Introduction to Ancient Indian Technology
Professor D. P. Mishra
Department of Aerospace Engineering
Indian Institute of Technology Kanpur
Module 6
Lecture No 29

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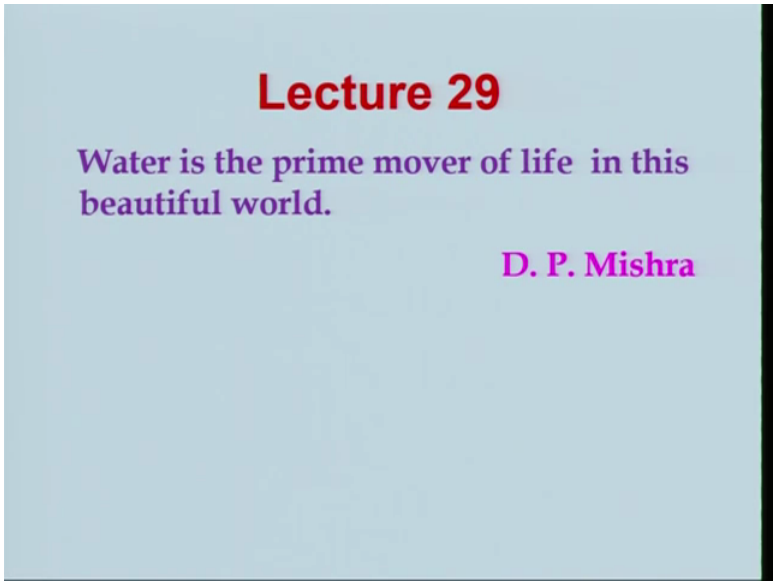

Let us start this lecture with a thought process, “Water is the prime mover of life in this beautiful earth”. So in the last lecture we were discussing about the irrigation system. Let us now look at another irrigation system which is known as interconnected tank irrigation system.

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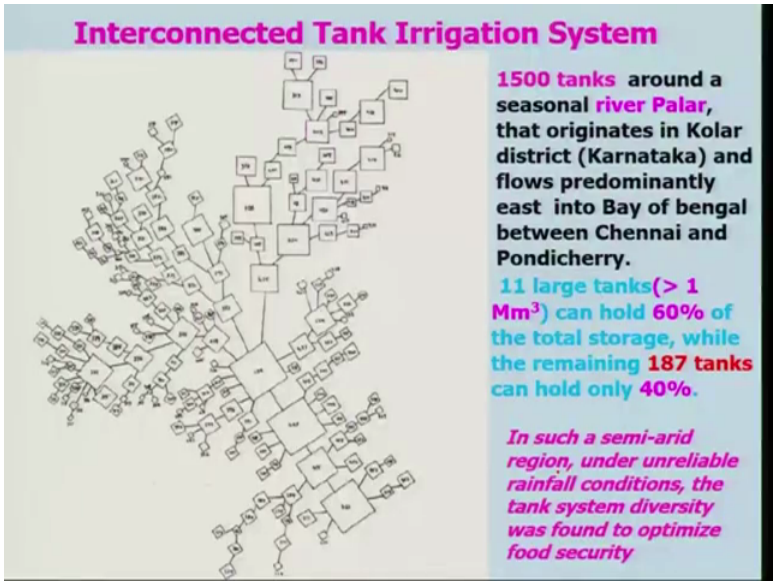

A figure I have shown here in which if you look at these are various big tanks and these tanks are connected with a smaller tanks or medium sized tanks and then this medium sized tanks is connected to a smaller one. People have found out something 1500 tanks around a seasonal river Palar that originates in Kola district of Karnataka. In this river the water flows predominantly east into the Bay of Bengal between Chennai and Pondicherry. And similar systems were also found in the Kaveri Delta what I was told, and if you look at there is some data I would like to mention here, that something 11 large tanks which is more than the one million meter cube can hold around 60% of the total water storage while remaining 187 tanks can hold only 40%.

And these tanks if you look at the generally in each year the smaller tank are get filled up, but whereas the larger tanks when there is a flood or very big (())(1.44) of water in the river, then this will be, the bigger tank will be field up, and these are all connected. And as a result you can have, you know water storage in all these tanks so that in semi-arid regions like this, where unreliable rainfall conditions prevails then we can utilise this water tank systems, optimise the what you call water usage and other things so that you can get crops, as a result the food security you know will be ensured. But problem with this kind of tanks is that there will be silting as well and those needs a regular maintenance. So if you look at, this is quite sustainable system and around that water is already there and you can have crops, right. It is not that it is located it will be going for kilometres, you know, so that in between you are having a scale where you can have your crops.

So sustainability appears intrinsic to the traditional Indian methods. Nowadays the way we do we talk about sustainable but sustainability is the part of the design in ancient India. So that is very important thing what need to, unfortunately these are not being maintained and these are all dilapidated condition and we need to revive this if we really, we want to have a passive irrigation system. These are not active irrigation system, this is a passive irrigation system inter connected tank irrigation system. In other words interconnected tank irrigation system is the passive one unlike the, your dam and well it is active.

