Water Society and Sustainability
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Lecture – 08
Water Harvesting and Water Use Techniques in Ancient India – I

So lecture 8, it should lies on a water harvesting and water used technologies in pre colonial India specifically ancient India. And I have not kept it as water management in ancient India, because when we are talking about ancient India we have to keep this in mind that water was not considered as you know private commodity and it was not meant people did not want to hardness water for seeking profits.

So, water was to a great extent public goal and it was looked upon as a valuable entity which was imperative and extremely required for lives and livelihoods of not only human beings human population, but also all other you know, animate species or animate beings on planet earth in this specific contest India.

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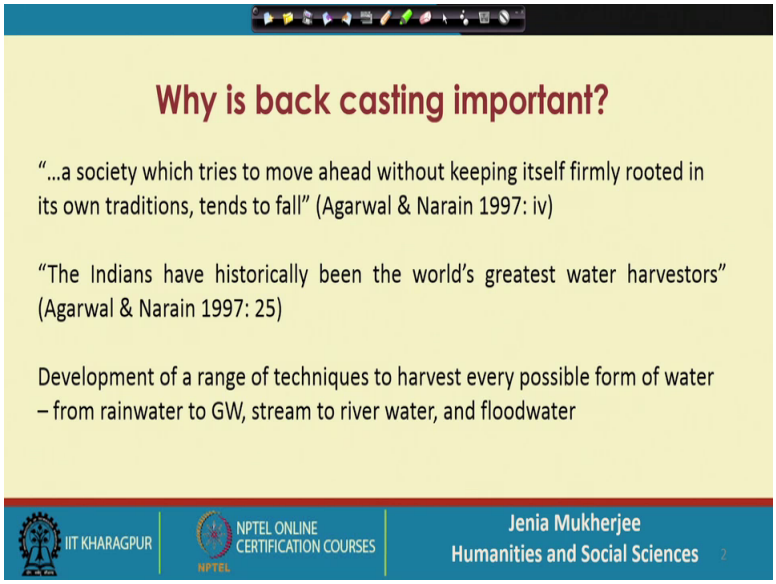

So, now why do we really need to know about pre colonial water harvesting systems? What is the need of back casting? So, this is called the back casting mythology. It is an important mythology of looking into the chronological development of things using a long term temporal scale or a temporal trajectory. Now why back casting is important because like these are taken from Arun Anil Agarwal and Sunita Narain. So, I will talk a

lot about them and their particular book call dying wisdom in the subsequent course of these lectures.

And here I have taken a quote from the very preface and the introduction of these particular book, where they say that a society which tries to move ahead without keeping itself find the rooted it is own tradition tends to fall. So, I will virtually explain that what happened to India and what happened to the Indian context. So, far as water scenario was concerned when they were coming up with their report called dying wisdom during the 1990's; the later half of the 1990's.

Now, this is again another important quote from the same report by Agarwal and Narain where they say that the Indian historically been the world's greatest water harvestors and I highlight this particular thing world's greatest water harvestors. So, definitely we really need to know so, what were the various harvesting mechanism that Indians were involved into and India we always it is a huge diverse and the complex scenes. So, so many ecological regions in India so, many states and all the states are also extremely diverse and complex.

So, what are the different and numerous water harvesting techniques that will prevalent in this various ecological zones of India so, we really need to know about this. And finally, as mention that India develop a wide range of techniques water harvesting techniques to harvest every possible form of water, starting from rainwater to ground water, from stream to river water and very importantly flood waters. So, when we will basically focus on Bengal for that matter is in India and even parts of south India, we will find that how flood water was harvested using indigenous low cost, very small scale, beautiful, you know eco friendly harvesting mechanisms and means.

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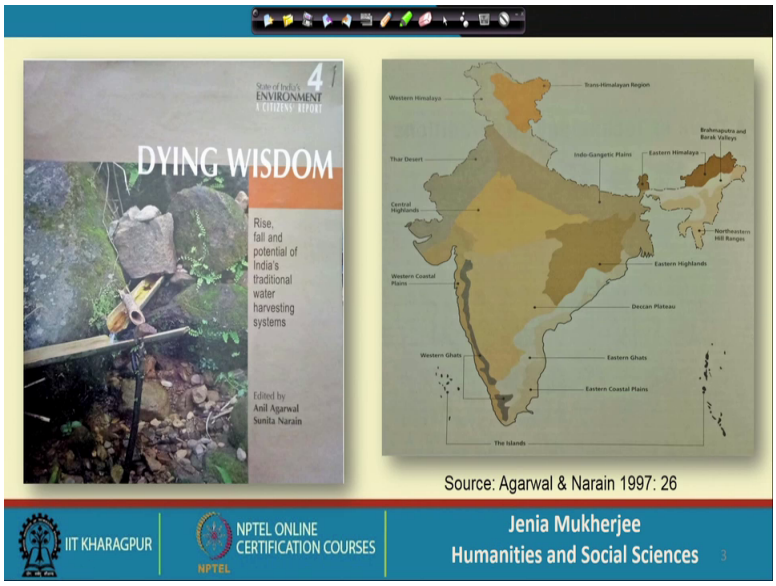

So, yes this is the book or the report that I was talking about it is a state of India's environment a citizens report published by the CSE which is centre for science and environment. So, either know whether you are aware of the history of the emergence of this particular think tank very important things and based in Delhi which is called the centre for science and environment and centre for science and environment it had a very interesting you know historical immergence when there was the kind of an environment and development debate going on in India during the late 70's and early 80's.

