Rural Water Resources Management
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Week 09 - Lecture 02
Rural Water Infrastructures - Check Dams

Hello everyone, welcome to NPTEL course on Rural Water Resources. This is week 9, lecture 2. In this week, we are looking at how to manage rural water resources using engineered infrastructure. So, the whole idea is we have been seeing that rural water issues, they are not of water is mismanaged, and infrastructures are absent to capture excess runoff or in groundwater recharge. On that note, in the last lecture, we looked at the largest infrastructure that be possible which are class dams and irrigation networks.

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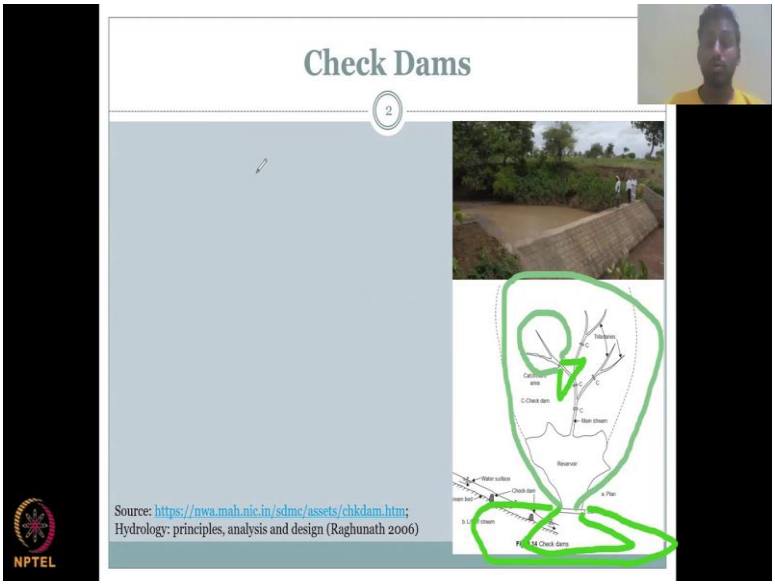

In today's lecture, we will be looking at the smaller brother of the dam hopefully, it is not much different, but just the size is different. Let us take a look. So, we are looking at check dams for this lecture. What you see here is you can see people working on the check dams. Whereas, in the large irrigation project I mentioned, you cannot walk on top there is really security issues that you cannot even go near to that wall of the dam, the storage structure of the dam whereas, here you see people happily walking on top and going around. So, this is more like a localized small size there and those are called check dams. And there are multiple, multiple designs.

First, let us look at the check dam. But before that, I would like to also talk about the areas that are above and below the dam, the area above the dam is called the catchment area,

whereas, below it is called the command area where the water is going to be given. So, this is your dam be check dam or large dam and then you have a catchment area on top this is where the water is caught and then stored.

So, that you can release the water later. Even though it says check dams and reserves those terms are kind of used and misused in literature, but reservoirs are larger dams and check dams which are placed on the top you could see are smaller dams, each check dam will have its own command area, very small command area at the bottom and catchment area on the top use different colours.

So, where the water is going to be caught is called the catchment area. So, this is the catchment area check dam, for the big dam this is the catchment area. So, it is that area above that point where water will drain and come into the storage then water is used below the dam for irrigation. So, that is a small, smaller area or it depends on the crop et cetera.

I am just drawing because of the space but it could be any design, any shape, whereas the catchment area is normally a watershed shaped firmly leaf or a leaf shape. So, the command area is where the water is released and given for irrigation through canals, river networks and other water bodies. So, let us look at the specifics of check dams.

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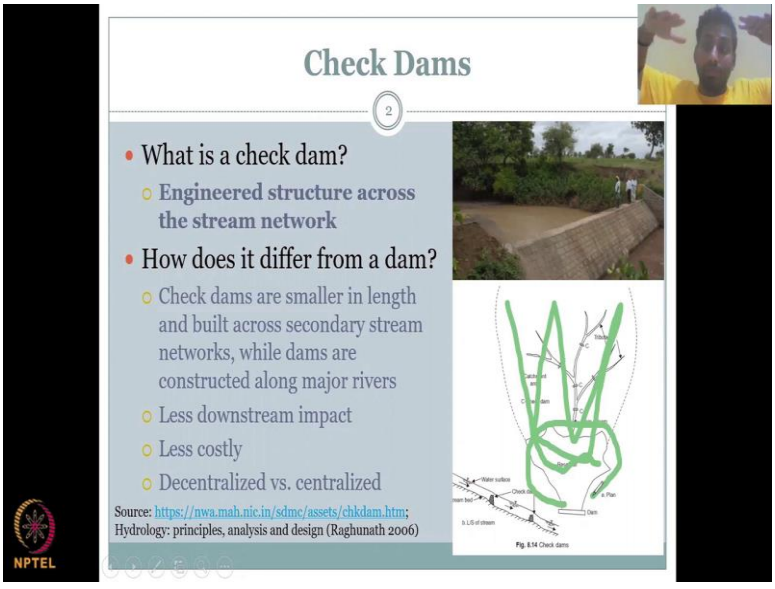

