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NPTEL ONLINE COURSE
ECOLOGY AND ENVIRONMENT
Sustainability and Case Studies
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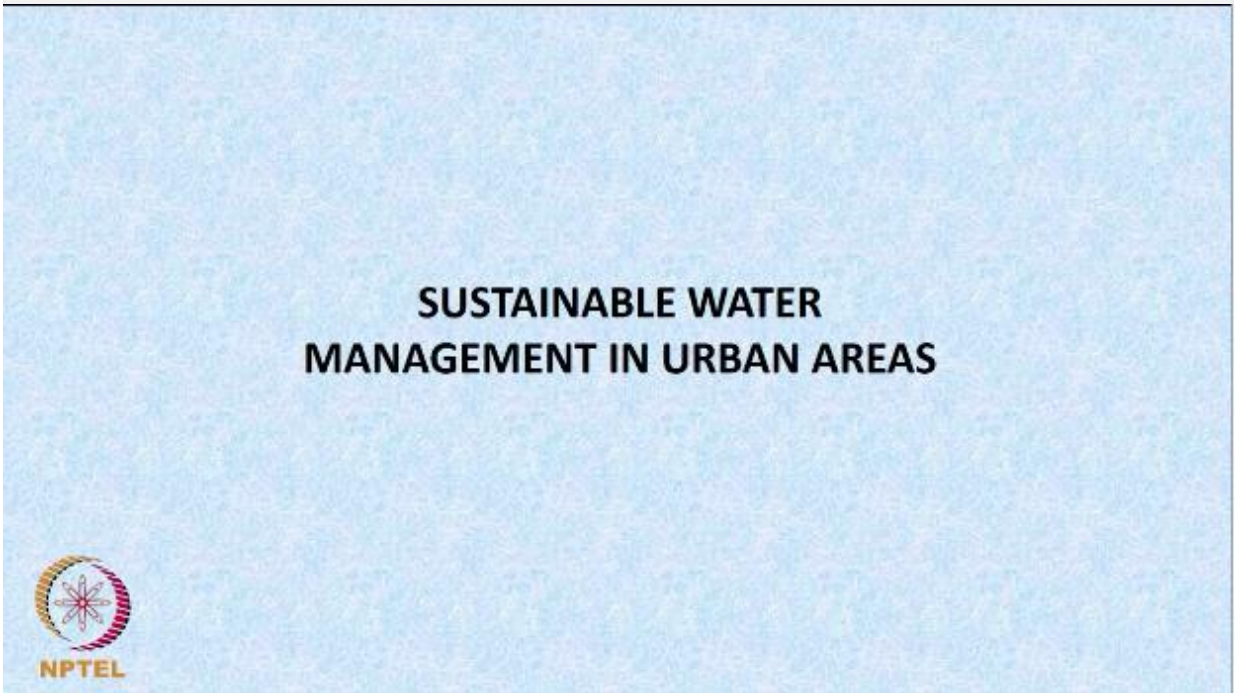
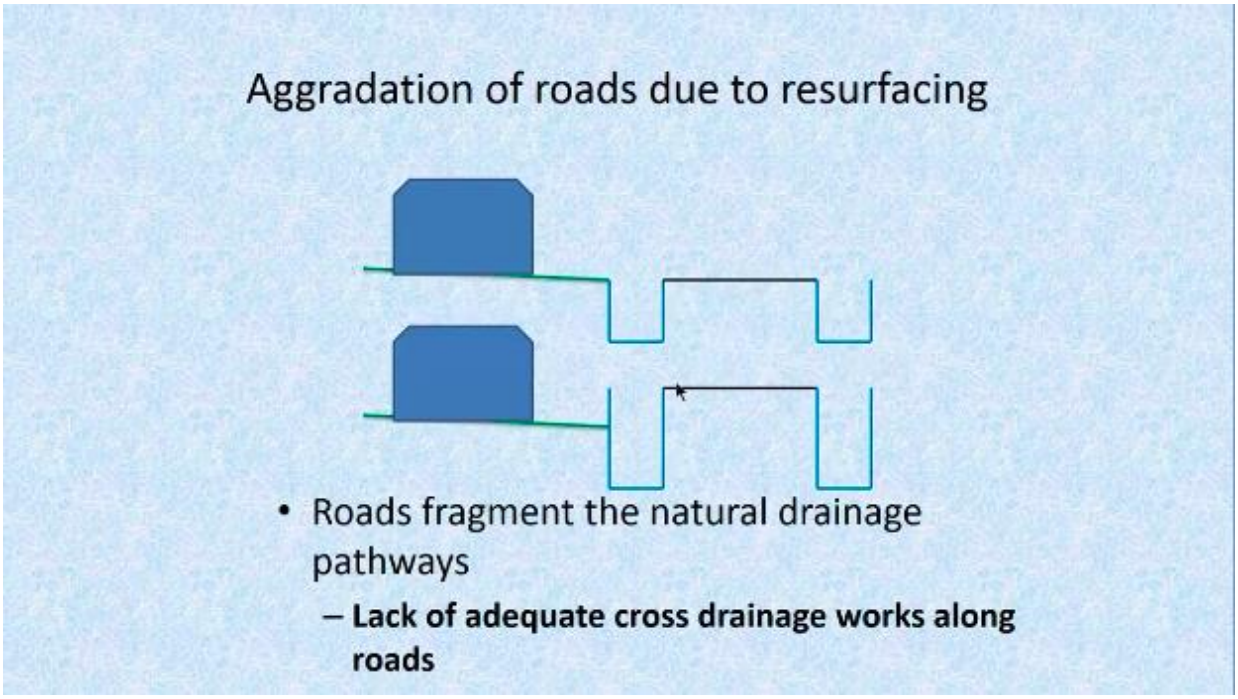
SUSTAINABLE WATER
MANAGEMENT IN URBAN AREAS



