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**Week - 05**
**Lecture - 28**
**Drought Management**

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These water harvesting structure as you see this picture, I have mentioned about certain very old kind of engineering technology which our people are following it up and there are few which relatively recent technologies for water harvesting structure. Now, let us shift from water harvesting flood to exactly the opposite aspect of management within a watershed and that is about drought.

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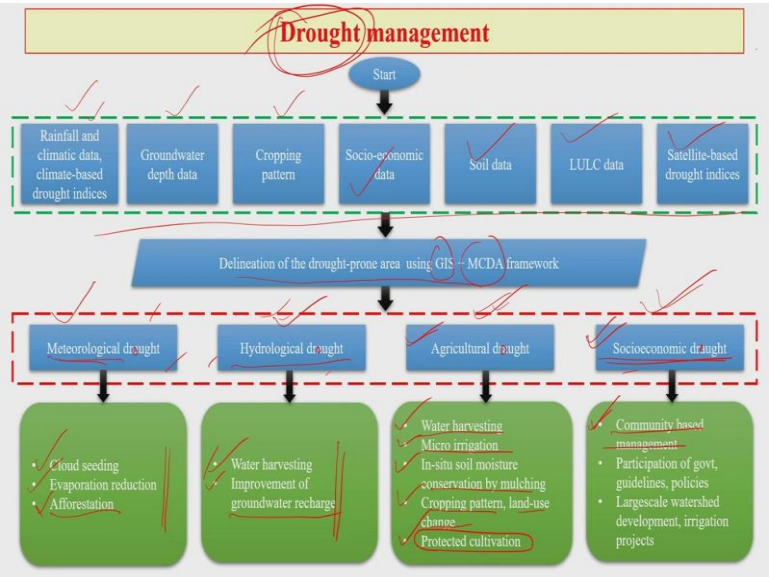


