Availability and Management of Groundwater Resources

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Lecture - 47
Groundwater Resources Planning and Management (Continued)

Welcome to you all in the part 3 of the module 10 groundwater resource planning and management. So, far we have discussed about the different concepts regarding the resource management and its planning. So, groundwater resource management is a very important issue for the present day we are knowing that groundwater scarcity problem has arise at several location all along the world.

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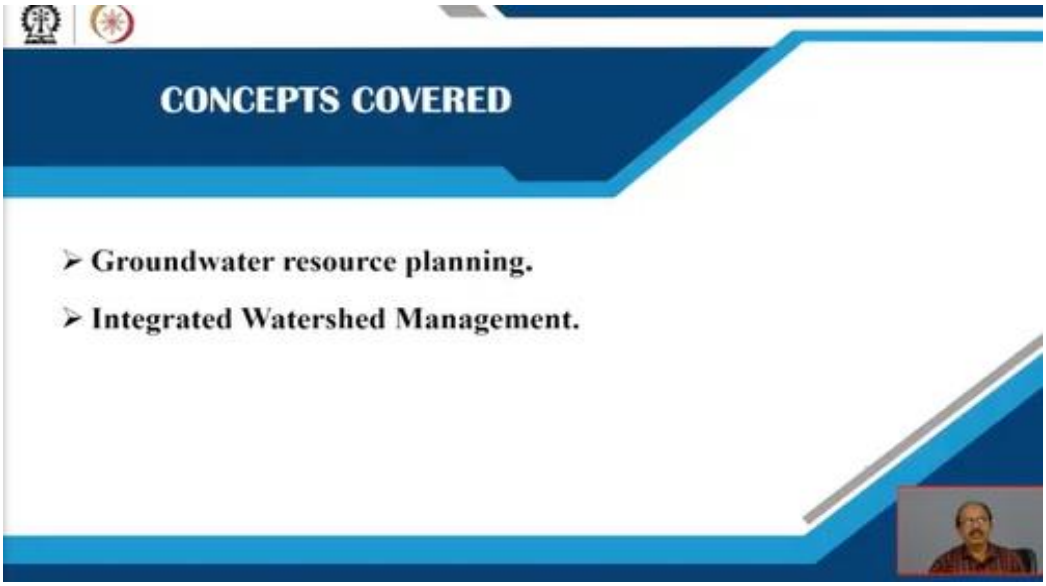

So, for its resource management in this part three we will discuss mainly the groundwater resource planning concepts as well as the integrated watershed management approach. So, this thing will be discussed in the; part three of the module 10.

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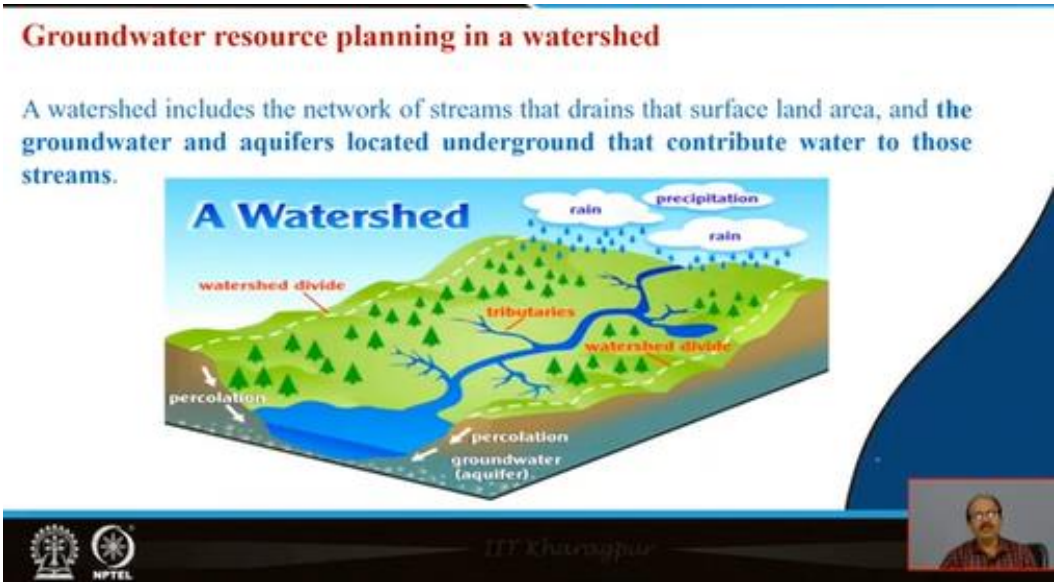

Now we are having the idea now that a geological formation is just storing the groundwater inside the earth's surface. So, these formations may lie at several depths that is; why we are getting the shallower aquifer as well as the deeper aquifer. So, from the shallower as well as the deeper aquifer generally we are tapping and we are taking out the groundwater issues for our portable as well as for other different purposes.

