Introduction to Ancient Indian Technology
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Module 6
Lecture No 26

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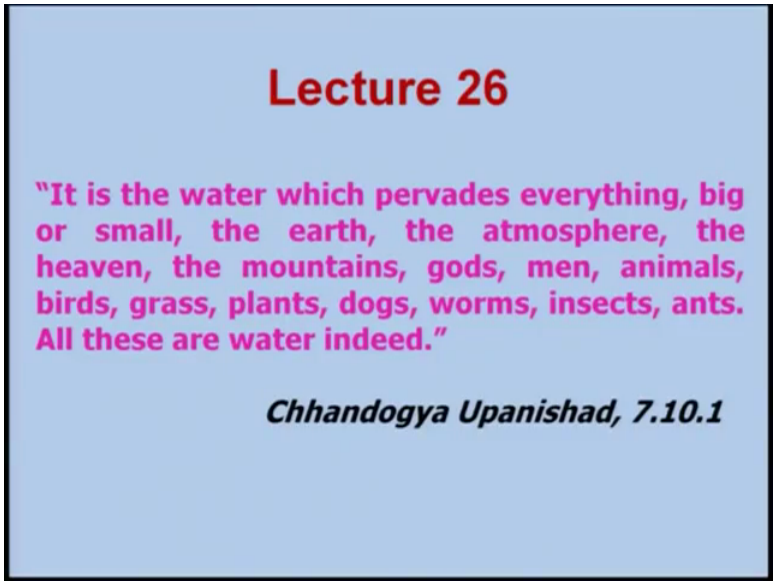

Let us start this lecture a thought process from Chhandogya Upanishad "It is the water which pervades everything, big or small, the earth, the atmosphere, the heaven, the mountains, gods, men, animals, birds, grass, plants, dogs, worms, insects, ants. All these are water indeed." Today we will be basically discussing about the water and how to harvest it, also the irrigation system, few lectures I will be devoting on that which were being practice in ancient time.

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If you look at this is a beautiful planet you know it is you can consider to be a blue planet and that is our mother Earth. Why it looks so beautiful? Because water is there.

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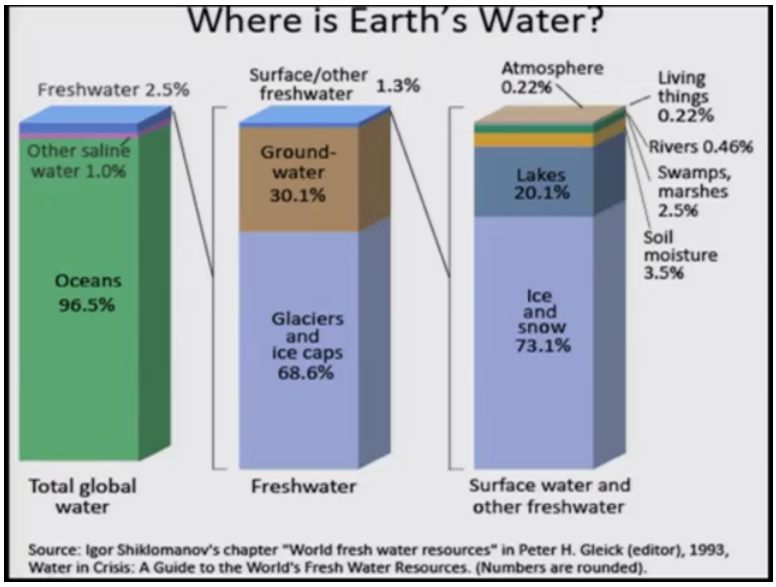

And let us look at that as per the Chhandogya Upanishad the water is everything so also even our body contains 70% of the water. The whole Earth contains you know 70% of water, but if you look at what is the amount of water or the fresh water that we can use? If you look at total global water here the ocean contains 96.5% which are saline in nature we cannot use it. And another 1% of water total water will be saline, that means the total water which is fresh and which is considered to be fresh water is around 2.5%. Out of these 2.5%, the 68.6% one cannot use because the glacier and ice caps. And there will be also ground water 30.1%,

ground water that means you will have to take it out from the ground using some energy or the now we are using now-a-days pump and also motor to extract the water from the ground and surface water is something 1.3%. Out of that 1.3%, the 73.1% is basically ice and snow and another 20.1% are lakes it is very difficult to use that even.