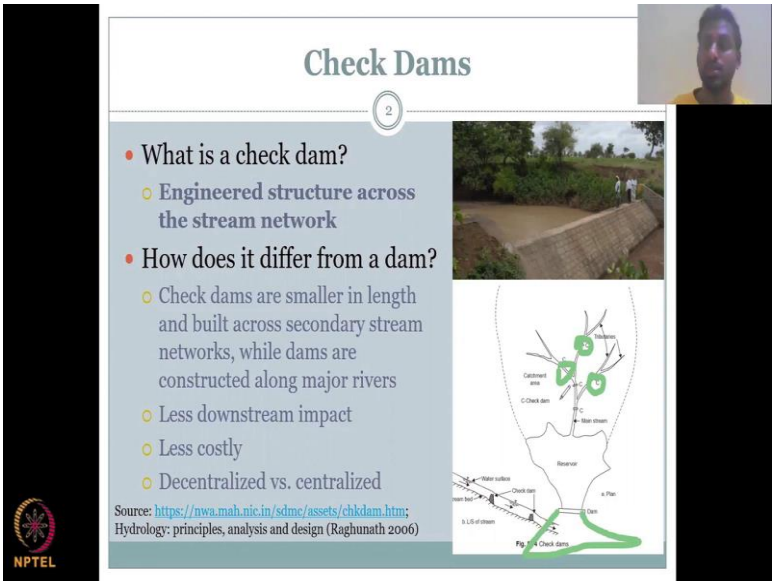

Again, there is a lot of government assets books on this revenue, the links please go ahead and look at it because these are very, very important for rural water resource management not only for groundwater, not only for surface water, but it gives a holistic picture of capturing water, storing water and then slowly releasing it to the downstream communities.

What is a check dam? It is an engineered structure across the stream network it is not parallel perpendicular to the flow of the stream, river et cetera. If it is a large river, then it becomes a dam. So, just think about the size you are not consulting on a big river, maybe small, small rivers and river network, stream networks it is possible. These are also low cost, you do not need to clear the land.

How does it differ from a dam? Check dams are smaller in length and built across secondary stream networks, while dams are constructed along major rivers as I mentioned, major please underline. If you go to the Ganges River, those were from the that area you had see the river is around more than a kilometer with how do you build a check dam you cannot. And that is where water was being stored in big dams and then released in the south Kaveri.

Less downstream impact compared to the death. Luckily, I have a figure which has both the large dam and the small dam, check dam in one image, you can see the sea is a check dam and this is the large dam what it says is there is less downstream impact. When you block water when you are blocking the water downstream there is no water. As a result, you are kind of stopping the water which is due downstream and then storing it in your large dams. Where in the check dam? Yes, you are storing water, however, the volume is very small.

So, sometimes water fills and then overflows and then goes to the next check dam or downstream because that is what is happening here. So, the water is coming and then there is a check dam whoops, there is a storage and then it goes down another storage and then goes down. So, you know actually drying down this area whereas in a dam, this area would be totally dry, no water where this dam is being filled up.

There are reuses for it, they want to create the level up so that they can draw hydropower it is called maintaining a head or elevation of the water so that when water falls it can be used for your hydropower. Whereas check dams normally do not use for hydropower, it is mostly for water recharge, irrigation, lift irrigation et cetera, it is less costly, small sites therefore less costly, you do not have to clear the land. So, all this land would have been cleared because the water is inundating the area.

So, let us think about it for a second you have all this as a forested area, shape before, before the dam was constructed, all this was a forested area. And then what you do is when you make the dam, this waterfront would be inundated, which means water would be filling up when water fills up those land cannot have any vegetation, it suffocates the land will suffocate and die. So, it is better to clear them off and then make it more storage like you take out the soil take out the rock so that water can be stored.

So, basically you clear the dam take out the soil and rock so that water can store more volume. Whereas in gender no you do not do that you just make maybe you clear the sides a little bit so that the bank is stable it could see they have done some work here and then you and then you also deepen this part. So, the deepening a little bit to store water otherwise it does not make sense to have checked out on a higher elevation.

