Availability and Management of Groundwater Resources
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Lecture 58
Impact of Climate Change on Water Resources (Contd.,)

Welcome you all in the part 4 of the model 12 impact of climate change on water resources. So, far we have seen that because of the different micro meteorological parameters variations, because of the climate change variations in a locality there are impacts on the water resources as well.

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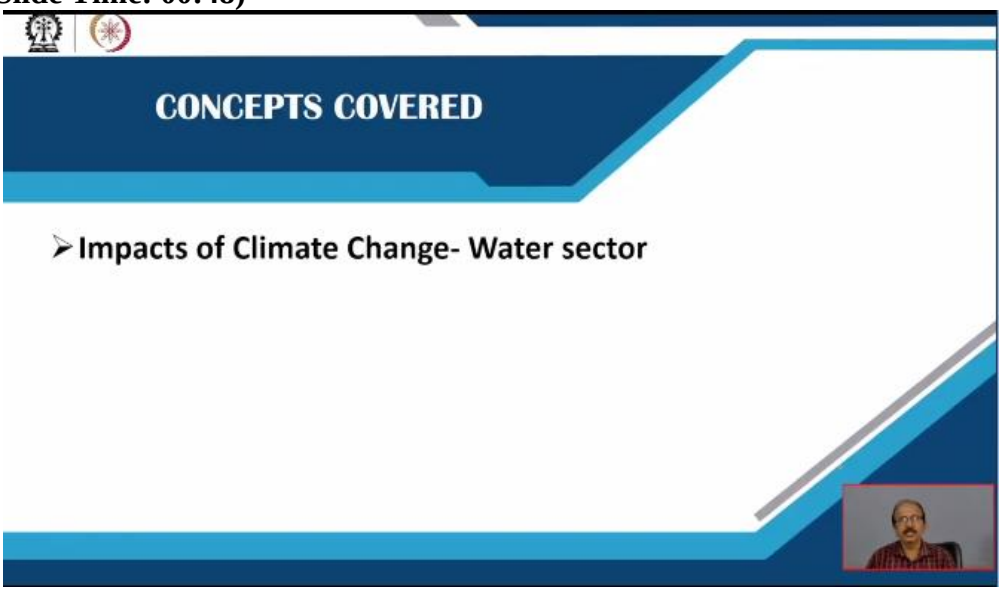

So, in this part we will primarily discuss about the different phenomenon which has taken place because of the climate change in the water sector.

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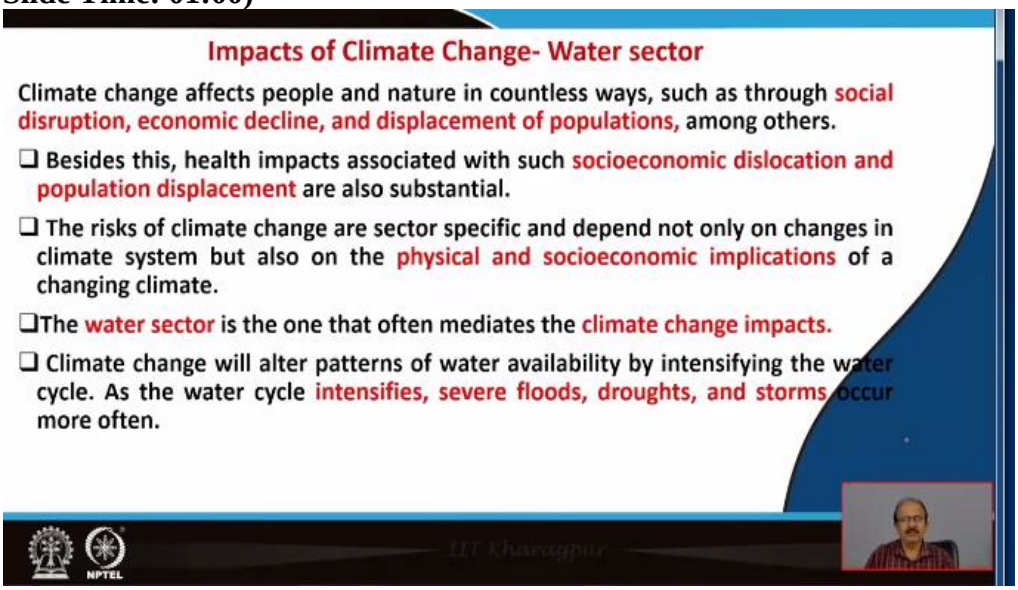

Generally, we have seen that climate change affects the people as well as the nature in several ways countless ways, such as through social disruption, economic decline and displacement of populations, among others. So, in because of the climate change, we have seen the different types of effects on people as well as on the nature. Besides this health impacts associated with such socioeconomic dislocation and population displacement are also substantial.