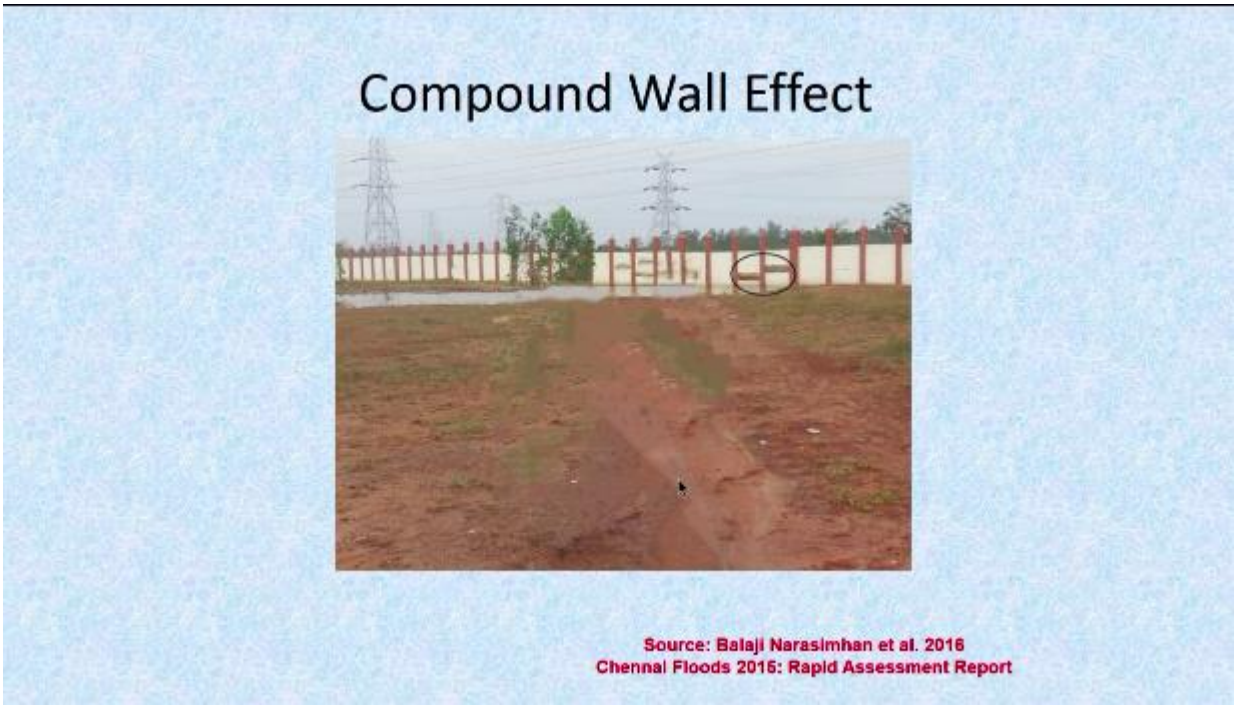


Then there is another issue of the aggradation of roads due to resurfacing. Let us say originally the road level is here, the house level is here, and then you have drains on both sides of the road. So, whatever the rainfall falling here or here or here, it goes to the drains, it goes to the drains and then it flows off into the drains and then the channel will drain the rainwater and that will prevent the water logging.