So, they came up with the first state of India's environment report in 1981 and then another report I mean following that in 1982, where they were actually to a great extent propagating and propounding ecological Marxism to try to you know create a bridge between the environmental list and the development list group. But that is a different story which I am not going to cover right now. And right now I will be focusing on this particular report called them dying wisdom and report be edited by Anil Agarwal who was the then director of a CAC and Sunita Narain his colleague.

So, as you see from the name dying wisdom so, which means that wisdom which was there, but unfortunately which was being replaced by maybe quote, unquote modern water management techniques for modern water management scheme. So, I also need to share a little bit about the concept behind the publication of this particular report. So, this share in the preface of this particular book that 2 things are, there are 2 major reasons

that led to the publication of this particular report and that led them to you know concentrate and focus on this particular theme of water harvesting techniques in ancient India.

So, one was during this time if you remember like this report came out in 1997. So, during this time what was going on was that a kind of an anti dam resistance movement. So, we know about the Narmada Bachav Andolan against the know implementation of the Sardar Sarovar Project. So, then the Indians and many people they were actually thinking of following some social and ecological less destructive mechanisms; so, far as environmental you know aspects or concept.

So, the same is very crucial was crucial for the water sector as well. So, people were really thinking of whether there could be small scale cost effective measures that can take care of the water bodies, rivers and also the community you know at the same time. So, this was one and at the same time they mention that they themselves and also a team a colleague from the centre for science and environment. They were exposed to very interesting small scale harvesting techniques and mechanism in different parts of India more specifically western India Rajasthan.

So, they went for field survey to this very different areas mainly you know Rajasthan and Madhya Pradesh and they got exposed to small scale water harvesting techniques like buns and hundeis and the huns and bhandaras so, which I will elaborate. And so, they say that when they saw all these I mean in this all the existence of these mechanism in different parts of India. So, they were extremely excited and fascinated by the fact that some of these very old systems were still you know running in this areas.

So, they thought that there should be a wild scale coverage of all these small scale harvesting techniques because otherwise you know lot of these techniques for getting replaced by the other large scale hydraulic technique and schemes. So, time was ripe and enough for them to focus on these harvesting schemes to give people an idea about the you know divergent small scale measures and mechanism that were already existing in different parts of India.

Now, this is a map that talks about what that describes the 15 ecological zones of India. So, if you go through this book, the very beginning you will find this particular map that talks about you know the classifies India into this 15 ecological zones from trans

Himalayan region to the Island that the Andaman and Nicobar Islands. So, and in between there are the Western Himalayas, the Thar desert, on the West Central Highlands, Western Coastal Plains, Western Ghats and on the East we have the Indo-Gangetic Plains, the Eastern Himalayas, the North Eastern region you know across this Brahmaputra and Barak valleys, the North Eastern Hill Ranges, Eastern is in Highlands, Deccan Plateau, Eastern Ghats and Eastern Coastal Plains.

So, this book is a wonderful book that provides a comprehensive coverage of the water harvesting techniques across this 15 ecological zones, but unfortunately I will not be able to you know cover and discuss all the harvesting measures or mechanisms across all this 15 ecological zones. And definitely I have my own way of classification and I would gradually narrate that how I would be classifying you know in India across the different zones and what are the different harvesting techniques that I will be discussing in this particular lecture.

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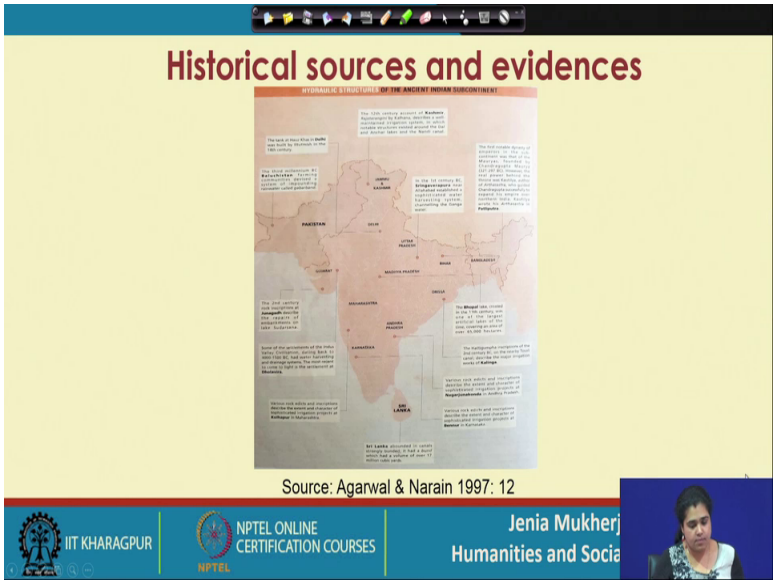

So, this is another interesting map which talks about historical sources and evidences. So, for that matter if we want to know about water harvesting techniques for Jammu and Kashmir, then this particular book we all know about Raj Tharangini by Kalhana. So, this book describes well maintained irrigation system in which notable structures existed around the Dal and Ancher lakes and the Nandi Kana. So, this is again a very interesting

map that talks about the different sources, the different historical sources and evidences that we come across for these different states of India.