Now a watershed is a very, very important term with respect to the groundwater resource planning because this watershed includes the network of the streams that drains that surface land area and the groundwater and aquifers located underground that can contribute water to those streams. So, suppose this area is suppose if we are telling watershed so definitely if we will pour a single drop of water in this a land area the total water will remain within it only.

So, for the management point of view generally we are delineating a watershed throughout the land area concept is that it is having a network of streams and it is draining in that very land area which we have delineated as a water shed. So, this is an approach the watershed approach management is an approach for the management of the groundwater resources because we are knowing just beneath this land area which we have delineated as a watershed is having or are having several aquifers underlying the earth's surface.

So, underneath the surface. So, in this way we can see the watershed management approach is very important for the groundwater resource planning.

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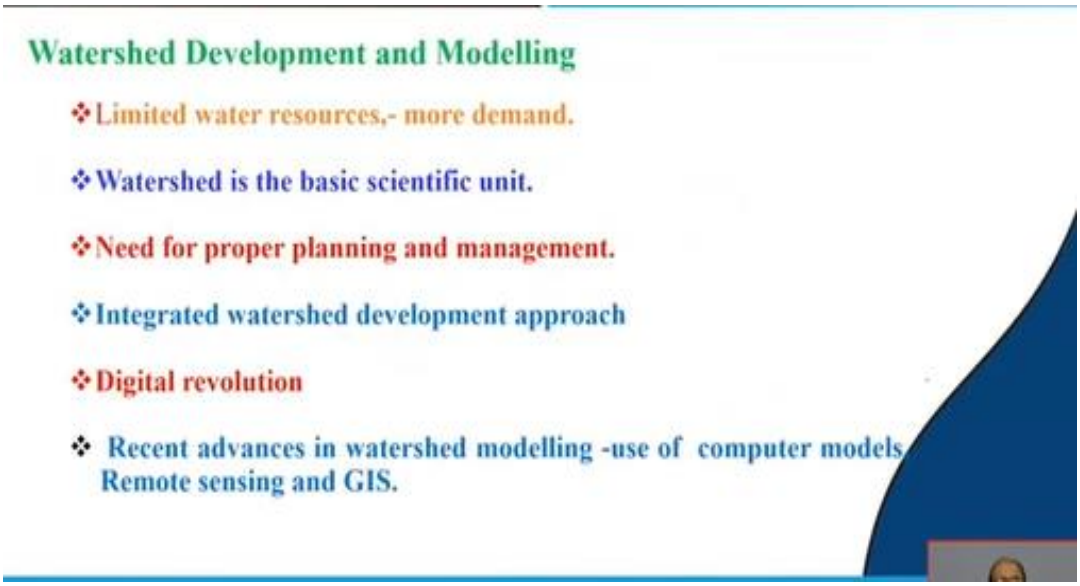

Now watershed development is also helping us in the modelling purposes because this within the watershed the limited water resources remains the within the limited water resources more demand generally**.** Watershed is the basic scientific unit scientifically we are just delineating this area water shed. In the watershed need for proper planning and management is required and that is why the integrated watershed development approach is being followed.

Now incoming of the digital revolution recent advancement in watershed approach is the watershed modelling. That is by the use of computer models and we can say with the help of the remote sensing and GIS in the watershed area the water resource management can be done very correctly.

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Now the watershed we have defined as an area in which a single drop of water if we are just if coming it will remain in that way it will not move to other land area or other waterside area. So, this water said is being is having classification based on its area in hectare. From the bottom we can see if the hectare watershed area in hectare is remaining 10 to 100 hectare, then such type of watershed is called as mini watershed that is called as mini watershed.

If the area varies from 100 to 1000 hectares the watershed is called as micro watershed from 1000 to 10000 area hectare area hectare waterside area is termed as milli watershed. Whereas milli watershed and from 10000 to 50000 hectare area the watershed is called as sub watershed and 50000 to 2000 hectare area is generally called as a watershed. So, the hectare wise classification of watershed is also is mentioned here from mini to watershed what we are defining the watershed.