Then you will be having soil moistures because soil also contains certain amount of moisture 3.5%. And when we discuss about the agriculture we are concerned about how to detain the moisture in the soil. That was a great challenge for the agriculturist and today it is difficult to have because of global warming, because of wrong practices of the agriculture or the forming and also the greenery coverage, those are you know receding or reducing the soil moisture content. And then the swamps or the marshes or something 2.5%, rivers are 0.46% right the total water, water it contains and then of course atmosphere will be 0.22%, atmosphere also contains some water and living things like 0.22%. If you look at the amount of water which are available to us for our uses are quite less. And then we are what we are doing, we are misusing it, abusing it right and then spoiling it also so far quality is concerned.

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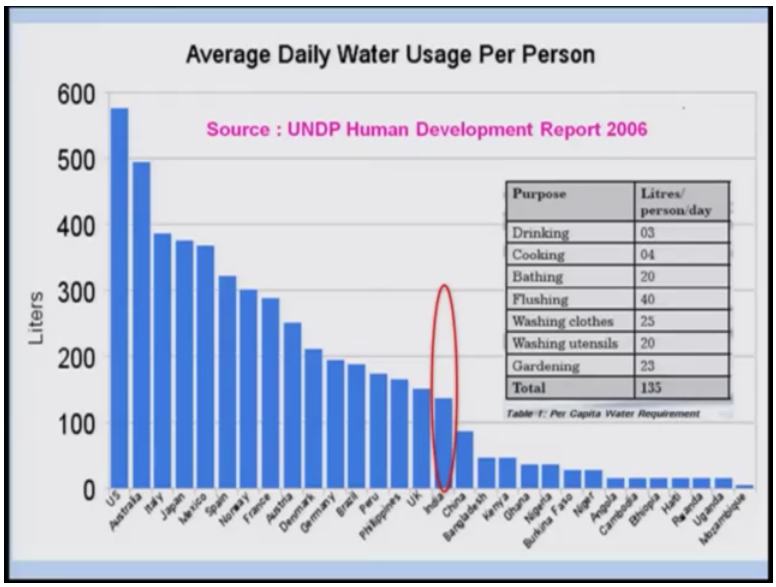

If you look at average daily water uses for person is graph being plotted here, these are the on this side these are you know liters per person per what this on the left hand side the average daily usage of water per person has been shown here right, in this these are the countries like U.S.A, Australia you know all those countries are there you can observe that this water uses is decreasing with the countries and these countries are basically undeveloped countries ok, And U.S.A, Australia, Italy, Japan, Mexico all those are developed countries. In developed countries per person usage water is higher and India is in-between which is around something

130 liters per person, are you getting? That means if you will be more developed, you will be using more amount of water. That is the one yardstick like the way we also judge whether you are developed or not developed energy consumption per person, per capita energy consumption.

And as we will be developing the so called development what we are seeing that means we will be using more amount of water, where water will come? And also we will be contaminating the water. But if you look at our ancient way of looking at use less in modern days in consumeristic society it is the consume more that means we need to follow that consume less amount of water for your survival, for your life and that should be the thing we should learn. And fortunately we are having very less amount of water usage per person as compared to the developed countries and we should keep it but unfortunately due to this industrialization, urbanization and other things our consumption for person you know water, is increasing at an alarming rate and there will be a problem, ok.

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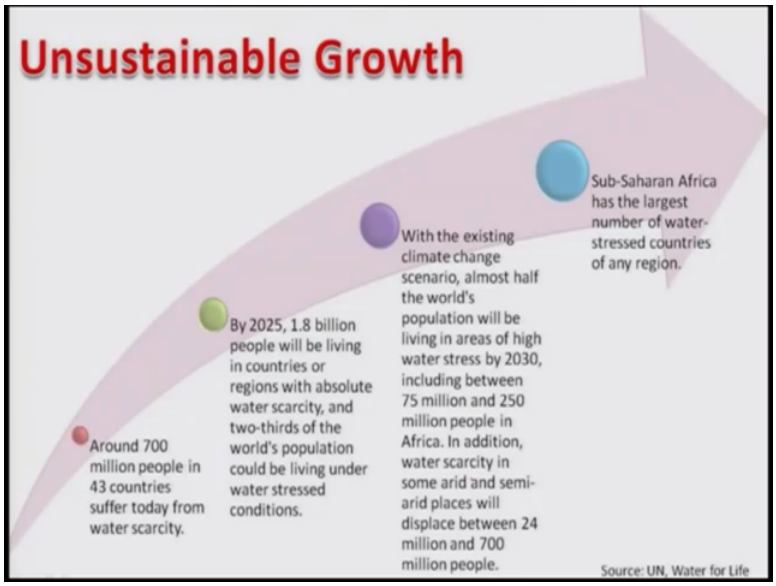