So, this is also decentralized versus centralized approach whereas a decentralized means it is not one dam for everyone. So, that is the large irrigation project as centralized approach, centralized heating, centralized AC recall. So, an air conditioner which is for the entire floor, it is called centralized air conditioning, theatre movie theatre for example. But when you call decentralized then the hallway may not be an AC, but you have each room in the office each floor each room can have air conditioner its own small air conditioner that is decentralized.

So, here what we say in the dam is the large dam would store all the water and then release it to many, many acres of land that is centralized approach. In a decentralized every small acre would have its own check dam and that water will be used only for that acre. So, as I said in

the drawing this area, the command area which is going to be here, all the area would be given the water from the centralized dam versus the check dam is only a small area which can benefit this small area which will get benefit.

So, as you could see that instead of putting one dam and having all the area irrigated by one dam, you are breaking it into smaller pieces and giving it a small area of influence. Now, this is easier to maintain, because people, power et cetera is easier if you have a decentralized for water. Otherwise, the controlling agent would be sitting on one end of the watershed, whereas people are fighting for water on the other end. So, that you know, distance is a big problem.

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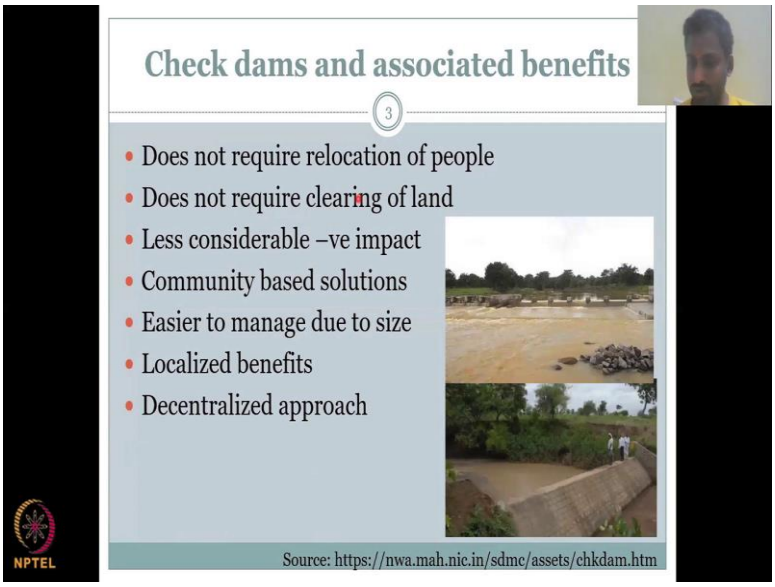

Check dam and associated benefits. So, let us look at the check dams and their benefits does not require relocation of people. As I said, when the big dam is filling up, all the areas of the site, the houses have to be removed, because the water will be full. And so, in the sector nothing, you just have to clear those sites and then the industry. Does not require clearing of land, you are not going to clear the land and then make the dam less considerable negative impact.

The negative is more subjective, depends on who uses it. But here overall negative is less in a check dam because you do not clear the ecosystem, you do not clear the forest or vegetation. So, the birds, animals, everything still remains whereas in a big dam, although those have to be cleared. Community based solutions, check dams are community based because as I said, decentralized means it has less water, less number of people benefiting but those people will be happy to maintain the check.

Easier to manage due to the size. Again, the size is very, very small compared to large dams. And that gives them a very good way of managing it more freedom and less people, for example, large dam you need a big agency to maintain it. Whereas the check dam, every week, one house can maintain it, you know, they just go and check. So, like here, you could see they are just checking the dam, the wall on the sides et cetera. And most probably everyone will be using it for the daily activities also like washing, bathing, fishing, whereas in large dam, you do not see those kinds of activities.

Localized benefits, the benefits are visual, you can see it local people would enjoy and they then understand that they should manage it whereas in a large irrigation dam you do not know how. For example, in Pune a water is being sold and it can be sent to Mumbai for use would Mumbai people know about this dam and the areas they may not know.

Whereas if it is a check dam a smaller tank for example, that is a decentralized. A small tank within Mumbai and people are getting water from that they will know about the tank. So, that is where localized benefits help in getting ownership and also benefits of the water to the people is a decentralized approach, I have spoken a lot about this. So, I would move on.