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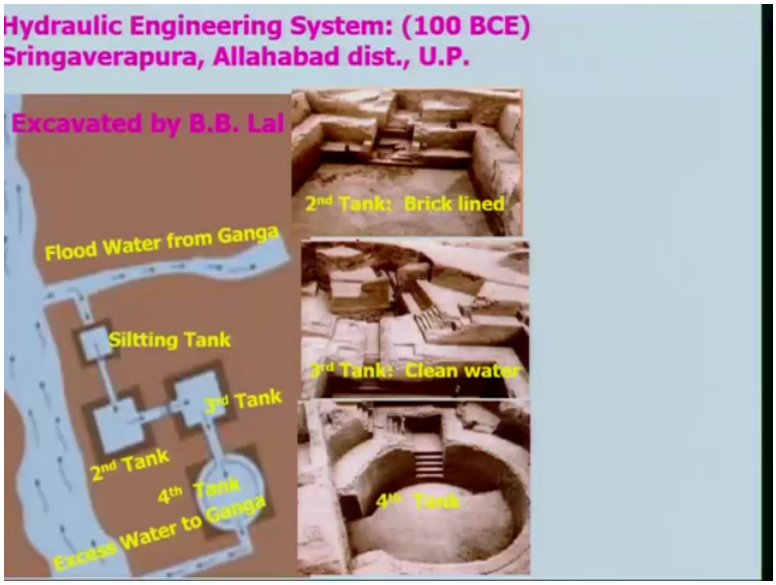

Let us now look at another hydraulic engineering system, which was there around 100 BC and in Sringaverapura in Allahabad district of UP and this work was excavated by BB Lal and if you look at this is the Ganga water, right this water is flowing in Ganga, and there is a channel which is coming from Ganga during the flood particularly the water will be flowing through this canal and which is around 11 meter wide and 5 meter deep. And during that flood time what will happen the water will come over here there is a tank, which is basically silting tanks, which will you know like such that the silt will be settled down in this place and then from that the water without silts will be coming to the second tank, which is having a brick lined right and this first tank the silting tank is having no bricks.

And as I told earlier from the silt tank or the first tank the clean water was directed to the second tank lined with bricks and then water is filled to the third tank, which is again with having, a stepped inlets. If you look at these are the step inlets will be there and again the water will come over here and there will be also a fourth tank it is of course circular in shape, these are all rectangular in shape, but this is circular in shape. It has an elaborate staircase with elaborate waste weir kind of things will be there and consisting of seen spill channel which are not shown here like one channel is here there might be seven spill channels, a crest, a final exit, this is the exit here, if you look at this is the exit, excess water back into the river Ganga.

So if you look at during the flood what will happen, you will take this, you know collect the silt around and when the flood is not there, you can clean the silts and that the silts to the field

and utilise it as a manure and again the water can be recharging this area, by the side of this river Ganga and of course that will be designed properly so that your recharging of water will be going on and then crop you can get very easily. That means the, it will not flood the areas it will be utilised again it will go back to the Ganga. So this is a beautiful system, hydraulic engineering system which can be even utilised in modern times, right. Of course more research is to be carried out how to do that and what are the things but it is not being used in modern time.

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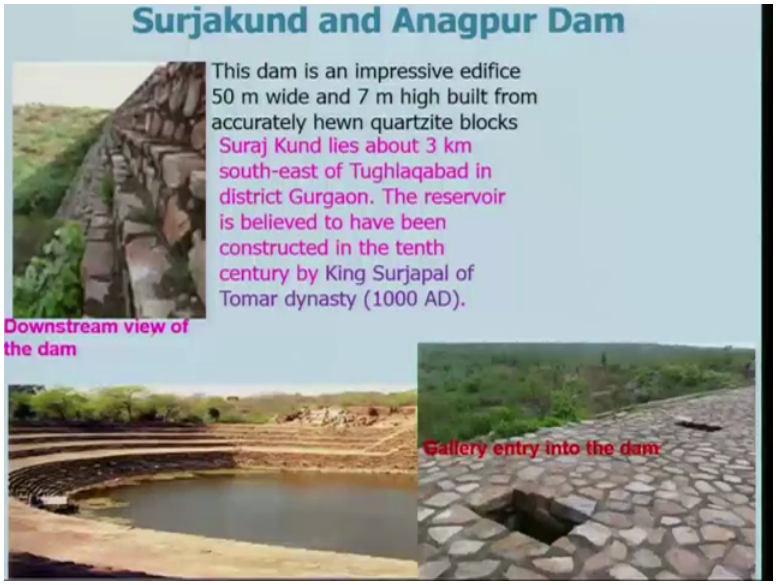

Let us look at this another dam which is Surjakund and Anagpur dam, this is in Haryana which is having a kind of a water will be coming over here and stored and silted and all silt will be removed from this place and then after that of course it will be steps. It will go up and this is the downstream view of the dam, which is there and Surjakund lies about 3 km south east of Tughlaqabad in the state of Gurgaon.

The reservoir is believed to have been constructed in the 10th century by king Surjapal of Tomar Dynasty around 1000 AD and let me tell you today the dam is being protected by the ASI but unfortunately lot of things are being taken over the land, the catchment area and other places by the local people. And this dam is an impressive edifice of 50 meter wide and 7 meter high built from the accurately hewn quartzite blocks. These are the quartzite blocks and of course some work is being done by the IIT Delhi Dr Biravali who had done some work, maybe some other people might have, I had a talk with him and then he told that it is a beautiful system. In this dam what was happening, during the rainy season the water will be flowing from the let us say up stream to the downstream in the spring season there is another

under stream which were there you know, that will be going from the left to the right side of the dam.

