Availability and Management of Groundwater Resources
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Lecture - 50
Rainwater Harvesting and Artificial Groundwater Recharge

Welcome you all in the part one of the module 11 rainwater harvesting and artificial groundwater recharge. So we have started the lesson learning in the subject from the hydrological cycle. So we after gaining the concept of the hydrological cycle we have understood that the only and only recharge source of the groundwater which is lying underneath the geological formation that is an aquifer is the precipitation.

So this precipitated water is generally infiltrated, percolated and then moves towards the gravity and stored in the, your rocky formations and from there it moves from one rocky formations to another rocky formation. That is why we are having the variation of the quantity of the groundwater within the earth surface. So now the present topic rainbow water harvesting means the, that concept still we are following, we just understand the concept.

Because that time also we have understood that the precipitation is the only recharge source of underground water. So now this rain water we will just keep it for our future generation by some scientific technique underneath the earth's surface.

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So in the present topic we will discuss about the in rainwater harvesting what is the need of the rainwater harvesting, and then the components of the rainwater harvesting structure.

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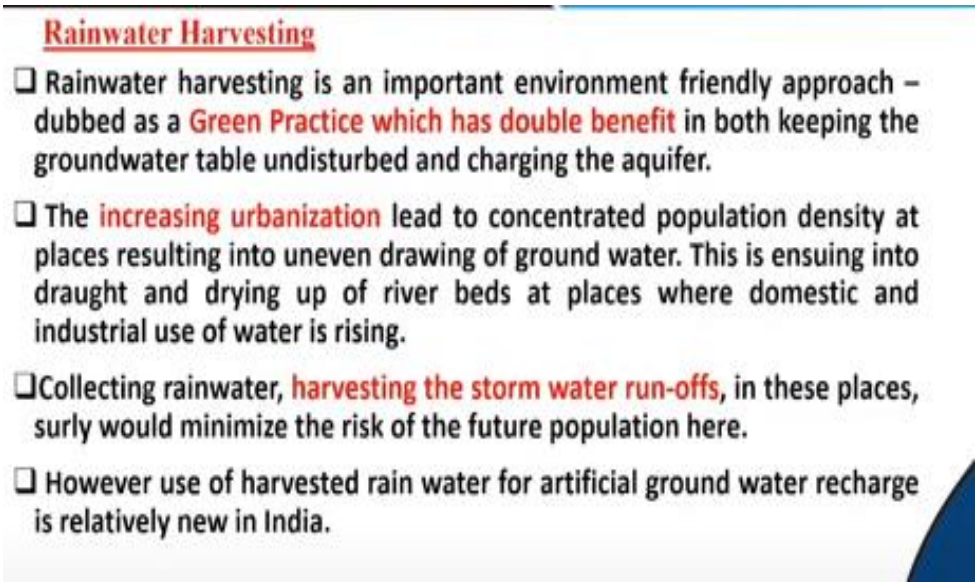

Now see the rain water harvesting is an important environmental friendly approach which is just a green practice which has double benefit why? Double benefit because it helps in keeping the groundwater table undisturbed first and second it is it also helps in the charging of the aquifer or the recharging of the aquifer. So this is a very good green practice which has double advantages double benefits.

The increasing urbanization lead to concentrated population density at places you can see at present day people are living in a very small area, lots of people are living in a small area say in a flat in a big apartment etc. And they what they are doing they are just withdrawing the water they are just to be drawing their water for the different purposes. So what is happening uneven drawing of withdrawing of groundwater from the earth is surface is generally seen at different urban locality.

So this is ensuing into the drought so just it is going to wash the drought, because suppose in an area the groundwater quantity is available for 10 person but for some other region if 100 persons are living there. All will withdraw the water from the same area then what will happen a day will come when the groundwater table will go under down and ultimately the drought condition will appear.

So what will happen not only the drought condition but also the drying up of riverbeds at several places, so this condition may arise because of the increasing urbanization. So the concept is to collect the rain water collecting rainwater harvesting the storm water runoff indeed places she only would minimize the risk of the future population here where the population density is more. So huge of harvested rainwater for artificial groundwater recharge is very important in our country also.

In our country although it is a new idea but it is groundwater recharging artificial groundwater recharging is a very important techniques there are several techniques through which we can just artificially recharge the groundwater storage in an aquifer. So this is the rainwater harvesting is an important environmental friendly approach.