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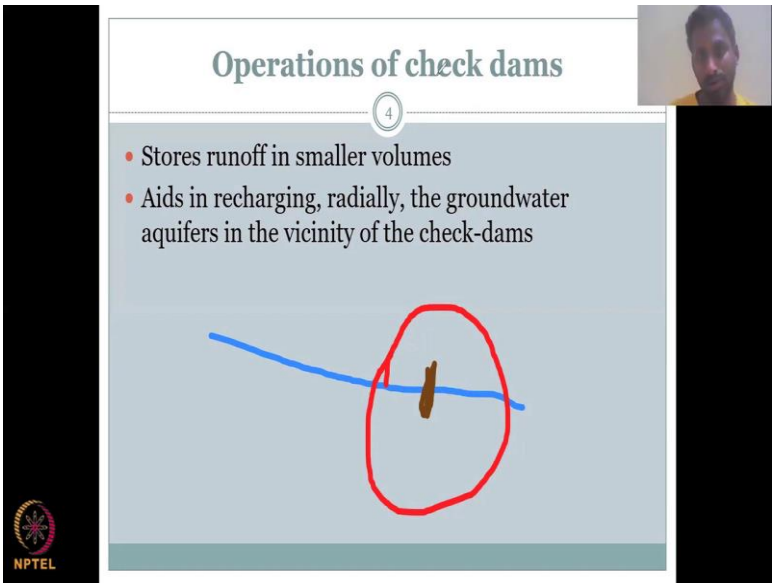

Operations of check dams

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- Stores runoff in smaller volumes
- Aids in recharging, radially, the groundwater aquifers in the vicinity of the check-dams
- Aids in increasing soil moisture near the check dam
- Mostly built by local agencies on a low budget
- Maintenance is not built in the budgets
- May lead to siltation upstream of the check dams

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Still Check Dams have been highly beneficial in many Indian rural regions

Let us look at the operations of check dams, stores runoff in smaller volumes, let us quickly look at what did we say as runoff, you have precipitation on a land some precipitation is happening part of it goes in as infiltration. Part of it goes as percolation into groundwater aquifers, plants uptake is that whatever remains which is a big amount will go as runoff.

In most systems are now three is the biggest component of the rainfall, rainfall into different compartments your runoff is the biggest factor because all the others processes is much slower than the rainfall rate. Whereas, runoff is much faster it can be faster than the rainfall thereby giving you ease of movement of water, water wants to move. It does not want to stay in one location because of law of physics it has to flow from high to low potential.

Aids in recharging, radially, the groundwater aquifers in the vicinity of the check dams. So, what it means here is the check dams. For example, you have a river in blue colour for a river, a river and then you put a check dam, there is a check dam. So, radially the influence of the check dam is felt in the groundwater this is radiating, it depends on how the aquifer is what type of rocks, soil water content et cetera.

But most probably the lateral movement of recharge from the check dam, water would be moving and actually contributing to groundwater recharge, most probably it will why? Because initially the river was flowing. So, the water level may be at the same level of the groundwater. But now, because you are pointing at the level rises in the check dam, and because of the level rise, the water is at a high potential compared to the groundwater which is at a low potential.

So, water would move from the check dam into the groundwater. But also, all these would depend on, is there space for the water to move issue is it empty unsaturated et cetera. Aids in increasing soil moisture near the check dam, because it is a recharging to the groundwater. In the process the soil moisture also gets recharged. Initially it is the soil moisture depending on the depth of groundwater recharge, or if it is moving in the seepage in the depth of the groundwater, it can move in the soil moisture profile, because of plant uptake et cetera.

Mostly built by local agencies on a lobe is very, very low compared to the irrigation dams. Wherein you do not have to have lots of rules and regulations accept some permissions are needed. So, the local agencies can build these check dams after they get some clearances. You do not have to have big for example, economic clearances, impact assessments that you

need in the irrigation dams. For small check dams normally, it is the people who have to talk to the low downstream communities.

And also, to the people who actually manage the water bodies CWC, PWD those kinds of agencies, and then get permission and do it on a low budget, as I said, it is gives you the freedom to use any material you want. It could be done by word, it could be done by bricks, sandstone, mud rocks, so the budget is low, you do not have to worry about whereas in a dam last dam, it has to have the dam clearances, safety inspections, the thickness of the wall should be appropriate.

So, there is a lot of issues because once it breaks, all the downstream communities are washed away. Where is it a sector not much disaster happens. You do not see disasters by check dam failure, you see that in the large dam failures. Maintenance is not built into the budget, as we looked at the issues before this class in the last week, major issue is people do not maintain it.

So, it concerns is a big concern, because it is your property in terms of it is a property, you are the major stakeholder, you are the major benefiter. Why are you not maintaining it is a question? So, we have looked at multiple answers to this question. Most importantly, they do not know that if they are allowed to manage the water, manage the check dam because the flowing river they never managed and that they know that that is their water they go and take in et cetera.