And there is a sluice system, sluice gate system which you know these are the gallery and entry into the dam where there will be sluice system and these steps into the gallery inside the dam. And this is the sluice outlet from this river, right there is a sluice outlet in such a way that what will happen like in the rainy season the water will be going, flowing from this side to that side and the other season or the, where it will be dry there is spring which is coming. That means there is a water sluice system that water will be coming from this side and that side, so both the crops they can do in the different, you know both the sides.

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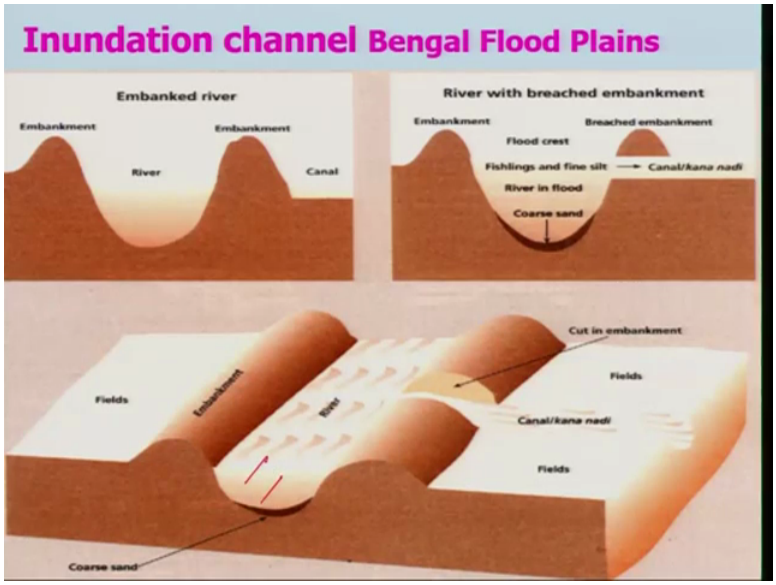

So that is the beauty of this system which you know, what according to Dr Biravali of IIT Delhi, who was trying to investigate this and concluded this way. So if that is the case then this a very interesting structure which you know, was built by our ancestors we need to be re looked at from the engineering point of view. Let us look at the inundation channel of Bengal flood plains. This is your river bed through which water is flowing, this is one embankment and there is another embankment on the other side with a cut in it.

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And there is a channel which will be you know, during the flood time this channel will be coming to the field and these are the fields which will be there. As a result what will happen, the coarse sand will be here and river during the flood the fishing and the fine silts will be passing through this channel and it will be, the whole field will be inundated during the flood. That means it will be supplying the silt which are having nutritional values you know, to the field where the crop can be made. According to sir William Willcocks a British irrigation expect, flood water enters the field to the inundation channel. These are the channels right, and water brings in reach silk and fish and the fish fed on the mosquito larvae and helped check malaria in this region that was the interpretation what is being made.

And it was prevalent just before 300 years back and got destroyed during British rule and also there was a war, Afghan and then Maratha war and during that time also this system was not maintained properly, as a result this is being, not in use. And of course after Independence and other things nobody really bothered about to look at it and this is a very simple system which were built earlier and people were knowing where to locate this canals and how, what will be the distance how much distance is required, lot of calculation, lot of data you know is required to design that one.

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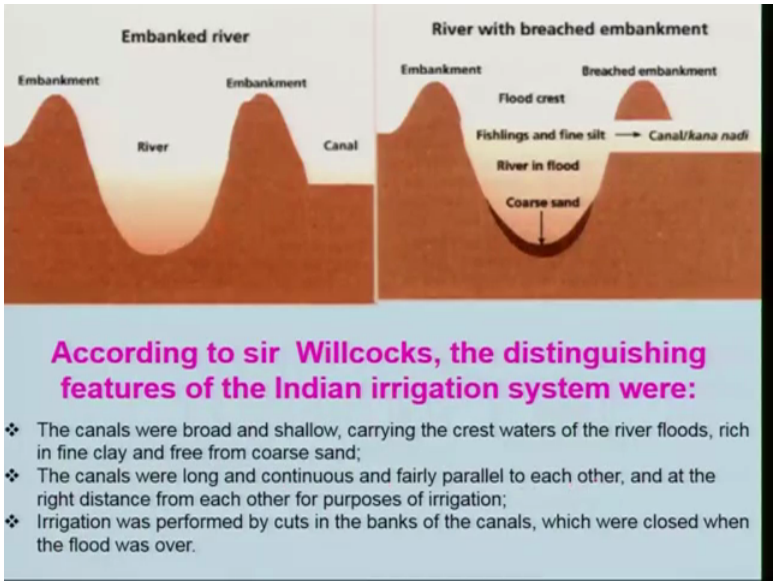

And as I told the canals were broad and shallow carrying the crest waters of the river floods rich in fine clay free from coarse sand, as I told the coarse sand will be here, but whereas the fine sands and then the silts will be going. Canals were long and continuous, fairly parallel to each other and at the right distance from the each other for the purpose of irrigation. Irrigation was performed by cuts in the bank of the canals which were closed when the flood was over. That means if the, there might be some sluice gates or gates or maybe they will be cutting it whenever it is required and do that in a regular pattern so that the soil gets fertilised by the slits and also the water.