So, again for example, let us say the example of Gujarat. So, Gujarat again we all know about the famous Junagarh inscription. So, the Junagarh inscription it describes the repairs and of the embankments on lake Sudarshan. So, what that done Anil Agarwal and Sunita Narain is that they had consulted all these archival sources they had consulted the repositories and they have tried to come up with an map that talks about the different harvesting techniques that has been reflected in the various sources historical sources that we find about you know that we find reflecting on ancient pre colonial India.

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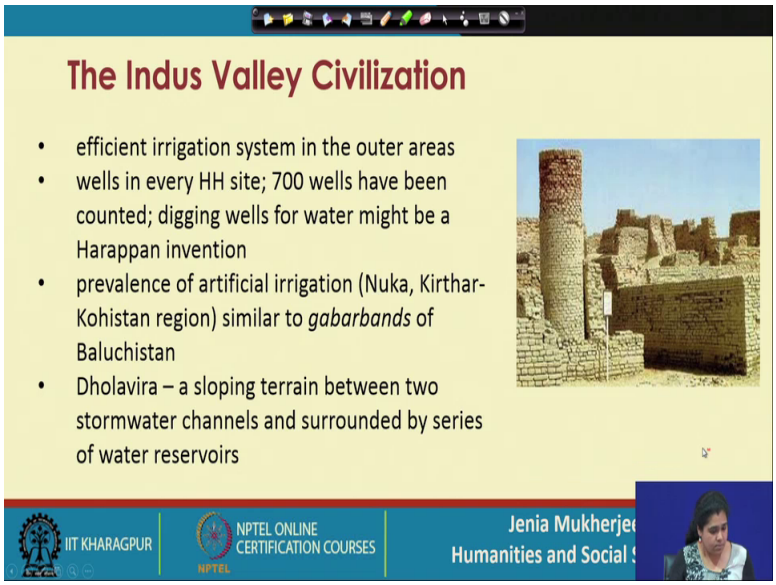

Yes so, to begin with this is the Indus valley civilization. So, this is the wonder that was India and this is the picture of a well. So, we all know about the Mohenjo Daro and grate bath of Mohenjo Daro, we also know about the extensive well irrigation system prevalent in the Harappan city and it is quite interesting to find out that you know maybe the Harappans might be given the credit so far as the invention of well irrigation systems was concerned.

Because we get few other sources like for example, if we see some of the scenes of ancient Sumer, then we find about you know there are pictographs of wells, again there are a few hieroglyphics script in Egypt where we again find some pictures and also some mention of wells, but then the historians or the historians of science and technology.

They had come up with the argument that those structure which had been discussed or described pictographs and high graphics of Sumer and Egypt those were actually not you know large scale water structures like wells that had been found or excavated in the Harappa, rather those were much you know smaller in size and those to a great extent resemble systems rather than wells.

So, you know we can definitely say that you know Harappa can be said, I mean it can be said that the Harappans were the first to invent well irrigation. So, apart from that we also find the other things like you know Dholavira again a wonderful example and the excavation in Dholavira was only conducted much later much recently during the 1990's and Dholavira is a fascinating sloping terrain between 2 storm water channels and surrounded by series of water reservoirs.

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So, this is the picture of a storm water drain which had been excavated in Dholavira and with an aperture of you know, with an aperture of an air pocket and this air pockets significant, because it was important for the smooth passage of water. So, this was the kind of scientific sophistication that the ancient India's could read during that particular point of time. So, it is very important for us to really un fallen unravel this precious knowledge which is otherwise you know getting you know what to say it is getting replaced and it is getting nonexistent due to the due to the prevalence and imposition of the so, called modern, western, hydrology or hydraulic techniques.

So, and this is an another interesting a picture it is not a real picture, but it is an artist expression of Dholavira that shows that how this entire scape, how this entire city was to a great extent surround by so many reservoirs, a water reservoirs and also wells I mean and wells and water reservoirs as an integrated ecological and hydrological system.

So, a little bit more on the Indus valley civilization. So, wells could be found or could be identified almost in every household site in Harappa. So, nearly if 700 wells have been counted and. So, we are already discussed about Harappan invention of the well irrigation system and there is also prevalence of you know other artificial irrigation system it is quite similar to Gabarbands of Baluchistan. So, I will explain what is this Gabarbands of Baluchistan or sin.

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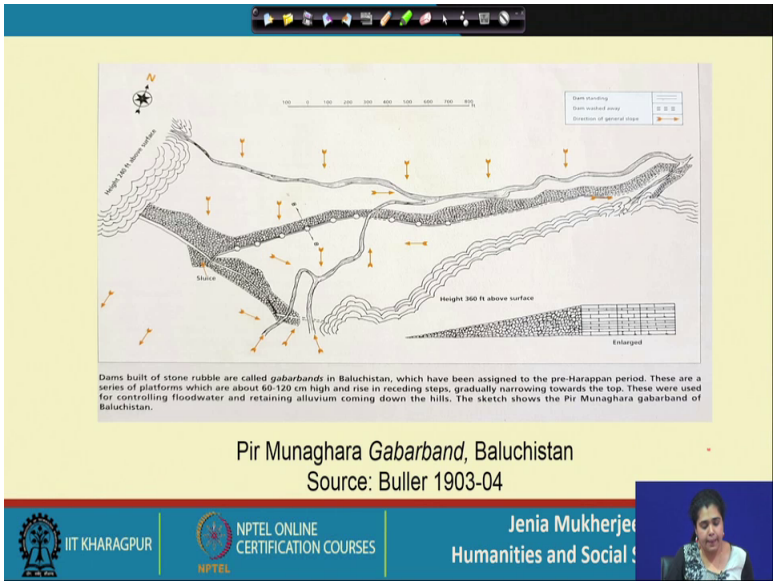

So, this is a picture of a particular Gabarbands which is the famous Pir Munaghara Gabbarband in sin more specifically like Baluchistan and also Gabarbands. These are the stone rubble of the stone dams which have been assigned even to the pre Harappan period and these are the these were the series of platform with an elevation of or which were write roughly 60 to 120 centimeter and the rose in receding steps and if you see the pictures. So, there are residing steps gradually narrowing towards the top.