But they do not manage the river which was a natural system, it just flows and then suddenly one day the river will wake up and she thinks I should move in a different direction it will go in a different direction like the Ganges, but check dam is like a structure and it involves money even though it is low budget for villages, it might be a big budget. So, that is where the maintenance is not built into the budgets may lead to siltation upstream of the check dams.

So, where the check dam is there for example, this check dam right in this point, when water is blocked, then this area can also have sedimentation. This we can see in the large dam also so the physics does not change between the size of the dam. So, you have water flowing and then a dam which is actually stopping your water because your water is flowing in this way for example, and then it goes like this. When it comes to this part, the water slows down. So, all the sediments and rocks and pebbles that it carries is deposited before the check dam.

This is a common thing because the velocity was enough to carry it. Now, the velocity is low so the materials drop. So, materials drop down here. Lands leads to sedimentation, once this is not clear, then water will go over the check that there is no point of storing the water. So, that is what nature is you can try to stop it and curb it, but if you do not maintain and accept the power of nature, she will just run through your check dam or large dam anything.

So, you have to be very careful about nature. May lead to less downstream flow and associated impacts on agriculture and aquatic life, even though you are making a small section of water storage, still it is a water. So, you have to accept that yes, down people will have lesser water than before and the impact could be on agriculture and aquatic life for example, the fish, the fish need water flowing water to lay eggs and if it is not there, then it is a problem insect all these things are tied in the ecosystem.

So, it is better to understand and then build these check dams anyway, any non-natural infrastructure will have impact on agriculture and nature anything your road for example has to have an impact of the land and the nature, any engineered product will have an impact. That is why if you see tribal, they do not the practice agriculture and associated things in one piece of land, then they move to another land, they do not own the land, they just go to another land and then they start agriculture. So, the old land will recuperate or bounce back in to a forest. So, this we do not do because we are engineering the land. So, still there is less downstream to flow that comes down. So, you have to be careful.

In the previous figure, here you could see that if everyone is stopping the water is that up check dams, then water would not come down into the reservoir. Slowly I am saying if one check dam is 1000 liters just for example, I am saying and your big dam is 50,000 liters, you build 50 tanks 50 check dams above the major dam, the dam you would not get any liter of water in the dam because you are already decentrally holding the water and only less water would come down into the reservoir for example, only this area rainfall will contribute to the water whereas all the other check dams are big and storing the water.

So, this understanding is needed to talk to communities about dams, any dams large or small check dam the only positive is it is less much, much less compared to a large dam. But if you can share the profit, make some aspects for aquatic life and agriculture, then it is a very good method to store water and use it for lean season non-monsoon season agriculture. As I said these check dams have been proved worthy in many, many areas. However, you have to do

considerable estimations of the properties before you assess if they work check dams as I said have been highly beneficiary in many Indian regions.

In fact, across the world, many people have seen rivers getting back to life because of check dams because initially the water would flow through the river and gone, only three months the water would be in the river. But now since you slow down the river water to check that you are seeing the water flow and nearly every day the year it will flow. This brings a lot of happiness to the people around because they used to see this water flow every day.

So, Narmada, Tapti and all these rivers in the northeast, north regions were used to flow fully there is a river called Vaigai, Madurai which used to flow every single day if you go there, it is like a kilometer with more than a kilometer. But then now there is no water because things have changed climate change et cetera. Water use, water abuse capacities et cetera. But now if the water is slowly, slowly released into the Vaigai, it will it will start to flow again.

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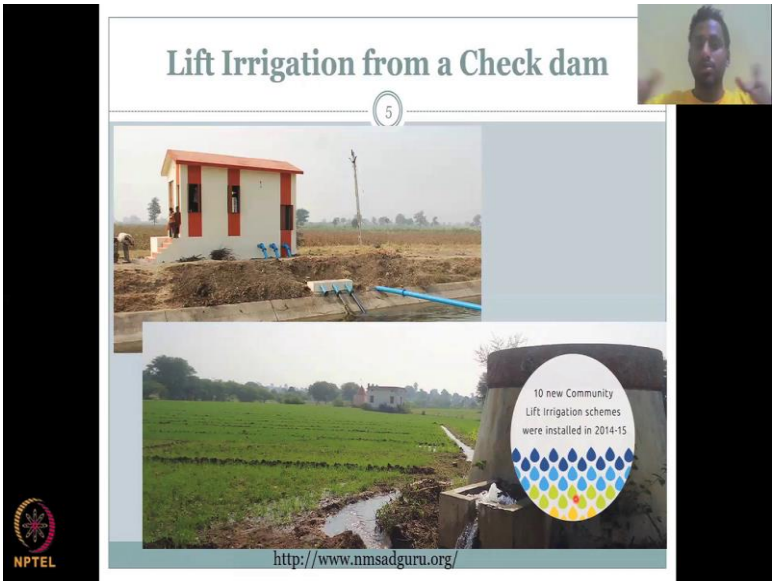

