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Historicizing lakes of Bangalore – social-ecological perspectives

Hello everyone. Welcome to this discussion on the historical co-evolution of Bangalore and its lakes. We are going to look at how Bangalore is a city and as a centre for settlements and urban growth grew from the 6th century AD to now through its water systems. We will start with a little bit of history. Bangalore is as a city itself, the market town of Bangalore was created in 1537 by Kempe Kouda. But if you look at the history of Bangalore as a settlement, not as an urban town but a settlement, it is much older than that.

There are megalithic stone tombs that tell you that Bangalore had people living in and around this area about 3 to 4000 years ago at least. And that is strange because, you know, we know if you open any of your history textbooks, they will tell you or geography textbooks that people always had ancient civilizations along water bodies. And we know people need water to survive as the most basic element of nature that you need. But how did people settle in this old Bangalore because it's a city that is or a geographic region before it was a city that is in the middle of peninsular India.

There are no perennial rivers, there are no perennial large lakes, at least there weren't at the time when these early megalithic stone tomb settlers were there about 4000 years ago. What did they do for water? How did they manage in this area? We have no idea because apart from the tombs that they have with the menhirs that are also sticking out around in circles, which they are very, very picturesque areas that they leave as signatures in fields, and that's how we know they were there. We don't know anything else about these people. We do know that there are other jars full of coins that were dug up, which is sometime between the BC to AD transition that have been dug up in different parts of Bangalore, you know, for instance, when they were doing metro digging work or other kinds of work. And you see from the coins in these jars, that there were Roman coins, there were comments from other parts of the world, which tells you that Bangalore was again, probably a center of trade in the BC to AD around that timeframe, let's say second century BC to about first century AD.

That is also interesting because it doesn't seem to be on any well known overland trade routes. Why I'm starting with this is to tell you that there is a great deal about the history of cities like Bangalore that we don't know anything about. But we can only speculate, but

the water problem has always been fascinating for scholars to understand why did Bangalore have so much of trade, so many people coming in, why was it such an important center. So first clues to the co-evolution of Bangalore with its water systems come from about 6th century AD. And what they do is they tell us that, you know, so India is a country that has had major land transformation in recent decades, the image that you see is a satellite, satellite picture of India.

And what you can see here is that most of India is now covered by lights at night. And what that really tells you is that these are cities because no one else switches on lights at night except people in cities. So the urbanization footprint is very vast in India. But if you go to Bangalore, it is one of the Indian cities where we have the most extensive information on urbanization and how it impacts biodiversity and ecosystem change in cities. But as I told you, we have these large gaps in terms of understanding anything about the actual ways in which these ancient people lived with water.

Now the story I am going to tell you about the documented part, the part that we know about the co-evolution of Bangalore and its water comes from my book Nature and the City, which is a 2016 book published by Oxford University Press, where I tried to go as far as the back as we can find written records. And this is a story of people and places and, you know, people of all kinds and places in different parts of the city and the past, the present and looking into the future to understand how people will continue to live with water in the city. So let us start with a spatial map of Bangalore. And this map, as you can see on the screen, shows you the market town, the small maroon polygon right in the center, the very small club-shaped polygon is actually the original market town that Kempe Gowda built. And what we know from the Wikipedia history of Bangalore tells you that Kempe Gowda, who was a great warrior king, came to this area, which is now the chick pit centre of Bangalore, where the old fort used to be.

And this is, they say that he came to a land that was completely barren in 1537. And he saw an auspicious sign of a hare chasing a hound, obviously, usually it's the other way around, hounds chase hares. When he saw the hare chasing a hound, it seemed like a sign of bravery to him and a sign to build a new kingdom. So he created the market town of Bangalore. And yes, this is true that he must have been a visionary to create a market town and create this fort and create the city where none existed.

But it's not really true that it was completely barren or devoid of human life and habitation. Because Kempe Gowda was also a vassal of the Vijayanagara Empire. And Achyutadeva Raya, who was then the king, gave him a grant of a jagir of several villages in and around this region in recognition of his leadership in creating this new town. So we know there were thriving villages. What were these villages doing? When you, for this you have to

go back into the ecological history.

And the map you can now see is a map of, it's called a digital elevation model of Bangalore. So essentially what it tells you is the ups and downs, the hilly nature of the terrain. And the black boundary you see around is the BBMP or the municipality, the Brihat Bengaluru Mahanagara Palakhe, the municipality boundary of Bangalore. So this is the boundary of Bangalore superimposed on the elevation model. And the first thing you can see here is that Bangalore is an extraordinarily hilly terrain.

And so you actually have the west side, which is relatively much more hilly, and the eastern side which is much more gradually sloped. So there are very few hills and it's much more flatter terrain on the eastern side. And the eastern side was called the Maidan of Bangalore and the western side was called the Malnad which in Kannada or the language means rolling hills. So you have this topographic gradient and there are three hill chains and therefore Bangalore is split into two major watersheds. And what is the city looking like at this time? It's of course pre-city.

What you had is you have from the 6th century onwards, you have stone inscriptions and inscriptions on copper plates. And these are our first written records that help us understand how the city co-evolved with water. And what we see is there were four major dynasties before Kempe Gowda came in. The Gangas, the Cholas, the Hoysalas and then the Vijayanagara Empire. So I am going to show you the maps in the next four images which tell you how these ancient settlers came into Bangalore.

