Watershed Management

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Lecture No. # 08

Integrated Water Resource Management

And welcome to the video course on watershed managements. Today we will start a new module, module on integrated watershed management, the topics covered in this module three will be introduction to integrated approach, integrated water resource managements, conjunctive use of water resources, rain water harvesting and roof catchment system. Today in lecture number eight, we will discuss the topic on integrated water resource management.

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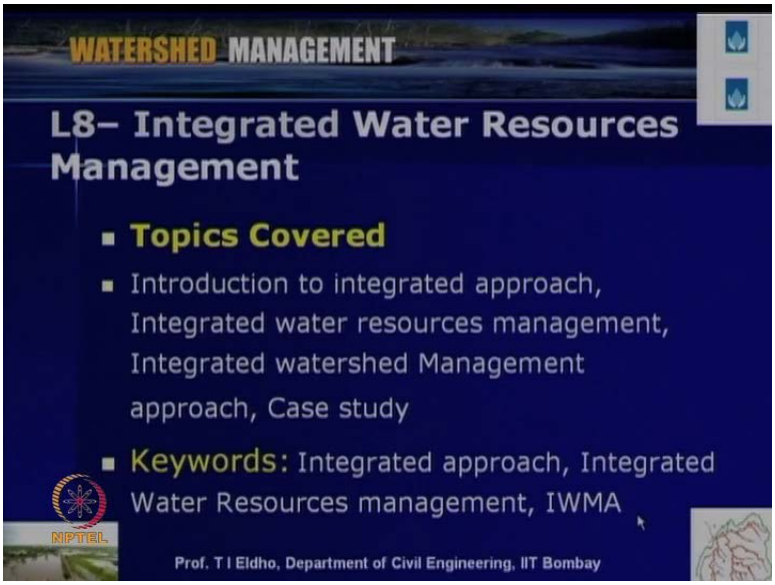

In this lecture, the topics covered includes introduction to integrated approach, integrated water resource management, integrated watershed management approach, a case study. Some of the important keywords in this lecture include integrated approach, integrated water resource management, integrated water resource management approach so the last few lectures we were discussing about the sustainability issues, the land sustainable land management issues, water resource management and within the perspective of watershed

management approach so we have seen that in one way or another way various resources or the management of various resources within a watershed, we have to integrate. So, we have to go for integrated approach for the better management of the various resources within the watershed so within this perspective, let us look what is integrated approach, what are the issues and what are the challenges.

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So, within the perspective of water, the various issues say in a river basin or in a watershed are so, the resources are under pressure, resources like the water or land or under pressure. Then many places population are under water stress, I mean sufficient water is not available even though water available in some locations, the quality is not good enough, so impact of pollution and water governance crisis. So, some people in some areas, some people get more water, some poor people are not getting sufficient water for various purposes.

So, these are some of the important issues as far as water is concerned. So with respect to these issues, what are the challenges, when you discuss in terms of integrated watershed management, so some of the challenges, I have listed here; for securing water for people. So, people should get sufficient water in good quantity and quality; then securing water for food production; that means, for agricultural activities, then developing other job creating activities within the watershed, then protecting the vital ecosystems. So we have seen that for the sustainable management of an area, so we have to look in to the

ecosystems, so we have to protect the various aspects or various things related to the eco systems; so for that, water is very essential.

So then dealing with variability of water in time and space, so this is another important issue as we have seen, say water is available in some locations too much water is available some locations, very less water is available, and then with respect to time also the water availability varies. Then the next challenge is managing the risk, so like various related issues like a climatic changes, so then how to manage the risk related to climate or say the when we will discuss with respect to the pollution, so how to manage the risk related to the pollution.

So then creating popular awareness and understanding so one of the important aspects nowadays which we discuss in terms of watershed management is that people should aware, what is going on and then people should understands the various issues, so that is very important; so, one important challenge is creating popular awareness and understanding and then forging the political will to act so even though we create plans generate plans very good plans for various watershed management or water resource management related issues, so there will be political there should be political will to act upon it so far, that say that is a we have to make the system in such a way that the there is a political view to do the things.

So, we have to do the things in such a way that there is forging the political will to act then ensuring collaboration across sectors and boundaries so we have to see that the water is say as far as water is concerned with respect to rain even though we classify in terms of watershed or particular river basin, so many times we have to deal with the say river passing through different areas or we have to deal with different sectors like agriculture sectors environmental sectors or forestry sectors, so like that. So, one of the major challenge as far as integrated approach is concerned we have to collaborator across sectors and boundaries, so that we will have a better management plans.

So, within this perspective of issues and challenges let us discuss the integrated approach; so, integrated approach can be the integration of various things with respect to the natural system or integration with respect to the various issues related to the human systems; so, these things I have listed here in these slides, so here you can see related to the natural system there is critical importance for resource availability and quality.

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So, that way when we call the integrated approach in terms of natural system includes integration of fresh water and coastal zone management so you can see that the rivers will be joining the sea, so then what is happening the coastal zone that it will be affecting the fresh water availability as well as the various related issues so we have to see the integration of fresh water and coastal zone management then integration of land and water management.

So, that is another important issue which we have already discussed earlier so in terms of sustainable land management or in terms of sustainable water management we have to see the integration of land and water management, then integration of surface and ground water managements; so, the water availability can be surface water or ground water so we have to see that both are used in an integrated way so that ah better utilization efficient utilization will be achieved then integration of quantity and quality in water resource management. So, say as far as natural system is concerned it is not only the quantity of water available, but we have to see that the available quantity of water has good quality.

So, that way we have to we have to integrate within the quantity and quality of the water resource system available then integration of upstream and downstream water related interest, so we have already seen that when we discussed especially in the watershed

based approach so, we what is happening the at the upstream areas that will affect the downstream people also so we have to see that there is integration of especially water related issues with respect to the upstream lands and the downstream lands or downstream areas.

So, we have to see within the perspective natural systems, so let this in an integrated approach there should be integration of various sectors like fresh water, coastal zone, land and water then surface and ground water and quantity and quality upstream and downstream; so, that is as far as integrate approach of natural system. So, now let us see the human system; so, the human system determines resource use waste production and pollution and development priorities etcetera.

So, a human beings or the people within the watershed or people within the river basin do lot of activities within the system so, that should be a streamlined in such a way that or integrated in such a way that say we can achieve the integrated water resources development and management in a better way so as far as human system is concerned we have to main stream the water resources available within the area which we consider then macro-economic effects of water developments so we have to see that the various developmental issues within watershed or within the area within the perspective of the not only the environmental, but economical aspects also that influencing economic sector decisions, so we have to see that say if invest say particular amount of money in a watershed then say what kind of activities in a effective way we can do so that we can have optimal same appliance, so that we can achieve better sustainable development.

Then integration of all stakeholders in planning and decision so this very important in terms of integrated water resource management, so we have already seen a the say people should get involved or the stakeholders should get involved from the beginning. So, in the development of the plans and then also implementations and maintenance so that is the integration of all stakeholders within the area then integrating water and waste water management.

So, as we already discussed it is not only the quantity of water, the quality is also very important so that way we have to see that the various sectors say not only the water resource, but the waste water management also should be integrated in such a way that

say the water a coming to a river base to a river or an aquifer system recharging an aquifer system that should be good quality of water and that will sustain the system.

So, that way the integrated approach we can discuss in terms of natural system or the human system, so now say out of these two issues natural system and human system say let us discuss two important issues; say first one is related to natural system so, that is integration of land and water management.

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So, the land use developments and vegetation cover like crop selection or a forestation etcetera, influence the physical distribution and quality of water, so that is very important, so considering say overall planning and management we have to see that say the land and water the both are resources we integrate both in such a way that optimal or sustainable developments takes place then promotion of catchments and river basin management like a logical planning say as a watershed or integrated water resource management plans, so that is very important in terms of promotion of the catchment say whether in the scale of a watershed or a river basin.

So, then as far as water utilization is concerned we can classify into green water and blue water, green water is the water directly used for biomass production and this in this process the water is lost as vapor transpiration so and then blue water means water

flowing in rivers and aquifers, so mostly say most of the times when we discuss about the the water resource management say we will be discuss the water managements with a focus on blue water only.

But green water is a same say lot of water about more than 50 percent of the water is same gone as green water or water used for biomass production and lost in vapor transpiration so management of the green water having significant potential for water savings also we have to see that. So, when we discuss about the integration or integration of land and water management we have to see not only the blue water, but the green water and also in the land.