What are the benefits of the Check dam? As I said there are many benefits let us look at some, irrigation scheme is a big hit in the check dams because you are storing the water, you are creating a pond thickness of water at the check dam. And now you can put a pump and remove it for agriculture. Because recharge groundwater can take time. Whereas this kind of activity can, at once take the water and prevent evaporation, loss, recharge loss and apply it to the field.

There is some energy component needed because you are using a pump, but farmers have the money to do it. If they want to have a product and agricultural productivity. The most important thing you need to understand here is, can you do this in a flowing water? Yes. But we do not know if actually the water would be there throughout. Whereas in a check dam, you pond the water and you see the water, I have this much volume of water now I can pump it up.

So, you know how to better control the pumps and also irrigation area, whereas in a running thing you cannot. Now, this is the N M Sadguru Foundation, which is an NGO in Dahod, Gujrat. I have been there multiple times to see the wonderful work they do. They bring communities together these lands were not agriculture, productivity at all, there was no water, very less rainfall, and water does not flow from check dam to the land. Because the land is high elevation, the check dam is low elevation.

So, you need to pump water up, which is highly energy intensive. One farmer cannot do it. But if the community joins together, that is what this foundation has shown. If the community joins together, then they can collectively work to pump the water and spread it for

agriculture. So, look at these 10 new communities 50 irrigation schemes were installed in one year. That is pretty big.

What they do is they pump the water bring it to a central location and from there they channelize it to different farmers. And from here also they can pump to different, different elevations. But most importantly this storage can be used to send water to each and every feet. And there are several foundations is not the whole Gujrat, please look at this link if you would like to get in touch, they have good training programs for people who are interested and they could take it up. It is an NGO, so it is not for profit, lift irrigation from a check tap.

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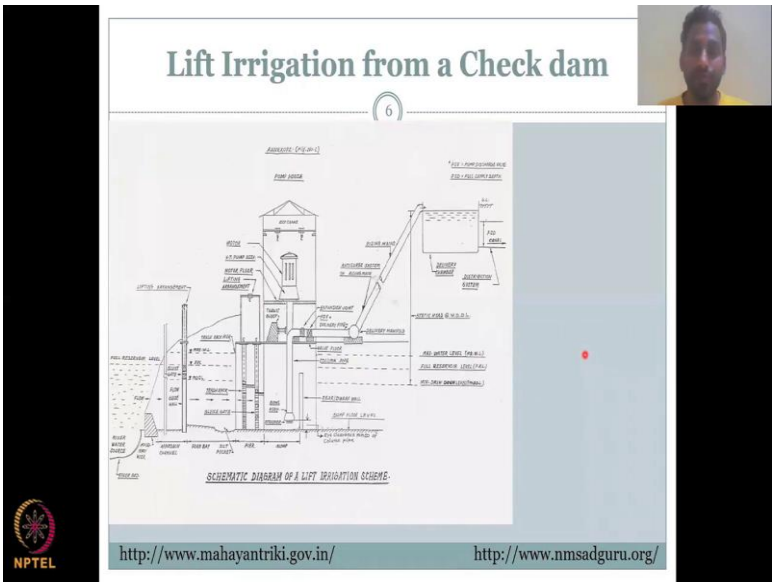

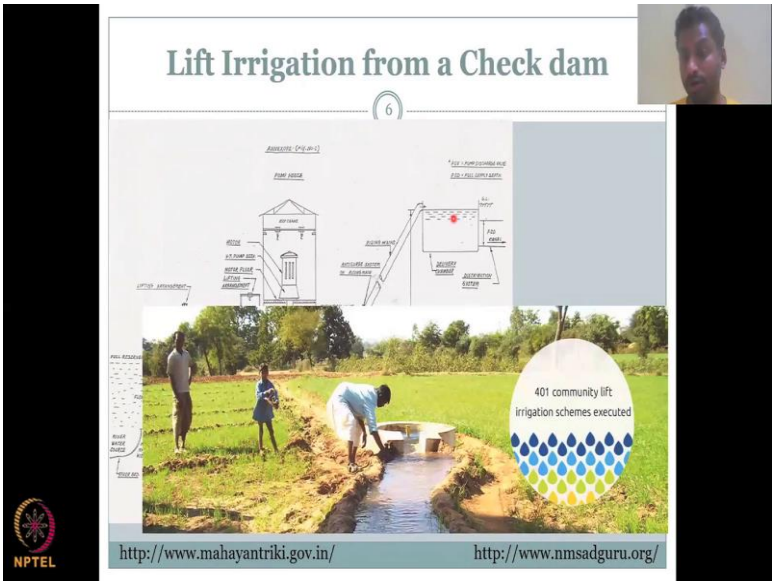

So, this is how the schematic works, you have the water the check dam you have a pump house as you see in this diagram, this is the house and then you pump it into a reservoir or a