So, this is the kind of the structure of Gabarband and if you look into their functions; so, 2 functions I mean they used to perform 2 major functions. So, one was the control of flood water and the second was retainment of alluvium coming down from the hills. So,

these are the 2 major task or the 2 major functions that the Gabarbands use to perform and so, these were very important in terms of both controlling flood water and also retaining the alluvium or silt you know for fertility so, silt coming down from the hills.

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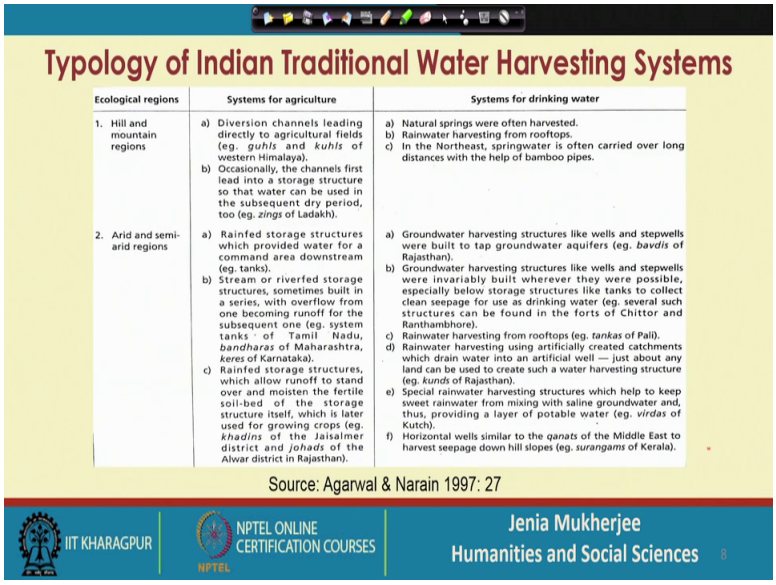

So, this is typology of Indian traditional water harvesting system where India again had been classified into 4 major ecological regions. So, we talked about the 15 major regions from the trans Himalayan region to the Islands and now we can again classify those 15 ecological reasons into 4 major regions consisting of the hill and mountain regions, arid and semi arid regions, planes and flood plains and coastal areas.

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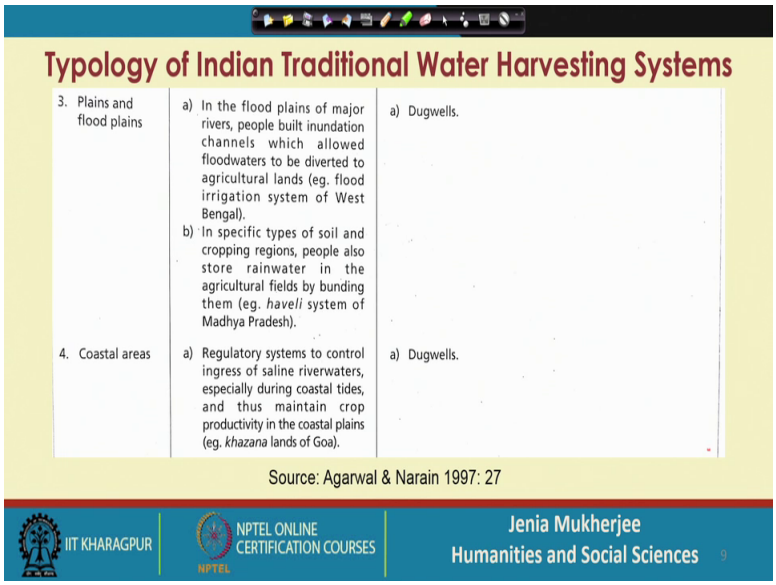

And now, if you look into this typology in detail you will find out that this is a table that talks about the different systems of agriculture for each of this ecological region for that matter hill region or coastal region or arid vision right and also it talked about the system for drinking water.

So, what kind of water harvesting technique was prevalent for agriculture and what kind of water harvesting system or technique was prevalent for drinking water purpose. So, this is where in detail you can just go through it and you can you know find out the information relevant for systems of agriculture and systems for drinking water across this 4 regions.