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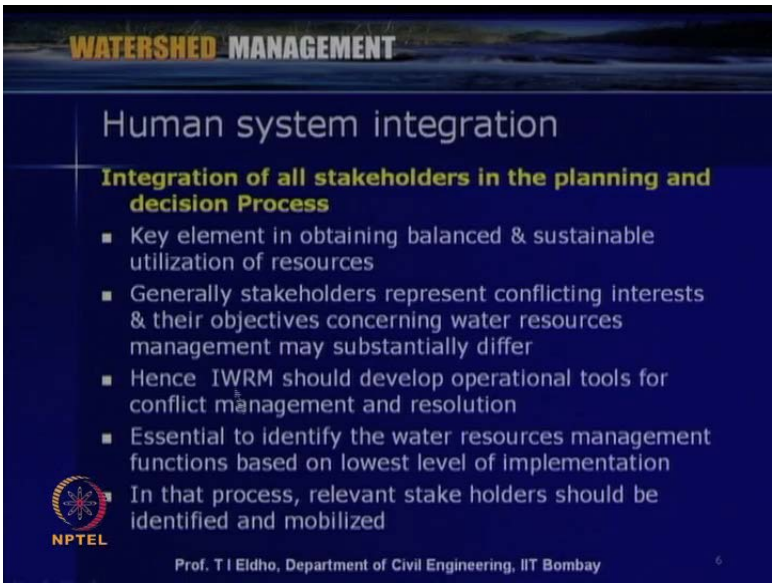

So, then the next one is say one issue which we want to discuss in terms of a human system integration so here a one of the most important issues is the stakeholders and people participations, so here we will briefly discuss about the integration of all stakeholders in the planning and decision process.

So, here the key element in obtaining balanced and sustainable utilization of resources any resource within a watershed in a in a (()) is integration of the stakeholders so depending upon their needs depending upon the the aspiration of people we have to see that the particular projects are implemented or particular management plans are made.

So, generally stake holders represent conflicting interest and their objectives concerning water resource management may substantially differ, so if you consider a watershed people will have different people will have different interests so the rich people may have a different interest poor people may have different interest, so which farmers want to say grow cash crops like your sugarcane and poor farmers may wish to say go for rice cultivations.

So, like that there will be differing views or different say the conflicting interest will be there. So, in integrated water resource management we should develop operational tools for this conflict management and resolution. So, we have to call all the stakeholders whether rich or poor and then we should have a mechanism for conflict management and then we have to resolve the issues so then also it is a essential to identify the water resource management functions based on a lowest level of implementation.

So, we had to see that from a small scale farmer to the particular the level or to all the implementation is concerned we have to see that all the people are part of the implementation process and in that process relevant stakeholders should be identified and mobilized. So, in any integrated system so, we had to see that say starting from the the grass root level people say people should get involved in in a developmental plans and also implementation and the maintenance, so now within this perspective, so when we discuss about the integrated water resource management say three major issues we have to deal.

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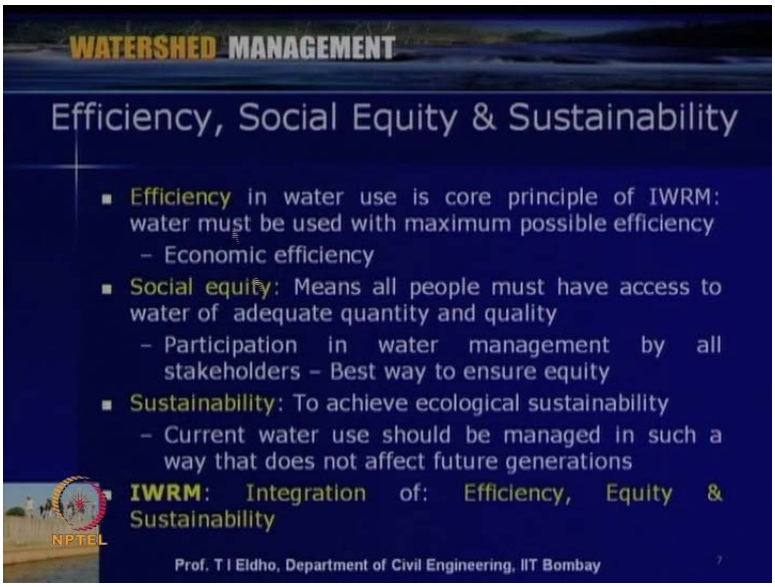

So, this issues are say efficiency of the system then social equity and sustainability of the of the watershed management or water resource plan; so this issues we will discuss briefly in this slide so as far as efficiency is concerned efficiency in water use is core principle of integrated water resource management, so water must be used with maximum possible efficiency.

So, as we discussed earlier say for example, in agriculture sector, so much of water is wasted say. For example, in case concerned more than eighty percent of the water is used for agriculture purposes, so how we can say deal with this demand and supply management so that we can achieve efficiency and then also we have to see economic efficiency, so as we discussed water resource it has to be considered as a good with an economical value so that we can achieve economic efficiency.

And then another important issue in integrated water resource management is social equity; so, social equity means all people must have an access to water of adequate quantity and quality; so this is a very important issue, so say within a watershed whether people may be poor or rich, but ah does not matter, so as far as water is concerned say adequate quantity and quality of water should be available all for all people say for all their needs say including the drinking or the sanitation purpose or the agricultural purpose or any other needs.

So, as far as social equity is concerned participation in water management by all stakeholders is very important in development plans and implementation so that is a best way to ensure equity as far as water management is concerned, then as we discussed earlier the sustainability issues are very important, so to achieve ecological sustainability we have to see that water is allocated or water is used in an appropriate way.

So, the current water use should be managed in such a way that it does not it does not affect the future generations, so say for example, if you are overdrawing water from an aquifer system and then if you are not recharging sufficient water to the aquifer system there will be the aquifer says the pump the pumping wells will get dry, so there will be problems, so like that say when we deal with any system within the perspective of integrated water resource management we had to see that a sustainability of the system is maintained.

So, finally so integrated water resource management means integration of in all these issues like efficiency the System should be efficient then equity should be there and sustainability should be there for the considered system. So, now within this perspective let us now finally define the integrated water resource management so now last two decades lot of discussions are going on at various international meetings like a global water partnership, unesco meeting, united nations meeting or even international monetary fund meeting etcetera, so the everywhere as far as water sector is concerned people are talking a term called integrated water resource management or integrated water resource development and management.

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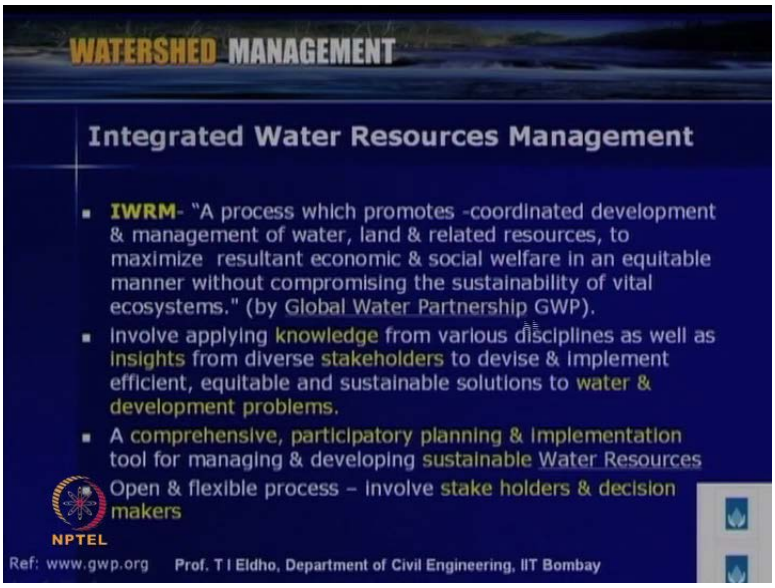

So, as far the definition given by global water partnership GWP, the integrated water resource management means is a process which promotes coordinated development and management of water land and related resources to maximize resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems, so this is the definition of IWRM or integrated water resource management as per the global water partnership which is given in their website.

So that way when we talk about IWRM, it involves applying the knowledge from various disciplines as well as insights from diverse stakeholders to device and implement efficient equitable and sustainable solutions to water and development problems so this is the explanation, so as we discussed in the last few slides there should be the as far as water use is concerned it that it should be efficient then social equity should be there and then sustainability should be there.

So, that way this integrated water resource management or integrated water resource development management is a comprehensive participatory planning and implementation tool for managing and developing sustainable water resource.

So, that ways we can see that say here a comprehensive participatory planning and implementation tool so that way we can say IWRM so within that perspective so all these

process are concerned or the process should be open and flexible and of course, the IWRM involves stake holders and decision makers in all the development plans so it can be either watershed basis or river basins basis or a regional basis or state wise or country wise.

So, whichever we term we call so IWRM or integrated water resource management, so there should be a equity should be there then the it should be efficiency should be there and then the system should be sustainable so, this is the fundamental definition as far as IWRM or integrated water resource management as given by global water partnership so that way, now let us look into what are the important principles as far as IWRM or integrated water resource management is concerned.