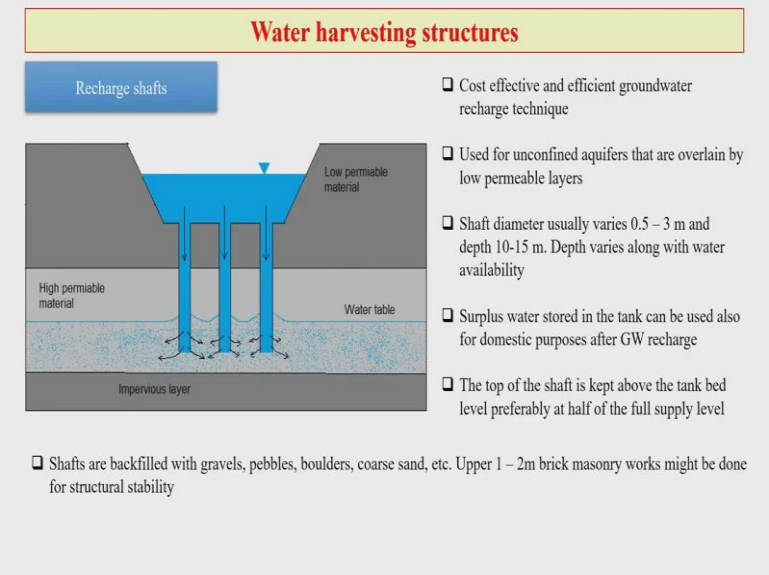


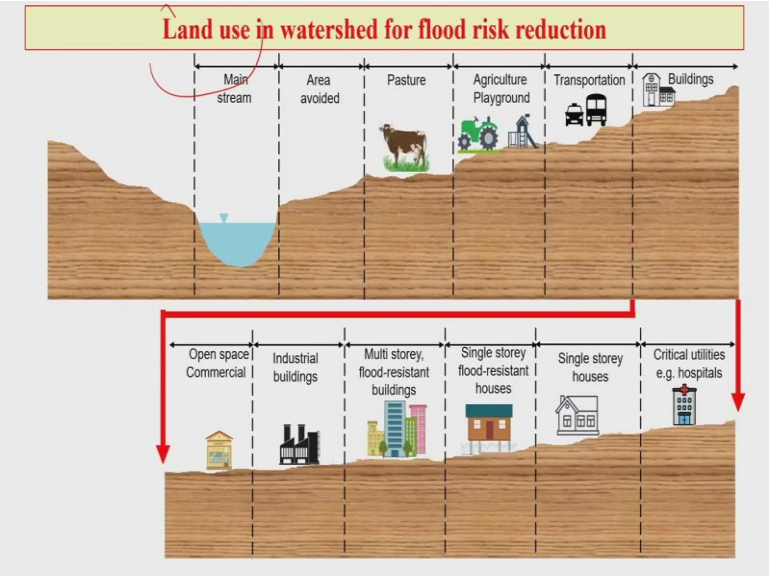

Now, like flood, the drought management also depends quite significantly on the data that actually you have with you. So, the drought management system, it is based on your rainfall data, climatic data, climate based different drought indices, groundwater depth data, cropping pattern, socioeconomic data, very important household level information, soil data, land use land classification data, satellite based drought indices.

So, these sets of data when you have with you, you actually have treasure in your hand. Now, on the basis of these databases or data, you start actually delineating of the drought prone area using tools like geographic information system, multiple criteria decision analysis framework. So, this can be carried out independently through GIS and MCDA, but, you can also bring these two powerful tools together for better decision on the basis of your alternatives that are available for drought management.

Now, let us see that, what different kind of droughts that you can actually expect, because on the basis of the type of the drought, we need to decide on the management practices. Now, metrological drought we have hydrological drought, agricultural drought, socioeconomic drought. Now, each one of them from the name itself you can very well understand that they have a different manifestation of single phenomenon that is drought. So, certainly metrological, drought, hydrological, agriculture, socioeconomic needs different type of management practices.

Now, let us see how actually we could actually approach each one of them. The meteorological drought means, that drought which is largely depending on the metrological parameters. So what are the options or management practices that actually you can try for managing metallurgical drought; cloud seeding, evaporation reduction, afforestation easiest, but very, very efficient.

Hydrological drought, you will see that the previous discussion that we had on watershed management, so from there, in fact, we can also find out the different approaches for addressing hydrological drought.

So, water harvesting already we discussed that how we can do that, improvement of groundwater recharge also we have discussed in the previous slides in quite detail, that what are the different kind of water harvesting we could do and also various other approaches for land use management and water management. So, once you have also these kinds of

techniques with you, you can actually try them for any watershed for hydrological drought management.

Agricultural drought, it is a bit complicated in comparison to the other two. So, in case of agricultural drought here, you are actually going to deal with water, importance of water and impact of water scarcity, on productivity, which is directly connected with the livelihood of the people and also their sustainable wellbeing.

So, here, again, some of the practices that we tried, for the other two kind of drought, water harvesting is actually a kind of a magic key for most of the problem that you have, which are related to water in case of watershed; micro irrigation, in-situ soil moisture conservation by mulching that could be leaf litter munching and also we discussed about plastic mulching which I personally do not recommend in every cases but if you have a large kind of farm then definitely plastic munching can be of good use; otherwise I think that we should go with our indigenous material like leaf litter and etcetera for in-situ soil moisture content.

Cropping pattern and land use change. Again, if you recall that we have discussed all those things in quite detail about land use for various purposes. We also discussed about the groundwater recharge and erosion control. So, I think that the previous lectures are very important that you refer to when we talk about drought management. So, agriculture drought management is also critical for another reason that is because you are actually going to lose your crops, if you are not able to give the water at the right moment.

So, protected cultivation is another very new type of cultivation practices, which in many places of course, in the developed country are being utilized, but in India also many places, this protected cultivation are being used for in addressing the agricultural drought. So, when you say protected cultivation, that means is actually to protect your cropping system for any kind of adversity, in this particular case, it is drought.