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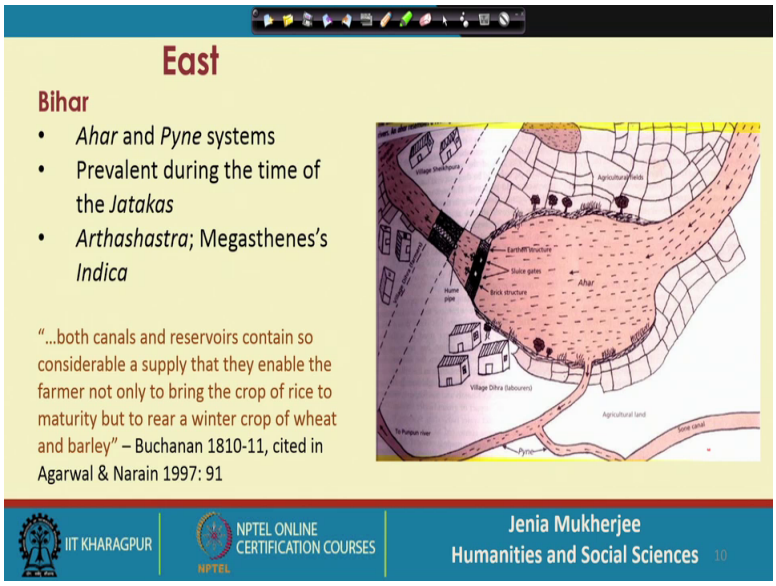

Now I will in this particular presentation in this lecture I will be focusing on 2 areas or 2 zones or regions geographical locations East and North East right. So, what I would try to do that as it would not be possible to cover the you know 15 ecological regions and so, I mean numerous water harvesting techniques that were prevalent across this 15 ecological regions from North to South.

So, what I will do is that, I would try to classify or divide the entire subcontinent into 5 major geographical zones or regions across North, South, East, West and North East. So, in this presentation or in these lectures I will be now focusing on the water harvesting techniques in East and North East.

So, east of course, east consist of the 3 major states Bengal, Bihar and Orissa. So, now, first if we look into Bihar we have to definitely talk about the Ahar and Pyne systems one of the oldest systems. So, far as you know water storage and irrigation for the (Refer Time:20:01) fields were concern. So, there are some literature few works on this particular system call the Ahar Pyne system I can remember of Senguptas work on the indigenous Ahar Pyne system in South Bihar and so, there Senguptas argues Nirmal Sengupta specifically.

So, he describes Ahar Pyne system the technical, it is of the system in detail and so, this Ahar this were the reservoirs. So, even see the Ahar in between this is a reservoir and surrounded by embankments on 3 sites and this is of course, connected to the channels or

artificial structure call the Pynes and so, the Pynes brought water from the river and impounding water to the Ahar. So, the Ahar and Pyne is an integrated and an embedded and a connected system which function together and it is played a very important part in paddy cultivation in South Bihar. And it is very important to mention here that South Bihar it was or even till today it is a I mean arid compared to North Bihar, because the amount of rainfall is always less in South Bihar the if you compare South Bihar with North Bihar.

So, Nirmal Sengupta he writes that it is these particular system Ahar Pyne system due to which South Bihar never suffered from any dearth of you know water which was required for paddy cultivation though it has less rainfall compared to North Bihar, but yet it did not suffer. Because it had this reminders and this fascinating Ahar Pyne system or we can argue differently or we can put it differently that you know South Bihar or the local people the native people in habitats of South Bihar. They could come up they could think of this Ahar Pyne system because it was a need of the topography. It was the need of the soil I means it was the need of the climate and the temperature that dictated them to come up with such a system through which they would be able to you know provide water to the I mean to the agrarian fields through the indigenous system.

And so, it is an age hold system the and the mention of Ahar Pyne is there in the Jatakas, in Kautilyas Arthashastra, Megastheness Indica. So, it was a very old system that was prevalent in Bihar more specifically South Bihar. And this is something from Francis Buchanan we all know about Francis Buchanan and he surveys across different parts of India.

So, Buchanan says that that both canals reservoirs so, the Ahar and Pyne contain so considerable of supply that they enable the farmer not only to bring the crop of rice to maturity, but to rear a winter crop of wheat and barley yes. So, I talked about the paddy cultivation. So, I must add to this that not only rice, but also South Bihar could produce winter crops like wheat and barley due to the prevalence of the Ahar Pyne system.

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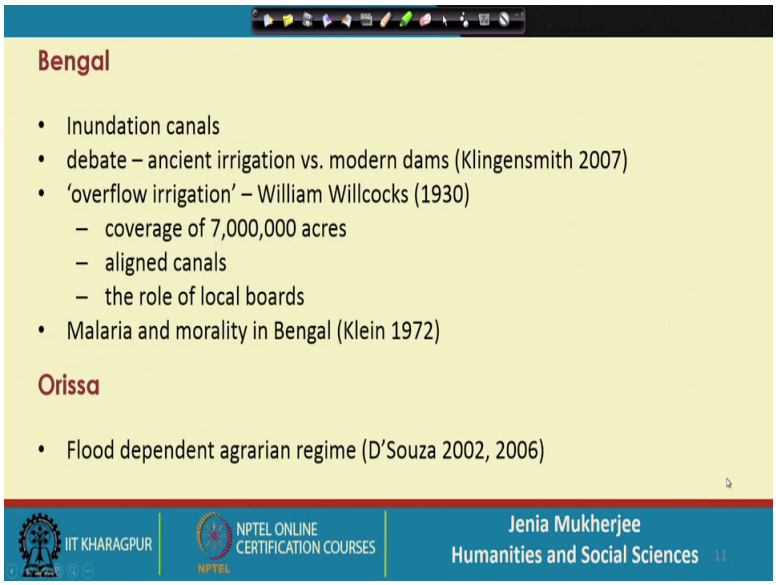

Yes now coming to Bengal. So, Bengal is famous for her inundation canals and there is a very interesting debate regarding why after particular point of time there was dissipation of the Bengal delta. So, and there is a scholar call Daniel Kligensmith who initially wrote a draught report entitled of ancient irrigation and modern dams and then he wrote an entire book a volume which you are published in 2007 it is called one valley and the thousand, dams nationalism and development. So, the name of the book is one valley and the thousand, dams nationalism and development.