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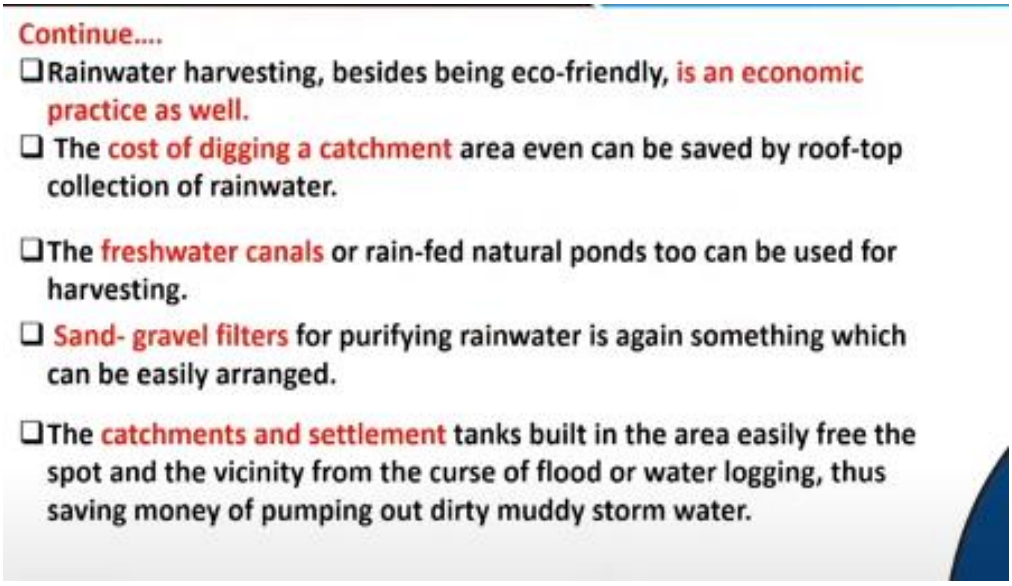

Now rainwater harvesting besides being eco-friendly is also an economic practice as well it is having some economic value also. The cost of digging a catchment area even can be saved by rooftop collection of rain water. So digging of a catchment area rigging of a well is much more, costlier than the saving water at the rooftop of any building. So the freshwater canals or rain-fed natural ponds too can be used for harvesting the rain water some natural ponds are in the area which can only be fill up with the rainfall.

So this why by the rainwater harvesting technique or by natural artificial recharge technique we can just fed the, we can just keep the water in the natural ponds also which is the rain-fed pond.

Sand-gravel filters for purifying rain water is again something which can be easily arranged. So sand and gravel filters are generally placed at some locality which is used for the purification of the rain water. If rain water will pass through it and then it will store somewhere, so while passing it will provide your contaminants from the inverter.

So the catchments and settlement tanks built in the area easily free the spot and the vicinity from the course of flood or water logging thereby saving money or pumping out dirty muddle storm water, so this is the important concept regarding this.

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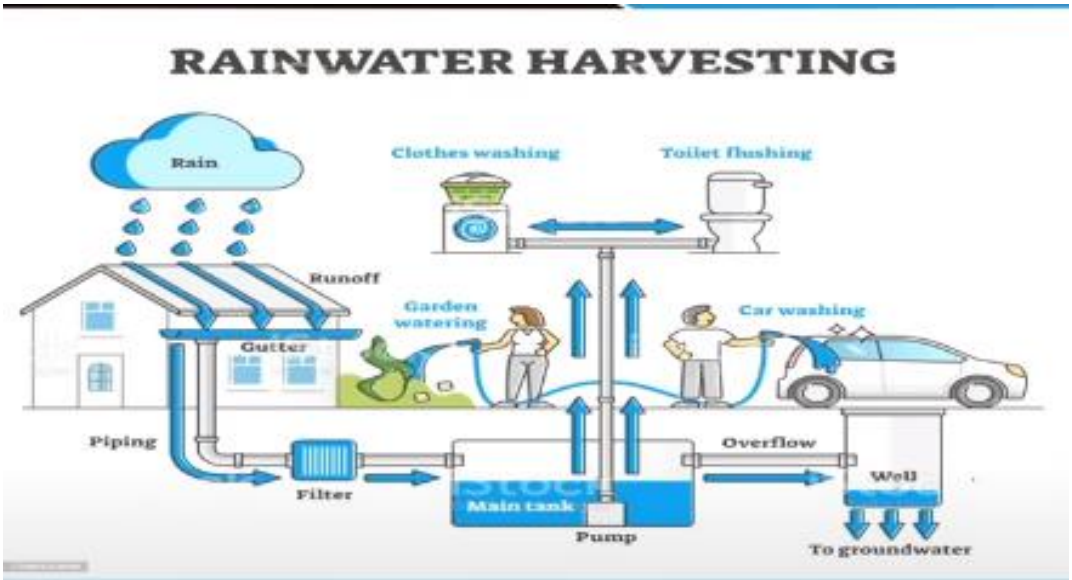