Whenever we are doing the resurfacing of these roads, what normally they do, instead of resurfacing the roads, they actually have to chip the road and then do this part of resurfacing, instead of that, we go from this level, this level and then raise the road level. So, every time the roads are re-laid, repaired, the road level is going up.

Now as the road level starts going up, naturally whatever the water is falling in these areas it will not be able to drain into this drain here, and the road starts fragmenting the natural drainage pathways. In fact, in the design of drainage system during heavy flooding events, we would like to use the roads as a drainage channels to pass off excess water, with this kind of a thing it is not possible because the roads are becoming like mini, mini embankments which will fragment the natural drainage pathways, this is not good.

And there is a lack of adequate cross drainage works along the roads. What we mean by cross drainage works is, you have a road like this, and then water is flowing from this side to this side. Let us say natural ground slope is like this, so when the rain falls here, the rain starts coming down, I mean the water starts coming down here and you need to provide what we call it cross drainage work. If these drains here, these are cross drainage works, these are culverts, if they do not have sufficient capacity or if you do not provide a sufficient number of these cross drainage works then the water will not flow from this side to this side because the road is coming in between. And then it stops flowing over the road, and it can cause breaches in the roads. In 2015 we have seen a lot of these breaches.



Another issue is what we call the compound wall effect. Every time there is a developmental activity or there is a real estate development, or some facilities are coming up, this is like the wall of an establishment, and before we develop our establishment let us say gated communities and then things like that, first thing we do is we go and then construct this compound walls. And this compound walls when you construct them particularly for large areas, and if we do not adequately provide, I mean for flow of natural water, and if it comes on its way, it will change the flow paths, it will change the local hydrology there and it can have localized effects in terms of flooding.

As we see in this picture, this is the compound wall of an establishment, and there is actually on the other side of the compound wall there is a natural lake. This natural lake depression used to take lot of water during the rains, water is, you can see this water like this, the water is flowing like this, and there is a lake on the other side. Now we have constructed this wall; water will definitely cannot flow over the wall until it piles up more than the height of the wall, which means that this wall is going to cause flooding on the upstream side and that is what happened in 2015 December. This wall was coming in the way of the water flowing so there was a village on the upstream side and those villagers were afraid that if they do not do something, then they will get flooded, and their property will get damaged. So, overnight they came in large groups and they actually broke the wall, you can see that this path here they took one panel out, they took one panel out here, so that water will flow towards the downstream side and it will not get piled up behind the wall and they will be prevented from flooding. Now this kind of actions do occur during major floods.

In 2015 floods, also it came to our notice that there are many, many lakes, their bunds were willfully breached because the upstream people do not want to get inundated. They go and then breach the lake and then let the water go to the downstream and then probably the people on the downstream side are not aware of this, and they get flooded without any warning. So, when we go and then talk about the drainage systems when we go and then talk about the development we have to consider all these things so that the drainage system is sustainable. So, we have to go in for the concept of a sustainable drainage system which we will discuss at length in a different lecture.

Sustainable Drainage System

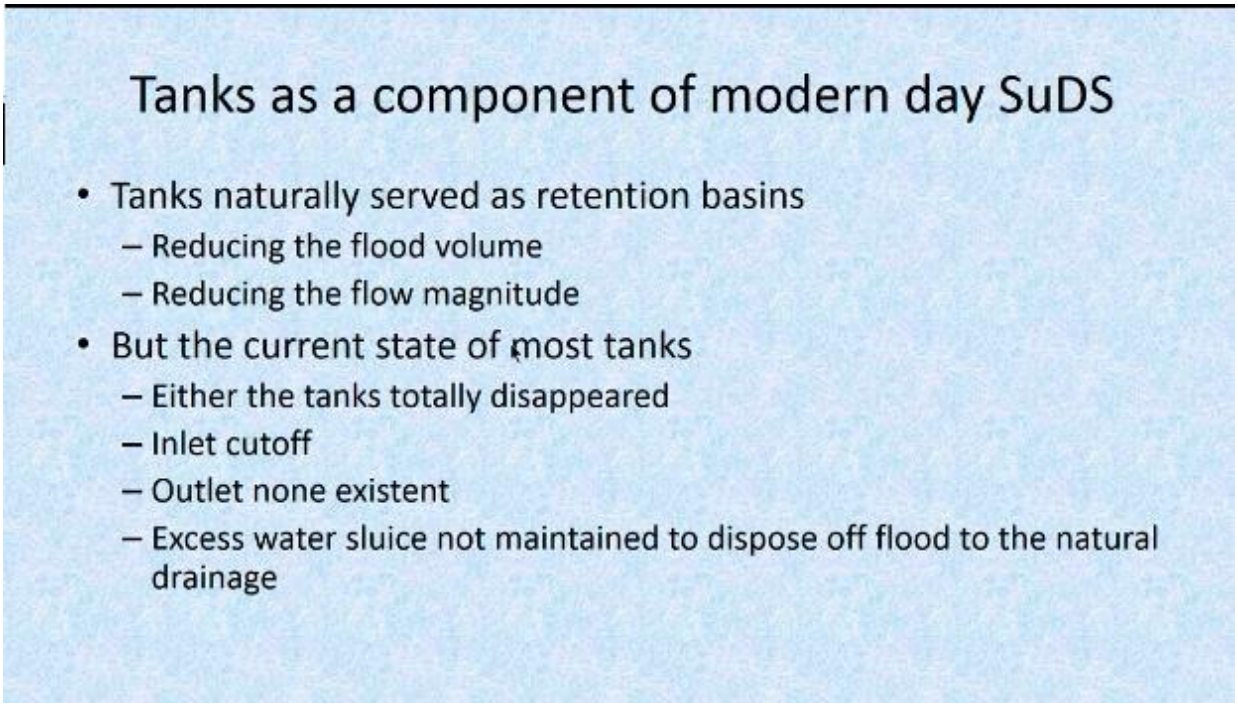
Sustainable Drainage System (SuDS)