So, generally for the management purposes groundwater management purposes we are selecting the sub watershed or micro watershed area. For through this we can have the proper assessment of the water resources within the earth surface. So, this approach the integrated watershed approach is being done by just delineation of the type of the watershed on the basis of the classification mentioned in the hectare.

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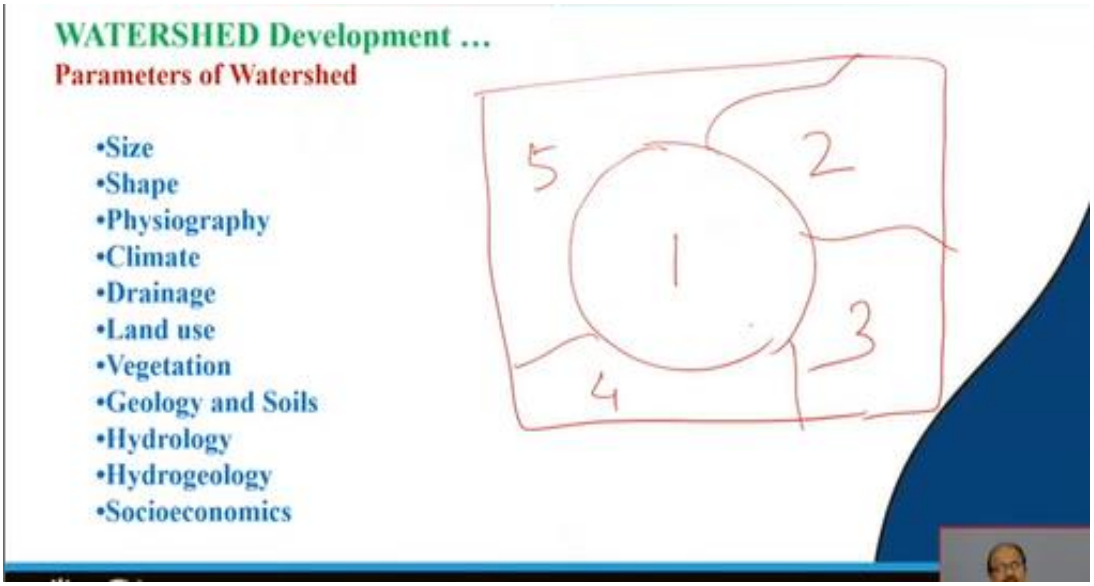

Now this watershed development approach is having certain parameters. So, the parameters are what is the size of the watershed? Size we have seen in the previous slide from your milli, micro then is this type we have seen according to the side area of the watershed in hectare. Say what is the shape of the watershed? Next is the physiography, physiographical aspects of the area watershed area.

Then the climate prevailing climate in the watershed area drainage pattern in the watershed area drainage pattern means line along with the water flows in the area that is the drainage line generally we are seeing in the topographical maps also. Then the land use pattern of the watershed area, how much area is the agricultural land how much area is your barren land how much area is having forest cover, how much area is having water bodies how much area is having your queries.

So, these whole parameters generally encompasses within the land use of the watershed. Now type of vegetations present in the watershed. What are the geology and soils cover? This is also very important because rock types are very important rock types and soil characteristics are very very important. We have seen from the very first lecture we have seen that aquifer which is a storehouse of the groundwater resources is nothing but a rocky formation.

A rocky formation we have seen that the rocky formation is holding the groundwater resources underneath the earth's surface. And the soil cover actually allows the precipitated water to infiltrate

and percolate and ultimately to reach near to the aquifer. That is the geological formations. So, for any watershed management integrated watershed management this is also one of the important factor geology and soils.

Then the hydrology of the soil hydrology of the watershed area hydrogeology relation with geology with the water your water points how the infiltrations are there, how the percolation behaviour of the soils are there and the last point of this parameters of the watershed is the socioeconomics. Because it is a very helpful parameter because the people who are living on the land surface in the locations where we are just conducting the watershed management approach.

We are following there by means of some questionnaire or by some interactions we can know how far they are getting the groundwater resources for their daily uses for their portable uses etcetera. So, these are the parameters which are related with the watershed development watershed management. See what suppose if this is the watershed management in an area suppose this is a area.

And in this area, there are so many watersheds. So, this is one watershed this is second watershed this is third watershed this is fourth watershed. So, what we have seen one watershed second watershed third watershed fourth watershed fifth watershed so this area total study area is are having five different micro watershed or sub watershed. So, now with first work is to delineate the watershed delineation of watershed is important, why?