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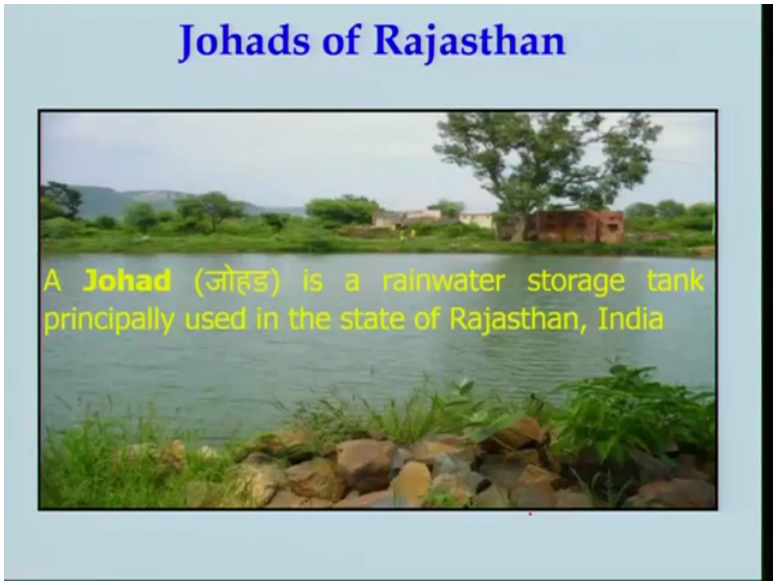

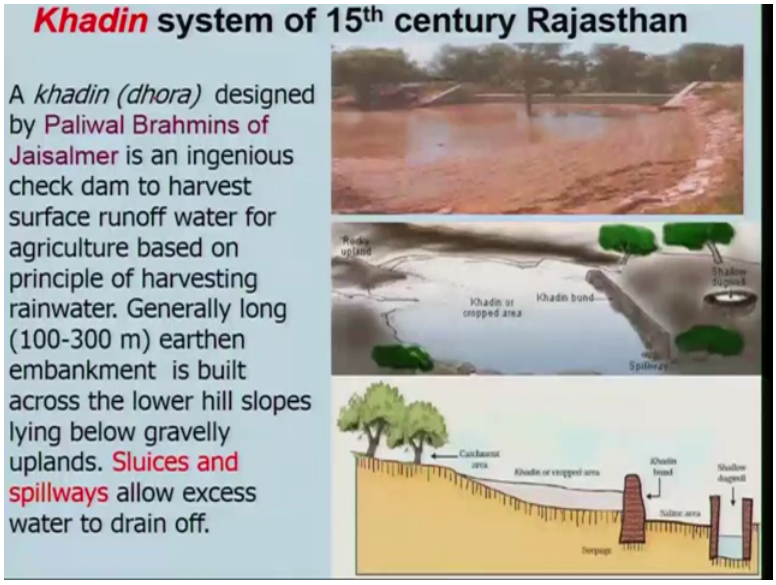

The Johads of Rajasthan which is basically a rain water storage tank used in the state of Rajasthan which is an arid area.This is known as Khadin or the Dhora designed by the Paliwal Brahmins of Jaiselmer, which is an indigenous check dams to harvest surface runoff water for agriculture based on the principle of harvesting rain waters. If you look at there is a rocky up line regions will be there and the water will be flowing and then there will be bunds, right. Bund means basically it is a dam and then water will be collected here and then it will be stored. For example this place is a new one that where the dam is being built over in this region and if you look at these are the catchment areas, the water will be stored here with this bund or the khadim what you call.

And of course in the downstream, this region you can have a shallow dug wells because the water will be seepage percolate into it and it will be recharging this area. This being a lower or the slope and then you can utilise this for the irrigation purposes and even for using water for general day to day affairs. And generally long like around 100 to 300 meter earthen embankment is built across the lower hill slopes lying below the gravelly uplands for that you need to choose it properly, the place and sluice and spillways allow excess water to drain off. There might be some sluice or the you know the spillways so that it will not you know affect these what you call the bund to be broken due to the water heads. So let us look at another irrigation system in the western Himalaya that is known as Kul irrigation system.