The risks of climate change are sector is specific places specific the location specific and it depends not only on the changes in the climate system, but also on the physical and socioeconomic implications of a changing climate. So, the risks of the climate change depend upon on the changes in the climate system. The water sector is one that often mediates the climate change impacts.

Climate change will alter patterns of water ability by intensifying the water cycle. As the water cycle intensifies, we have seen on the previous chapters also those severe floods may take place severe droughts may take place, and storms occur more often only. So, this because of the climate changes it is also changing or disrupting the water cycle of the location of the area specific.

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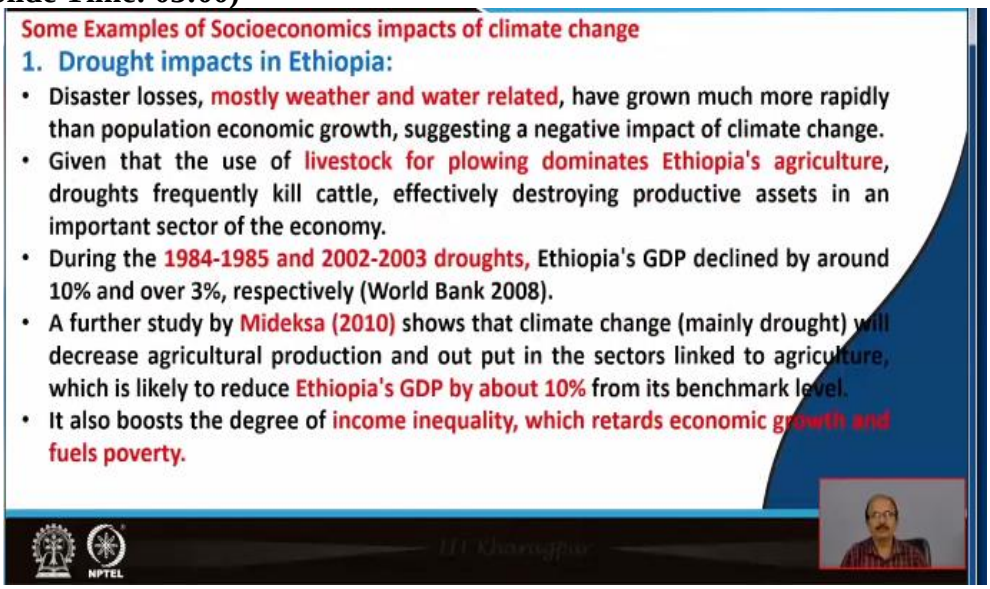

So, some impacts on the due to the water sector changing the climate factors on the water sectors, we can see the first example as drought impacts in Ethiopia. Generally, droughts, we have seen we have already discussed in the previous chapters also that when the summer will prepare for longer time or the rain will have the erratic pattern. So, evaporation and

transpiration will remove then what will happen the soil moisture will reduce and ultimately the water level goes down and droughts take place.

So, disaster losses mostly weather and water related, draughty also be disaster have grown much more rapidly than population economic growth, suggesting negative impact of climate change. Given the use of livestock for plowing dominates Ethiopia's agriculture, droughts frequently kill cattle, effectively destroying the productive assets in an important sector of the economy. So this is a case of the Ethiopia where for use of livestock applying, dominating their Ethiopia's agriculture conditions.

Droughts frequently are killing cattle, effectively destroying the productive assets. During the year 1984 85 and 2002 and 2003 droughts Ethiopia GDP declined by around 10% and over 3% respectively this is the World Bank report of the year 2008 that in the year 1984 85. The GDP declined by 10% and in the year 2002 2003 droughts time the GDP declined by over 3%. A further study by Mideska shows that climate change, mainly drought to will decrease agriculture production.

So the climate change will decrease the agriculture production of the area and output in the sectors linked to the agriculture, which is likely to reduce Ethiopia's GDP by about 10% from its benchmark level. So, it can also boost the degree of income inequality, which retards economic growth and fuels poverty in the country. So, what we are seeing that because of the impact of climate change, drought is taking place which is a disaster.