Because we have seen that watershed is the good way to have detailed studies of these parameters say size, shape, physiography, climate, drainage, land use pattern, vegetation cover, geology and soil, hydrogeology, socioeconomic sector. So, these parameters can be studied for the watershed one, again this parameter can be studied for the parameter two. So, in this way we can study the different parameters in the delineated different types of watershed different your size of watershed.

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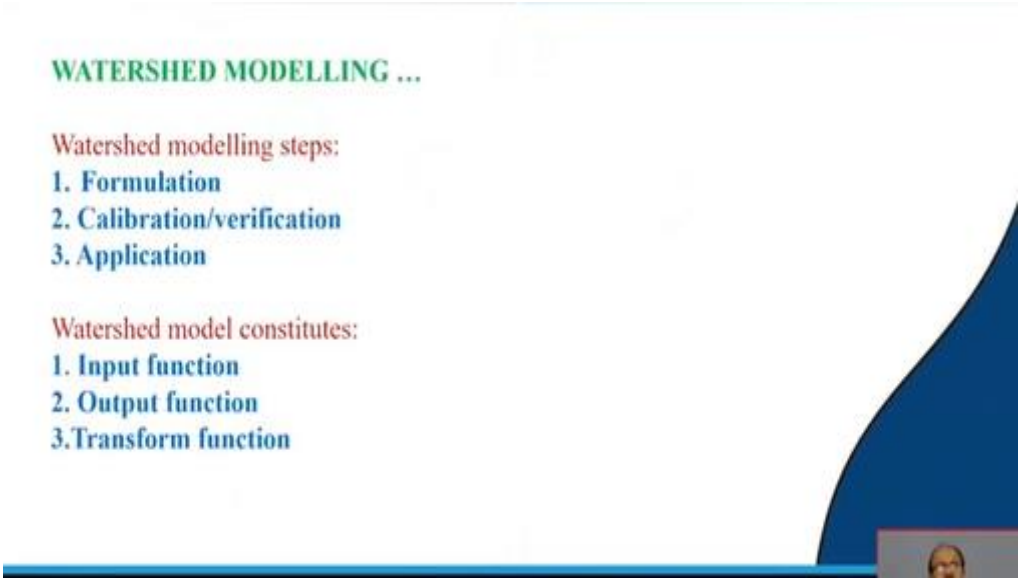

Now after this the watershed modelling can also done it can be also done and in the watershed, modelling steps the formulation, calibration and verification and its applications are the important steps for the watershed modelling. So, this watershed model consists of input function some of the input function then the output function and some of the transform function. So, we have started for the integrated watershed modelling by the delineation of the land area and we kept the name watershed.

So, this watershed is having certain parameters which we have monitored already for the different, different sub watershed of micro watershed. Now further we can move for the watershed modelling also with some steps formulation, calibration, application etcetera. And the model generally constitutes the input function output function and the transform function.

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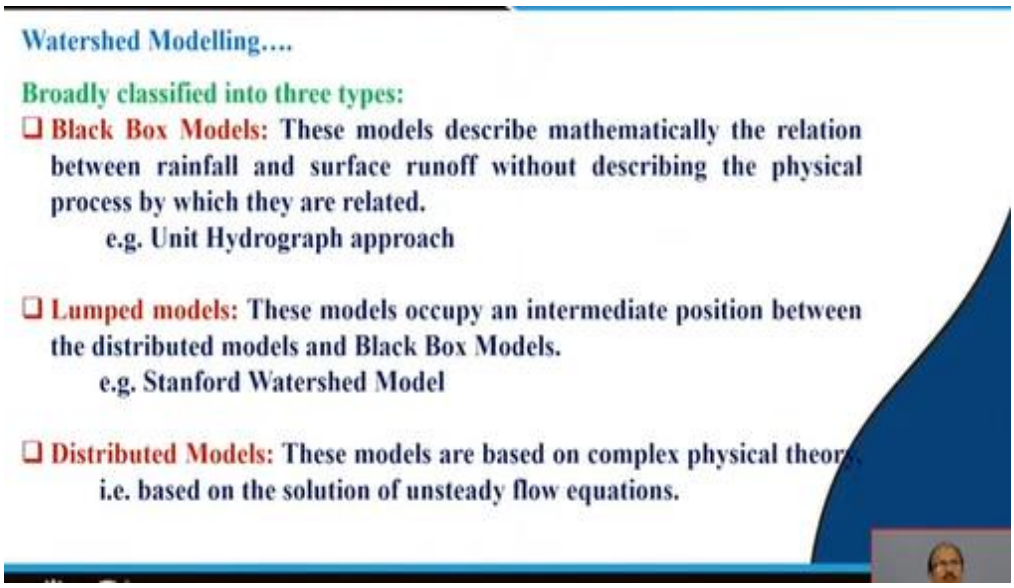

Now broadly the watershed modelling are classified into three types into three different types. First is the black box models, second is the lumped models and third is the distributed models. So, broadly this watershed modelling is divided into three different types. The black box models describe mathematically the relation between rainfall and surface runoff without describing the physical process by which they are related.