So, let us look at the even report like water for life has come up. Around 700 million people in 43 countries suffer today from water scarcity and that is UNA report data. And by 2025, if look at after 8 years today is 2017, 1.8 billion people will be living in countries or regions with absolute water scarcity, and two thirds of the world's population could be living under water stressed conditions right, 2025. And if you look at 2030 what will happen? With the existing climate change scenario because the climate has been changing, global warming, the temperature has gone up. Almost half of the world's population will be living in areas of high

water stress by 2030. These are of course prediction but still there will be something will be there you know, not that it will go loft sided.

Including 75 million people and 250 million people in Africa, this will be affected by the water. In addition water scarcity in some arid or semi-arid places will displace between 24 million to 700 million people they are predicting because water will notbe there, they will have to shift, they will have to go move to some other place where water will be there, otherwise you cannot survive. And sub Saharan African has the largest number of water stressed countries of any region. Of course Asia is the next after Africa is here the next because it is a populous place, and we need to face the problem for water. And we are also spoiling the water quality by drainage system you know putting the sewage into our rivers, most of Indian rivers are polluted you know, not only the Ganga but any other river you can think of right.

And also the we are not taking care of what you call preserving it and the even you know water. And underground water is also contaminated to some extent rather you know particularly in urban area is water is contaminated, underground water. Now where we will go because water is the elixir of life without water, can you think of any life? Forget about any development may be right? And that is about global scenario I guess, let us look at water crisis in India.

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I will be giving you a very you know a brief view of the thing. The states which are hit by the water scarcity is Rajasthan, Uttar Pradesh, Madhya Pradesh, Chhattisgarh, Andhra Pradesh,

Tamil Nadu of course the Gujarat, Maharashtra and very few states were are not affected by you know water scarcity. And if you look at this is a picture what I have shown few here, this is New Delhi Municipality Corporation. New Delhi, capital where people are on this tank sitting around and they want water, and similarly here in Rajasthan the women folk they are walking may be 2-3 kilometers to get water. And this is of course in Natwarghad in Gujarat there is a what you call large well and people are swarming around that well to get some water. These are real pictures you know right situations, situation is quite alarming.

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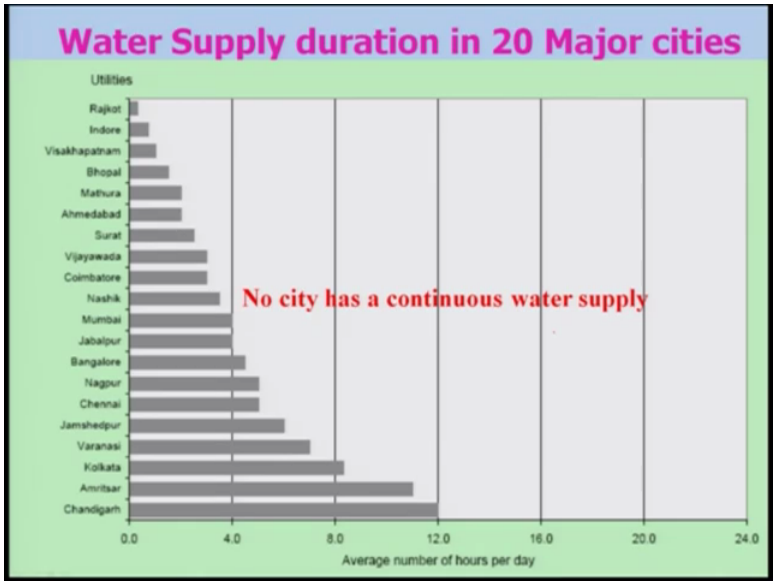

So, now if you look at water supply duration in 20 major cities and this is of course Rajkot which is having very less number of hours may be you know half an hour per day. And of course the Chandigarh if you look at is having 12 hours per day on an average. Rest of the things Mumbai, Jabalpur, Bangalore having you knows, all these things these are the 20 cities where people are not getting 24 hours water supply. Of course in IIT, Kanpur we get it is a luxury for us you know right. So, the problem is quite grieved, it is quite alarming and we are having 130 crore people and may be it will be after few years it will be 135 or 140 after 10 years, 20 years like that. So, let us look at what are the main causes of present water crisis in India.