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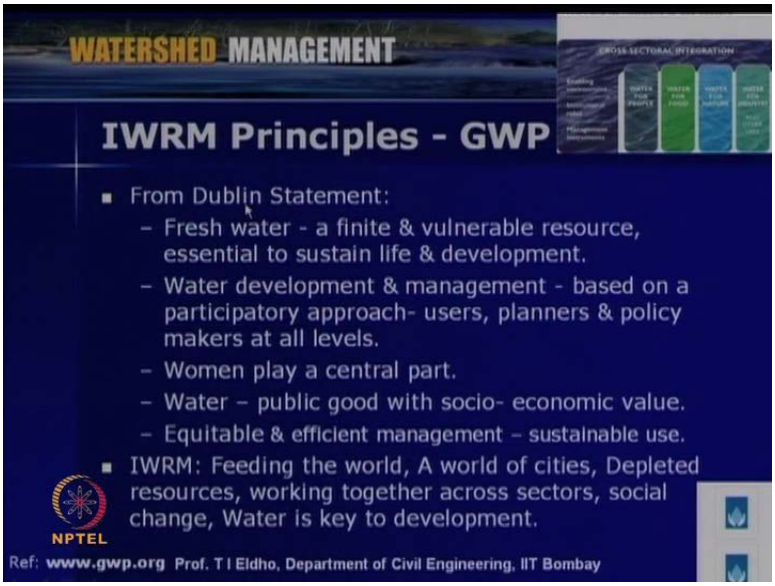

So, as given by GWP or global water partnership say in the Dublin statement the important principles are the fresh water is a finite and vulnerable resource which is essential to sustain life and development; so this is the first principle as given in Dublin statement then second principle is water development and management should be based on a participatory approach. So, the users the planners and policy makers at all levels

should in should be consulted and should include in all the developmental plans implementations and maintenance; so, this is the second principle as per as GWP.

And then is a third principle from the Dublin statement is women play central part as far as the integrated water resource management is concerned, so especially we can see that in developing countries or under developed countries you can see that women say they have to get water from say for their for the daily life of the family for the cooking and all other purposes so the women should always have central role as far as any of the development plans as far as integrated water resource management is concerned.

And then the fourth principle is the system should been so, that way water we have to say put it in such a way that it is a public good with socio-economic value, so this is the one of the most important aspect of this Dublin statement so water resource it water we had to see it as a good, but it is a it has a socio-economic value, so it not only economic value, but socio economic is most important since say we cannot put say the as far as water rate is concerned or when we supply water we cannot increase the rate beyond certain level since it is also a socio socio-economic good.

So that people need for the for their for the sustaining the life, so for the sustaining the ecological system, so that way water is public good with a socio-economic value, so in all these the basic is the water should be there is a watershed resource should be equitable and efficient management should be done in all levels as and then the use should be sustainable.

So that is so these are the important principle four principles as far as Dublin statement is concerned, but the final one say in all these four principle say the management is concerned it should be equitable efficient and sustainable system so that way if you as per global water partnership, so I W R M or integrated water resource management, so if we can say achieve say all these important principles as far as the water management is concerned.

So that way say we can feed the world; that means, say we can produce sufficient biomass for the people and for the ecosystem and then say you can see that the say now a large scale urbanization is going on say in all developing countries so that way lot of stress is there as far as water is concerned so that also we have to deal and then water resource system is get depleted and so we have to work together across all sectors so that

we can have social change and all this development plans water is the key as far as the development is concerned.

So, when we are looking for all the development plans as far as a country is concerned or as far as state is concerned or even local government is concerned, water is the key aspect as far as the developmental issues, so say we have to see the development of this water resource system in an integrated way by considering all these principles discussed here, so now let us see, what are the important concepts are as far as integrated water resource management is concerned.

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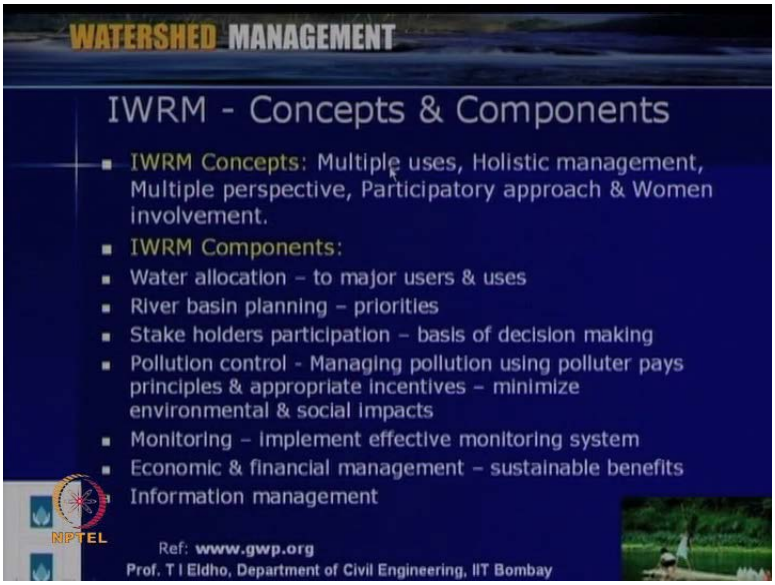

So, we have seen that water is concerned say multiple users are there multiple uses are there. So, we have to go for holistic management, so it is not only you know say management of a one sector, but say we have to integrate various sectors so that holistic management is there.

And then we have to see the various perspectives as far as water use is concerned like multiple perspective and participatory approach and women involvement so all these things we have to see as far as integrated water resource management concepts are concerned, and then let us see what are the important components as far as IWRM is concerned.

So, important components are listed here like water allocation to major uses and users so how we allocate for each sector and then how efficiently we can do this then river basin planning so as far as river basin is concerned what are the important priorities so that way we have to see then stake holders participation.

So, as we discussed in earlier lectures it is very important not only in a planning stage, decisions making and implementation then not only the quality of quantity of water, but quality is very important so pollution control like managing pollution using say for example, polluters pay principles and appropriative incentives, so that we can minimize the environmental and social impacts as far as pollution are concerned.

Then monitoring so we have to monitor the various systems so that we can implement effective monitoring system for the considered as a watershed or river basin scales system, then economic and financial management so so as we have seen water is a socio-economic good.

So, when we invest money for a particular project we have to see that where is the benefit are sustainable so that it issue also we have to see and then finally in as far as I W R M components are concerned information managements. So, the people should know what is going on or what kind of projector is implemented and what will be its benefits, so information management is also very important.

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So, now say within these perspectives as far as integrated water resource management is concerned the three basic pillars of IWRM include; first one is enabling environment so, there we have to see the suitable policies then various strategies and legislation for the sustainable integrated water resource management so that is the first pillar and second one is institutional framework, so we should make a sufficient appropriate institutional framework so that policies can be practiced and we can develop appropriate strategies and legislation.

And third important pillar is setting the management instruments for the implementation so, it is not only once the plan is made we have to implement appropriately and then we have to maintain it appropriately so, the third pillar is the management instrument for implantation. So, like this so if we consider the various aspects of integrated water resource management as far as IWRM planning is concerned we can put it in a cycle. So, we have to consider it is a particular system which we are considering whether it is watershed system or river basin system. So, then we have to see what are the issues as far as the system is concerned, so then we have to analyze the gaps as far as the various say resource management is concerned and then we have to build commitments to actions so, that we can say remove these gaps and for better management plans.

And then we have to go for implement the framework within the watershed or within the area which we consider and then we have to continuously monitor and evaluate the progress, so it is not only simply implementing the plan, but we have to continuously monitor and then see whether whatever we put us our objectives whether we are able to meet those objectives and we should go for appropriate evaluation system.

And then we have to establish status and goals we again we may have to comeback so this is a cycle, so we have to further based upon the the experience based upon the earlier studies we have to establish again status and goals, and finally we have to build commitment to reform process.

So, earlier implemented plans may not be correct there may be mistakes so; we have to change with respect to plans which were say which were made earlier and then we have to reform the process so that we will have a better integrated water resource management plans; so, this is this will continue again back to the we may have to go back to the

system and then analyze and then continue various aspects as far as the integrated water resource management plans are concerned; so, this is this way we can see that this is a cycle IWRM planning is a cycle so, which we have to continuously keep on going from one aspect to another aspect.

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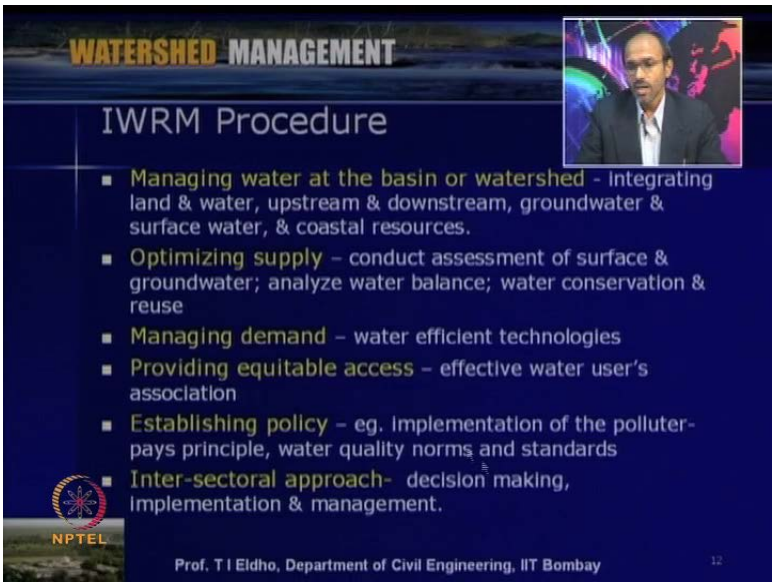

So, now a within this perspective let us see how we can implement integrated water resource management plans, so what are the procedures, so the various say steps as far as the implementation is concerned or IWRM is concerned are listed here; so, first one is managing water at the basin or watershed scale, so, whatever is available within that basin or within that watershed we have to manage their itself.