And because of this the drought disaster already happening the Ethiopia's GDP are declining, we have seen in the year 84 85. If you goal GDP declined by about 10% and 2000 to 2003 the GDP declined by over 3%.

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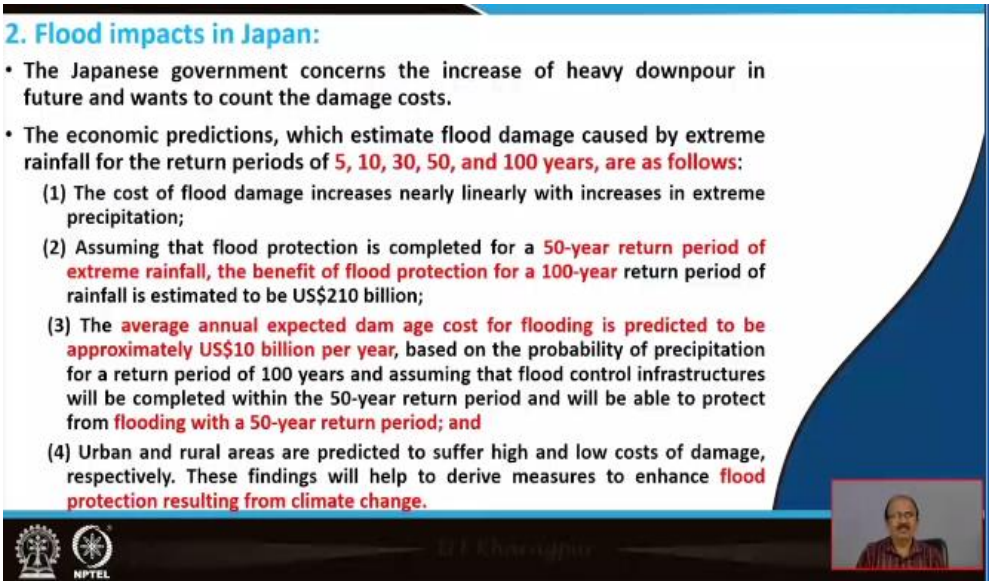

The second impact is the flood impacts in Japan, country Japan, the Japanese government they are having concerns the increase of heavy downpour in the future and wants to count the damage costs. The economic predictions which estimate flood damage caused by extreme rainfall for the return periods of 5, 10, 30, 50 and 100 years are generally soon as a first point the cost of flood damage increases nearly linearly with the increase in extreme precipitation so this is the linear relationship is here.

Second is the assuming that flood protections are is completed for a 50 year return period of extreme rainfall. The benefit of flood protection for 100 year return period of rainfall is estimated to be US dollar 210 billion this is the benefit. The flood production is generally completed for a 50 year return period of extreme rainfall. Benefit of flood protection for 100 year return period of the rainfall is estimated to be US dollar 210 billion.

The average annual expected damage costs for flooding is predicted to be approximately US dollar 10 billion for the year, based on the probability of precipitation for a return period of 100 years an assuming the flood control infrastructures will be completed within the 50 year return period. And we will be able to protect from flooding with a 50 year return period. Urban and rural areas are predicted to suffer high and low cost of damage relatively.

These findings will help to derive measures to enhance flood protection resulting from climate change. So, in urban or rural areas, in these areas which are suffering high low cost of damage. These findings will help them to derive measures to enhance the flood protection resulting from climate change. Now, this is the case of the impacts in Japan.