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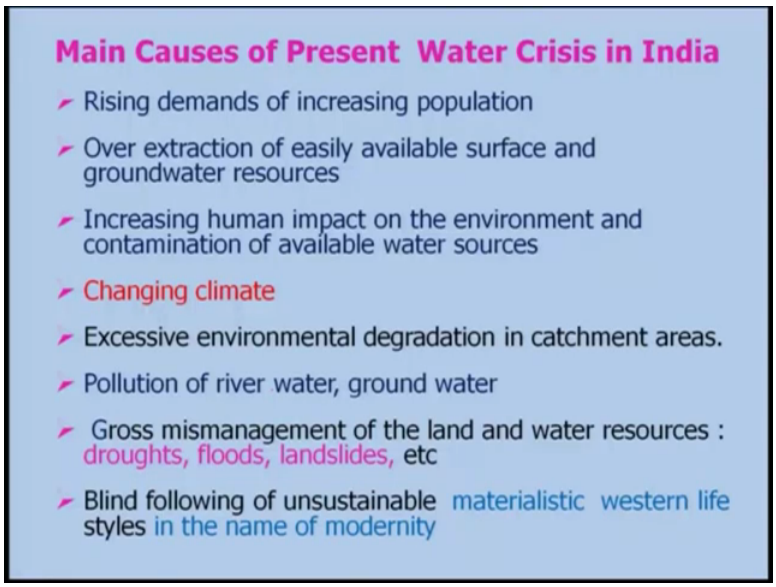

And of course there is a rising population therefore, demand for water is increasing. Over extraction of easily available surface water and ground water resources because we are having now electricity and then we are having also the what do you call diesel set, gen set, generator set, where you can use that power to extract you know water from the this thing and we also misuse the water for agriculture because now-a-days water is free for farmer like then it will be all they will be misusing. And besides this whatever water is there also we what to call not use properly and also that is contaminated, that is a one problem. So increasing human impact on the environment and contamination of available water sources because as I told earlier that our sewage system you know we are putting into the rivers.

And so industrial herbs, or industries they are also putting their garbage into the river because that is a poor you know fellow like nobody to take care of river and so there is a thing. Beside this there is a climate change; of course global warming the evaporation rate is increasing and then also water is scanty. Scanty in the sense some places of course too much of water is coming and then some other places there is a problem and excessive environmental degradation in catchment areas. If look at catchment area means mountains and other hills and other places, if look at those are flooded with what? With lot of garbage, people are going for tourist right, and then they are putting lot of materials leaving as it is and coming back, those are contaminated right because of this tourism you know is become a business, so therefore that is creating a lot of problems in the pollution in the catchment area.

And the catchment area means encroached by the people also, earlier days people do not want and then mountains they are disseminating like from there it will come. And then pollution of river water, ground water I have already talked about it, and gross mismanagement of the land and water resources because in as I told in agriculture we are using lot of chemicals today, and those are you know like percolated when water comes you know you are using irrigation that also coming to the soil and then other things it is affecting. And like of course there is a problems as a result they will be droughts, floods and landslides you might be aware that Himalayan region is now more prone to land sides because people have blasted it you now for making houses.

Those are rocks are being together you know there any time it can crumble because lot of blasting are going on to make home or to quarries and then you know take out so these are the things we should not spoil. And some of the floods of course people have put a lot of dams in the rivers as a result you know they are not having good management and they whenever they will get pressure from the water due to water load or due to mismanagement they will release the water, so there is also floods comes you know man made. Now-a-days some floods at least not all but some of them are man-made as being told to me, and why it is so? Because we are following unsustainable materialistic, western way of life in the name of development or the modernity without really thinking that look those things cannot work for here because India is a populous country. We cannot have you know like a system where people will just misuse it and give them freely, no.