So, we have to integrate land and water upstream and downstream and ground water and surface water and the coastal resources so like that we have to manage whether watershed scale or basin scale then the second step is we have to optimize the supply so we have to conduct assessment of surface and ground water available.

Then we have to analyze the water balance then we have to see that how we can conserve the water and then whether we can go for water recycling or water reuse so that issue we have to see, so that is the next step optimizing the supply. And then the next step is managing the demand so we can see that various sectors will be are having

different demands so we have to optimize these demands so that we will be having an efficient water utilization, so we have to also in this especially in agricultural sector we have to go for water efficient technologies we also in industries also we have to go for water efficient technologies.

Then next step is providing equitable access so within the perspective of integrated water resource management we have already seen that there should be social equity should be there, so we had to see effective water users association are there say on a watershed scale or a river basin scale so that we can have equitable access as far as water resource is concerned and then we have to establish a policy as far as the water management is concerned, so for example, implementation of the polluter pays principle say for the particular river is concerned if the if some companies or some industries are polluting the water then they have to pay for the cleaning up operation.

Then water quality norms and standards so we have to establish policies so only this much total dissolved solids are BODCOD that for that particular location of the river or lake that is only allowed so that way we have to establish the policy, then the last one is inter-sartorial approach, so as far as IWRM procedure is concerned so we have to see that various sectors are integrated in such a way that starting from the development plans to decision making and implementation and management of the system.

So all the sectors including stakeholders, government and then the NGOS or other all the sector people are involved in an appropriate way so that way they are the important steps as far as the I W R M procedure is concerned.

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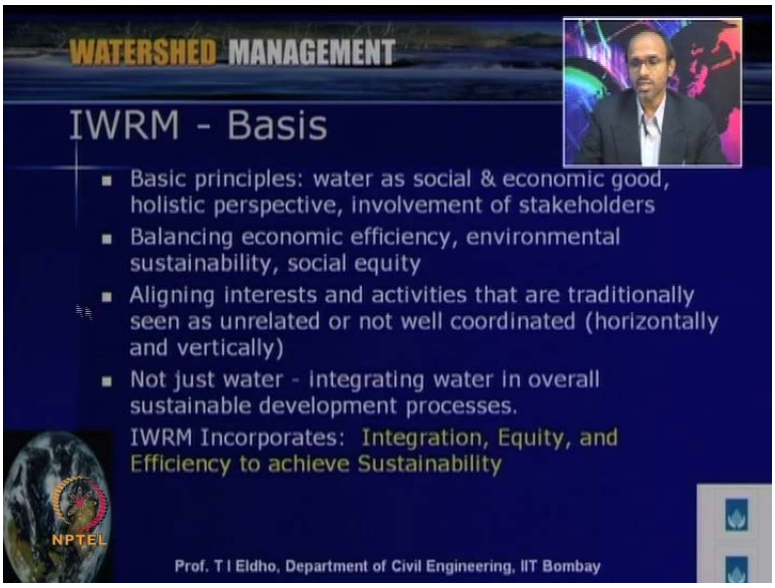

So, finally so when we when we are looking to implementation of integrated water resource management, what are the basis so some of the important points are listed here; so, first one is the basic principle which we already discussed earlier, so in the as far as basic principle is concerned we consider water as social and economic good so we have to go for a holistic perspective as far as a water management is concerned.

And then we have to get involved with all the stakeholders so these are the basic principles and then balancing we have to balance the economic efficiency environmental sustainability and social equity as far as water is concerned within the perspective of IWRM.

Then we have to align the interest and activities that are traditionally seen as unrelated or not well coordinated. So, we had to see that the all the sectors or the all the people all the stakeholders are actively participating and then all are all needs are say either in horizontal or vertical direction all the traditional systems are taken care all the people needs are taken care.

And then it is not just water, but we are integrating water in overall sustainable development process so it is not only water as we discussed it is water land all resources all the people and the ecosystem so that way as we discussed earlier IWRM incorporates

integration of the various sectors so that there will be equity will be there efficiency will be there and finally, we achieve sustainability through all these means; so that is the fundamental principle or the basis of integrated water resource management.

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So, now say we have seen the basis the principles concepts of integrated water resource management, so now the next question is how to implement as far as this integrated water resource management is concerned either on a watershed scale or a river basin scale how to implement these principles so the implementation is concerned the various issues are listed here in this slide.

So, the enabling environment likes a national provincial local so said to the implementation is concerned it can be by national government or the provincial government or local panchayat. So, it can be from top to bottom or say from say various companies to communities so like that so the enabling environment it can be so this various say sectors either national government or provincial government or local government then the role of government so we had to see government as a enabler, government as controller, government as regulator and also government as service provider.

So that say the government can improve the public sector and then government can the various sectors of the government as well as private sectors can come together so that say the principles of the integrated water resource management system can be implemented for the particular area, then water legislation so there should be framework either political say there should be political will to enforce and then the various requirements as far as the system are concerned, and then cross sect oral like an upstream downstream dialogue allocation, coordination and implementation then we have to see the finance and economics.

So, finance and structures and investment allocations for water resource, infrastructure then public investments then private sector public private partnership then cost of water so etcetera, then cooperation within the international river basins so, in many areas one river will be passing from one country to another country.

So, there should be cooperation between the countries so that the available water resource can be utilized in an efficient way in the within the perspective of I W R M then in the institutional roles so we have to as far as institutional roles are concerned the capacity building should be done between the various sectors then we have to develop the various instruments so called management instruments such a way that we can achieve the integrated water resource management.

Then water resource assessment so we have to see we have to assess the available water resource so that we can deal with the availability and the demand then communication, and information systems so that all the stakeholders know what is going on within the system then water allocation and conflict resolution as we discussed there will be conflicts will be there between the people between various sectors.

So, we have to see an appropriate plan for allocation and conflict resolution and then finally the regulatory and economic instruments so the from the government sector or the regulatory sector there should be direct control and then also of course, there should be self regulation as far as say like in the water uses groups make their own plans as far as water management is concerned so this way we can implement the integrated water resource management plans.

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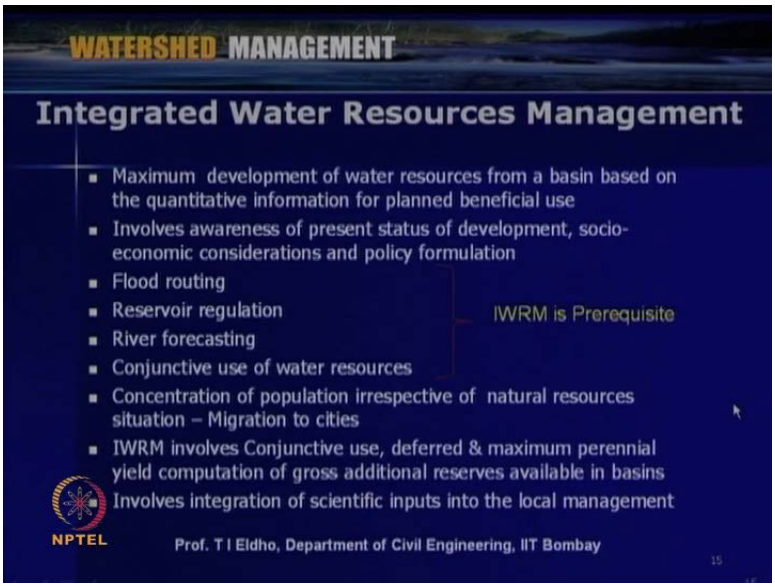

So, now finally here say as far as integrated water resource management is concerned say it can be various things can be there like a maximum development of water resource from a basin based on the quantitative information for planned beneficial use then involves it can involve awareness of present status of development socio-economic consideration and policy formulation.

So, there can be various technical issues like flood routing reservoir regulation, river forecasting then conjunctive use of various water resource so we will be discussing about conjunctive use of water resource in the next lecture then concentration of population irrespective of natural resources situation, and then migration to cities so like this say when we discuss the IWRM so it may involve the conjunctive use differed and maximum perennial yield computation of gross additional reserve available in the basin, the river basin and it may also involves integration of the scientific inputs into the local management on a watershed basis or on a river basin scale.