So, this is very important we have seen just if we will recall the previous lectures, we have discussed the important parameters of the hydrological cycle the four important parameters were there. The first is the precipitation second is the surface runoff third is the groundwater runoff and the fourth is the evapotranspiration which combine which is the just the combination of evaporation from the land surface water from the land surface.

And transpiration the water is just evaporating from the stomatal opening of the leaf surface. So, in the black box model for the watershed modelling approach generally this model describes mathematically the relation between the rainfall and surface runoff. So, example is the unit hydrograph approach which we have followed while the discussion of the runoffs. Now lumped models these models occupy an intermediate position between the distributed models and black box models.

So, this is just the mid type of models example is the Stanford watershed model and the distributed models are based mainly on the complex physical theory that is based on the solution of the unsteady flow equations. So, these different types of your modelling aspects are also there through which we can just get some sort of prediction that whatever what will the real quantum of the groundwater resource remain present underneath the earth's surface.

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So, now in the integrated watershed management approach generally large water resource development projects are being taken and we have also seen that the large water resource development projects in India have adverse socioeconomic and environmental consequences. So, adverse socioeconomic means the land and the people the water users they are not satisfied. As well as the environmental so many environmental consequences are there.

The failure of such projects because large in the larger way the water resource development water resource management are being done but generally these types of projects, this type of works are not remaining successful. So, the failure of such type of projects contributed to in-depthness raising economic pressure and jeopardising the future development. So, this usually happens because of the failure of the large water resource development projects.

Indiscriminate expansion of marginal lands and over utilization of existing water resources for irrigation then what will happen the expansion of the marginal lands will take place and the

important point is that the over utilizing of existing water resources. Because whatever water resource are remaining present inside the surface that is your existing water resource. So, this water resource whatever present is being over utilized and for what for the irrigation purposes.

Therefore, traditional water harvesting systems which were in the past also that have suffered severe neglect. So, in one side we are seeing the large water resource development projects are having the failure when the other side we are seeing that the traditional water harvesting system which were available in the area you are suffering from the negligence. So, this type of development not only called into question the adequacy of water resource schemes.

But also triggered the urgent search for more effective and appropriate management studies that is why it is the need of the hour to have the effective and appropriate management strategy because of this problem. So, the major response to follow is the integrated watershed management approach. So, this is the demand there should be the integrated watershed management approach.

Then only we can think that the groundwater resource will remain available for the present use as well as for the future usage. So, this is the about the important points about the integrated watershed management approach.

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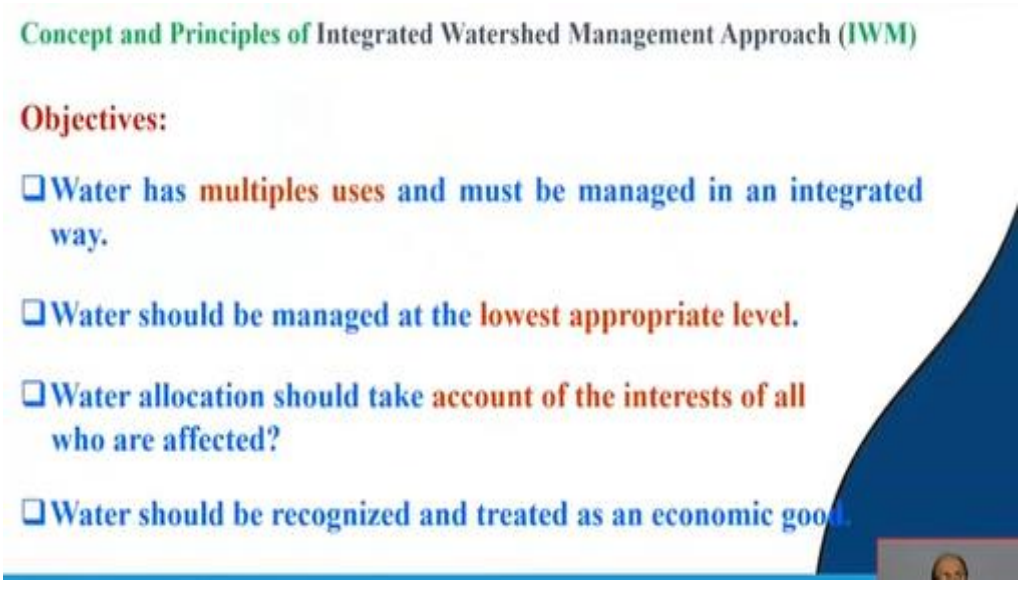