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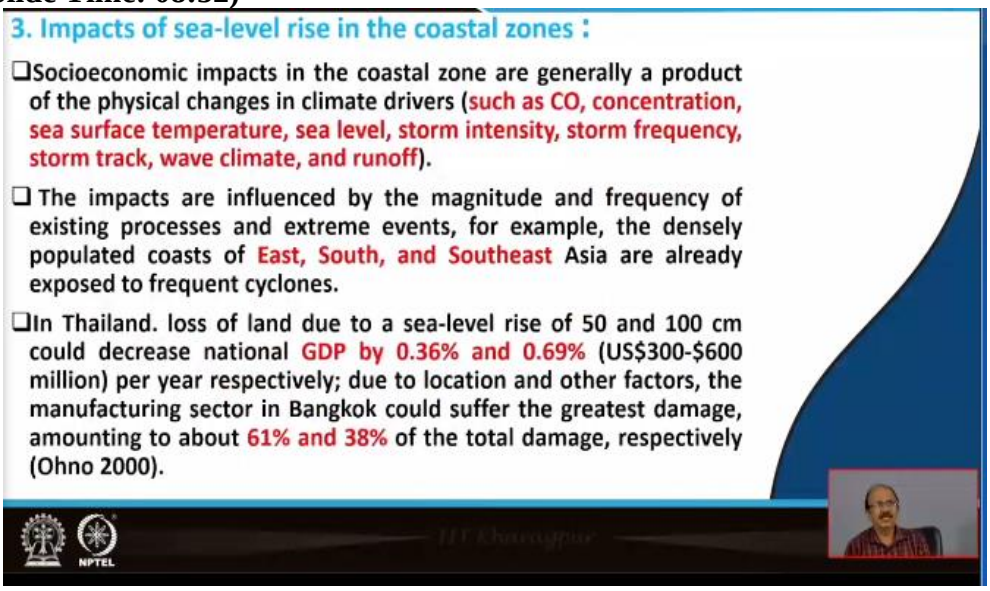

Now, third is the; impacts of sea level rise in the coastal zones. So this is also one of the impacts sea level rise because in the water sector. Socio economic impacts in the coastal zone are generally a product of physical changes in climate drivers such as CO concentration, sea surface temperature, sea level, storm intensity, storm frequency, storm track, wave climate and runoff. The impacts are influenced by the magnitude and frequency of existing processes and extreme events.

For example, the densely populated cost of East, South and Southeast Asia are already exposed to frequent cyclones. The densely population are shown in the East South and Southeast Asia and they are exposed to frequent cyclones. In Thailand loss of land due to sea level rise of 50 and 100 centimetre could decrease national GDP by 0.36% and 0.69% per year respectively.

Due to location and other factors, the manufacturing sector in Bangkok could suffer the greatest damage amounting to about 61% and 38% of the total damage respectively. So, in Thailand also we are seeing the loss of land due to the sea level rise of 50 and 100 centimetre. So, the decrease in national GDP is also mentioned here 0.36% and 0.69%.

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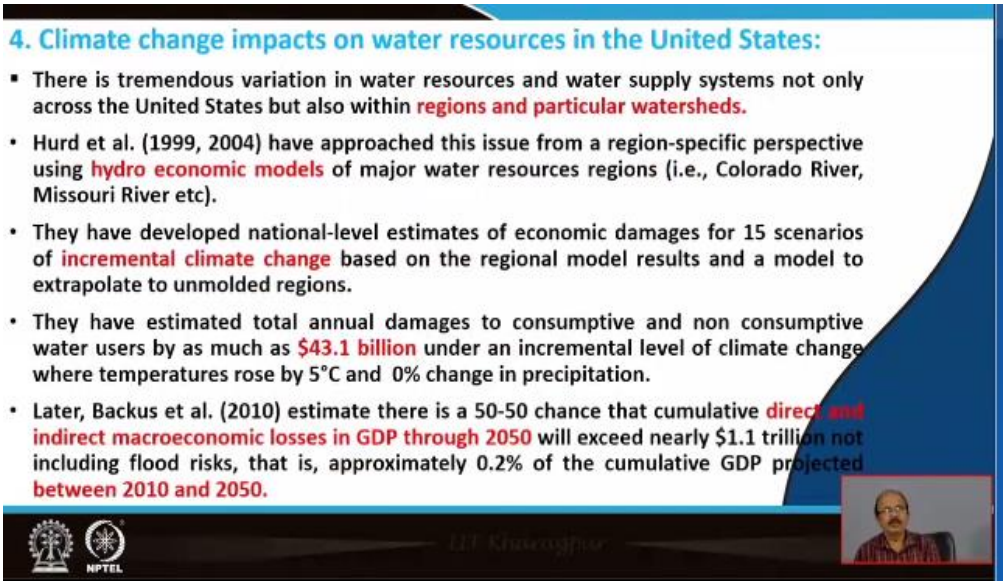

Now, the next one is the climate change impacts on water resources in the United States. So, there is tremendous variation in water resources and water supply systems not only across the United States, but also within regions and particular watersheds. Hurd et al have approached this issue from a region specific perspective using hydro economic models of major water resources region, for example, Colorado River, Missouri River etcetera.