- SuDS Philosophy
  - Going beyond traditional rainwater harvesting
    - Mimic natural drainage from a site
    - Where possible, manage water on the surface
    - Manage runoff close to source
    - Provide multiple benefits

SuDS scheme at Stamford

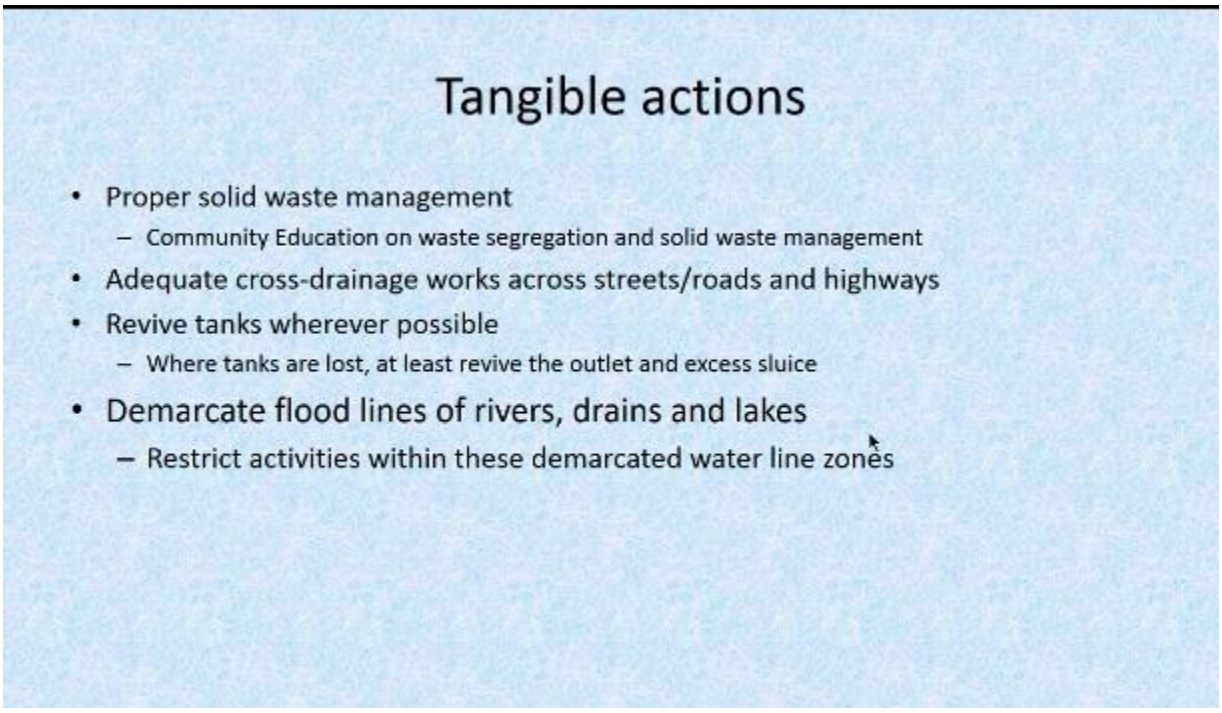
Robert Bray Associates

Basically, in a sustainable drainage system we have a philosophy, It is you go beyond traditional rainwater harvesting, we try to mimic natural drainage from a site, and where possible you manage water on the surface, and you manage runoff very close to the source wherever whichever the localities which are generating more runoff. You try to keep the water there itself, you try to manage there itself and then you also provide multiple benefits, these are the philosophies of the sustainable drainage system.