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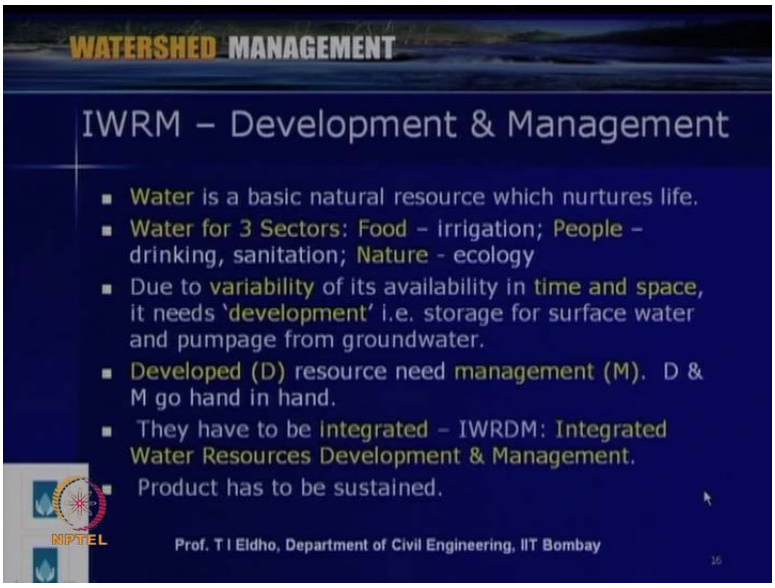

So, finally now what we are discussed is integrated water resource management. So, let us look as far as the issues related to development and management so as we discussed earlier water is a basic natural resource which nurtures life so water is basically used for three sectors; like food, production say for example, for irrigation then people use like drinking, sanitation, industrial purposes then natural uses ecological purpose.

So, as we discussed earlier due to variability with respect to space and time so we have to develop the available resource and then we have to see that say for example, surface water and ground water developed in integrated way so whenever we go for development so, we have to manage the systems so the development and management go hand in hand so that way within the perspective of integrated water resource management principles which we discussed earlier.

We have to say integrate the integrated water resource system so that way we can call the term called integrated water resource development, and management compared to simply IWRM so it is development and management so that the water is the availability is there and then sustain sustainability is there as far as the water sector is concerned.

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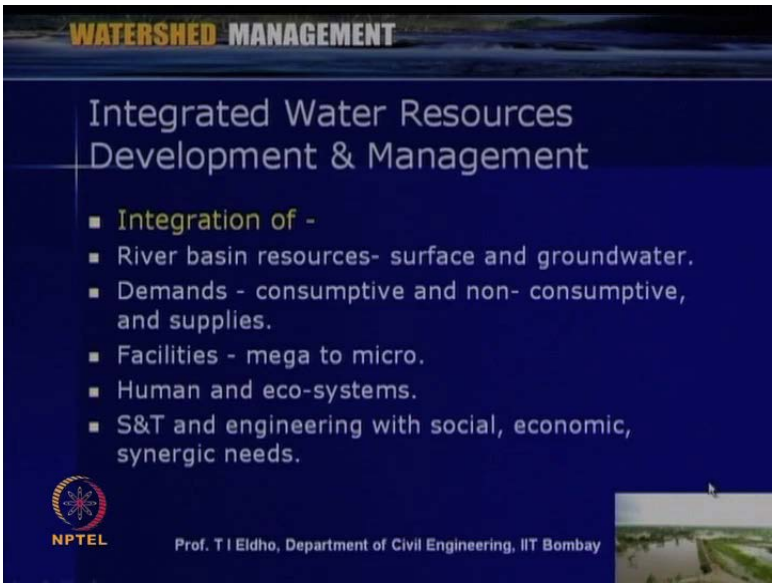

So, that way as we discussed it can be integration IWRDM integrated water resource development and management is concerned it can be integration of say river basin resources like a surface water, and ground water it can be integration of demands like a say for demands for agriculture purpose or non agriculture purposes so that way consumptive demands and non consumptive demands and then how much water is available as far as supply is concerned.

So, this this IWRDM can be in terms of the demand and supply managements and then also we can also talk IWRDM in terms of the facilities like integration of micro projects to mega projects so that way also we can discuss, and then as we discussed in the earlier slide slid so, it can be also integration of human system and ecosystems and then also we can integrate the science and technology and engineering with the various issues related to IWRM like social economic and their synergic needs so IWRDM can be in terms of integration of all these things either sum of these things or all the things depending upon the particular problem which we consider.

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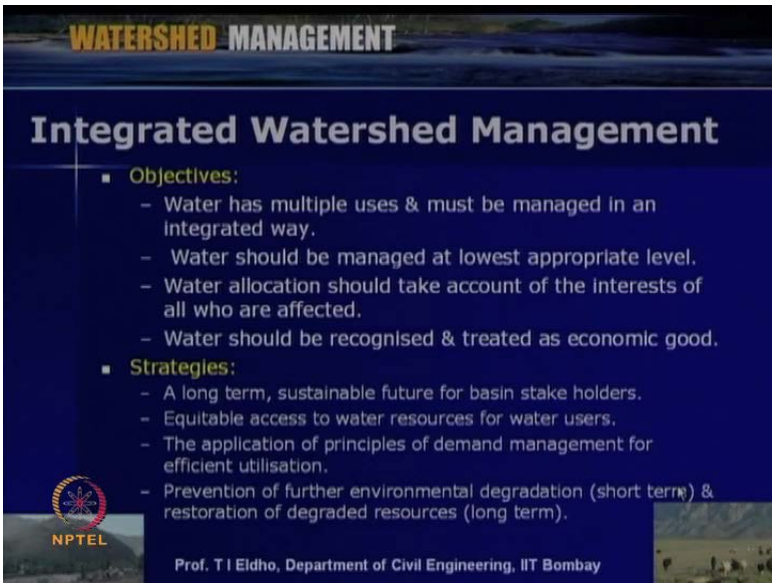

So, now, a so far we discussed about the integrated water resource management and integrated water resource development and management. So, now let us comeback to the say this aspect in terms of watershed so that way now we will discuss briefly about the integrated watershed management approach.

So, when we discuss in terms of watershed the integrated watershed management approach the main objectives are listed here so this includes say this is very similar to what we discussed earlier as far as IWRM is concerned also, but now we are talking in terms of watershed scale so as far as watershed scales the objectives are concerned water has multiple uses, and must be managed in an integrated way; that means within the watershed then water should be managed at lowest appropriate level so that means, from the say the people who are using the water on the watershed scale then water allocation should take account of the interest of all who are affected so that way all the stakeholders should be consulted.

Then water should be recognized and treated as an economic good so the objectives are almost same as I W R M then say as far as watershed integrated watershed management is concerned the various strategies are listed here, so it can be a long term sustainable future for a basin or watershed stakeholders, so whenever we make plans integrated watershed management approach we have to see that we have to plan for long term.

Then equitable access to water resource for water users so this is also very similar to I W R M as per global water partnership definition.

Then application of principles of demand management for efficient utilization so we have to see the supply and demand management then prevention of further environmental degradation says that it can be a short term goal, and then restoration of degraded resources so this issue also we have discussed so in terms of watershed we have to see short term goal may be to prevent further degradation, and long term goal may be we have to restore the degraded the watershed system so that way these are the objectives and strategies as far as integrated watershed management approach is concerned.

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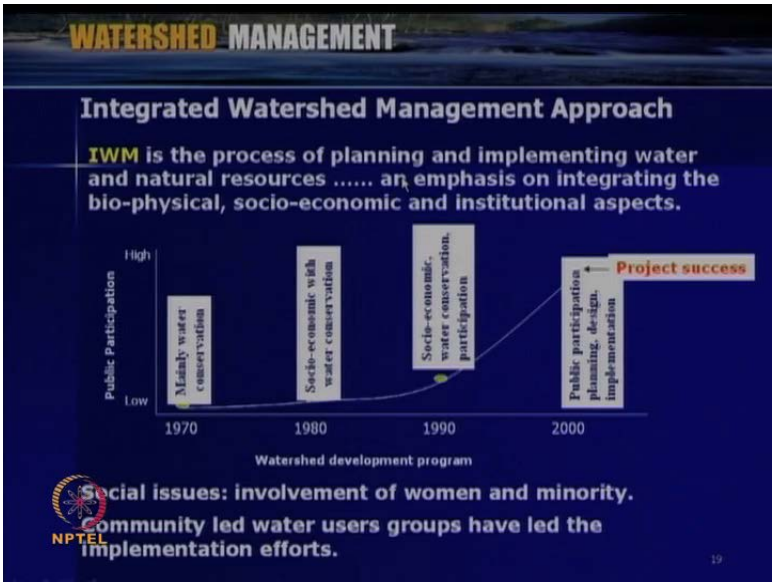

So that way finally, we can define the integrated watershed management approach as the process of planning and implementing water and natural resources so that the emphasis an integrating the bio-physical socio-economic and institutional aspects as far as the considered watershed is concerned. So, now you can see that say if you critically analyze the watershed development programs or projects say in india say for example, in 1960s and 1970s, the main emphasis on was on water conservation.

So, the projects the important projects where implement by central and state government so, the mainly it was for water conservation so the people were not consulted in these issues. So, public participation was very minimal then in eighties thrust was socio-

economic with water conservation so, the sum of the social issues, economical issues also were considered and in again in the project many of the projects were not successful.