We can understand this thing I say as a rainwater harvesting just a model rainwater rain is falling on the, your surface roof top surface. And from where it is just through a gutter it is just going down and into the tank just you can see in between a pump a filter is there which is just purifying the water incoming. Water which is coming to maintain and from the main tank it is just sent to the from some your reservoir your reserve tank you can see from here the water is going for the huge of the cloth washing, for toilet flushing also for gardening watering and then car washing etcetera.

And if there will be overflow of water it will come and it will reach to the well and from the well it will go to the aquifer to groundwater. So you can see from the main tank also if you are just collecting the rain water to maintain you can do so many applications with the, your collected rain water. And if there will be surplus rain water then overflow will take place this overflow water

will move to the well, and from the well since well is in the ground surface. So from there it will percolate down to the aquifer had to meet the groundwater. So this is the concept of rainwater harvesting in a very simplest way.

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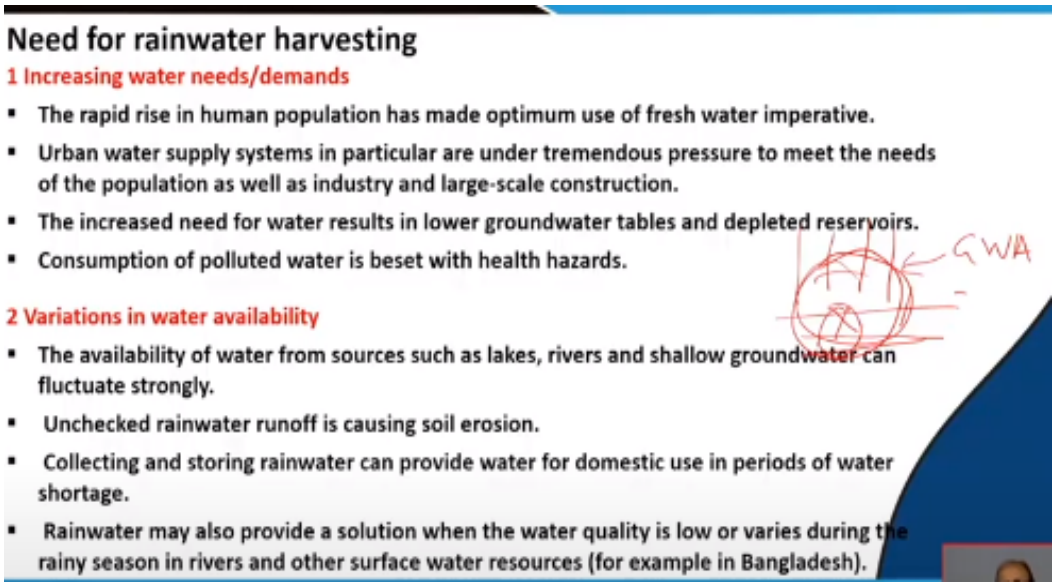

Now question is after understanding the rainwater harvesting the question is what is the; need for rainwater harvesting? So this is the question, the solution is that first solution is that increasing water needs and demands. So; water needs are day by day increasing demand of water is divided increasing, so we are thinking for the in water harvesting. So the point is the rapid rise in human population has made optimum use of fresh water imperative.

So what is happening population are gradually increasing, so we have learned in some previous lectures also that the guidelines for a person is 135 liter per capita per day for the total activities of a human being. So; if the number of persons will increase what will happen, they will withdraw the water for their specific uses. So just now I have told you suppose area so this is a small area and in this area we can find out the groundwater ability we are knowing the concept for finding the groundwater ability by the Tar method we have discussed total annual replenish able recharge method.

So we have also discussed in the previous lectures about the watershed wise finding out the groundwater ability. So we have just revised those your practice those methods those calculations and we got that in this area we are having say x cubic meter of water only. But the demand of but

in this area we are having say x cubic meter water and the number of persons in this area is; are more so what will happen.