smaller tank where water is stored and from there you disperse it to the field. So, there is some power and cost for lifting the water, the pipes et cetera. But this NGO would give money for 10 years and then later they say, I will build it, you manage it, the farmers should manage it and then if you want you can increase the area of acreage.

401 community lift irrigation schemes executed and this is how as I said the distribution point these are called. So, from one check dam the water goes to the distribution point and every farmer can now manage the water.

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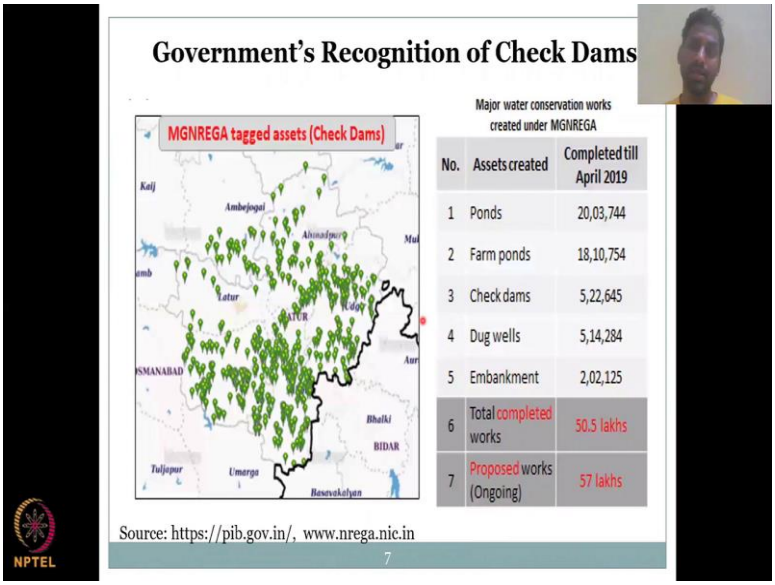

Also, it is making it easy for the farmers to get the water. And this has also been done by the government of India schemes especially the MGNREGA. Under the MGNREGA there is the NRM national natural resource management and under the NRM, there is a lot of budget for water resources, almost 75 percent of NRM budget then, what they do? They do is mostly they do check dams; you could see here they do ponds, small, small ponds, which are not connected to a river or a stream. farm ponds and ponds are not connected.

So, along the river, the biggest investment is a check dam where they stop the water and then from there, they spread the water. If you look at budgets also compared to ponds and farm ponds check dams are pretty expensive compared because ponds and farm ponds are small. There is no missionary involved, et cetera. Whereas check dams running water. We have dug wells, embankments, et cetera.

So, there is lots of lots of assets have been created because of the positive impact on the farmers livelihood, rural livelihood. It is also used for drinking for washing, bathing all I said

write the check dams store the water people go there for fishing, bring water for drinking or cleaning the vessels in rivers and stuff you had seen in villages. It is the same water for everything.

They boil it, maybe they filter it, but at the end of the day, the water is good for them. They have been doing this for a lot, lot of years, a lot of generations I would say. The impurities are very less. So, here you can see in Maharashtra where the locations are some locations like Latur has less, but others have a lot of check dams.

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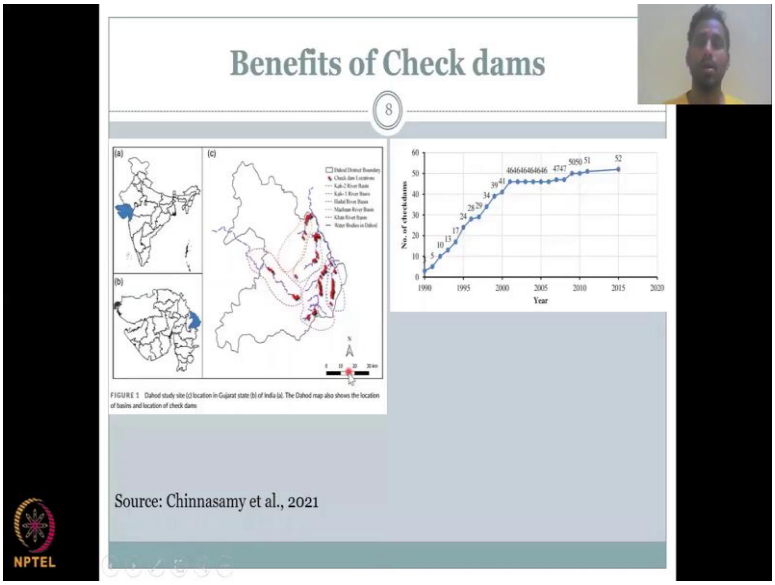