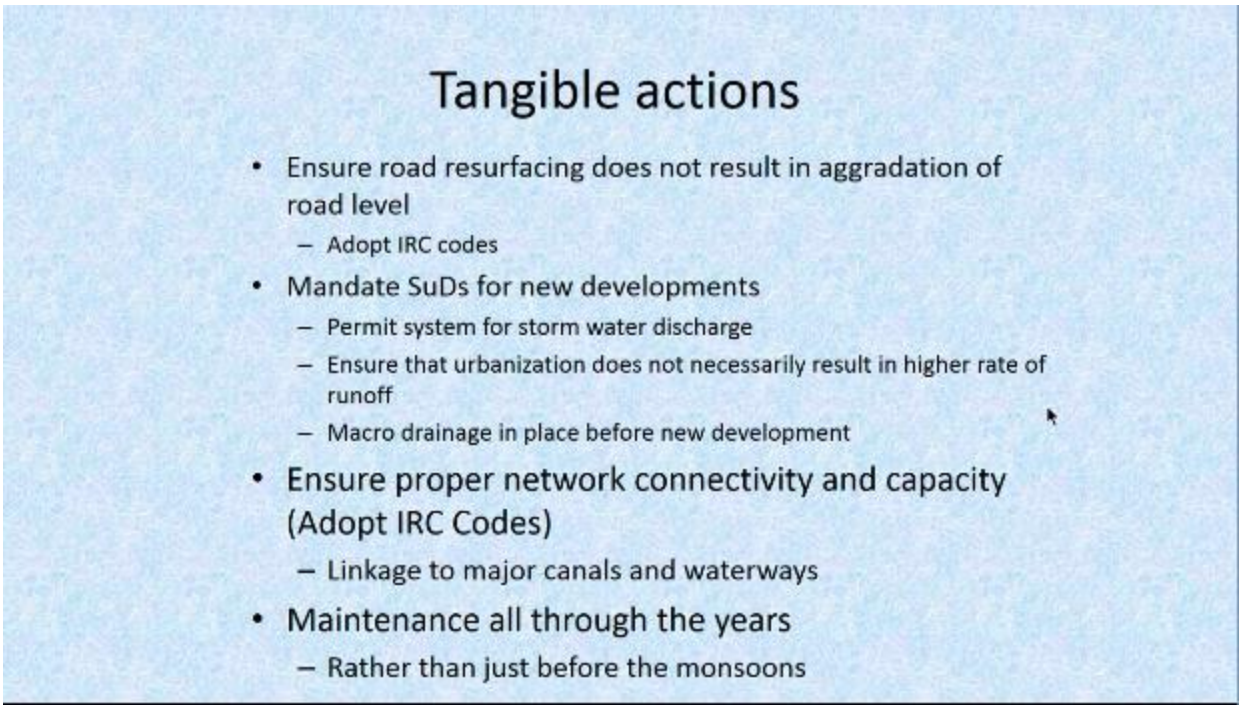


And there are different components for this sustainable drainage system; we can use tanks as a component of modern-day sustainable urban drainage systems because we can use these tanks, these natural tanks I mean naturally if we can use them as retention basins. What these tanks would do is they reduce the flood volume because they can reduce the flow magnitude. These detention basins, the concept of detention basins is very similar to the concept of flood control reservoirs and flood control dams like the Hirakud dam in Orissa. Which was constructed to prevent flooding of the coastal cities or the coastal habitation, like for example the flooding in the city of Cuttack, to prevent the flooding there they constructed a multipurpose dam, Hirakud dam. What they do is when the water, when there is heavy rainfall, and large water is coming in, they temporarily store the water in the reservoir and later on they release it to the downstream slowly and gradually, so one can take this tanks which we have and then use them as retention basins.

What is the situation in Chennai, what is the current state of most of the tanks? Either the tanks have totally disappeared in many cases, or the inlet to the tank is cutoff, that means the tank exists, but then water cannot flow into the tank. It is cut off from the rest of the you know catchment area or outlets are nonexistent. Because when you have a tank, you should have an inlet which will bring the water to the tank and then the water gets temporarily stored in the tank and then the water flows off from the tank when there is excess water. Otherwise, the tank will overflow and then will cause the breaching, or it will cause the flooding, so outlets are also important, in many cases these outlets are not existing.
The excess water sluice is not maintained, wherever there is an outlet, then you have a sluice gate there, and that excess water sluice are not maintained to dispose of the flood to the natural drainage.