The water is very limited in this area but the number of, persons are too much so their need will also be too much, there will be more need in this area related to groundwater utilization. So what will happen? So for this from where the water will come here, so the way is to do the harvesting that is the rainwater harvesting and try to conserve the rain water in the area. So that if all the people will utilize the, your ground water then there will be no scarcity in this area, so this is the, that is why we are thinking nowadays for rainwater harvesting.

So increasing water needs and demands the first point was that the rise in human population, if the population will increase naturally the demand will increase, if the demand will increase from some way you have to increase the water needs in the area. So the only your answer will be the rainwater harvesting urban water supply systems in particular are under tremendous pressure to meet the needs of the population as well as industry and large scale construction.

So for all the purposes say for the construction purposes for industrial application purposes for the use of the domestic needs for every places water is required. And the increased need for water will result in lowering of the groundwater table and ultimately the depleting of the catchment of the reservoirs. If the need will regularly increase then what will happen the water in this area say if the need will regularly increase at present 200 people is there after 2 years 500 people are there, so area is the same groundwater ability in the area is the same okay.

Then what is happening number of people, number of water demand users are more for domestic users, for industrial users, for construction usage. So a day will come when there will be if this area will face the lowering of the groundwater table and again further if the process will remain in the same way. Then what will happen total water of this area will deplete means this reservoir this catchment will deplete.

And then there is no option only and only option is to have the rainwater harvesting because consumption of polluted water is wizard with health hazards; consumption of polluted water is wizard with health hazards, so generally it just gives to the healthy yards. So that is why we are having the need of rainwater harvesting. Now second point is in the need of rainwater harvesting

variation in water ability the ability of water from sources such as lakes, rivers and shallow groundwater can fluctuate strongly; they are fluctuating strongly.

Unchecked rain water runoff is causing soil erosion suppose the rain water will just flow as a runoff then what will happen it is flowing through the soil only, so the problem of soil erosion will take place. Collecting and storing rain water can provide water for domestic use it will just you can utilize it, we can utilize it as a domestic use.

In periods of water shortage time when there will be water shortage say in the pre monsoon period, suppose in the pre monsoon means summer period summer period we are having no rains or less rains, so chances of groundwater recharge being is less. So what will happen during the monsoon area monsoon season we have already collected the rain water we have stored the rain water at certain place.

So this collected and stored in water will provide water for domestic uses, for industrial uses, say for your commercial users for every user it can be utilized in periods of water shortage time. So this is the way this is the need for rain water harvesting, because if the rain water will remain then only we can utilize it. Rainwater may also provide a solution when the water quality is low or varies during the rainy season in reverse and other surface water sources.

So this is also providing solution for getting the water quality in a good way because during the rain what is happening is just the pollutant just it dissolves. So the concentration of the pollutant you will get less during the rainy period because generally it moves through the water and goes somewhere else settles somewhere else or it becomes dilute. So rainwater is providing a solution for when the water quality is very low or varying during the rainy season.

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Now the next need is the responsibility towards protecting nature so by using more rain water it helps to conserve and augment storage of groundwater. So it is just also not only conserving but just also storing the groundwater at a specific place and it helps to arrest the sea water intrusion in coastal area. So once the groundwater will remain underneath the surface then there will be no intrusion of the sea water in the land surface rather it will remain in the coastal areas only.

So it helps to avoid flood and water stagnation in urban areas if there will be some specific place for the harvesting of the rain water then definitely the, it will avoid the flood. And the water stagnation which is the general we are seeing in the urban areas waters magnetic problem is there so this also we can just avoid by the your rain water harvesting. So the for this need generally rainwater harvesting is a very good process and it also reduces the water and electricity bills. So there will be definitely the reduction in the water bill and the electricity bill.

Now next need of the rainwater harvesting system is the advantage of collection and storage near the place of use this is also very interesting that you are just collecting the rain water and storing it as well to the place where the use is there. So collecting and storing water close to the household definitely improves the accessibility and convenience of water supplies and also has a positive impact on the health.

So just rain water is collecting on the surface and then storing nearby the house so it will be used when there will be any need it will be used so it is a good method through which it can be collected

and stored as well. It cost less to collect rainwater than to exploit groundwater, so it is also very interesting that the cost for collection of rain water is less whereas the cost for withdrawing of groundwater in the area is more. So this is why because of your rainwater harvesting system.