Then in 1990s, the thrust into socio-economic and water conservation and also to certain extent the people needs people participation were considered so you can see that a project success in many of the project implemented were successful during that time and finally, now within the perspective of integrated water resource management the government various state government and central government identify the needs of the people.

Then how the stakeholders involvement and the public participation in planning and design and implementation stage where now done in a say that the project implemented in the last two decades, so that way we can see that many of these projects are successful, so that way like the social issues like involvement of women and minority were consider community led water users groups have been formed in many of the projects area.

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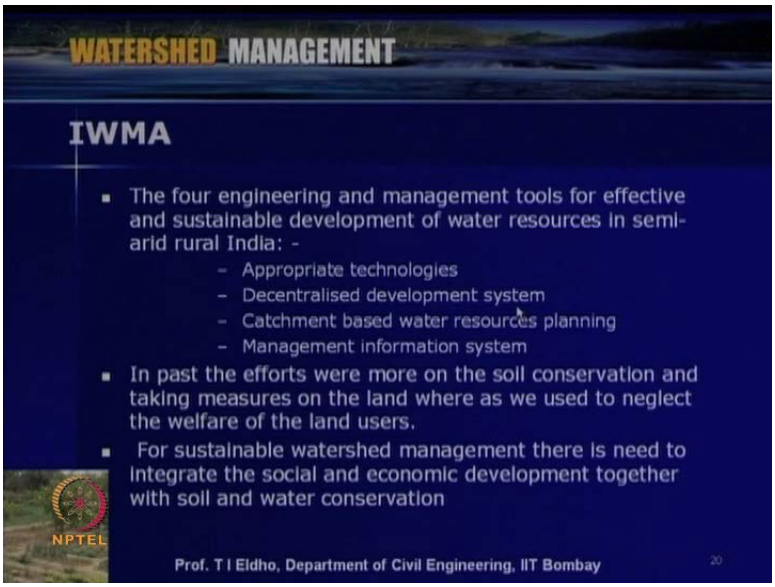

So, that way now most of the cases we can see that the projects have become successful so within the perspective of integrated watershed management approach say as far as science and technology is concerned we can see that for engineering and management

tools which can help in effective and sustainable development include appropriate technologies decentralized development system then catchments based water resource planning then management information system, so for the considered system we can develop appropriate technologies and then we can go for decentralization of the system and then catchment based or watershed based planning is implemented and we can develop appropriate management information system for the by considering various issues.

So, in the past the efforts were more on soil conservation now by say earlier we used to neglect the welfare of the land users, but now we look into the sustainable watershed management we are integrating the socioeconomic development together with soil and water conservations, so that way if we critically analyze you know the recent recently many of the projects which taken care the socio-economical aspects and then the various other technical issues we can see that most of the projects are successful.

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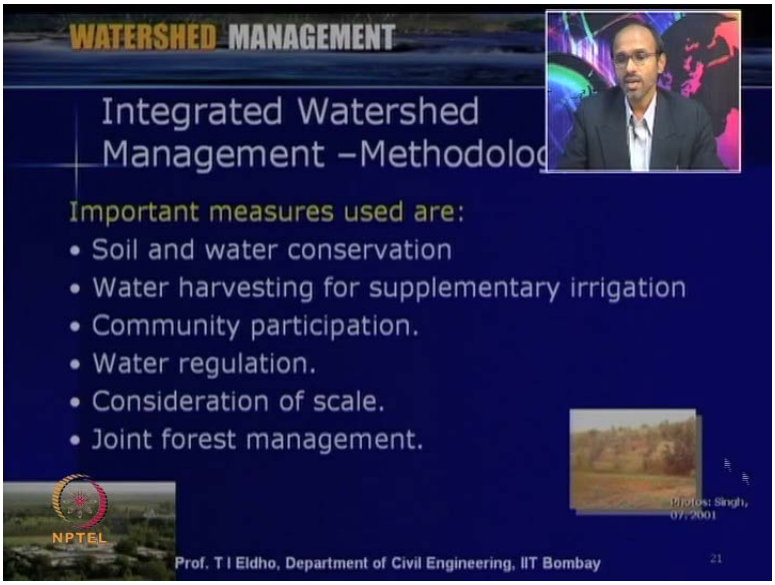

So, that way say in an integrated watershed management say the methodology which is to be adopted the important measures used are listed here like a soil and water conservation, water harvesting for supplementary irrigation, community participation, water regulation, consideration of the scale say like on a watershed scale as minor watershed or major watershed depending upon the requirement and then the joint forest management so, like that various issues we can integrate together so that we can develop

an appropriate methodology as far as integrated watershed management approach is concerned.

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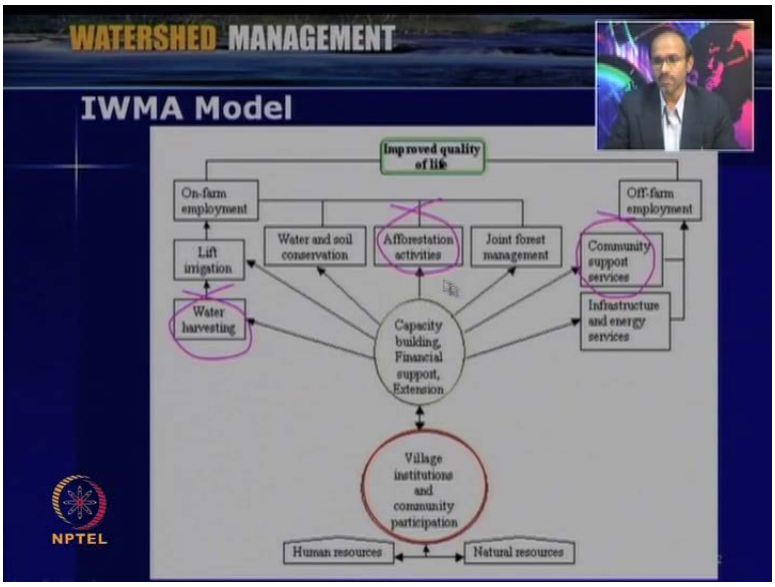

So, that way we can develop an integrated watershed management model so this model we have discussed earlier also so the there will be human system will be interacting with the natural system and then say the all the stakeholders will be coming to picture, so then we will be having appropriate capacity building so then we go for various sectors like water harvesting then soil consideration a forestation then community support services so like that, finally they will lead to achieve better quality of life or improved quality of life and poverty elevation as far as and the watershed is concerned.

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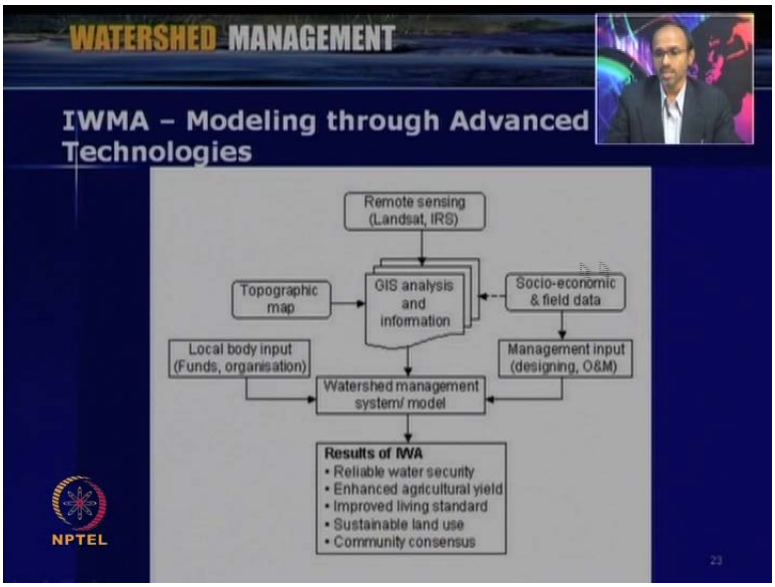

So, now, let us see the various advanced technologies how they these technologies can help as far as the integrated water resource management approach is concerned so say for example, if you consider remote sensing that can be used for to see the in a get a holistic picture of what is going on within a watershed and then land use land cover, the crop management issues, availability of surface water etcetera.

So, that we can get through the remote sensing and then we can use the topographic map within geographical information system so that we can develop better maps and then we can integrate within the socio-economic aspects as far as the watershed is concerned, and finally by considering all these issues we can develop appropriate watershed management system or model. So, from that say once it is implemented the results may be reliable water security enhanced agricultural yield improved living standard sustainable land use and community consensus.

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So, that way as far as the integrated watershed management approach is concerned say when we are looking for watershed management plans so as we discussed earlier we can start with natural resource mapping for the area then social mapping then we can go for users group, village volunteers then we can go for participatory appraisal and then we can prioritize the options then we can go for the implementation.