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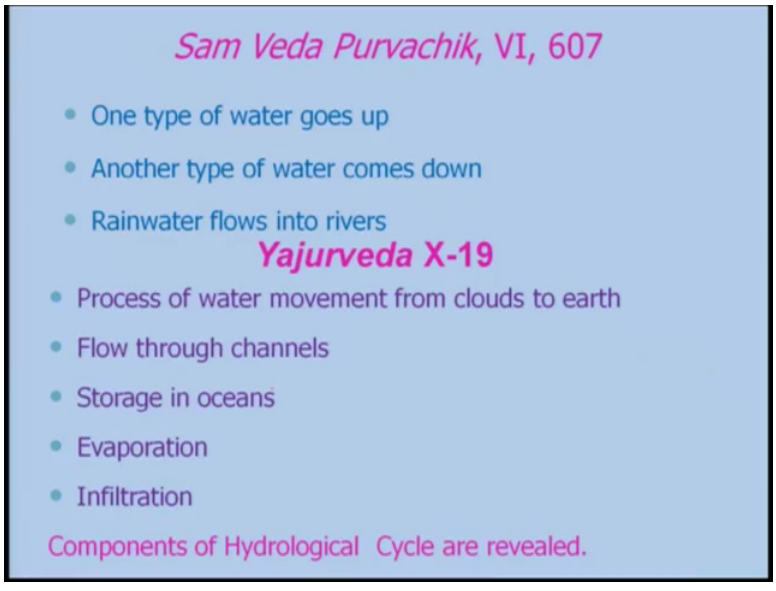

So, then we need to look at like what you call our ancient Indian wisdom and see how they were managing the water at that time. And how we can have sustainable water harvest harvesting system right? That we can learn from them and re look at it and that is the objective of basically this course to relook at them how they were managing properly. So, if you look at you go to the Sam Veda like according to that one type of water goes up right. Another type of water comes down, rain water flows into rivers right because that is a one process if you look at it is basically hydrological cycle, what is talking about in their own language.

Process of according to Yajurveda water basically moves from clouds to the earth right, because from the sea it will be evaporated and then it will go and then wherever mountain and other places greenery will be there it will condense and rain will be forming and flow through channels and again it will go and store in the ocean, right. So this is the cycle and of course there will be evaporation and there will be infiltration kind of thing in the soil. So, this is a beautiful cycle right, what nature is doing for us.

Now, if you imagine that we want to use the sea water which is saline and evaporate it, condense it and use it, right. Will it not be very costly? It will be extremely costly, but nature is doing for us, what we need to do? And nature has also has created how to collect wherever the you know will be there, that is why all components of nature like mountains, jungles all other things, rivers are already designed by the nature, we need to protect it that is all and then use it right? That is the thing what is being basically we can learn from these things.

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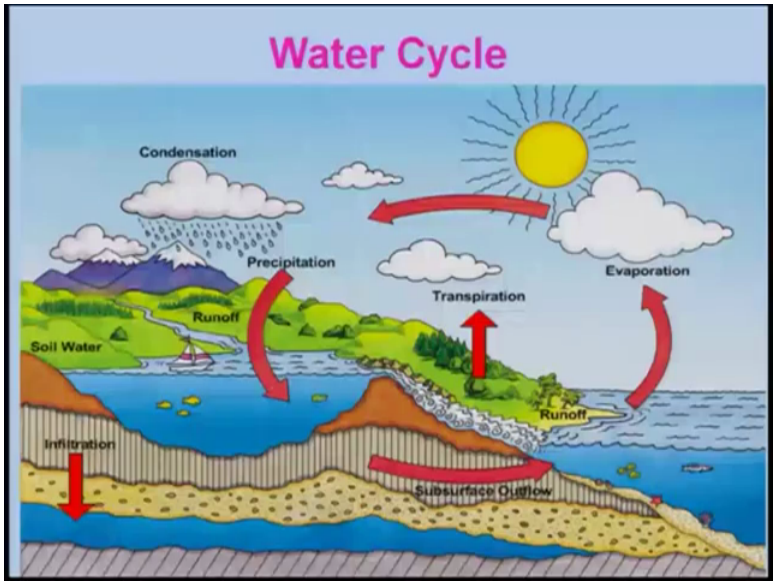

And if you look at this is we already know that is basically if you look at there is a sea here and you might be aware that sea, marine life is very important. But we are all already spoiling the marine life, particularly the coastal nearby area even in the deep sea also being spoiled by us because of exploration, because of other things. And this evaporation will be cloud and then again cloud will move towards that, there will be mountains and then you know and also greenery that will be precipitation, condensation, precipitation then water will be coming through all this land areas there might be run offs right? And even some it will be inflated it will go and as a ground water if you look at these are the ground water right will be stored and then you can use right that water also, so this is a beautiful system is there in place by the nature but we are spoiling it in the name of what? Development, in the name of you know what you call modernity.