And what you see is there were the Ganga dynasty came in from the 6th to the 9th centuries and you can see the inscriptions. These are inscriptions coverage you can get from there's an epigraph here Karnataka, which is a book that collates all the inscriptions from different stones from different copper plates across Karnataka. And from these are pulled out the areas around Bangalore. And the oldest one is the inscription of Begur from 517 CE. And this continues to the Ganga dynasty and stops around 900 CE.

What can you see from this map? The first thing you can see from the Ganga dynasty map is that all the settlers almost without exception are coming to the plains. So they come in first into the east because these are the flatter lands. Because remember I told you the west has more of a rolling hills and those rolling hills come with large granite boulders. They are extraordinarily difficult for people to live and make their homes and do agriculture or anything like that in. So that becomes a very difficult place for them to settle in and they prefer to stay in the east.

So they start with the Ganga dynasty. And even in the west you can see numbers 2 and 3.

You can see that they are still it's above the hills and into the plain areas because that's easier places to settle in. The Cholas come in from the 10th to the 12th centuries in the next map. And what you can see here is that they start moving a little further because some of the best places or the easiest to settle in places are taken.

So they start moving slowly closer into the rolling hills. And then if you go to the next map by the 13th and 14th century you see the Hoysala dynasty and now there is a huge burst of human settlement. They are actually stretched across the entire landscape. And this is where they start building tanks. The Hoysalas are invented tank builders.

They are very well known for building tanks across the entire South Indian peninsula. Of course, the Cholas do it too. Any of you who have seen the latest Poni and Selvan movie would know that the Cholas build these large tanks and they are very good at it. But so do the Hoysalas. And you can see here that many of the tanks which are called Sandra, like the first one called Honga Sandra or you can see 19 and 20 called Mala Sandra, Singha Sandra.

Sandra is a corruption of the Sanskrit word Samudra which means large bodies of water. So they are actually creating large bodies of water which are tanks which we call lakes today and that is where Bangalore residents, early residents before the city was formed, these are the places that people got their water from. And then by this time of Vijayadagara dynasty you can see they are actually spread across the entire landscape. And this really helps you solve the early puzzle of where these people got their water from. So let's recap a little bit of what we have learnt so far.

We learnt that Bangalore is an ancient settlement that it was inhabited at least 3 to 4000 years ago where people came and built these megalithic stone tombs. And we also know that between the turn of, let's say second century BC to about first century AD there were lots of jags or earthen jars found underground with coins from across the world which tell us that Bangalore was also an incredibly important trade center. But it leaves us with a big mystery of how the city grew and coevolved with, because it is a city that did not have water around close by. It didn't have any perennial sources of water. So what did these early settlers do? Unfortunately, we have very little that we know but we start getting information from the 6th century onwards with inscription stones that show us that Bangalore first started getting populated to the east in the relatively flatter areas and slowly started as the Gangas gave way to the Cholas who gave way to the Hoysalas and finally the Vijayanagara dynasty.

There were at least 75 thriving villages in this area. Now why were they thriving? What did they do with these lakes or tanks and how did they create them? For that we need to go into the text of these settlements. And the first text I am going to show you is one from Kempepura of 1306 CE which tells you about the kind of landscape that you had. Now these are very typically land grants. What do I mean by land grants? These you will see across different parts of India.

So often it's with the temple, associated with the temple you will find some stones. The stones will tell you about the history of the region, how was the village built, what are the boundaries of the village and what are the lands in the village that are given to the temple as an endowment by the king. So this is one of the typical examples of these and let's read it. It says we grant with a pouring of water as a Devadana that is as a gift to the gods for the god, witch god Villisvaramudaiyar of Viligamundanpalli. That is it's a village of Sattaidevanapalli in Erumarainadu.

That is the region, that is the region of a particular chieftain. What are they granting to these gods? This is a very interesting description as you can see in yellow. It's a tank which is called the Avanjikattu of the village. Okay.

And all the wet and the dry lands. What do we mean by the wet and the dry lands? What they mean is these were areas where you had overflow irrigation, not pumped irrigation but overflow irrigation. So you had a tank. Above the tank at higher elevation was the millets were grown, which are typically dry crops and they don't need so much water. Below the tank at times of rain when the water was excessive you would open the kodi or the lever of the tank and this rain water would overflow and fill the channels and there you would have fruit and vegetable orchards, you would have flower orchards, you would have coconuts and you would have a lot of paddy. A lot of paddy that was grown which is the wet lands that they are talking about.

So the tank of the village and all the wet and the dry lands, what they mean is the produce that comes to them. That is the millets, the paddy and all the other produce that is grown is given as a gift to the temple which can sell it and use the money as well as use it for their own use. But also this lake, you know this lake was like I want to emphasize this, this lake was not perennial. It was only rain filled. So it would become dry or at least large parts of the lake would become dry during the summer season.

Then where would you get your water from? See these lakes didn't come independently. If you look at any of these lakes in this region and we know this because if you look outside the city you can see the same area, same kind of relationship survive. You will have a large lake, you will have grazing land to one side of the lake but you will have very large wells

to the east and the west of the lake. And these very large open wells with steppes, what we call steppe wells and you can still see remnants of them across many parts of India. These are what would provide water through the earth because the water would percolate through the lake or the tank into the underwater ground supply and that would refill the wells through the earth.