So this this can also strengthen a sense of ownership it gives an opportunity for communities to come together and work closure. So it is giving an opportunity as well to come at a place and work closure it allows for the decentralized control and community management of water. So wherever the decentralized your control and community management of water is prevailing it is just allowing it.

So it is a good method through which it is providing the productive employment to the rural people as well in their own villages. So rural people they are not moving out from their village rather they are getting the employment say productive employment in their own village. And the next is the quality of water supplies. So water supplies can become polluted either through industrial use, or human waste, or by inclusion of minerals such as arsenic salt or fluoride etc.

So then the water becomes polluted so this quality of water is also one of the very important content and this concept should be kept in the mind while going for the water rainwater harvesting or the artificial rain recharge structure plan. That the water supplies, should remain pollution free, then only it can be used by the human beings, as well as it can be used by the industrial operations, or some commercial operations also.

So rainwater is the ultimate fresh water and it is generally remains in a good quality. So this is the, your basic need of harvesting of rain water of the rainy season, so this is the also one of the need.

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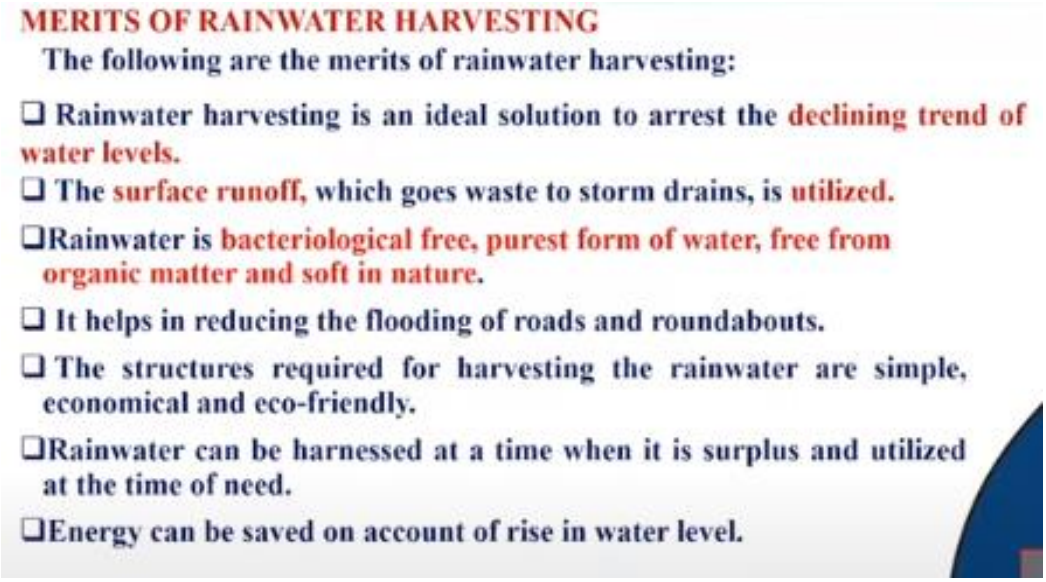

Now what are the merits of rainwater harvesting, so after knowing the rain water harvesting, the needs of rainwater hosting now we will discuss something about the merits of rainwater harvesting. The following are some of the merits of the rainwater harvesting are like rainwater it is an ideal solution to arrest the declining trend of water levels. So rain water harvesting, through rain water harvesting it is helping in the arresting of the decline in trend of the water levels.

So if the water level is declining so again it will just give more amount of water and it will come to the usual position. The surface runoff which goes waste to storm we have learned the surface runoff is only flowing through the topography, so ultimately it is wasting and ultimately joining to some stream or river channels. So this he suppose the, if the, we will think for the rain water harvesting the surface runner which is generally the wasted water it can also be utilized this water can also be utilized.

Rainwater is bacteriological, free purest form of water, free from organic matter, and soft in nature so these are the general characteristics of the rain water. But at every place you can we can't say because it depends upon the at your place atmosphere climate of the area also. So it helps in reducing the flooding of roads and roundabouts, so these are the merits. The structures required for harvesting the rain water are simple economical and eco-friendly and this rain water can be harvested at a time when it is surplus and utilize at the time when there is a need.

So, this is the good point that the rainwater it can be harnessed at a time when it is remaining in plenty in surplus and it utilize when there is a need of the groundwater. So energy can also be saved on account of rising water levels suppose the through the rain if we are just helping the catchment area to just rising of the water level. So definitely less energy will be used for taking out the water from the down to the ground surface. So this is the, these are some of the merits of the rainwater harvesting.