So, that we need to look at that nature is divine as being talked in our scriptures and we will we are a part of it. It is not the human being alone will be enjoying the fruits of the nature or the resources of the nature, others also should have. But they will not do any damage, can an animal will do damage to the nature? No , it is the human being who can spoil it. So, that is the thing we can learn from what you call ancient way of looking at this hydrological cycle which was mentioned in the Veda in a little different way. And let us look at Birds eye view of water harvesting systems in our country.

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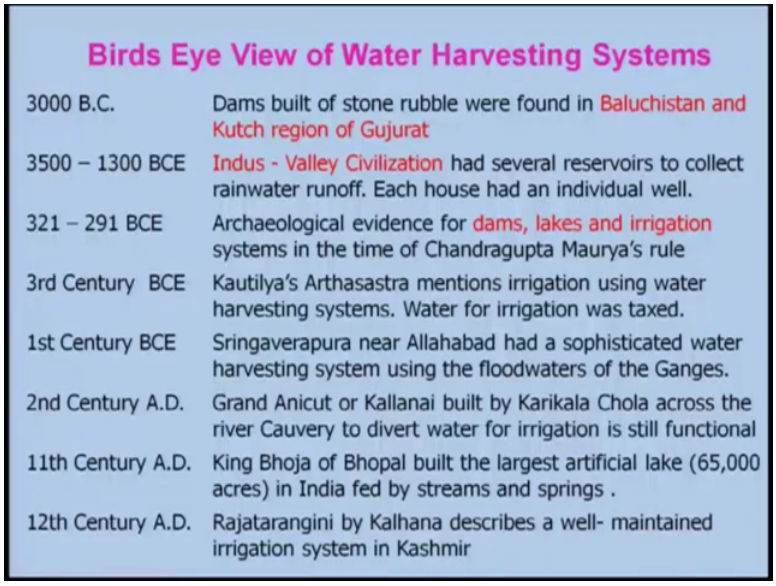

And what I am showing here is a very very brief things right. It is a very vast so I cannot really talk about it. But however I will say that 3000 BC or even more before that we have seen in Indus Valley Civilization you know like people found dams built of stone rubble in

Baluchistan and Kutch region of Gujarat. And of course during Indus Valley Civilization what we call it now Saraswati Civilization at several reservoirs to collect rainwater runoff. Each house had an individual well and so also public well they were having. And 321-291 BC if you look at archeological evidence for dams, lakes, irrigation systems during the time of Chandragupta Maurya's rule you know people have found out.

And even if you look at during that time Kautilya's Arthasastra, which we had talked several time it has mentioned the irrigation using water harvesting system and even at that time there was a provision for taxing the farmer whoever uses water from the irrigation system. Existing irrigation is not free ok, like today we are giving free to the people, Freely give to the people then they will misuse it. And the first century BC if you look at Sringaverapura near Allahabad had a sophisticated water harvesting system, which I will be discussing and also controlling the flood waters of Ganges. That means you know you will have to there is a flood, whenever there will be there is a river there will be flood but that also you can use it for your advantages and manage your water need.

And 2nd Century AD is a Grand Anicut or the which is also known as Kallanai anicut like built by Karikala Chola king right, across the river Cauvery to divert water for irrigation, which is still functional today, even today right and it is a very old. Then of course there are several other things but I am coming to 11th Century AD King Bhoja of Bhopal built large artificial lakes around 65000 acres in India fed by streams and springs of that area right. They have joined altogether like today people are talking about joining rivers they had joined also springs, but they were having certain understanding right.

And 12th Century AD Rajatarangini by Kalhana described a well maintained irrigation system in Kashmir, which I will be discussing because those things were managed by the people at that time not the king who is you know supposed to manage. Today government is trying to manage everything but at that time people were managing their own resources right, there is a difference of governance. So, let us look at you know Historical Perspective of well and water bodies like what are the things?