Now, what are the tangible actions? Let us say this is the scenario, what are the tangible actions that one can take to prevent the occurrence of huge flooding or waterlogging. First thing is proper solid waste management is, I mean one cannot overemphasize this, a proper solid waste management needs to be there. For this, community education on waste segregation and solid waste management is absolutely essential. Other day we found in one of the meetings that even in a Chennai city apparently the segregation of the waste at the source which we think is should be a common knowledge to many educated people or urbanized people, the segregation is being done only probably 20% of the wards. So, we need a community education on waste segregation and solid waste management. We should have adequate cross drainage works across streets, roads, and highways. We have to revive the tanks wherever it is possible, wherever tanks are lost at least revive the outlet and excess sluice, demarcate flood lines of rivers, drains and lakes and restrict the activities within these demarcated water line zones just like they have coastal regulation zones. So, we have to restrict activities within these demarcated water line zones; we cannot let encroachment of floodplains of the rivers.



We have to ensure resurfacing does not result in aggradation of road level. We have to adopt and implement IRC codes properly, Indian Roads Congress Codes properly. And in my opinion we should mandate sustainable urban drainage systems for all the new developments, we have to have a permit system for stormwater discharge, whenever there is any development that is taking place we have to ensure that that development has considered how the development affects the stormwater discharge and how they are taking care of it. Then only the permit should be given. We have to ensure that urbanization does not necessarily result in higher rates of runoff. Like we need not go and then construct completely impervious parking lots all over the place. We should not go and then pave the surfaces with concrete and then prevent infiltration.
And then before any new development takes place we have to make sure that macro drainage is in place, then ensure proper network connectivity and capacity. Linkage to major canals and small, small drains they have to be linked to the major canals and waterways, that linkage has to be ensured. And there has to be a maintenance all through the years rather than just before the monsoons. And most of the time again this cleaning activity goes on because of various reasons, funds, lack of man power and so on, only major drains get cleared whereas micro drains which actually feed these major drains should also be maintained properly.

Many Developments / New Proposals !

- River Restoration for Improving the Quality
- New Treatment Facilities for Wastewater
- Ecological Park in the Estuary
- Increasing the Flood Carrying Capacity
- 5 Check Dams in the Upstream Region
- Creation of New Storage Facilities
- Linking Palar river with Adyar River

https://commons.wikimedia.org/wiki/File:Adyar-Tholkappiya-Poonga-Park-Chennai-India-5.jpg

In this context if you look at the Adyar River basin, there have been many developments and new proposals, there is a river restoration for improving the water quality and ecology, new treatment facilities for wastewater are being proposed. They have constructed an ecological park in the estuary, the picture is shown here, and they are proposing five check dams in the upstream region and creation of new storage facilities, thinking of creating new storage facilities or to solve the flooding problem. They are also saying that we can link Adyar River with Palar River and then divert some of the flood waters to the Palar River.