Now the concepts and principle of this integrated watershed management approach are first the objectives water has multiple uses and must be managed in an integrated way. So, since it is having the multiple uses so its management should be done in an integrated way. Water should be managed at the lowest appropriate level it should remain. Now water allocation should take account of the interest of all who are affected it should not be localized.

It should have the water allocations should take into account the interest of all who are getting affected and water should be recognized and treated as an economic goal. It should be recognized as an economic goal as well it should be treated as an economic good. Then only the watershed management or approach will remain successful.

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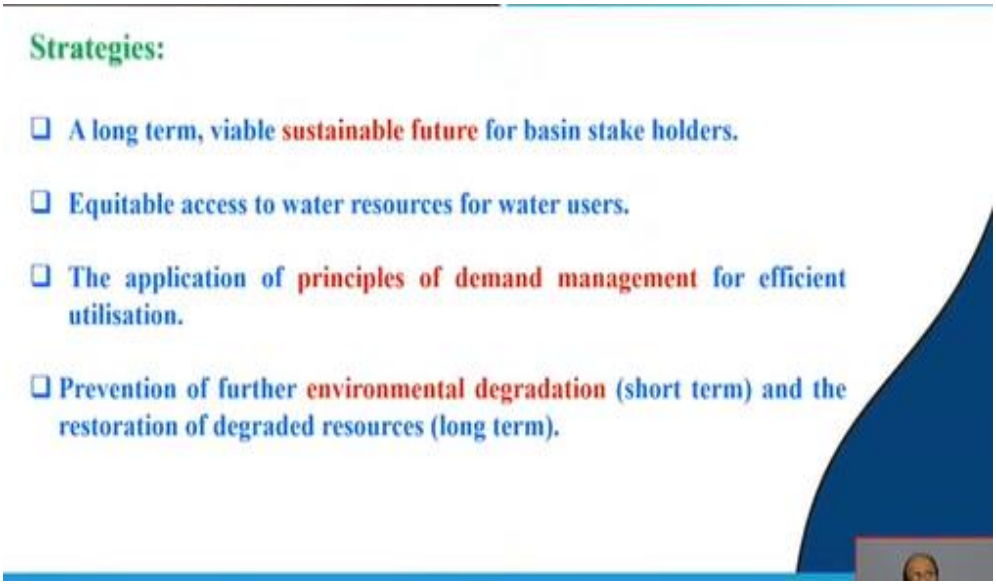

Now strategies are a long term viable sustainable future for basin stakeholders should be done not a short term it should be a long term a viable sustainable future it should have some good future sustainable future. The equitable access to water resource for water users, this is the also one of the good strategies. The application of principle of demand management for efficient utilization, this property principle of demand management is very important for the integrated water resource management approach.

So, its application is required for efficient utilization and prevention of further environmental degradation short term and the restoration of degraded resources long term this will be also one of

the biggest strategy of the integrated watershed management approach. There should be the prevention of environmental degradation in short term basis and the restoration of degraded resources.

Once the resources degraded, we should think over how to restore the degraded resources which is a long term planning. So, these are the long term strategy. So, it should be followed for the integrated watershed management approach.