So the land grants here including the wells underground and the trees over ground within the four boundaries adjoining the village. And this is a really beautiful land grant description because look at any British land records. You will never ever find a land record that or even look at a survey document today, the property that you own or anybody that you who is your neighbour ask them for the land records. You will never find anything that talks about the wells underground and the trees over ground. What do we do when you get land passatory? The first thing you do is you fill in the wells and you build.

The next thing you do is you cut down the trees and you build. We don't want the trees over ground and we don't want the wells underground but look at this. This is an inscription that tells you that they valued this so much that they talk about the wells underground and the trees over ground as being part of that three dimensional landscape. And in this you provide it for worship, sacred service and offerings of rice to the temple.

As I told you rice was built. So this is a very typical inscription this wells underground and trees over ground the wet and the dry lands comes in inscription after inscription which really tells you that this is how these areas coevolved with their lakes. This is another example. This is the lakes were created by people 870 AD Agara lake which is one of the oldest lakes in Bangalore. In fact the oldest lake to have an inscription stone. This is an inscription that describes the lake and tells you that the lake was even older than 870 AD.

It says be it well in the victorious year of the Sri Rajya under a particular ruler Satyavakya Permmadi's Kaliyuga Hanuman, Nagattara. Nagattara is the local chieftain of Bangalore. There are many other inscription stones about Nagattara who would later became a hero. He died in a large battle and there is a separate inscription stone for Nagattara. But Nagattara the Irugamayya or the ruler Irugamayya's son Sirimayya that is the ruler of this region.

What did he do? Sirimayya fixed Louis's to the two tanks. He had a third tank or the eastern tank built and because he did this he obtained the Bittuvatta for three tanks. What is Bittuvatta? It's a land, it's a tax grant. What it says is that and it's very common again in these inscriptions that if you built a tank or you restored a tank you would get the Bittuvatta that means that the irrigated land the paddy that you irrigated downstream you didn't have to pay tax for three years or some fixed number of years. The king would

encourage local chieftains to create these lakes or local wealthy people to restore lakes and in return they would get a tax break.

Somewhat like our solar panels of today you know renewable energy we are trying to encourage it. This is a very different environment but it's the same sustainability thinking that you have an economic also goal associated with this. So what do we understand from this that there were two tanks in the Agara region and Sirimayya got a third tank built. Unfortunately in this region we have only one tank that now survives which is Agara lake and next to this Agara lake was this inscription. Again unfortunately when the lake was restored the inscription itself has been lost.

People remember seeing it about 25-30 years ago when the lake was restored but nobody has any idea what happened to the inscription stone since then. So these are vestiges of history that we are gradually losing but are very important clues for us. What were the other two lakes? Some people speculate that one was Madiwala lake and one other one was Belandur lake but some others say they were too far away to be the three lakes of the region. We have no idea frankly and so these are all mysteries that we need to find out but we know that lakes in Bangalore clearly were older than 870 AD.

And I will give you an economic motive just now. I told you that there was you know that it was Bituvatta but it was a financial motive but I must stress there were not only financial motives and it was not only rulers who built these lakes. For instance, there is a lake called Suli Kuntai. Suli in Kannada means prostitute and so you can understand how a woman at great sacrifice and personal cost used money probably accumulated through great suffering to build a lake. And so this tells you that there were all kinds of people who built it. And sometimes they left inscriptions behind that tell you why they built these lakes.

You know so there is one woman who wrote for a lake in 1372, 1342 AD that she built this lake for the support of animals, cattle, birds, all other living beings and the service at all times of the goddess Ganga. It is such a beautiful inscription that she has created this lake not for anything else but for the service of biodiversity and for the service of the water goddess. There is another woman who both prosaically built a lake in 1366 AD for her husband and other relatives for 21 generations to get married in the afterlife. And another man in 1515 AD who in order the dharma might be to his father. So there were a variety of sacred, metaphysical, afterlife, service to the community as well as economic benefits.

And so people, common people of various kinds and rulers of various kinds contributed to this. Again the Agra Lake inscription if you see this is the one that I showed you was from one time period but about 20-30 years later than that about 890 AD there is another inscription near Adara Lake which talks about a particular man who was granted again

some tax benefits because he was the person who brought his carts and used them to desilt the lake because water would come into these lakes and silt them over. So they had to be desilted every year. So this was a community activity again that people engaged with and the silt was used to fertilize the crops.

So it was a very integrated kind of system. And how do they protect this? So they had various phrases in that ensured the sustainability that said that we would create this lake, it is associated with this temple and it has to be for this temple or for this village if at what time horizon. This will be the case this lake is associated with this temple or this lake is associated with this village as long as the sun and the moon endure, as long as the rocks, the kaveri, the grass and the earth endure. So they are not thinking about 10-20-100 years, they are thinking of infinity. And people who violate this by despoiling the lake or by taking it for private possession shall incur the sin of having slaughtered tawny cows and brahmins, shall be worms in order that is in faecal matter and a person who is truly horrific because anybody who violates this will be born the husband of his own mother. So you can you think they are trying to hedge this lake, right to say that this lake is sacred and anyone who messes this lake will have truly horrific problems in the afterlife.

On the other hand anyone who creates these lakes will be blessed through 21 generations they will have paid merit, right. So it is a very different integrated view of human beings and water. How did they create these lakes? Here is another beautiful inscription of 1307 in Vibhutipura village.