They have developed national level estimates of economic damages for 15 different scenarios of incremental climate change based on the regional model result and a model to extrapolate to unmolded regions. They have estimated about the total annual damages to consumptive and non-consumptive water users by as much as dollar 43.1 billion under an incremental level of climate change, where temperature rose by 5 degrees C centigrade and 0% changing precipitation.

Later, Backus et al estimate there is a 50-50 chance that cumulative direct and indirect macroeconomic losses in GDP through 2050 will exceed nearly dollar 1.1 trillion not including flood risks that will have approximately 0.2% of the cumulative GDP projected between 2010 and 2050. This is the scenario of the US the climate change impacts on water resources in the US.

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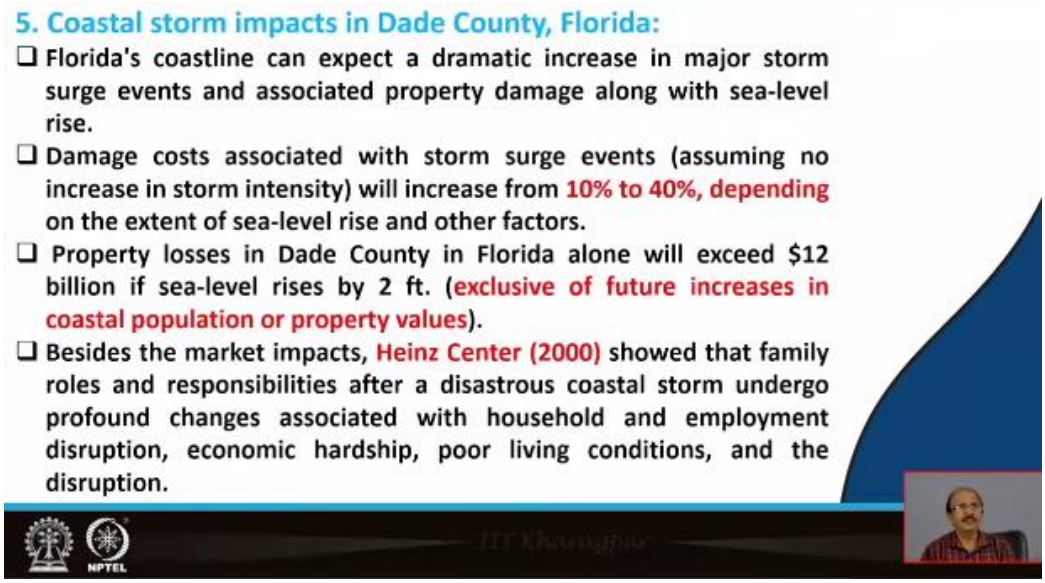

Next is the; coastal storm impacts in Dade county Florida. Florida's coastline can expect a dramatic increase in major storm surge events and associated property damage along with sea level rise. Damage costs associated with storm surge events assuming no increase in storm intensity will increase from 10% to 40% depending on the extent of sea level rise and other factors. Property loss in Dade county in Florida alone will exceed dollar 12 billion. If sea level rises by 2 feet exclusive of future increases in the coastal population or property values.

Besides the market impacts, Heinz Center showed that family roles and responsibility after a disastrous coastal storm undergo profound changes associated with household and employment disruption, economic hardship, poor living conditions and the disruption. So, these are also we noticed because of the coastal storm impacts in Dade county, Florida.