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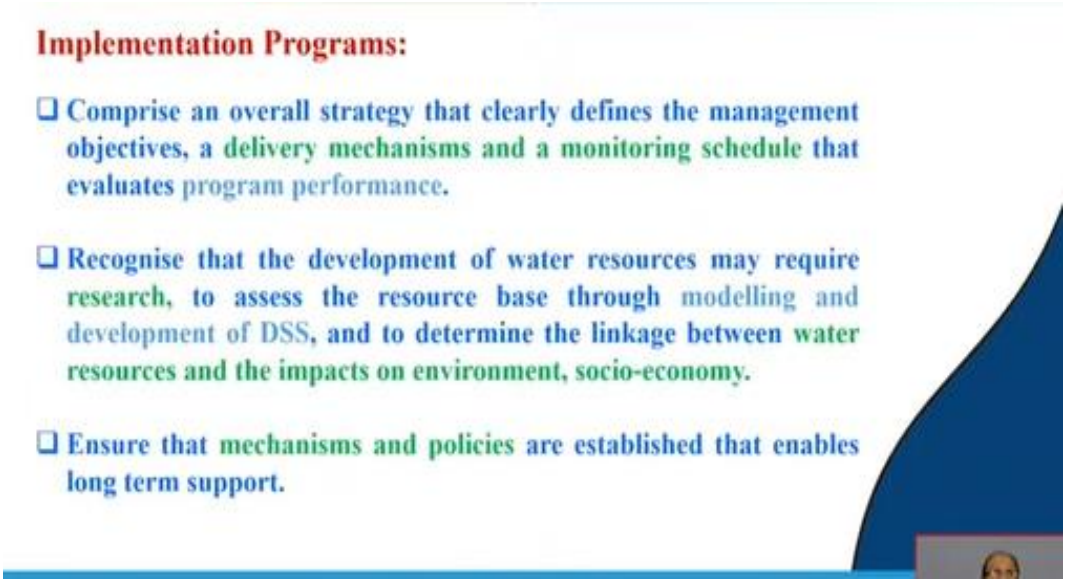

Implementation programs are should be also there because once the policy has been framed up the implementation program should be there if it is comprise an overall strategy that clearly defines the management objectives. The definition of the management objectives should remain clear a delivery mechanisms and a monitoring schedule that evaluates performance program performance should be there.

Recognizing the development of water resource may require research, so some research is required to assess the resource base through modelling and development of DSS and to determine the linkage between water resources and the impacts on environment socio economy. So, this is a very important aspect for the integrated watershed management approach because here we can see the linkage between water resource as well as the impacts on environment and socio economy.

Ensure that mechanisms and policies are established that enables long-term support. This should be also while thinking for the implementation program of the water through the watershed management approach ensure it should be there that the mechanism policies are established which will enable for the long term support.

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Now IWM integrated watershed management is the process of planning and implementing water and natural resources. It is the integration of the biophysical, socioeconomic and institutional aspects. Generally social issues are addressed through involvement of women and minority. Community led water users group have led the implementation efforts. So, the four engineering and management tools for effective and sustainable development of water resource in semi-arid rural India are appropriate technology.

It should be there then only we can think for the sustainable development of water resources. Decentralized development system then the catchment-based water resource planning and the management information system, so, then only if we will follow the four engineering and management tools then the we can think for the effective and sustainable development of water resource in semi-arid rural India.

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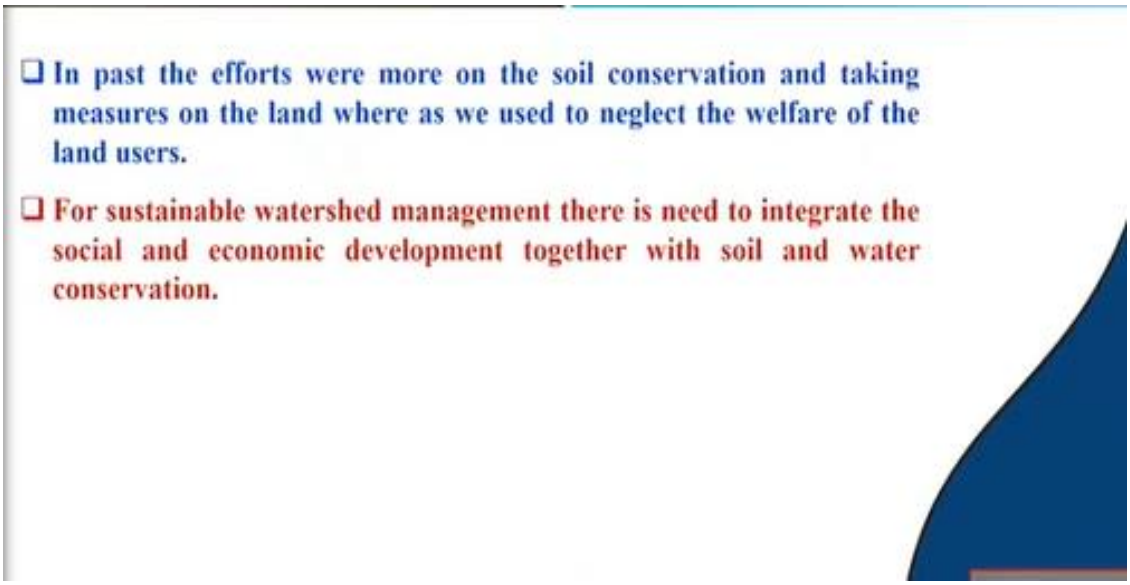