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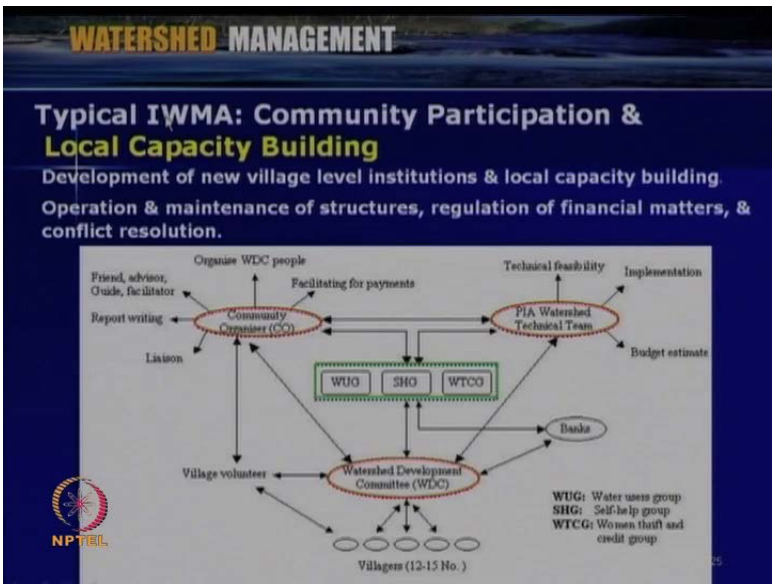

The integrated watershed management approach it is development of new village level institutions local capacity building and then we go for a holistic development plans, so it

can be say starting from with village then watershed development committees then water users group like that various users group can be formed so that we can go for a appropriate watershed development plans.

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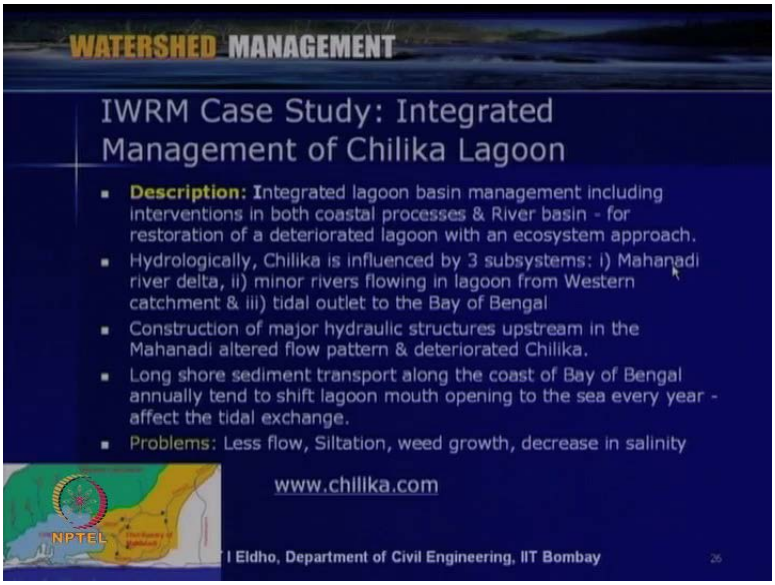

So, now before closings today let us briefly go through one case study of integrated water resource management so this case study is integrated management of Chalice lagoon so this is a lagoon system located in Orissa in India. So, this case study to describe on the integrated lagoon basin management including the interventions in both the coastal processes and the river basin for restoration of a deteriorated lagoon with an eco system approach so this is the lagoon system in Orissa so you can see that the water is coming from Mahanadi river basin and some small rivers, and then that is finally passing through this lagoon system to the Bay of Bengal so here this is the Hydrologically this was influenced by Mahanadi river delta some few minor rivers and the tidal outlets to the Bay of Bengal. So, construction of major Hydraulic structures upstream in the Mahanadi altered the flow pattern and lagoon was deteriorated with the siltation weed growth and decrease in salinity.

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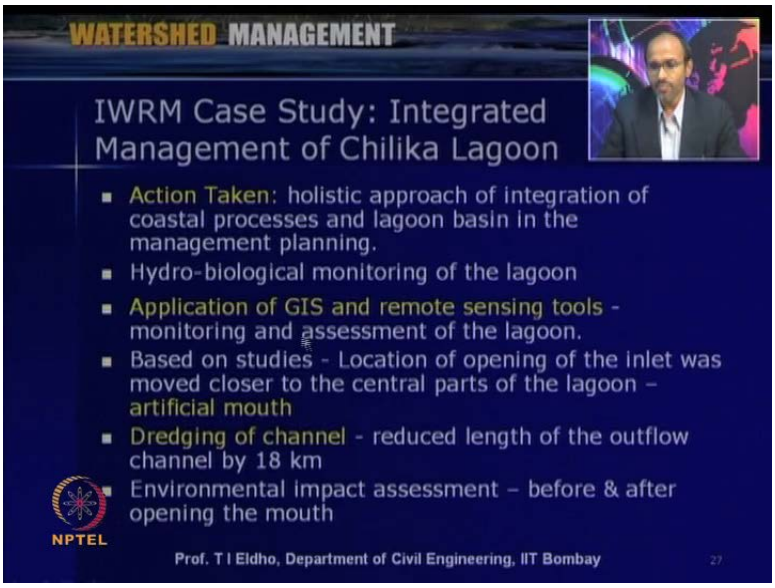

So, some of the action plans taken say as far as this Chalkier lagoon is concerned the holistic approach of integration of coastal processes and lagoon basin in the management planning so hydro-biological monitoring of the lagoon has been done then modern tools like GIS and remote sensing were used for monitoring, and assessment based on various studies say the location opening of the inlet was moved closer to the central parts of the lagoon and an artificial mouth was generated and the dredging was done for the silt channels and areas. And then also the environment impact assessment has been done before this project has been implemented and after the project has been implemented.

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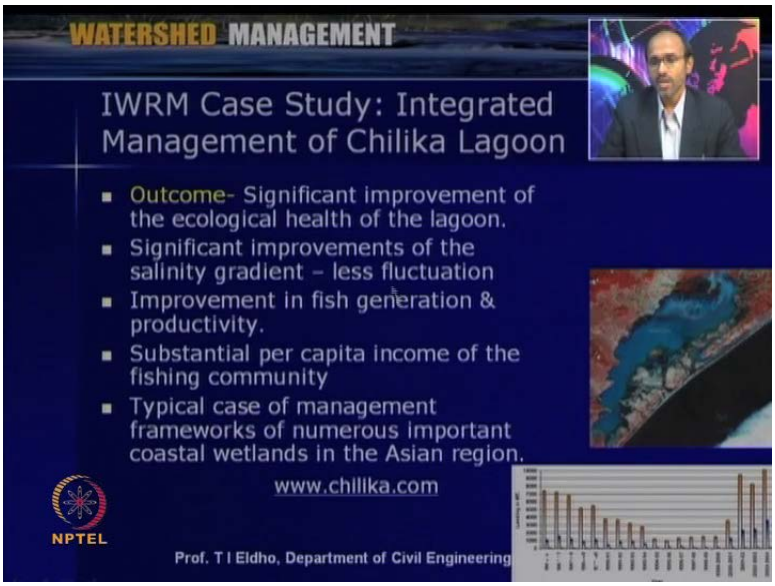

So, some of the outcome of this project are listed here there was significant improvement of the ecological health of the lagoon then significant improvements of the salinity gradients with less fluctuation so due to this reasons there are there was considerable improvement in fish generation, and fish productivity so this say the outcome was substantial per capita income of the fishing community in this area then this is a typical case of management framework of numerous important coastal wetlands in the Asian region.

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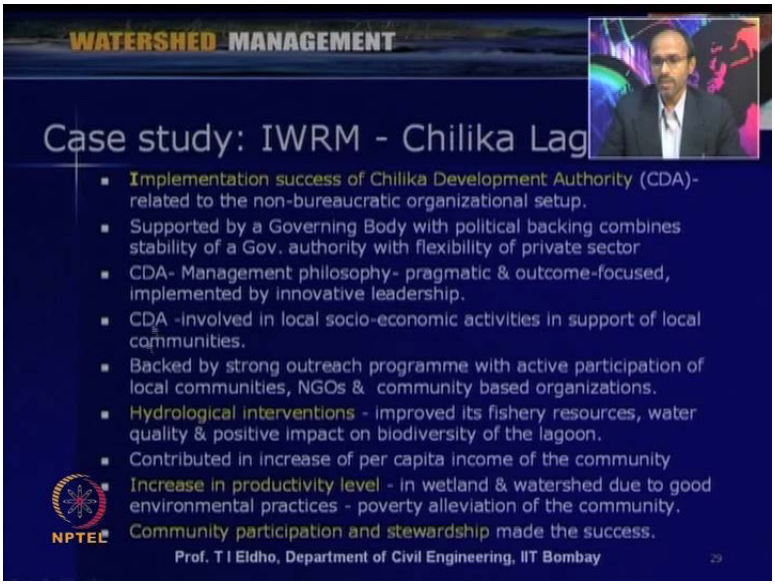

So, the details you can see in this website and say the impacts of the lessons learned from this case study this is a say successful implementation of Chalkier development authority related to non-bureaucratic organization setup supported by government, and other agencies so Chalkier development authority is concerned management philosophy include pragmatic outcome focused implementation by innovative leadership.