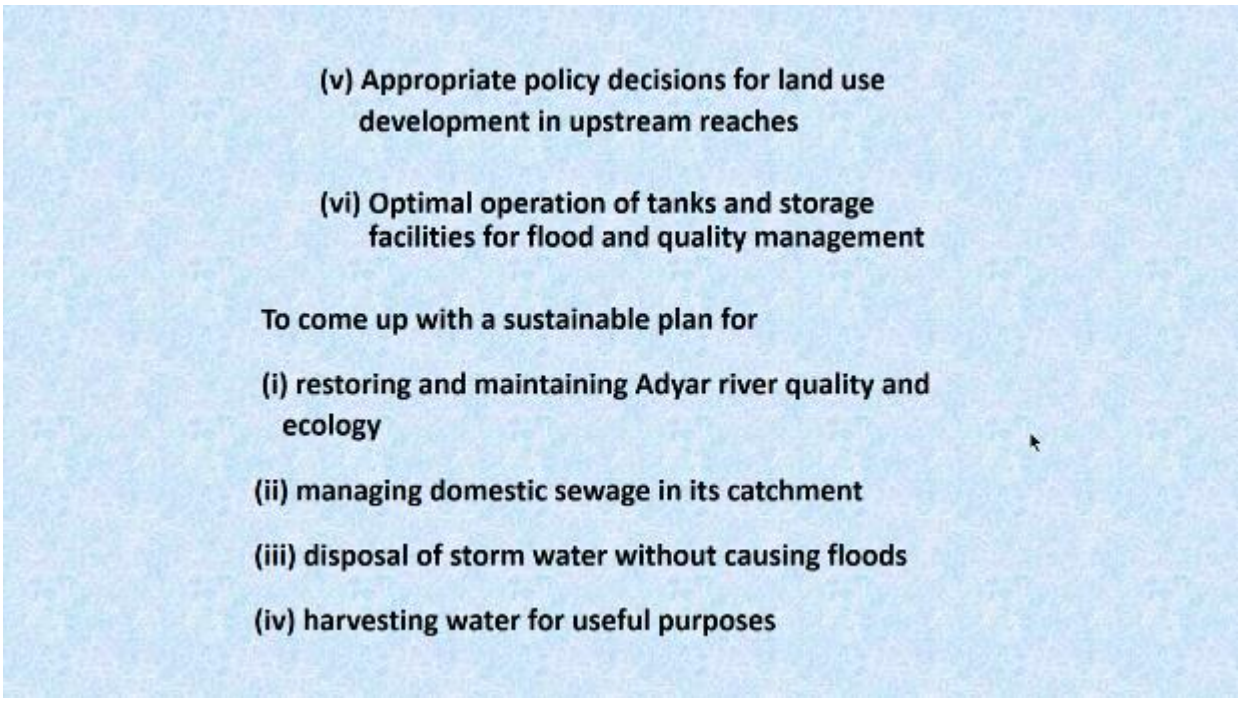
Concerns at the Planning Stage

- Is there any holistic view taken in design and implementation of these projects?
- Is the land use plan scientifically linked to flood and pollution problems?
- Is the river quality restoration plan sustainable?
- What is the effect of upstream developments on floods, river quality, and ecology?
- Are these plans socially acceptable and how do they implement resettlement of slum dwellers?

What I would like to say here is, there are certain things which need to be considered during the planning stage or some concerns, one should raise at the planning stage itself, that is, is there any holistic view taken in the design and implementation of these projects? What is the effect of implementing any of these individual projects on the whole system? Have we taken any holistic view? Is the land use plan in the peri-urban areas scientifically linked to flood and pollution problems in the downstream areas? Is the river quality restoration plan sustainable? That is okay you go, and then you restore the river today and then after two years it goes back to the same bad situation that we have now.

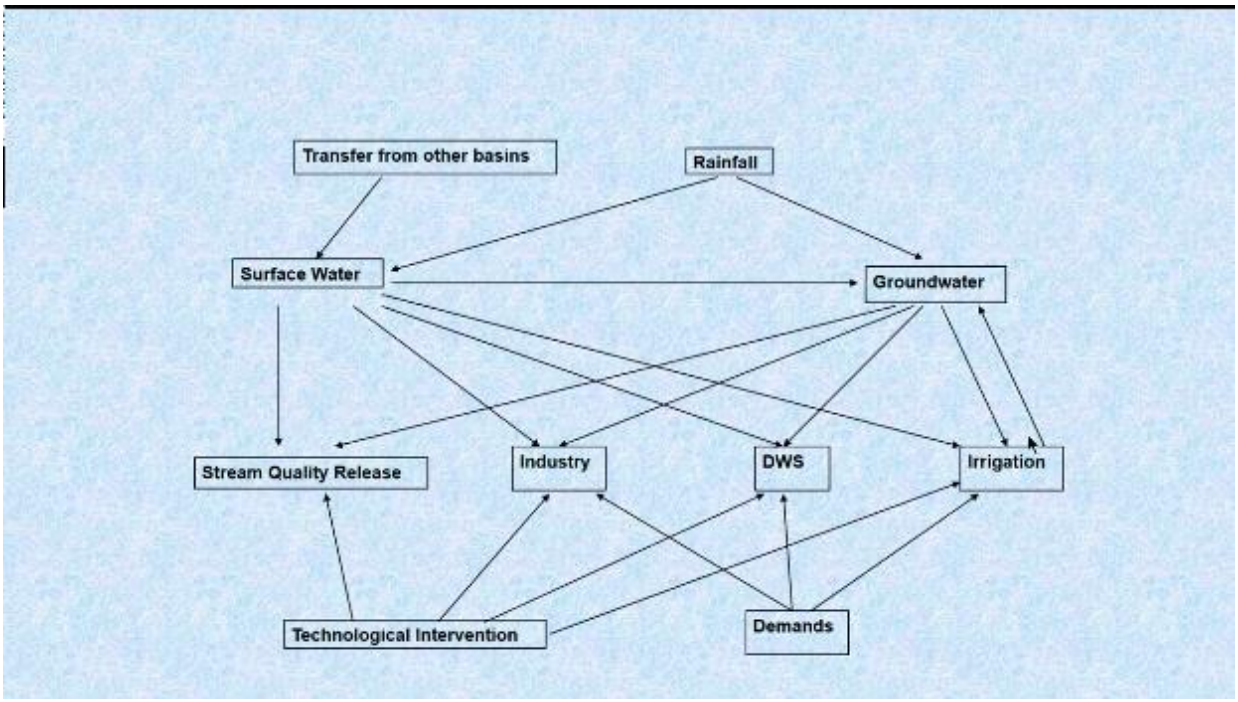
Is the river quality restoration plan sustainable? What is the effect of upstream developments on floods, river quality, and ecology? The next thing is, whenever we talk about sustainability we have seen earlier there are the 3 pillars, one is economy that means the system should be designed at less price, less cost, and the second one is the preservation of environment and ecology, and the third pillar is of course these plans should be socially acceptable. So, when we design these things individually, have we considered whether these plans are socially acceptable and how do they implement, resettlement of slum dwellers is it part of the planning of these projects.