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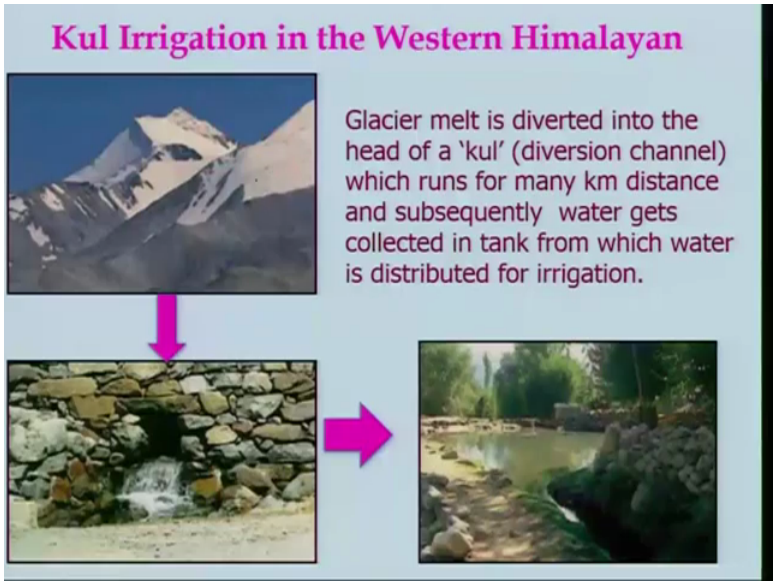

Generally these are the glaciers which are there part of Himalaya and it gets melted and diverted into the Kul in these areas and there will be diversion channel you know, which will be making this one kind of things and subsequently water gets collected into a tank you know, these are the tanks, right and this water can be distributed for the irrigation purposes this is the channels. And if you look at this is beautiful system which were there I think till 1980s in the Himalayan region which was maintained by the local people, but unfortunately government interfered and then the how system collapsed and it was being maintained and they were charging the people for you know, for some revenue for supplying the water and it was managed well.

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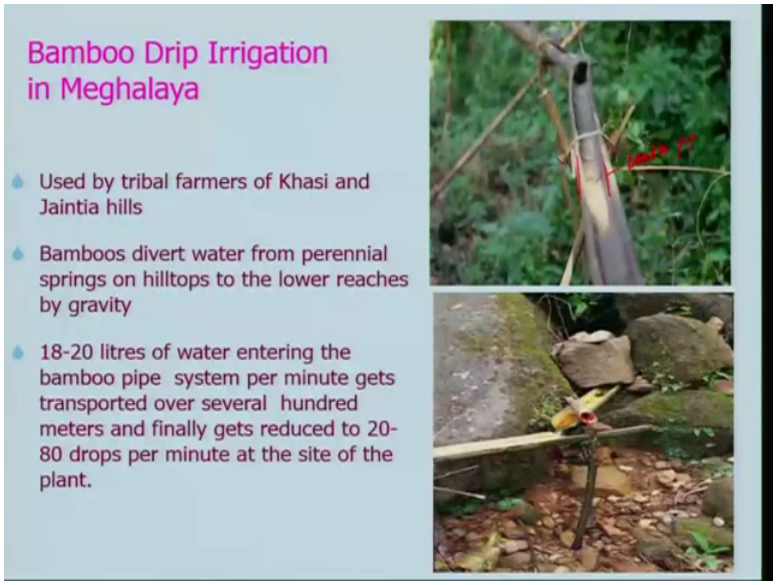

Let us look at another irrigation system, this is known as Bamboo drip irrigation system in Meghalaya region. They were using the hilly areas, they will be using the bamboo pipes these are the bamboo pipes right which are used in those regions and used by tribal farmers of Khasi and Jaintia hills. Bamboos divert water from perianal springs on the hill tops to the lower reaches by gravity and it will be coming in a very very slow manner. And what people have found out something 18 to 20 litres of water entering bamboo pipe system per minutes gets transported over several 100 meters you know, finally get reduced to 20 to 80 drops per minute at the site of plant. There might be lot of losses if you look at, these are the bamboo pipes and then water will be transported. And if you look at they were managing to irrigate their land and cultivate also.

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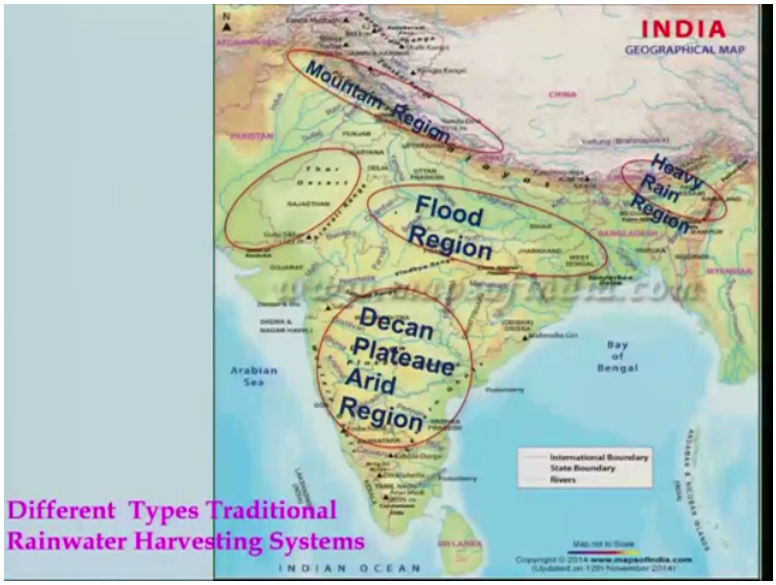

If you look at this India geographical map we are having various regions. To start with the Deccan plateau, arid region the irrigation system will be different. This is the flood region, the gangetic planes, this is a heavy rain regions in Assam, Meghalaya, this is a mountain region and these are basically dessert and arid region in Rajasthan the Rann of Kutch etc. So the same irrigation system cannot be utilised all the places. But unfortunately modern time people just put a dam and then go I ahead and do that. So there is an indigenous technology people had developed earlier according to their need and their understanding and today it is not, those things technology are not being utilised unfortunately, and that has to be revived so that we can have you know depending on the need and local materials and technologies people can use the traditional rain water harvesting systems.