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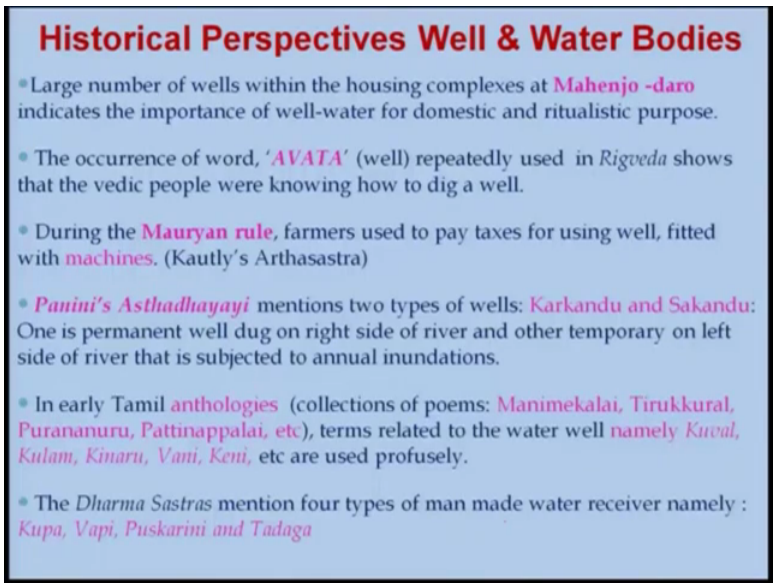

So, if you look at the large number of wells within the housing complex at Mohenjo-Daro and Harappan clearly indicates the importance of water for domestic purposes and ritual ritualistic purposes. And the occurrence of word "Avata" which is basically "well" repeatedly used in Rigveda which indicate that the Vedic people were knowing how to dig a well and use it right. Of course during Mauryan rule, as I told earlier, farmers use to pay taxes for using well and also the other irrigation system fitted with the machine of course. There is nothing much about those machines which are being used. I presume there might be some water wheels or something to you know take out the water kind of things. And the Kautilya's Arthasastra had mentioned about that.

And besides these Panini's Asthadhayayi as already talked about two words of course there might be more words also but what I have mentioned here is Karakandu and Sakandu. One is permanent well dug on the right side of the river. I do not know really why right side, you know that is one question coming to mind. And another in temporary on left side of the river that is subjected to annual inundations, there will be annual inundations and inundation means flood will be coming. And it may happen that flood is moving towards the what you call right side that is why that well might be temporary whereas the left side might be you know stable one or may be having embankment which is flood will not go.

People have also you know while studying this I learnt that people are having embankment on the river one side, they allow river water to flood in other side you know that means they wer having certain control over the rivers movement right. If you are having good

embankment one side and other you allow then anywhere you are what will come that will be that will be going, so that is the one reason what you know came to my mind. Of course in early Tamil anthologies, there are several collection of poems like Manimekalai and Tirukkural, Purananuru, Pattinappalai, etc, of course I am sorry I am not pronouncing this Tamil word properly I think my my Tamil friends will tolerate me. And terms related to water well namely Kuoal, Kulam and Kinaru, Vani, Keni there are several words are there which are used profusely in these literatures of Tamil Nadu. that means they were concerned about well right and how to make and other things.

Besides this, Dharma Shastra's mention four types of man-made water receivers like that means you know if you were having if you could dig well, let us say will get some punyas right and like Kupa, Vapi and Puskarini and Tadaga. Like earlier days there was a belief system on the people, if you give your resources or donate your resources for having a Kupa that means you know you will do a lot of what you call punya. Punya means what it will be? Like m good deeds right, this is considered as a good deeds. Similarly you know that is why that believe system was working, people were coming forward to give their you know resources, money, even their own man power to use that, so that public will use it that was the feeling people were having.

And with this I will stop over here and we will be also discussing about the other you know aspects of well and water bodies ad also other things how they were doing and how the society was doing not the government was doing that is the there is a difference. Today government is trying to do but earlier days the public things means public will take care of themselves in a group manner not in individual manner. So, therefore society was alive at that time but today society is almost be with a begging bowl to the government right? Society should be you know do their own work of doing the things right? So, with this I will stop over we will see in the next lecture Thank you very much.