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Now the process of rainwater harvesting it is a technology used to collect convey and store rain for later uses and this we are going to suit. It involves direct collection and storage of the runoff water and water for direct use in future. Different uses of this rainwater harvesting water is that it can be used for cooking, washing, bathing and agriculture purposes like watering a feeding cattle etc.

It can also be artificially recharged into the ground which is the natural aquifer rainwater harvesting and this this is the way to support the ecosystem and human well-being. So these are some of the advantages of the rainwater harvesting.

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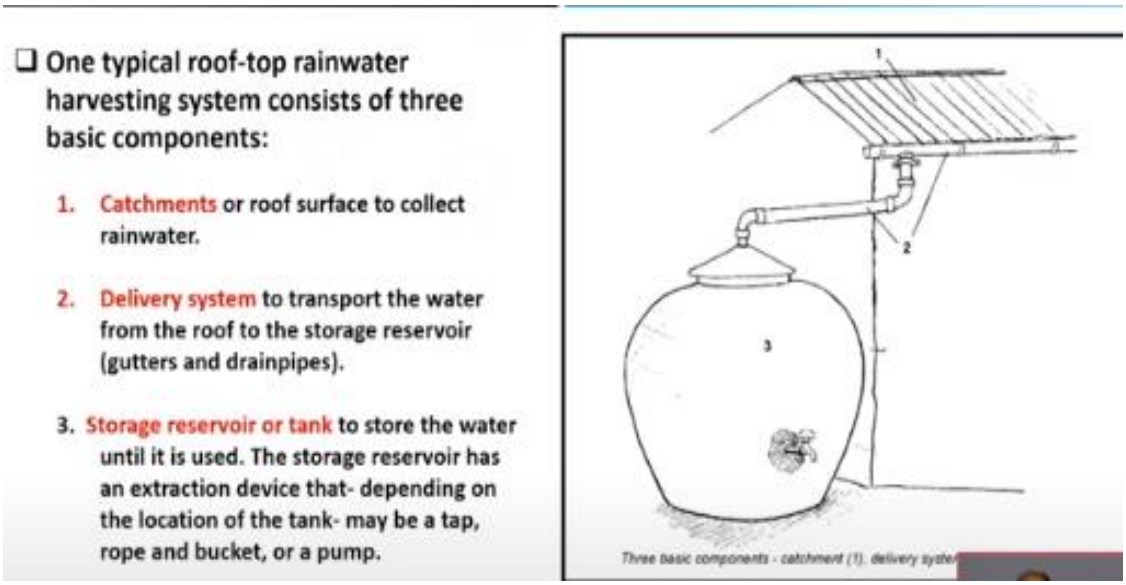

Now a typical roof top rainwater harvesting system we can just discuss with the help of the diagram. That one is the catchment the area where the water rain falls the roof surface where the just which is where the rainwater falls. Delivery system is the mode through which the transport of the rainwater from the roof top to the storage reservoir. And the storage reservoir tank is the place to store the water until it is used.

The storage reservoir has an extraction device that depending on the location of the tank may be a tap, rope and bucket or a pump, so of three basic components 3 fundamental basic components of a roof top rainwater harvesting system.

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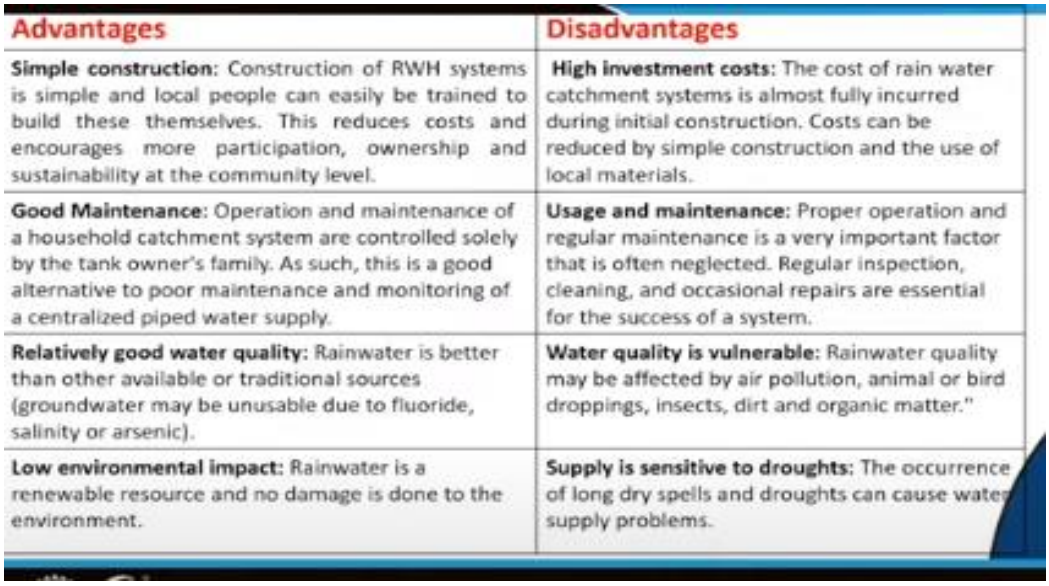