And in that particular book Daniel Kligensmith brings out this particular debate among the health officials, the bureaucrats, the colonial officials and also the politicians and even the scientist people like Meghnad Saha and he you know civil engineers and officials like William Wilcox. So, I would definitely focus on William Willcocks when I would you know when I would be a focusing on what he calls over flow irrigation.

So, over flow irrigation we need to understand overflow irrigation in great detail because William Willcocks he provided a series of lecture in Calcutta university during the twenties and then he could come up with a you know publication and compilation compiling all these lectures in 1930's and William Willcocks say that this was the system in Bengal through which nutrient rich sealed laden in the water used to enter the Bengal delta from the upstream ok.

From the if not the highlands at least from the upstream from where water used to enter into the Bengal delta and then the flood water it used to get to you know evenly distributed across the Bengal delta. And this flood waters where dejected through the maintenance of system of shallow and void channels and this flood waters were extremely important not only you know for watering this terrain deltaic terrain, but also you know it perform many other functions including the wiping up of the you know malaria the miscued lava. So, William Willcocks argues that this was one of the reasons due to which Bengal was not suffering from malaria.

But later how he explains that how this entire system was replace and disrupted by the colonial hydraulic management not only colonial hydraulic management, but also the implementation of the railway project, because when this railway networks where laid out then this entire mechanism and this canals it got affected like anything and then Heraclene he writes a book on malaria and morality in Bengal and we see that how I mean what is really meant to lose this overflow irrigation.

So, finally, so far as Eastern India is concerned we have to definitely talk about Orissa and on Orissa I mean there is literature on Orissa, but I should mention about Rohan D'souza and his particular book call Drowned and dammed. So, we will discuss about Rohan D'souza and more on Orissa in our next lecture. So, Rohan D'souza argues that you know Orissa in Orissa it was and it was a flood dependent agrarian regime.

So, flood was never a perceived as a cars flood was rather perceived as a blessing or a both the same thing you know which was going on in Bihar and more importantly in Bengal as well. So, Rohan D'souza also talks about the importance of overflow irrigation and more importantly the importance of flood waters for Orissa. And so, we will discuss about Orissa in great detail in a next lecture, but for now we should say that you know Orissa had a very interesting a flexible water harvesting system because I mean the and through that how it used to retain the flood waters and also the series and the alluvium that used to come to Orissa from the upstream reverse more importantly the Mahanadi ok.

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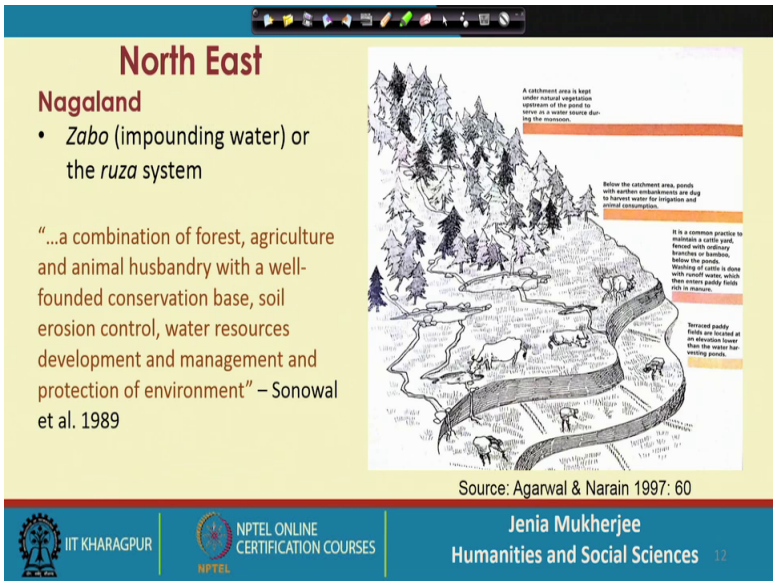

So, now we move on to North East. So, there is this particular area is unexplored compared to the other regions of India and so, there is very little documentation on the water harvesting techniques in different states of northeast. But I mean we know about the Zabo or the ruza system which was prevalent the very old water management or water harvesting system in Nagaland.

And so, this particular report by a Sonowal it says that this Zabo system it was a combination of forest agriculture and animal husbandry with a well founded conservation base, soil erosion control, water resources development and management and production of environment. So, it was an integrated system so, a system which was totally tuned to the ecology and to the you know very many environmental parameters of this specific context of Nagaland.

If you see this illustration this explains the Zabo or the ruza system. So, you can see that how you know this is catchment area which was kept under natural vegetation. So, this was the first layer so, a catchment under natural vegetation upstream of the ponds. So, the ponds served as water source during the monsoons and below the catchment. So, below this vegetation response with air also surrounded by the earthen embankments right the buns and these were dug to harvest water for irrigation and also for animal consumption. So, this is also important feature that they also thought about you know water consumption by the animal so, this was there.