It is near HAL airport near a lake called Vartur lake right now. And if you look at this particular region what it says is again in two of the first part about which tells you about victory of the sword of the arm and of who it was the superintendent and named inhabitants of the Nadu. But what did they do? They cleared the jungle in a tract of land adjoining the village. First they cleared out the vegetation. Then they levelled the ground. Then they built a village. Then they constructed a tank by removing the sand. And then they named the village Vachideva Pura. Vachideva which is the god, the village god, got the wet and the land, dry lands adjoining it with their four boundaries as a gift exempt from taxes as long as the moon and the sun exist. So you get a sense from here how they constructed these. What did they do? They came into an area and they would look for where is the wet or the marshy land and that gave them a signal of this is where water is stagnant or the sandy areas that tell them that this area again has a lot of water flowing through.

So first they clear the vegetation and then the village itself is because it is an undulating terrain. You have some rocks you need to clear it. You have some low lying land and you fill that in. And then you build the village. But then you take this wet area and you remove the sand and you scoop out the mud and you create a large depression and that depression

is your lake.

And then again what they did was they linked this lake to the other lakes in the landscape in a three dimensional kind of way following the topographic gradient. So a lake at a higher level when it overflowed the water wouldn't get wasted but it would trickle down and fill the next lake and the next lake and the next lake. And so you see from this map that you have the three watersheds of Bangalore now and you can see the entire network system. This is based on 1970s toposheet. You can already see the lakes in the heart of the city have disappeared and I will tell you why.

But what you get from this is that there are three watersheds and this entire region is an entire connected kind of region. So what happens after these chains are set up? Of course we know now again to recap quickly that we had the you know these four dynasties that came in and we looked at the topography of Bangalore and we saw that there are three watersheds. Now this must have been the situation around the time that Kempe Gowda came into Bangalore. And Kempe Gowda constructed this market town and it grew from the villages around which were all nurtured by these tanks. There were four generations of the Kempe Gowda dynasty and after that sometime around 1638 to 1640, Shahji Shivaji's father came at the head of the army of the Bijapur Sultanate and they took over the town of Bangalore and he became the ruler of Bangalore and his court poet Shahji wrote a poem called Shivghara in 1670 which describes how Bangalore looked in the 1640s.

And that gives us our next glimpse of how the city has by then co-evolved and found its connection to water. Sorry. So Marathas called it Bingarool and you can see this from this beautiful poem. It talks about Bangalore as a matchless city with smart fortifications and towers which has pigeons, it has peafowl.

But what's the connection with water? It says the city teemed with deep lakes. Each house was graced by a well. Fountains gurgled at every square spouting a fine mist. Trees thick with flower and shade lined each home garden. The city itself was gurgled by a bottomless moat shimmering with water and dotted with countless lakes each as big as a sea.

So you are back to the Samudra. You know I was telling you about Mala Sandra, Sinkha Sandra, the lakes that end with Sandra and that Sandra is a corruption of Samudra. So it's lakes each as big as a sea that an entire metaphor comes back. And there are picturesque parks festered with creepers swinging gaily in the breeze that adorn the city. And of course he is a court poet so he ends with Shahji was ruling here like Indra in his paradise enjoying sports and pastime with his kinsfolk. But you get a sense clearly of a city which is coevalled with water where water, the lakes, the wells, the fountains, the moat, they are

all integral to the life of the city.

We also hear through oral histories that Kempe Gowda and his dynasty created new lakes when they came into the city. And we know for a fact that Hyder Ali and Tipu Sultan also paid attention to these wells and the lakes and their revival. But Bangalore took a huge hit during the 18th century because there were continuous wars between the Marathas, the Tipus and Hyder, the Vadiyals and the British. And because of this landscape, each time there was a battle in this region, whichever ruler came in for a brief period of time or whichever armies came in trying to take care of the city, they would first thing they would do is breach the lakes and poison the wells because they wanted to create a location that was inhabitable or inhospitable for the other soldiers. So, Hyder and Tipu after each battle had to spend a lot of time reviving the lakes and reviving the wells.

But what we know is around 1791, after the Third Anglo-Mysore War, Tipu lost Bangalore briefly to the British. And the British came in and of course being map drawers, the first thing they did was make sketches of the city. So now you get a glimpse of the city in 1791 which had a lot of lakes and the boundary you see here is of the, what became the contonement later and what was the old part of Bangalore, that is the Pate which is the town and the protected fort of Bangalore. So, Tipu's Bangalore, Hyder's Bangalore was confined to the Pate and the fort and the lakes around is what later became the contonement area where the British created the contonement.

You can see that there are a lot of lakes in different parts of the city. Now the British continued this as they took over Bangalore in 1799 after Tipu's death and then Bangalore became the capital city of Mysore kingdom in the 1820s. From then on, they started as the population steadily grew, they created newer and newer lakes and water bodies. And each time they expanded this, they created a settlement by creating a new region, they created new lakes in that area. And then they created new smaller kalyanis and tanks around it and then they created wells to supply the water, place with water. And at some point in 1799, sorry, at some point in 1892, Sankey lake was built and Colonel Sankey who was the British major who created this, British Colonel who created the Sankey lake said that now we are completely full, Bangalore has no space for additional lakes, we have to start getting water from the outside.