Socioeconomic drought, again, it is very important from the perspective of the community and the people because everything that we have been discussing is actually related to human. So, the society is right at the center of our discussion. So, socioeconomic drought actually is important from that point of view. Anytime when drought takes place or flood takes place, any natural calamity, immediately, the first effect is that the livelihood gets somehow disturbed. So, community based management is one way that we can address socioeconomic drought, participation of government in following guidelines policy, large scale water

development, irrigation projects are some of the tools and techniques that can be used for addressing socioeconomic drought.

So, as you see, overall, that in case of flood, as well as drought management, we need a mix of technology and society. So, a perfect combination of Technology and Society will definitely lead to sustainable management of your watershed, and does also ensure the sustainable wellbeing of the community.

Next, in case of specially the cloud seeding that we just now discussed about metrological drought, because rest of the things I am sure that most of you are well aware of and many places, these are being followed also.

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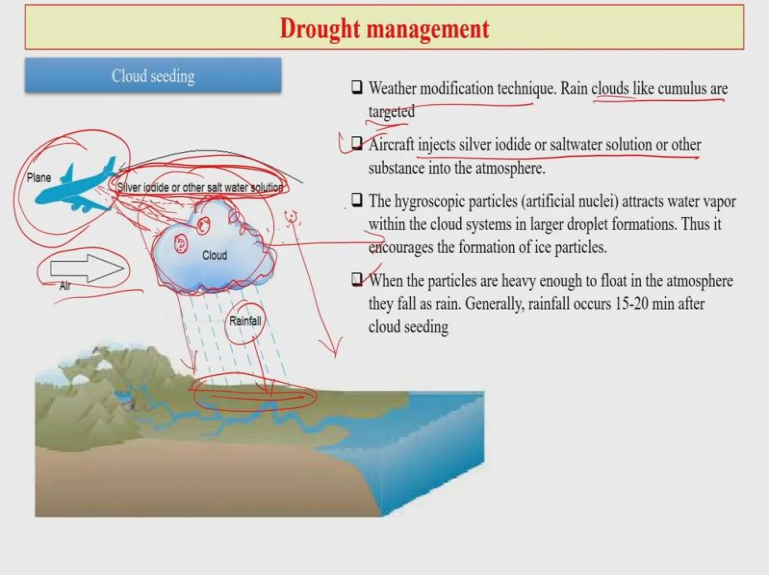