So, what is needed is a holistic view of upgradation of treatment facilities, that is capacity enhancement and technology choice, creating upstream storage facilities for flood control as well as maintenance of environmental flows to increase the flood way capacity. Socially and politically acceptable ways for removing encroachments.



Now, appropriate policy decisions for land use development in the upstream reaches, and of course optimal operation of tanks and storage facilities. Here I give the example of Chembarambakkam lake. This is actually meant for a drinking water purpose, so it will be operated as a drinking water reservoir that means as and when the water comes, we do not want to lose it, and so we go and then store all the water. But it is not operated as a flood control reservoir, the operation of a flood control reservoir is very different from the operation of a drinking water reservoir. So, if you want to go and then utilize Chembarambakkam lake for controlling the floods in Adyar river, then we have to relook at the operational policy of this particular reservoir, and then whether that is acceptable from the drinking water supply point of view.

So, we have to come up with a sustainable plan for restoring and maintaining Adyar river quality and ecology, managing domestic sewage in its catchment, and disposal of stormwater without causing floods and probably we can harvest water from Adyar river basin for useful purposes.



If you look at the water management in any urban area, there are a lot of linkages. For example we need water for stream water - the stream quality maintenance, we need water for industry, we need water for drinking water supply, we need water for irrigation in the upstream areas because crops are growing and then we can supply water to any of these four needs either through surface water or through groundwater sources. And what is replenishing water in our surface water and groundwater bodies, is actually the rainfall. If the amount of rainfall is not sufficient to replenish the water in surface water bodies and groundwater bodies as we take from the storage, for any of the uses, then, we have to transfer water from other basins, and of course, that is costly and then may not be possible always.

And when we talk about the industry and the requirement or when we talk about the drinking water supplies, the demands for this drinking water supply and industry we can control. Let us say we have a water distribution network where we are losing 30 to 40% of the water that we put into the network through leakages, if we plug the leakages then certainly the demand for drinking water will come down. Not only that, if we have technological interventions. That is we bring in the concept of recycling of treated wastewater for many of our purposes like flushing of the toilets or many non-potable uses. We can use the recycled, I mean treated wastewater, we can treat it to a tertiary level and then we can use it. So, if we do that technological intervention then certainly the demand for fresh water for the drinking water supply schemes will come down. What is this technological intervention going to have in terms of its magnitude? And what are the other side effects that may be having when you put in this technological interventions, all these things have to be looked into in a holistic way, in a system, in a system sense, it is all part of the entire system.

I will give you an example, 2015 we had huge floods, and we could not store the water anywhere, and then we let it go to the sea eventually, and then in 2016 and parts of 17, we had a significant drought. We didn't have a lot of water to drink in the summer. So, when I talk about the flooding problem, I should not look at only the flooding problem. I should combine it with

the problem of drinking water supply; I should combine it with the problem of maintaining the stream water quality, I should combine it with the problem of how much of water I have for irrigation and so on and so forth. I have to take, I have to design, I have to plan for all these things in a holistic way, otherwise, our solutions will be piecemeal, and then I am also sure they will not be economical. So, in this context we would say that sustainable urban drainage systems are to go further, we should bring in the concept of water sensitive urban design, you design the urban spaces in such a way that all of planning, construction, maintenance, operation everything is water sensitive. This water sensitive urban design is becoming need of the day, in fact, it is practiced in several parts of the world and we have to bring in that concept to India also, the water sensitive urban design, I will discuss about this water sensitive urban design in another lecture.

Thank you.