Advantages	Disadvantages
Simple construction: Construction of RWH systems is simple and local people can easily be trained to build these themselves. This reduces costs and encourages more participation, ownership and sustainability at the community level.	**High investment costs:** The cost of rain water catchment systems is almost fully incurred during initial construction. Costs can be reduced by simple construction and the use of local materials.
Good Maintenance: Operation and maintenance of a household catchment system are controlled solely by the tank owner's family. As such, this is a good alternative to poor maintenance and monitoring of a centralized piped water supply.	**Usage and maintenance:** Proper operation and regular maintenance is a very important factor that is often neglected. Regular inspection, cleaning, and occasional repairs are essential for the success of a system.
Relatively good water quality: Rainwater is better than other available or traditional sources (groundwater may be unusable due to fluoride, salinity or arsenic).	**Water quality is vulnerable:** Rainwater quality may be affected by air pollution, animal or bird droppings, insects, dirt and organic matter."
Low environmental impact: Rainwater is a renewable resource and no damage is done to the environment.	**Supply is sensitive to droughts:** The occurrence of long dry spells and droughts can cause water supply problems.

Now advantages if you will see the advantages of the, roof top rainwater harvesting is that simple construction of we get in the rain water roof top rainwater harvesting. Because construction of rain water harvesting system it remains very simple and local people can easily be trained to build this type of structure. This reduces cost and encourages more participation, ownership, and sustainability at the community level as well.

Then second advantage is that good maintenance here operation and maintenance of a household catchment system are controlled solely by the tank owners family. I said this is a good alternative to poor maintenance and monitoring of a centralized piped water supply. Third is the relatively good water quality then water is better than other available or traditional sources, groundwater may be unusable due to fluoride, salinity or arsenic. So relatively good water quality also we get in the rain water harvested rainwater.

Low environmental impact is there rainwater is a renewable resource, and no damage is done to the environmental components, so low environmental impact is there with the help of the rainwater harvesting, roof top rainwater harvesting structure. However, few disadvantages are also here we can see the high investment cost, the cost of rainwater catchment system is almost fully incurred during initial construction, cost can be reduced by simple construction and the use of the local materials.

Then usage maintenance proves proper operation and regular maintenance is very important that is often neglected. Regular inspection cleaning and occasional repairs are essential for the success of the system. Water quality is vulnerable; rain water quality may be affected by air pollution, animal or bird droppings, insect's dirt, and organic matter. And supply is sensitive to droughts because the occurrence of long dry spells and droughts can cause water supply problems.

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Advantages	Disadvantages
Convenience at the household level: It provides water at the point of consumption.	**Limited supply:** The supply is limited by the amount of rainfall and the size of the catchment area and storage reservoir.
Not affected by local geology or topography: Rainwater collection always provides an alternative wherever rain falls.	
Flexibility and adaptability of systems to suit local circumstances and budgets, including the increased availability of low-cost tanks (eg made of Ferro cement, plastics or stone/bricks)	

Some more advantage and disadvantages of this technical; that the convenience at the household level, it provides water at the point of consumption. Then not affected by local geology or topography rainwater collection. Always provides an alternative wherever rain falls. And flexibility and adaptability of systems suits local circumstances and budgets, including the increase availability of low cost tanks.

Whereas one more disadvantage limited supply, the supply is limited by the amount of rainfall and the size of the catchment area storage reservoir. So this is a good system through which we can just store the rain water at a specific place and which can be utilized during the when we are just facing the lower quantity of the groundwater in the surface. So thank you very much to all.