And they did. What they did was they found three lakes on the Arkavati basin and they started pumping in water from there into the city. Now the thing they could have done at that point was to replace the, was to supplement the water supply of the city with pipe water from the outside, but they did not do that. They made a very critical decision at that point to replace the water supply from the lakes and the wells, to replace it with water from outside the city. The moment they did that, the local loop of the importance of water in

Bangalore completely broke and people started disrespecting the lakes.

So you can see from 1791, you have these many lakes. 1888, you can see that there are many more lakes and water bodies. As I told you, they were built and constructed and you know, the city is full of water. But by 2015, this is almost gone. All you see is Alsoor lake in the heart of the city, just half the side of the lake and a few smaller lakes outside.

You can also see this other map that we did from 1885 to 1935, 1973 and 2014. And all the tiny dots that you see are the wells. And so the city had a number of open wells from which it derived water and all of those wells from about 2000 wells in 1885, you had barely a handful, less than 50 wells. And many of these, most of these are actually in unusable condition by 2014. So what you saw was a city that is a Kalyana Nagara.

Bengaluru was known as a Kalyana Nagara, which is a city of lakes. It then became a lake once piped water came from outside where this entire historic co-evolution, you know, over centuries the city grew and co-evolved with water. And then it has now become a city where the lakes, the connecting channels, the wells are forgotten, uncared for, nobody considers them important. What does the city think? It thinks that it can get more well water and it turns to the Kaveri for water, but both of these are running dry. There's not enough water in the bore wells and the Kaveri can only supply so much water.

It cannot quench the insatiable thirst of a city for water. So now we are turning to Yathinhole, which is a distant river or we are turning to the coast to try and get desalination water, you know, all kinds of crazy ideas. What we need to do is get back to the idea of the fact that a city that co-evolved for centuries with its own water supply must look locally for its water. So we need to get back to our wells and our lakes for revival of our water. And this is what really the history of Bangalore tells us. Lakes in a city or rivers in a city or any other water bodies, especially in Indian cities are socio-ecological systems.

And what we mean by that, I will give you an example through a narration of lakes in Bangalore. And this is based on work that we have been doing on Bangalore lakes for above more than 15 years now. Now what is a system? If you think of a system, your car could be a system, you know, you can think of it, your brakes are one part of it, the gears are another part of it, the seat is a third part of it, the steering wheel is a fourth part of it. You need all parts of the system to be moving along smoothly and be interacting with each other for the car to move. So systems are clearly one very important part of the system is that there are components.

The second part is the interaction. One part interacts and makes the other part move faster or one part interacts and makes the other part move slower. So they are what we call

positive or negative feedback loops. For instance, if you move into higher gear, your car moves faster, that is a positive feedback loop. But if you press the brake, the car slows down and that is a negative feedback loop.

So similarly, our human body is considered a system. If you let us say have fever and your temperature rises, then you sweat and then that sweating cools you down. So that is a negative feedback loop. So those are the kinds of, but if you have runaway fever and that negative feedback loop is not working well, then your fever spikes and spikes and spikes and then you need something else like medicine or an injection. So that is a problem of a positive feedback loop. And so, lakes are social ecological systems where humans lived in balance with nature and especially in cities like Bangalore where lakes were constructed by people, then these are very closely linked, interlinked close social ecological systems.

Unfortunately, this is something that we have forgotten now and because we have forgotten the urban design and urban planning of lakes is actually dysfunctional and leads us to the kinds of challenges we see today of polluted bodies. What do I mean by that? Let us look at it a little further. If you look at lakes in Bangalore, for instance, it is very widely used by a number of people, fishers, grazers, migrant workers, there are fish that are seeded in the lake and people use them for their fishing and their daily livelihoods. There are goat herders and cow herders who graze their cattle and their goats around the lake. There are migrant workers who wash their clothes at the lake because they will add, there are people who use the lakes as toilets.

There are people, dhobis who wash their clothes, commercial laundering is done at the lake. There are people who forage at the lake, women who pick weeds and other kinds of things that grow at the side of the lake. So they are intimately connected to the lake in many ways that impact their daily lives as well as their subsistence and their livelihoods. The branches that people depend on the lakes for play, children used to always learn swimming in the Bangalore lakes and they play cricket on the side of the lakes, they learn how to climb trees, they pluck different berries on the trees and they eat them and that is play. They jump, they play from, jump from branch to branch and they learn how to play on these lakes.

It is important for mental health. I think during COVID time we all realize how much, how badly we need to see nature and if you looked at the lakes in Bangalore and the parks in Bangalore, people were thronging to these areas in the COVID lockdown time with masks around their noses but walking briskly trying to relax a little bit and get some stress relief around these lakes. So they are extraordinarily important for mental health balance as well as physical health of course to maintain exercise. There are also sacred spaces. Every lake had a goddess, a lake goddess and she was worshipped and this is so it is very

important sacred systems of co-evolution and therefore lakes are very important for the resilience of the people in the city of various kinds. But what happened to Bangalore? As the city got piped water over time and this is something you can see in Indian city across Indian city, lakes and wells became polluted.