And finally, there was a cattle here. So, the animals could come and drink water from these ponds and the so, there was a cattle war which was a fence with either branches or this now eco friendly materials like a branches or bamboos for that matter and this was below the ponds of this was the third step.

And so, washing of cattle I was done with run of water which then entered the paddy fields and which was already reach in manual by the that time. So, it is an entire scientific system so, each component integrated to the other for you know holistic management of the entire ecology of Nagaland. So, and finally, we of course, have this terraced paddy fields located at an elevation lower than the water harvesting pond. So, this is the zabo system which was prevalent in Nagaland.

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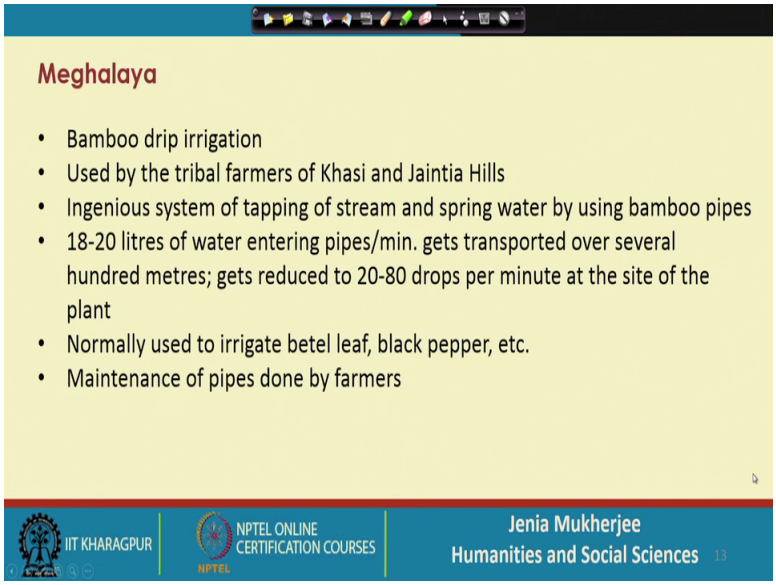

So, coming to Meghalaya, Meghalaya is famous for it is bamboo drip irrigation and so, bamboo drip irrigation we find from oral narratives and oral sources that this was used by the tribal farmers of the Khasi and Jaintia Hills and it was of course, an engineer's system of tapping of stream and spring water because we find so many streams in Meghalaya. And so, in order to tap the spring water bamboo pipes where use. So, you will see the picture because again it was you knows stage by stage drip irrigation system.

So, like 18 to 20 liters of water enter the pipes per minute and then got transported over several 100 meters finally, getting reduced to 20 to 80 drops per minute at the site of the plant. So, I will show you the picture and it was mainly used to irrigate (Refer Time:

32:29) like a betel leaf and black pepper and maintenance of the pipes were done by the farmers themselves so, again it was a community manage and community wound system.

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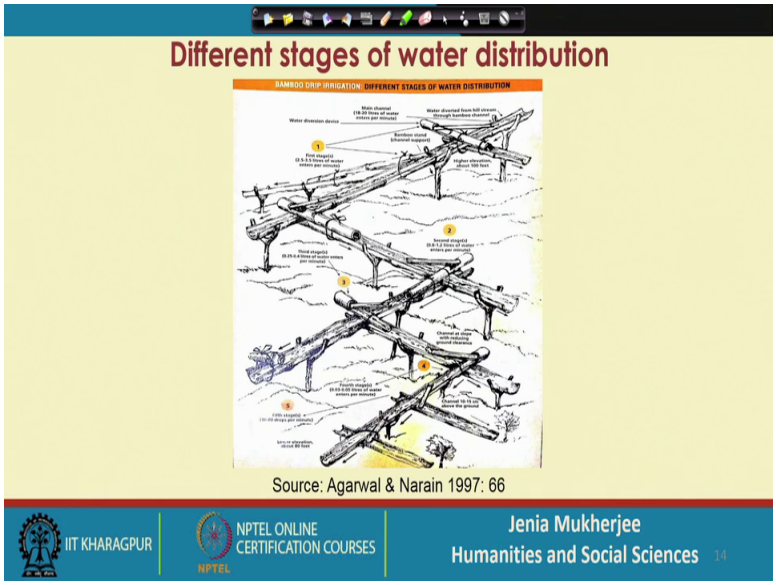

So, this is the illustration reflecting on the different stages of water distribution through you know bamboo pipes and for each of the stages so, this is stage 1, stage 2, stage 3. So, at each stage find you know difference in the amount of water entering through this bamboo per minute so, an extremely sophisticated system ok. And finally, stage 4, stage 5 so, stage 5 by 10 to 20 drops of water enter to this bamboo per minute and finally, you know before got it got transmitted to the plans.