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Let us look at the reservoirs which were used for irrigation system in ancient India. So this is the Bhimkund reservoir which was basically build by Paramara Raja Bhoj around 1005 to 1055 and large dam cum reservoir, which is around something 650 square kilometre known as Bhimkund reservoir by merging 365 rivulets and carefully directed various dams of moderate sizes. It had maximum depth of nearly 100 ft. these dams you know, like whether the width. See today people are talking about joining the rivers it is ancient time people have joined the rivulets and this rivulets will be coming from these mountain regions and then they have joined.

There is a lot of story about it I am not going to talk about it you cans see that. They were having some knowledge about it, but today those knowledge are not really with us and we need to re-look at it. I would like to suggest that instead of joining the rivers which are very mightier, big, it is better to first get experienced joining the rivulets what our ancestors have done and get some experience and then you go and do join those rivers, big rivers if the need arises. The dam wall is more than 1 kilometre long now serve as a road connecting the Mendua village with Bhojpur. And the upper lake the bada Talab, what we call or the big pond, until March 2011, it was renamed Bhojtaal. This is the Bhoj photograph or the statue they have installed here in honour of great king Raja bhoj who build it.

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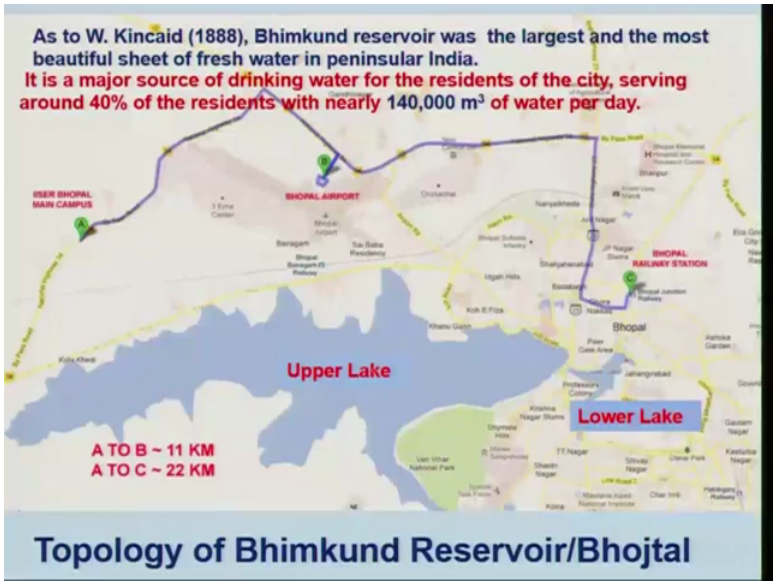

And this is the topology of the Bhimkund reservoir or the Bhojtaal, this is the bigger lake which is there and there is a smaller lake in this region. Lower lake they call, this is called upper lake and these are of course, if you look at Bhopal railway station and Bhopal airports all other thing, this is a very big lake, still this lake I there. According to the W Kincaid 1888, Bhimkund reservoir was the largest and most beautiful sheet of fresh water in peninsular India, that is his claim and it is the major source of bringing water for residence of city, serving around 40% of residents with nearby 1,40,000 meter cube of water per day as of few years back.

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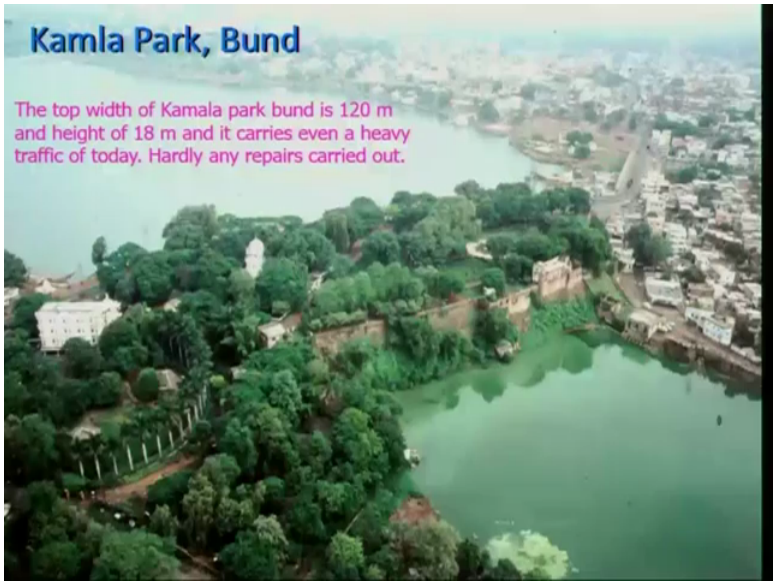

If you look at this is the Kamla bund, which is basically this is the big lake and this is a small lake kind of thing and top of the width of Kamla bund is around 120 meters and height of 18 meters it carries even a heavy traffic today. Hardly any repairs being carried out since then and it is there.