Also we stopped realizing and when we say we, what I mean is the middle class and upper middle class and the city planners stopped realizing that a large part of the city, the low income communities, the traditional communities like fishers and grazers and fodder collectors and dobies still depended on the lake as an everyday system in which they interacted where their gods and goddesses were, where they collected their forage, where they collected their firewood, where they collected their fish from and they had their livelihoods based on that. We instead started reimagining the lake instead of a multifunctional social-ecological system we started thinking of it a place of recreation, a place of nature worship, a place that would be used for water recharge, a place where you could plant only ornamental plants and that is a fundamental shift in our imagination which means as Indian cities become modern we failed to appreciate that these were actually social ecological systems. So many lakes which were polluted have been revived by local groups which focused on recharging the groundwater table by government institutions that focused on groundwater recharge and creating ornamental parks. So when lakes were once used for washing and watering livestock, for washing clothes, for foraging and giving nutrition supplements for like this woman who collects weeds on the side of the lake they have been focused on recharge purely for groundwater for recreation and nature watching. And with that comes a fact that there are gates, there are roads that you can walk on and there are series of do's and don'ts and there are timings because there are guards you cannot come to the lake in the morning and you cannot come to the lake and you can only come in the morning and evening during fixed times but you cannot come in the rest of the day.

What actually are lakes as a social ecological system? They provided cultural services, provisioning services and regulatory and supporting services. So they were spiritual and sacred, they are recreational, aesthetic. They offer us inspiration. You know, so many of us when we are stuck and trying to figure out something, it could be in our daily lives, it could be something work related, it could be something creative if you are an artist or it is something that you want to develop in terms of education programs you come and sit at the lake, you let your mind water and you get inspiration.

They are important for environmental change education. We are living in a fast organizing world and many of the kids who grow up in Indian cities today have no exposure to nature. How will they become conservationists or passionate about the environment unless they learn from places like lakes. So, lakes are very important focus for environmental education. Then as I said they offer important provisioning services like fishing, grazing,

growing food, fresh water, fuel wood and these are very critical for adapting to climate change and for adapting to environmental change because these lakes are buffers for the very poorest of the poor. If you had for instance COVID lockdown and you did not have money to buy food, you could forage at the lake or you could get some fish in the lake and you could maybe wash clothes and you know if you did not have a place to and you did not have money to wash clothes elsewhere.

So, there are very important provisioning services that these lakes provide which are critical as buffers for the resilience of the people. And of course, then there are regulatory and supporting services like regulating the microclimate. We all know that cities are getting hotter and hotter. So, the areas in urban heat islands can be as much as 8 to 10 degrees hotter than the neighborhood certainly 3 to 5 degrees hotter, but in some cases 8 to 10 degrees hotter than the surrounding neighborhood. But lakes are very important they are very large water bodies they cool the place system down and they make it easier for the people around the lake to live comfortably.

So, there is social ecological systems in that way too. They of course, do groundwater recharge, but they also purify the water in the air because the trees around them suck out the pollutants from the air and reduce suspended particulate matters. They reduce the noise around the lake the traffic noise that comes in and therefore, they help in mitigating climate change and mitigating environmental change also. And so, they have a lot of important cultural provisioning and regulatory and supporting services and yet when we restore lakes we only think of a couple of things. We think of water recharge and we think of recreation that is the and aesthetic values of lakes. So, two three of these very large services very small part of this entire social ecological system that we actually land up focusing on.

And this you can get from some interviews for instance when we conducted Hitha Amnekrishnan, Amrita Sen and I did have done research on lakes in Bangalore for a long time and these are some of the stories that people talk about which give you a sense of the collective rights of they have over the lakes. A cattle owner says he comes twice a day to graze his cows. An artist in bird watcher says he comes from inspiration and to watch the birds. A migrant security guard says she comes twice a week to wash her clothes.

And an office worker says she comes to relax and watch the scenery. This tells us that a lake means so many diverse things to so many different people and they are relating to the lake as their own personal social ecological system which then makes a collective social ecological system in the city. With the collective rights over the lake also came a series of collective responsibilities. People used to manage this lake in terms of who would get the water, who would desilt the lake, how much could you forage, who would have fishing rights over the lake. It was a very complex systems of rights and responsibilities and which

was managed by traditional communities of various kinds who then got benefits in various ways around the lake. So, they were Nirganti's, they were Thottis and Taliaris all traditional communities that manage the lake in a particular way.

Once the British came and codified these arrangements a lot of the responsibility for lake management moved to the municipal authorities or the village authorities and with the city growing and the Bangalore municipality taking over many of these lakes. Now these have become functions of the Bangalore water supply and sewerage board, the Bangalore lake development authority. And then what happens is that these collective responsibilities go away and so do the collective rights because what you have is a gated path next to the lake which has entrance timings and restrictions of use. The lakes actually disallow grazing. So, grazing is not allowed and fishing is only given to contract fishermen who have the money and the muscle power to hold the rights over fishing to a lake.

In some lakes even that has been disallowed. The fishermen are often the best ally of a lake community but even that has been disallowed. Many lakes they have disallowed the planting of fruiting trees and had pure ornamentals because they say people will fight over who has the right to the fruiting trees. So, while traditionally one planted tamarind and jamun and mango and those kinds of trees we only plant ornamentals at the lake and only some hazardous lakes are desilted. So, there is a very piecemeal approach to lake restoration. So, what is all of this doing? Essentially what this leads to is fragmentation of that sociological system because it puts a barrier between people and the lake by saying you can't do this and you can't do this and you can't do this.