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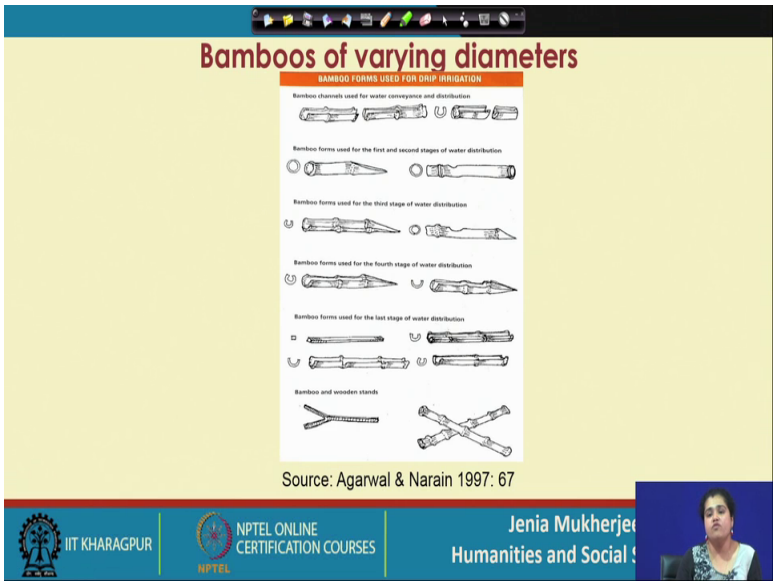

And interestingly these are the bamboos of varying diameter. So, for each stage you have bamboo of different shapes, different sizes and different parameters so, an extremely sophisticated system which is still prevalent in many parts of Meghalaya.

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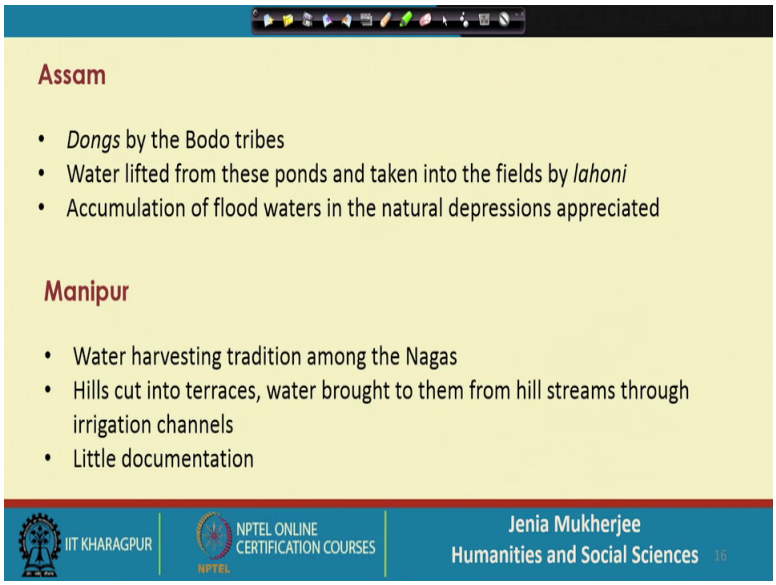

So, finally, little bit on Assam and Manipur. So, Assam is famous for it is dongs to dongs means the ponds which were excavated by the Bodo tribes who are the inhabitants of the slightly you know elevated area of Assam. And so, water was lifted from this pond and taken into fields by lahonis another kind of an instrument and so, like accumulation

floodwater there is accumulated in the natural depressions of Assam and Assam had numerous natural depressions because located in the Brahmaputra and the Barak valley. So, if we have the Brahmaputra and Barak valleys in Assam. So, we have numerous natural depressions in Assam. So, the water harvesting techniques where quite in tune to the natural topography of Assam and Manipur.

So, again different interesting indigenous water harvesting tradition among the Nagas including buns and the huns and dongs. So, Hills they I mean hills are cut into terraces water brought to them from hill stream to irrigation channels. It was a the quiet I mean an extensive system, but a very common system in Manipur, but again as I mentioned earlier we have very little documentation I mean so, far as this harvesting mechanism are concerned.

So, I mean people like Anil Agarwal and Sunita Narain they went to the field and their colleagues from the CSC centre for science and environment they meant to the fields and they talk to the people they collected oral narratives oral data and they saw the systems I mean the functioning of the system by themselves and they could come up with like what was going on in North East for that matter.

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So, these are some of the references for the introductory part and also for this 2 specific zones East and North East and in the next lecture we will be focusing on the 3 other zones regions West, North and South.

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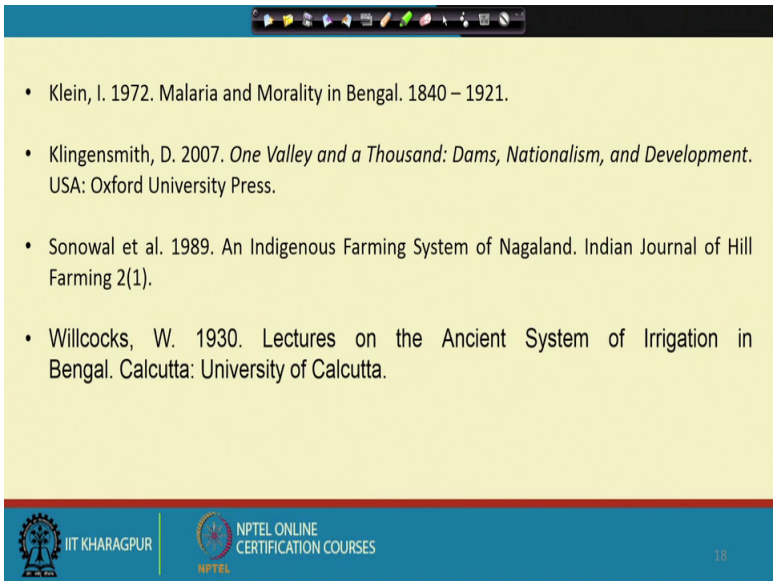

Thank you.