So, in past the efforts were more on the soil conservation and taking measures on the land where as we used to neglect the welfare of the land users. So, earlier also some of the strategies were there even the soil conservation that was the very important issues earlier period. So, this some of the efforts were more like the soil conservation and taking measures on the land where we need to neglect the welfare of the languages.

Now for sustainable watershed management there is need; to integrate the social and economic development together with soil and water conservation. So, for this for the sustainable watershed management approach there is a need to integrate the social and economic development both social as well as economic development together with soil and water conservation along with soil and water conservation.

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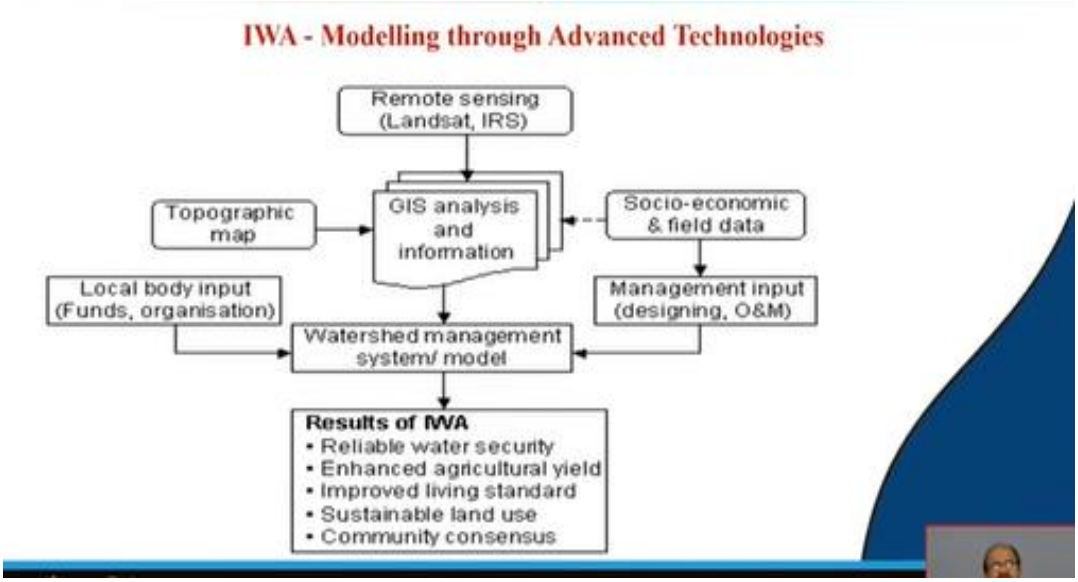

So, in this way we can see that this integrated watershed approach management approach or modelling through advanced technology we can do with the help of the remote sensing tools that is the you can see the remote sensing to study we can do with the help of the topographic map the GIS analysis and information then the socioeconomic and field data. So, this is all we should think collect and prepare some maps for a defined area in which we can also put the local body input that is fund an organization.

Because we are thinking for the watershed management approach, we are thinking for this one so some of the information we can take from the about the land use cover etcetera we can take from the topographical maps and some of the socioeconomic data we can also collect from some of the census book etcetera. And then with the help of the remote sensing tool through the GIS study we can just reach to the with the local body input as well as the management input we can just make the integrated watershed management approach.

So, if the integrated watershed management model will develop it will keep the reliable water security it will enhance the agricultural yield it can help to improvement of the living standard of the human beings there. And it is also helpful in the sustainable land use of the area and the it is just having advantages on the community consensus. So, this approach that is the watershed management approach is one of the best approach for the groundwater resource management.

And for the groundwater resource management this concept the watershed concept is important through the watershed concept we can go for the modelling and through the modelling we can get the details about the area by making collecting several data as well as making several thematic maps. And with the help of remote sensing and GIS tool we can go for the integrated watershed management approach.

And this approach will help us for getting the reliable water resources within the your area as well as it is enhancing the yield in agriculture yield, improving the living standard and sustainable land use in the area. So, this approach integrated watershed modelling approach is one of the best approach; for the groundwater resource management and planning. Thank you very much to all.