You can't fish, you can't graze, you can't come in at a certain time, you can't play, you can't swim, you can't only if you have a contract you can fish, you can't plant fruiting trees, you can't climb the trees. When you do that where is the sociological system? You are breaking all of these lakes. Now I will just illustrate this to one particular lake and talk about how that lake has changed and also tell you about some of the good things that have happened since the lake was destroyed. So, this is a lake I have been involved with the restoration of. It's a lake called Kaikondarahalli on Sarjapur road and when I first moved to this region in Sarjapur road in 2005-6 it was a lake that looked like this.

It was extremely polluted, filled with silt, it didn't have industrial pollution fortunately it was just local domestic sewage in the lake. But it had a lot of silt and a lot of sewage and therefore it had vegetation everywhere. Now what happened was a group of people, local communities got together and they revised the lake restoration and they created an active collaboration with the BBMT. The BBMP being the Brihad Bengaluru Mahanagara Palike which is the local municipality which got together. This restoration project restored the lake and revived it into a beautiful lake which as you can see today, it was done over three

phases.

Not just this lake, what the community managed to do was to work with the BBMP to save an entire set of seven lakes which is part of a local socio-lacological system, a chain of lakes could actually get restored. And this was revolutionary for Bangalore because there has always been piecemeal lake restoration. You have one in one part of the city and another in another part.

These are also hydrological systems. Water flows into one lake and then into the next and then into the next. So if you will restore a lake and you don't do the upstream lake and the downstream lake, your lake in the middle is just going to get polluted again. So seven lakes have now been restored at this region and they look like this. And this lake, Kaikondrahalli lake has now more than a 100 bird species which is something I will talk about in a little bit. But we also, my colleague Amrita Sen and I were interested in understanding in a city like Bangalore when lakes have been socio-lacological systems which are really common systems, collective systems that people use as communities. What happens when the city grows and you get migrants coming in? New people who are not used to living in this area and migrants really in this part of the city are overwhelmingly large.

The local community is now small and the migrants are very large of various kinds. You know some are the IT workers, some of them are construction workers, some of them are fishers and weasels from outside the city. So you have a range of people coming from across India, from across Karnataka and from within Bangalore, different parts of Bangalore. And what we found was the lake continues to be the lake for commons and for very diverse groups for IT workers, for migrant workers, for village residents, for transgenders, for parents of special needs children. And just to give you a sense of what they did, we found that it was important for environmental place making. For instance the migrant workers that you see in the top right, this family comes from Raichur in North Karnataka and they are climate refugees.

Their area has become too dry to live and they moved to this lake because they said that it is a, you know they could work in a construction, they have moved to Bangalore, they could work in the construction area for instance in the area opposite the lake as you can see on the other side of the wall. And they would get 1000 rupees more for that. But like us they want their children to have a better lifestyle. So this young boy accompanies them and they do not want him to be in the site of construction workplace because it has cement dust, it is not safe for him.

They want him to grow up in a happy and healthy place. So they are used to lakes in their

neighborhood. Through this they see signs of the ecology they see and they say they feel that this lake is theirs. Or village residents like Bhagyama, the lady you see below, she is from one of the village residents in the like Alice in Wonderland in the Red Queen. She is in the same place but the place has changed around her.

So she was from one of the villages, she calls herself the lake's Dattaputhri. She says she was baptized at the lake. But the lake is not the lake it was. She showed us around 13 large wells that used to be in this landscape. None of the wells are now visible. They are all under tennis courts and apartment complexes. But she knows the lake intimately in such a way she can tell us of the gods and the goddesses and the chains of lakes and where the water came from.

Similarly we found transgender people who came and they said they like to sit at the lake because the lake doesn't judge them and it's the one place they can sit and breathe in peace in the city without the police harassing them. And then parents who specially needs children similarly said they like to bring their children here to let out their excess energy because they can scream and they can shout and this lake is a place for them to let out all of this excess energy, be happy in the morning and then go to the school happily. So instead of the morning becoming a tense scene for the parents and children it's a lovely place. So what this tells us is that lakes continue to be social-ecological systems in the heart of the city. But in new social ecological ways where the grazers and the farmers and the fishers are important as well as the people are getting these new nodes of environmental connection.

And this is really the social ecological system of the future urban city. Kaikondrahalli Lake was able to do, maintain this connect to a new social ecological system in a growing city like Bangalore because it created several exemptions. For instance there was a low income school on the side of the lake and that land some of the they had taken the playground of the lake area as some of their playground. And in the original restoration plan the playground was supposed to be taken away from the children and converted into a park, a landscape park with ornamental species. But the residents of in and around the area contested this and they said you know it's not fair to take away a playground from children even though it's part of the lake. So a compromise solution was reached where it was fenced it is still part of the lake but it's created as a large open playground where visitors to the lake can use this as a playground as well as the children from the lake can access it through a side gate.

You know on the weekends and early mornings and late evenings people can use it as visitors to the lake but the children you don't deprive children of the access to the only playground that they have in the heart of a crowded city. Similarly though grazing is not

allowed by the lake by the at the lake by the municipality there is still some sewage that finds its way and therefore there are plants and vegetation that grow because of the nitrogen and phosphorus that the sewage builds in them. So what with the lake community has done is allowed grazers to come in, cut the lake grass and take it on bikes. So they are the only two wheeler motorized transport that is allowed into the lake where they can take this grass away free of charge and feed their cows. So it's good for the lake because it removes the extra biomass and it's good for the grazers because they can actually continue to feed their cattle and it builds a strong relationship, continued relationship with the villages that live around this lake which used to be the original custodians.