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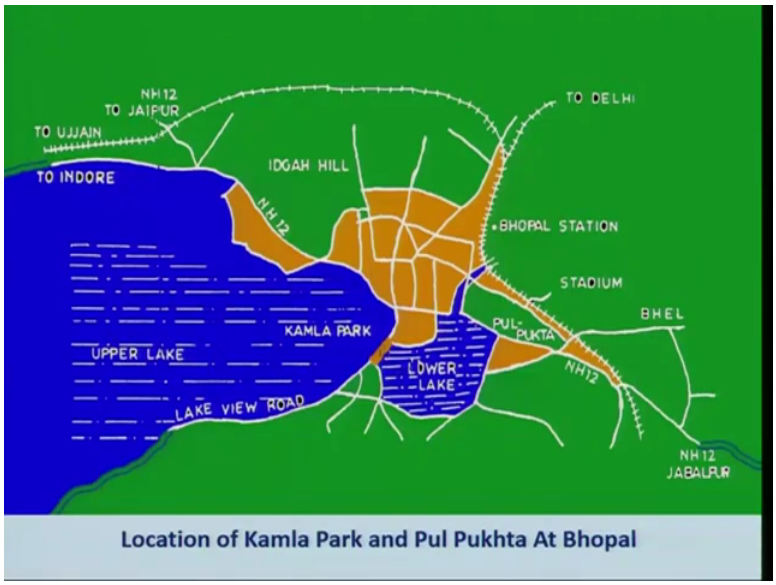

And this is the location of what you call Kamla Park if you look at this region and this is the upper lake and this is the lower lake. And of course the Pul Pukhta is this region.

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And this is the Kamla park, lower side lake and which is not being maintained properly and this water is stagnant and also lot of plants are being growing here which might be causing some pollution as well one has to look at it.

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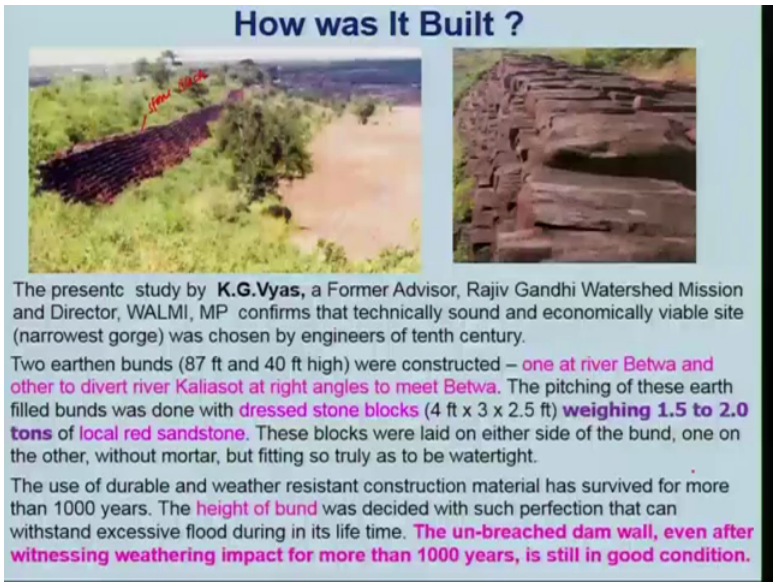

How was it built? The present study by K G Vyas a former advisor Rajiv Gandhi Watershed mission and director of WALMI, MP that is Madhya Pradesh confirmed that technically sound and economically viable site the narrowest gorge was chosen by engineer of the tenth century. They have built this earthen bund which is something 87 feet to 40 feet height were constructed one at the river Betwa and other to divert the river Kaliasot at right angles to meet Betwa. Pitching of this earth filled bunds which is not shown here was done with dressed stone blocks, these are the stone blocks they were using the local red sandstones weight around 1.5 to 2 tonnes.

These blocks were laid on either side of the bunds on one and the other without mortar but fitting so truly has to be water tight, this is a very important technology one can think of. Whether is it possible? Today I am thinking that how they are making the stone that they will be water tight right and is it you know we can repeat even with modern technology. What technology they were using and also very important thing, they were using very local materials at that time.

Wherever they will go they will find out local materials and use of durable whether resistance construction materials has survived for more than 1000 years and the height of the bund was decided with such perfection that can withstand excessive flood during this life time. Of

course one has to look at what kind of technology what kind of judgement they were having, what kind of design they were having, we need to do research on this and unbreached dam wall even after witnessing weathering impact for more than 1000 years still in good condition that is of course I have taken from K G Vyas report and this statements.