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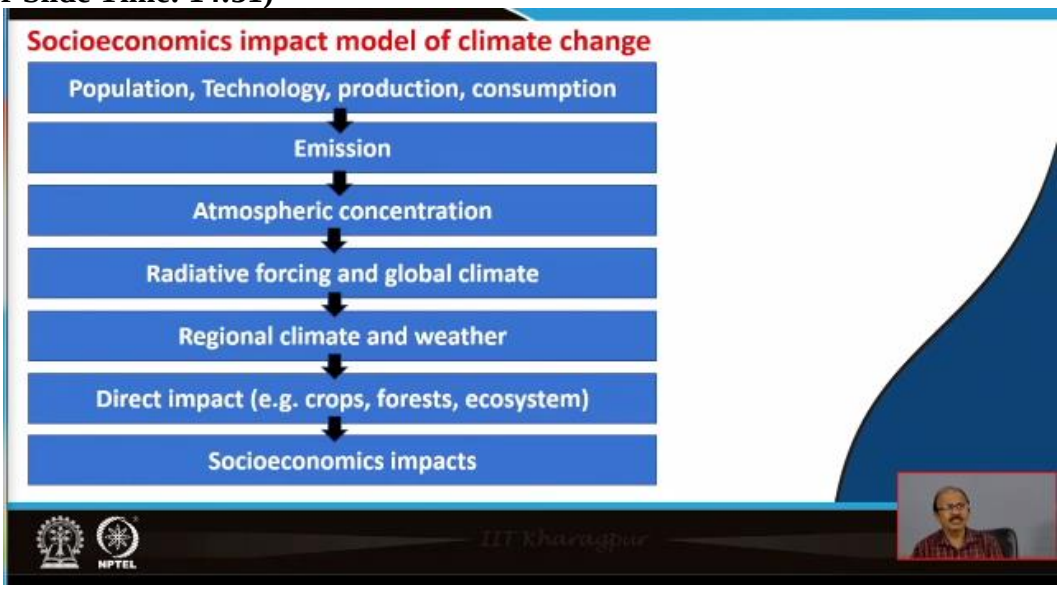

Now, next is the socioeconomics impact model of climate change. So here we can understand that population, technology, production and consumption. This give rise to emission and this emission gives rise to atmospheric concentration. Thereafter radiative forcing and global climate, regional climate and weather and then the direct impact will crops, forest ecosystem and last the socioeconomic impacts. So, these are the socioeconomic impact model of climate change with respect to climate change.

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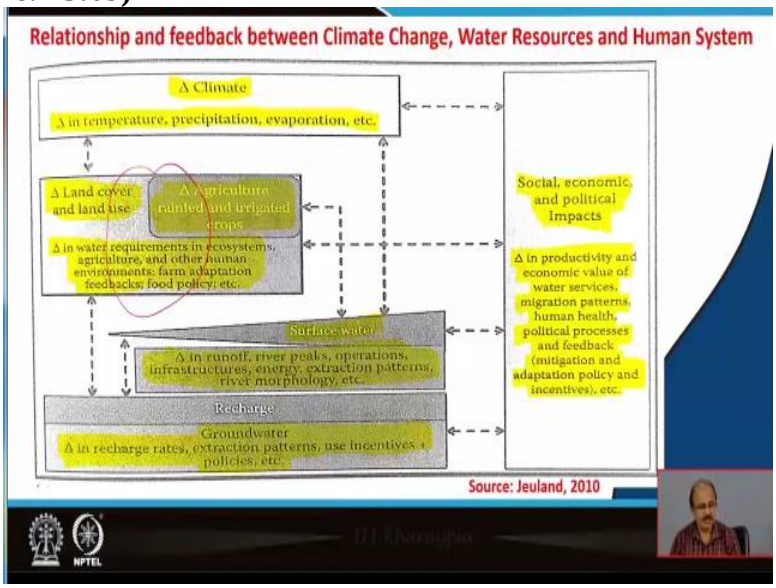

Now, relationship and feed between climate change water resources and human system here we can understand that climate in temperature, precipitation and evaporation generally climate in temperature, precipitation, evaporation. This land cover and land use agriculture, rainfed and irrigated crops. In water requirements in ecosystem agriculture and another human environment.

So, now, we can understand the relationship and feedback between climate change water resources and human system and this is a very systematic understand meaning of the climate change and water resources. Here we can see the change in climate is because of the change in temperature, precipitation and evaporation, these are the climatic factors and because of the change in land use and land cover the temperature, precipitation, evaporation also changes.

Change in water requirement in ecosystem agriculture and other human environments, farm and adaptation, feedback's, food policy etcetera. We are also just a human system is also forcing the to change the climatic factors in the local level agriculture and rainfed and irrigated crops

we are also because of this whole factor, they are also changing the climate they are also giving the climate change effect.

Now, the point you are seeing here this factor is because of the change in temperature, precipitation and evaporation and because of this factor again it is putting impact on the temperature, precipitation, evaporation here. The surface water case you can see that change in runoff, river peaks, operations, infrastructure, energy, extraction then patterns river morphology etcetera they are also putting impact on the change in land use and land cover and ultimately putting impact on the temperature, precipitation and evaporation.