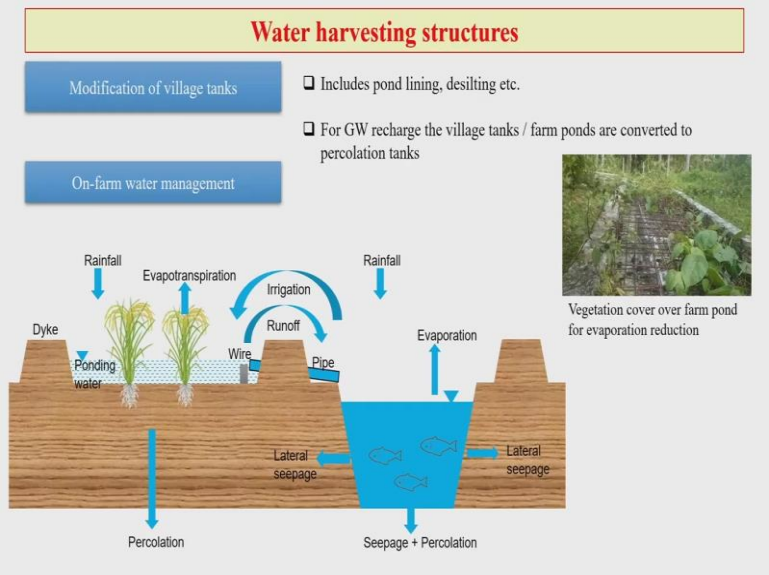

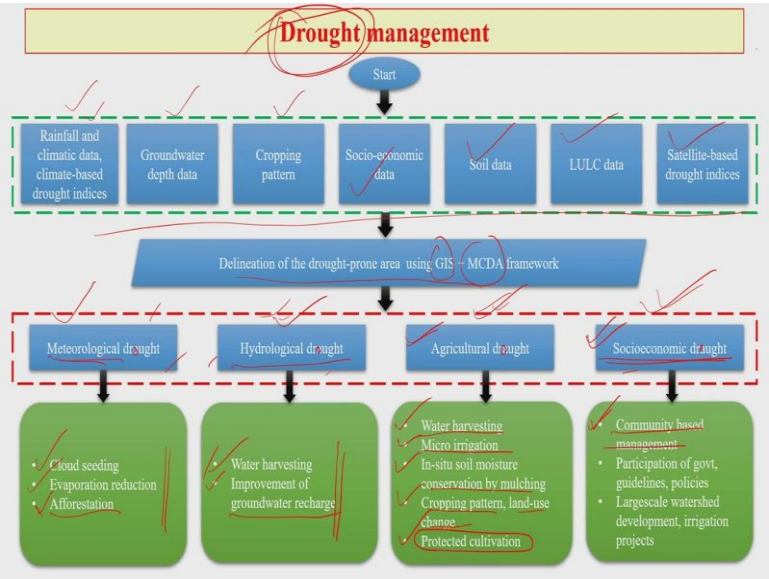


I just would like to take the case of cloud seeding because that has become a kind of a very popular way of managing drought mostly in the developed countries, but we can also try in India, so why not to see that how these actually work. So, in case of cloud seeding, basically, a plane is being used, and what do you actually carry in that is silver iodide or other salt water solution, which you basically sprinkle or spray into the environment in which actually form a kind of a cloud basically, and then in presence of low temperature and movement of air, finally, the cloud will convert it into rainfall and then you get the water.

So, weather model it is a kind of a weather modification technique, and rain clouds like cumulus are largely targeted for that. What aircraft actually or plane does aircraft injects silver iodide or saltwater solution or others substance as I said into the atmosphere, and these hygroscopic particles, which actually being sprayed or sprinkled from the aircraft, it attracts water vapor from the ambient environment within the clouds system for larger droplet formation within this particular cloud.

So, thus it encourages the formation of ice particle. So, the large droplet first of all silver iodide this comes into the cloud helps a small water droplet to become a bigger droplet then under the low temperature and other conducive condition it becomes into ice particle when the particles become a very heavy enough and cannot float in the atmosphere any farther then automatically they fall, they fall they come down to the earth. Generally, the rainfall occurs 15 to 20 minutes after this kind of cloud seeding, the cloud seeding which is being done by silver iodide or other salt solution.

So, this is one artificial way of forming bigger droplets and forcing a rain at the time of requirement on the ground, I simplify this case. Say for example, in an area in Rajasthan, you want to grow a crop and that crop is one of the main livelihood option for that particular community, but, you are sure that you are not going to get rain naturally. So, what to do? In that case, you probably try cloud seeding. So, this basically helps to bring the rain at the time when you want. Otherwise, if you leavethis cloud to the nature completely, it might so happen that the small tiny droplet will never become of the size which finally can fall down on the earth. It might also happen that strong wind can flow over this cloud from the area where he actually want the rain. So, this is how cloud seeding basically helps in case of drought management.

So, friends, as we discussed in this particular lecture that we discussed about water harvesting various water harvesting structures, and also we discussed about that how we can have kind of a win-win solution in certain cases, like on from water management or modification of village trying to get plants also in the water filled areas. And we also talked about different other techniques for water harvesting. And then finally, we also discussed about that the exactly opposite situation, then the flood, that is drought, how to manage that. So, more or less, you will see that the basic water harvesting, approach and management of resources at the watershed level scale is critical for either flood or drought management.