Similarly the fishers are actually the best people in terms of the lake guardians. They live there, they seed the lake with fish, they are there at night and when someone encroaches the lake or puts in sewage or does something that can harm the lake it's the fishers that are sound the first alarm, alert the local residents and then can alert the police or whoever else, pollution control board, whoever needs to take charge. So these are the strong relationships that Kaikondrahalli lake that for instance the Jakkur lake in north Bangalore and several other of the restored lakes in Bangalore have been able to build to maintain them as social ecological systems. However, many other lakes like the one you see in this photograph which I will not name have not been able to do that. They have created exclusive places which are only for people to jog and walk in and they have removed the, so you can see this kind of a fence that keeps out the cows. So they change the ecology, they change society, they change the social ecological systems and these have become perennial lakes that are filled with sewage which basically means that they are altering the social ecological system fundamentally.

This is an example of some of the signs at these lakes. No flower plucking, no damaging trees, no swimming, no you know really no engagement of the lake as opposed to only viewing it and interacting with it as a recreational system. In fact, you can see that there was a group of citizens a few years ago that opposed the takeover of the Bellandur lake wetland for building a large socio economic zone and opposed to them another group that was for the building of the social special economic zone came and said that we want Bangalore to be Singapore who is sponsoring these NGOs who are protesting for lake restoration and we want, so the imagination of Bangalore to become Singapore is a place without lakes which only skyscrapers and it is very ironic because if you look at Singapore's own plans, Singapore is saying that it is not only a garden city but it is also city in a garden that is they were saying that the entire city of Singapore is so social ecological that they want it to be embedded within the garden. Not just a garden city will give you an impression of a city with gardens inside but they say no we are a city inside a garden and that is what the kind of imagination that Indian cities need to recover of social ecological spaces not the idea of Bangalore being Singapore in the sense of just the skyscrapers.

So let the special economic zones overtake the lakes. We need the lakes if our cities have to survive. So through these kinds of interviews with a hundred like diverse visitors and users of the lake which Amrita Sen did, we have seen that these lakes are very important for people like Bhagyama, for the parent mother of the differently abled child, for corporate employers, workers, transgender communities and they tell us that if you restore the lake with attention to the social ecological system you get a new ecological wisdom for a city. You also actually help the ecology of the city and this is new work that we did in collaboration with the colleagues from the Nature Conservation Foundation where we looked at eBird data. eBird is citizen science data where you collect information on birds across the city. Citizens have collected this and logged it into apps and what we find is as lakes have been restored the resident population of birds in many parts of the city have actually gone up.

So many of the resident birds that stay here year round have improved in terms of population. Migratory bird populations have come down and that again tells you that a social ecological system is nested at multiple scales. For instance, these migratory birds some of them come from across the Himalayas. They encounter many threats along the way and so this is not something that local lake revival can fix. It is basically interruptions in their entire path of distribution. But what is heartening is with lake revival in Bangalore we have been able to actually improve the resident bird populations of many kinds of birds and that is again a very positive sign that tells us we must go ahead with this kind of lake restoration.

In fact, the 2009 economics Nobel Prize winner Elinor Ostrom who passed away several years ago came to Kaikondrahalli lake the year that she passed away and planted a jackfruit at the lake to recognize the importance of the social ecological system and the importance of the community's efforts at this lake and that jackfruit tree is now thriving. Now what does this mean for India? If you look at the insights from the latest IPCC working group 2 report you will see that India is going to be ground zero for climate change and has a lot of threats emerging for this for the country. And one of the biggest threats is urban areas because urban areas are going to be drought prone, heat prone and flood prone. And lakes are very important as a social ecological system for all of these.

They reduce the heat waves in the city, they reduce the likelihood of floods and they will reduce the likelihood of droughts. We looked at Hitha in in in Krishna and a colleague of mine and I looked at climate resilient cities in the global south and we assessed city adaptation plans whether to heat or to climate change across different parts of India. And we found that nature based solutions were very high. Most of more than close to 50 percent of the plans that we looked at had nature based solutions. But almost none solicited local

community involvement.

Almost none really talked about it as understanding context based solutions or thinking of equity for the poor or thinking of gender sensitive solutions. And this is a problem because unless you understand them as social ecological systems what you get is a nature based solution that focus only on recreation. And these are the problems that we talk about. Its exclusion of the poor, its exclusion of the fishers, of the grazers, of traditional livelihoods and finally it means that this lake cannot contribute to the resilience of the city as a whole. So in summary the story of Bangalore and the lakes as social ecological systems is many parallels to the stories of cities across India because these are cities where water bodies are cultural heritage.

They have connect to the past through their sacred spaces, through the livelihoods. Yet there is a strong desire of these cities to all modernize and become like Singapore without understanding what the importance of the history was. Bangalore grew over thousands of years because of its attention to water and because of fact that these were social-ecological systems. And this really challenges our idea that urbanization is incompatible with water conservation. In fact what it tells us is we need to look back at our history of how we manage these lakes as social ecological systems to understand how we can actually bring Bangalore forward into the 21st century, the rest of the 21st century as a resilient city.