In the case of groundwater also we can see recharge after recharge groundwater in generally change in recharge rates, extraction pattern, huge incentives policy etcetera. So, these whole total systems are responsible, they are intermixed with each other and they are responsible for creating change in the climate system. Once the climate system changes you notice there are the effects on the water resource and because of climate change and water resource their impact on the human system.

Social economic and political impacts in productivity and economic value of the water services, migration patterns human health political processes and adaptation policy and etcetera this whole gives rise to we can see the total system and the arrow is of both sides, the it gives rise to the change in land cover land use, it also disrupts the pattern of the runoff in the areas as well as the recharge pattern in the aquifer. So, this relationship between climate change and water resources and human systems are very important to find out the effects of climate change on water resources.

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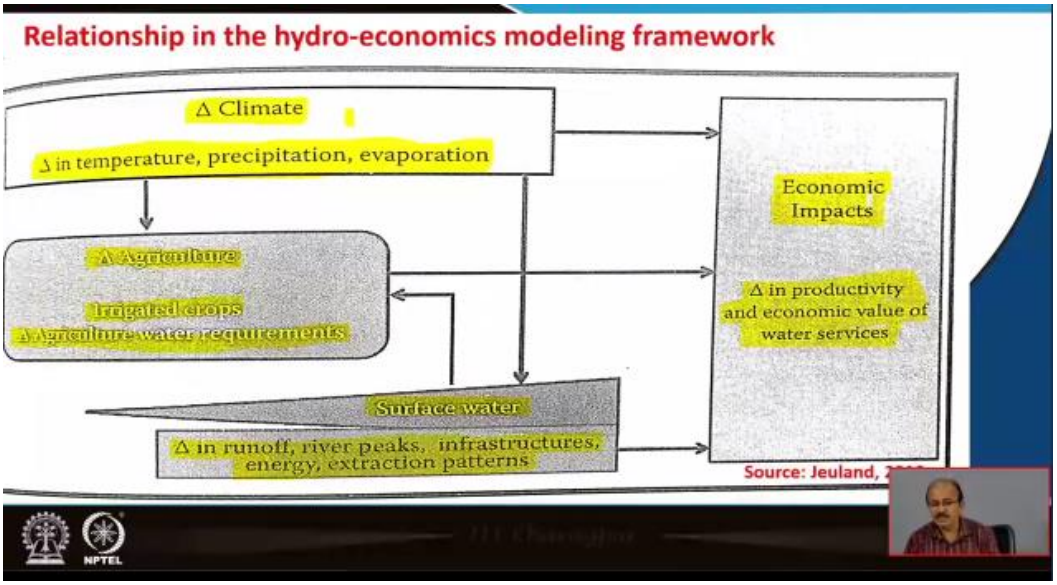

Now, there is a hydro-economics modelling framework also we can see that changing climate is because of the change in temperature, precipitation and evaporation, which gives rise to the changing agriculture pattern also irrigated crops, changing agriculture water requirements and this changing climate and change in temperature, precipitation evaporation floods, the impact on the economic impacts is changing agricultural activities and irrigated crops and putting impacts in productivity and economic value of water services.

And in the case of surface water, we can see here that surface water is required for irrigation of the agriculture also. So change in runoff, river peaks, infrastructures, energy, extraction patterns are affecting the changing agriculture pattern. So in one way other the relation between the hydrology and economics have been shown here with respect to the change in the climatic factors, especially the temperature, precipitation and evaporation.

Because if there will be the change in temperature definitely are in changing the precipitation pattern definitely less water will reach to the surface once it will reach in less content than what will happen, there will be very few water available for the irrigation of the crops in the agriculture activity. Generally surface water is also supporting the agriculture in certain areas. But here again we are seeing that because of the change in temperature, precipitation, evaporation.

It is putting impact on the surface water sources also and thereby reducing the runoff, river peaks, infrastructure, energy, extraction patterns etcetera. If this condition will prevail, that there will be impact on the agriculture, irrigated crops and then runoff, river peaks etcetera,

then what will happen it will put the overall impacts of the economics that is the economical impacts because of the change in productivity and economic value of the water services.

So, we have seen that because of the change of the climatic factors that especially the temperature, precipitation evaporation, we are getting several types of disaster like droughts, sea level rise, floods, etcetera which is putting impact on the economy of the area of the country also. Thank you very much to all.