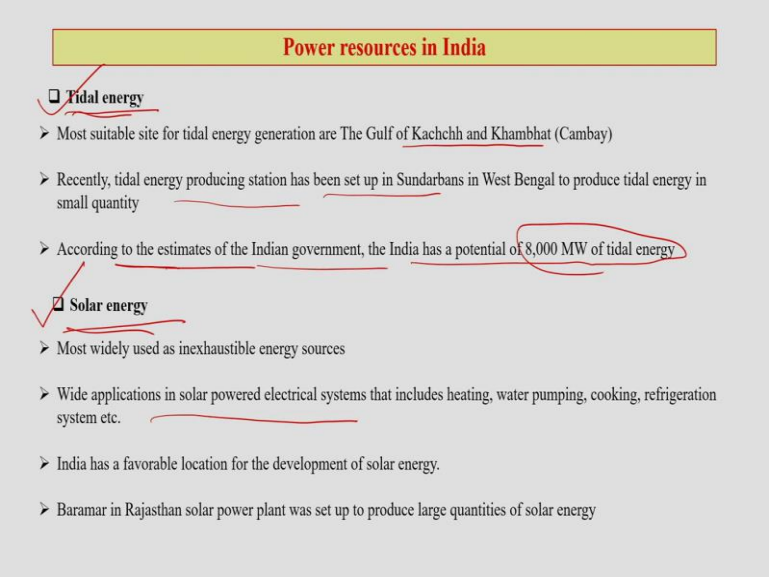

Next is tidal energy. This is an area where a lot of research are still required a lot of innovations are required, because tidal energy is most suitable for green energy production and the Gulf of Kachchh and Khambhat in India are areas where tidal energy can be a very suitable option.

So, recently a few tidal energy producing stations have been set up in the Sundarban area in West Bengal, and then, according to some recent estimates of the Indian government, our country has a potential of around 800 megawatt of tidal energy, which is quite significant. So, this energy resources is very important as far as future sustainable energy production and utilization is concerned.

Solar energy; a lot of discussions and developments are happening in the recent time in this particular field of energy, solar energy. So, this is largely one form of exhaustible energy, as

we discussed in the previous class. In this form of energy you can actually keep on using and in principle, it is inexhausible in nature. Wide application of solar power is in the electrical system includes heating, pumping, cooking, refrigeration, etc.

India is actually a favourite location for solar energy application and Rajasthan solar power plant are set up and produce large quantity of solar energy, few of the pockets in Gujarat, in the southern part of our country are also coming up with solar energy application exploration and research quite significantly. So, as in in India, we get quite significant amount of solar light so, we have a good scope and opportunity for utilizing solar energy as a source of energy.

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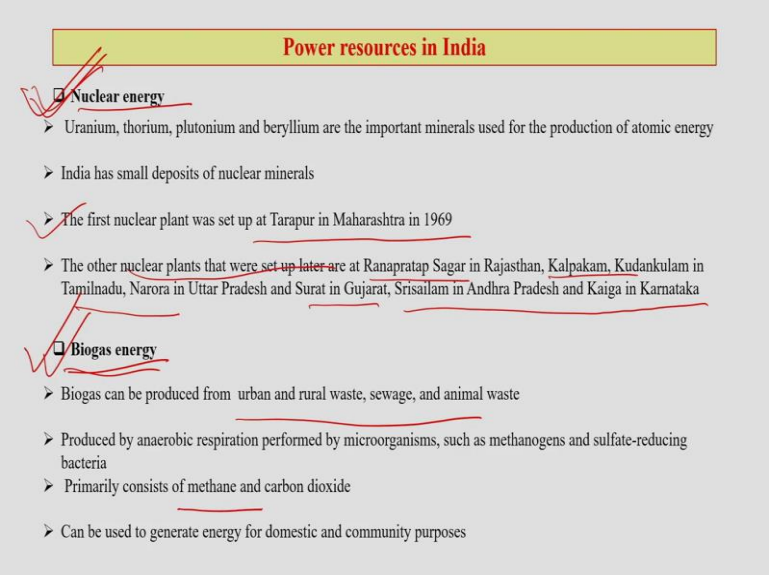

Nuclear energy; another, very coming up and being discussed almost in all forum about this form of energy. India has very small deposits of nuclear mineral and the first nuclear plant that was set up was in Tarapur, Maharashtra in 1969. Then few other nuclear plants are also has come up Ranapratap Saagar in Rajasthan, Kalapakam, then Kudankulam in Tamil Nadu, Narora in Uttar Pradesh, Surat in Gujarat, Srisailam in Andhra Pradesh and Kaiga in Karnataka. So, India as a country actually started exploring these nuclear energy and various future plan planning exercise is going on. So, we hope that probably in future nuclear energy also will be another form of energy that will be utilized in great manners.

Finally, biogas energy; biogas energy is a area where a lot of research are being carried out over the last one or two decades. Biogas can be produced as from rural waste, sewage, animal waste, and largely it is produced through anaerobic digestion, anaerobic respiration

performed by a certain group of microorganisms and primarily, this consists the gas which are coming up from this anaerobic respirations are largely methane which is inflammable in nature. These biogas can be used again as a source of green energy and at least in small areas, rural areas where grid connections are not available, biogas energy can be explored.

So, that is all for this particular class, where we talked about the various resources, natural resources that are available in India and their potential uses and also the places where they are found.

So, all participants, I will request you that you have now two classes where we have discussed about the various concepts and ideas and principles of natural resource management. And then we discussed about the different type of natural resources that are available in our country and their uses. In the following class we will meet and discuss about another new topic. Till then, take care goodbye.