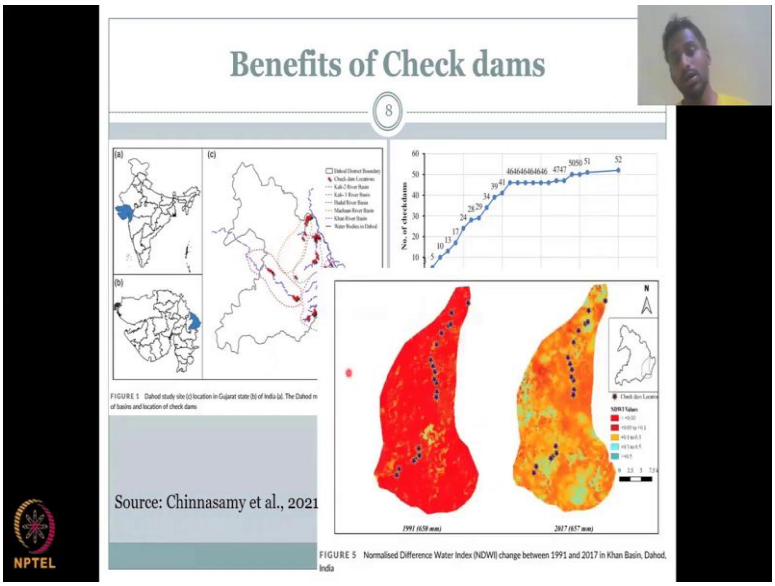

So, the benefits of check dams have been studied very, very explicitly and detailed in many, many literatures. Let us look at this study, this study used remote sensing to look at has the check dam improve the condition of soil water and the groundwater recharge this was in a

location in Gujarat same the whole location and we could see that the number of check dams increased from 1990 to 2015. So, from 0 to 52 and then all these areas are the basin boundaries where the check dams are placed.

And you could see that in a year where the rainfall is comparable same rainfall 1991 and 2017. The rainfall is almost the same, but you could see that the NDWI which is an indicator of water in the soil is higher in 2017 after the installation of 52 check dams, you can see here all these areas are turning into yellow and if it is positive high number of positive means, it is more water is available, you can see all the red is converting into yellow or orange and these pockets are coming up where water is there. So, there is a radius of influence, but overall, these check dams are improved the water because from here they take the water out and recharged the entire area there is lift.

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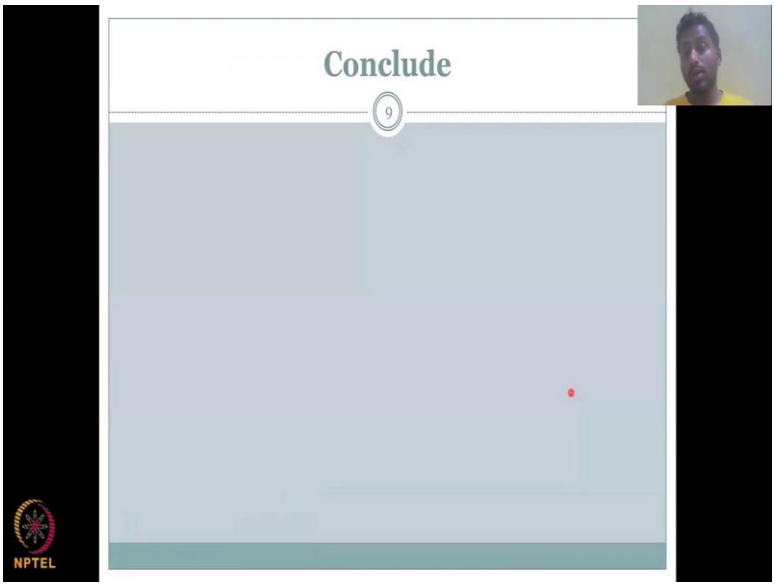

So, with this I would conclude today's lecture we looked about check dams and how they are useful. I will meet you in the next lecture with another engineered infrastructure for rural water management. Thank you