And it involves local socio-economic activities backed by strong outreach programmers including NGOS and community based organizations and then scientific interventions like hydrological interventions were done, and then finally the outcome is increased productivity level and says the one important aspect is community participation and stewardship made the success as far as within the perspective of integrated water resource management as far as this Chalkier lagoon case study is concerned.

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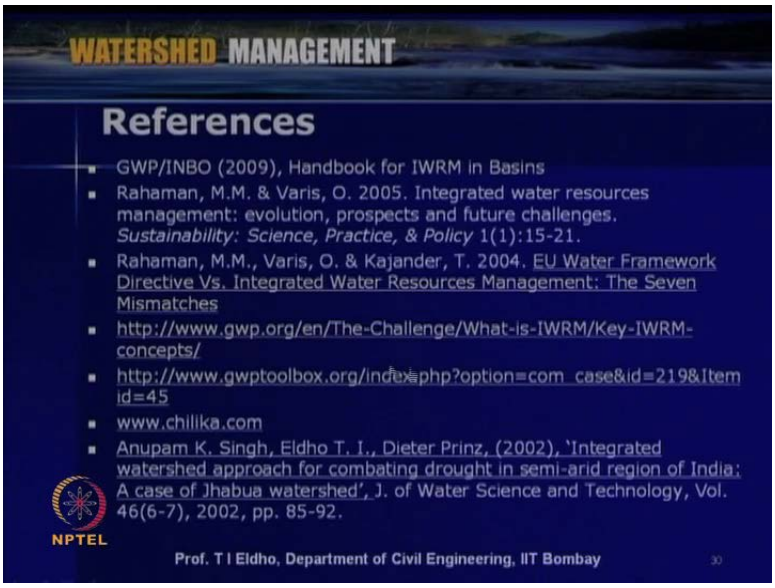

Some of the important case references used in today's lecture is listed here.

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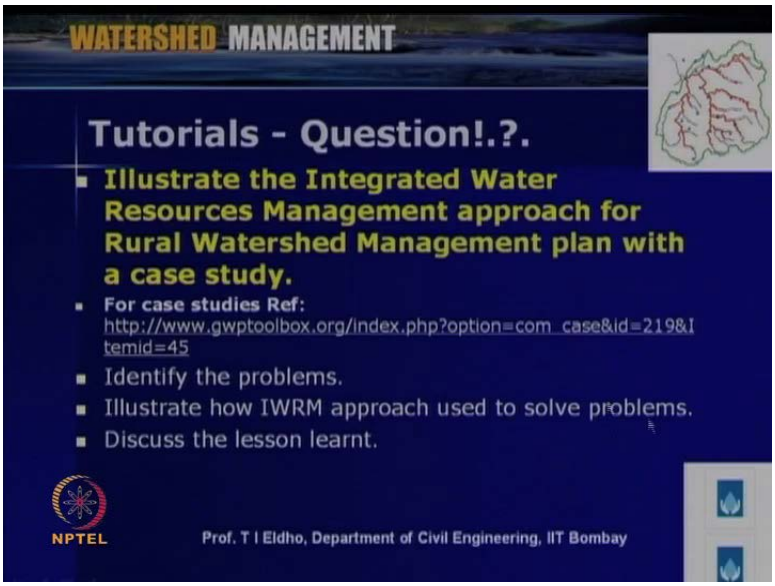

So, finally say one tutorial question illustrates the integrated water resource management approach for rural watershed management plan with a case study. So in this gwp website, you can see number of case studies so you can look into these case studies, and then identify the problems and discuss the lessons learnt as far as the case study, which you are looking to.

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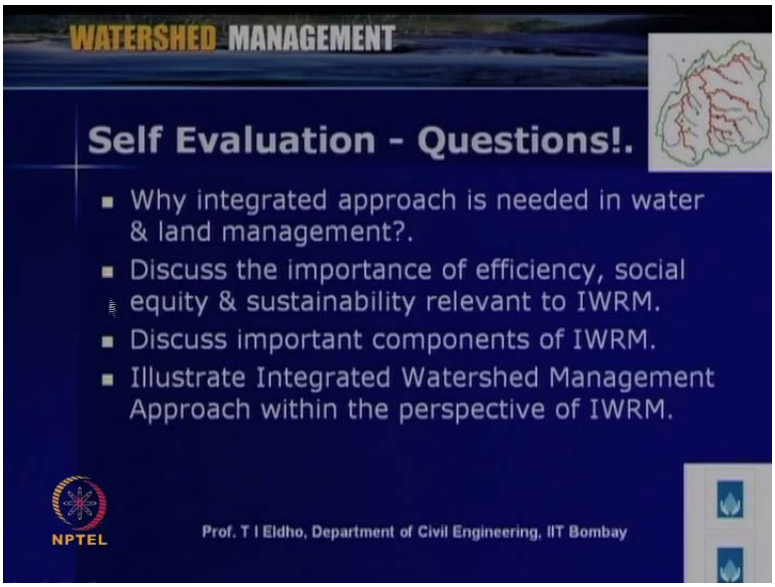

Then some self evaluation questions like, why integrated approach is needed in water and land management then discuss the importance of efficiency social equity and sustainability relevant to IWRM Then discusses important components of IWRM illustrate integrated watershed management approach with in the perspective of IWRM.

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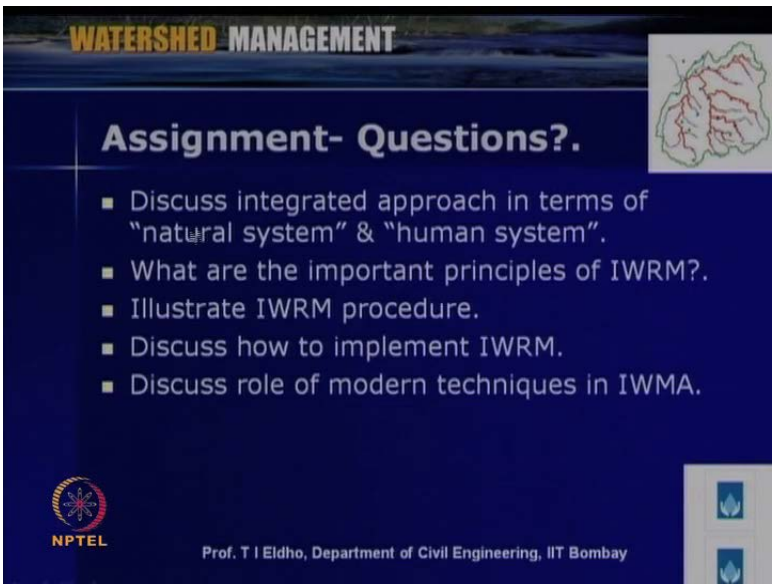

Then few assignment questions discuss integrated approach in terms of natural system and human system, then what are the important principles of IWRM illustrate, the IWRM procedure discuss how to implement an IWRM scheme then discuss role of modern techniques in integrated watershed management approach so these have some of the assignment questions.

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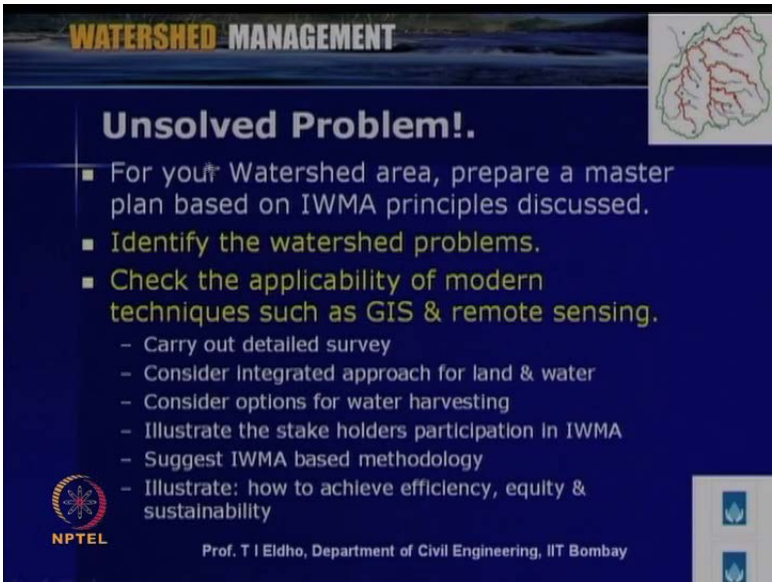

So, finally one unsolved problem for your watershed area, prepares a master plan based on the integrated watershed management approach principles discussed earlier, so you can identify the watershed problems; check the applicability of modern science, and techniques scientific techniques such as GIS and remote sensing. So, you can carry out detail survey then we can consider various options within the integrated watershed management approach, and then you can develop a methodology for your watershed. So with this the first lecture on this module, module number three on the integrated water resource management is over. So we will see now the in next lecture, the conjunctive use as far as surface and ground water is concerned, we will discuss in the next lecture. Thank you.