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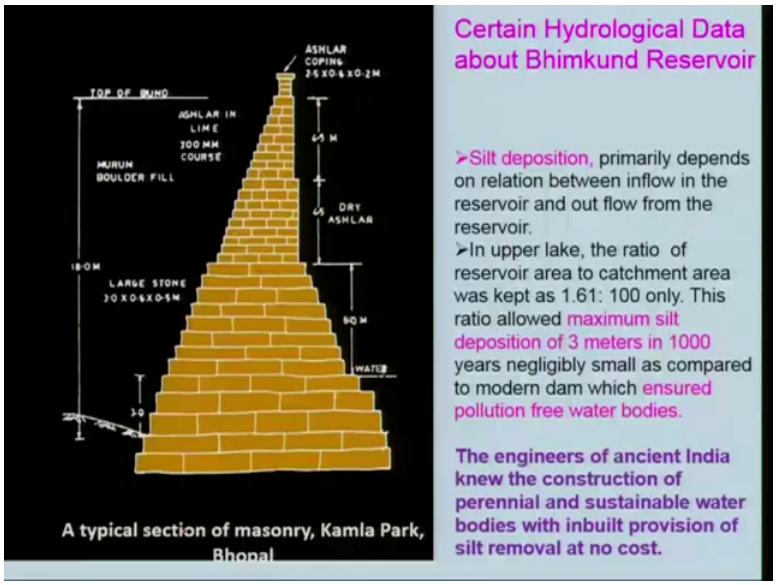

These big stones were there, this is the typical section of masonary work in Kamla Park in Bhopal and this is of course still water and this is the large stone are being used and after that it is a dry ashlar and this is ashlar in lime, you know reduces its width and then of course you use ashlar coping kind of things smaller ones, that they were also managing the silt deposition because the silt deposition primarily depends on the relation between the inflow in the reservoir and outflow from the reservoir. In the upper lake the ratio of reservoir area to catchment area was kept around 1.61 to 100 only. See what will happen if it is 100 the velocity will be reduced, if the velocity will be reduced the silt will be deposited there before it is being transported.

And whenever it will be dry then you will use this silt and then you know for the crop production. This ratio allows maximum silt deposition 3 meters in 1000 years negligibly small as compared to modern dam which ensure the pollution free water bodies. That means, what it indicate that, engineers of ancient India knew the construction of perennial sustainable water bodies with built in provision of silt removal at no cost unlike the modern system where silt you know has to be removed and then at a very larger cost and it is causing lot of problems to the most of the modern dams built by in modern India.

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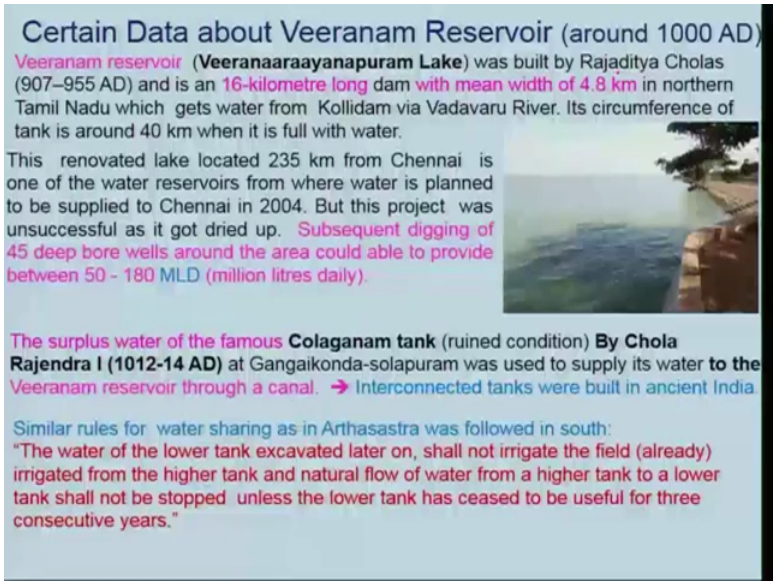

Let us look at certain data about Veetamma reservoir which was built around 1000 AD. This was built by Rajaditya Cholas around 9007 to 9055 AD, it is around some 60 KM long dam with mean width of 4.8 Km in Northern Tamil Nadu and this reservoir gets water from Kollidam via Vadavaru river. That I have talked about Kollidam basically in the river Cauvery River as a part of systems and its circumference of the tank is around 40 km when it was full with water. This renovated lake located 235 km from Chennai is one of the water reservoirs from where water is planned to be supplied to Chennai in 2004 because this is a big water body and then it can be utilised. Always Chennai was having even today it is having problem of water.

But this project was unsuccessful as it got dried up and subsequent digging of 45 deep bore wells around the area could able to provide water between something 50 to 100 MLD, MLD means million litre daily. That means whatever we had built if we could maintain well you know it can solve the problem of water even in modern time. Surplus water of famous Colaganam Tank ruined condition that is today by the Chola Rajendra in around 1012 to 14 AD, at Gangaikonda and Solapuram was used supply its water to the Veeranam reservoir through a canal. That means if you look at it is interconnected tanks were built in ancient India around that places and very interesting things I must tell you that certain rules which were mentioned in the Artha Sastra was also followed in South.

That is water in the lower tank excavated later on shall not irrigate the field already irrigated from the higher tank. And natural flow of water from higher tank to the lower tank shall not be stopped unless the lower tank has ceased to be useful for 3 consecutive years. So these are

the rules, can be applied today also so that lot of disputes can be you know solved because if you follow certain rules which were their earlier in the psychic of the minds of the people, naturally you know it will be better for this. And with this I will stop over and we will see some more reservoirs in ancient India which are still being used and also can be revived without really much technology this thing. But however we need to study and improvise the methods of reviving them in a natural way than the artificial way being done formaking money, Thank you very much.