Sustainable River Basin Management

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Module – 4 – 2

Lecture - 32

Part 2

Welcome everybody to sustainable river basin management; module 4- 2, part 2. We are still talking about the module, towards sustainability in river basin management.

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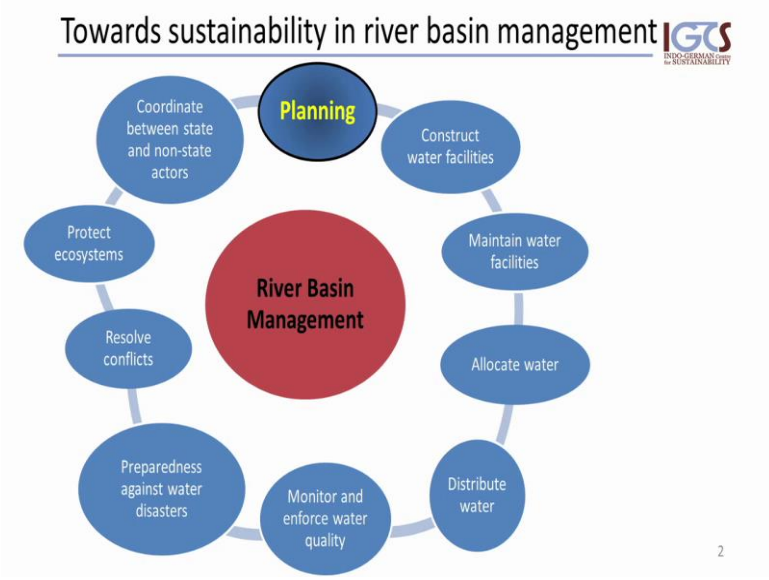

All right, this time, we will continue on river basin management functions and planning specifically.

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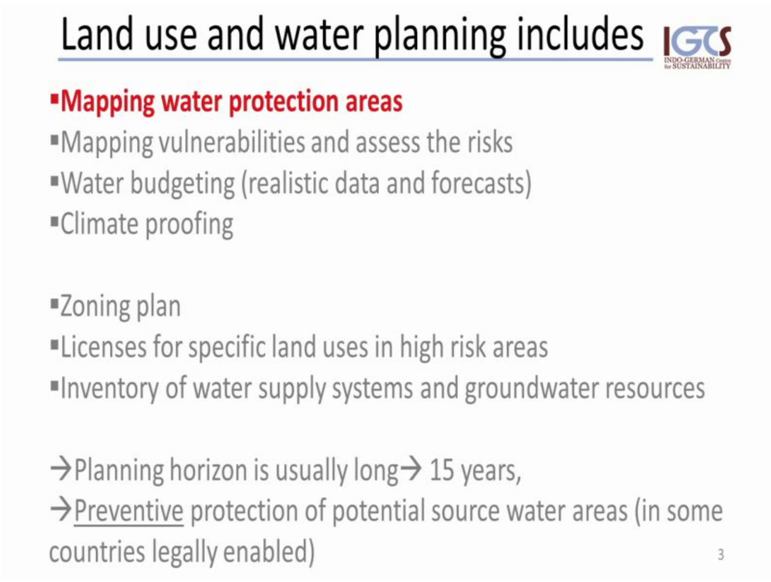

Last time, we had started talking about land use and water planning, and in this module, I want to talk specifically, about mapping of water protection areas.

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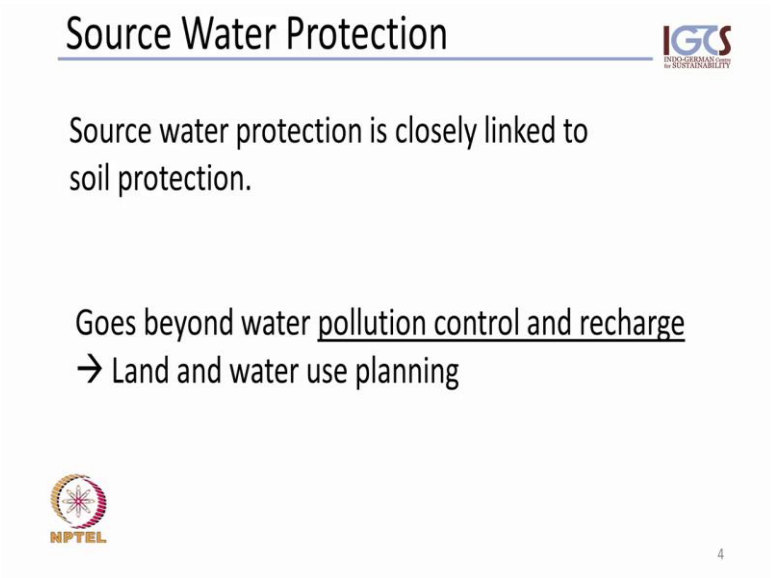

First of all, what is source water protection? Source water protection is very closely, linked to soil protection, soil sciences, or that goes beyond simple water pollution control and recharge; it is essentially in part of land and water use planning. In many countries, source water protection is conducted in the way of artificial recharge or water treatment for recharging artificially, ground water, but this is just one of the functions of source water protection.

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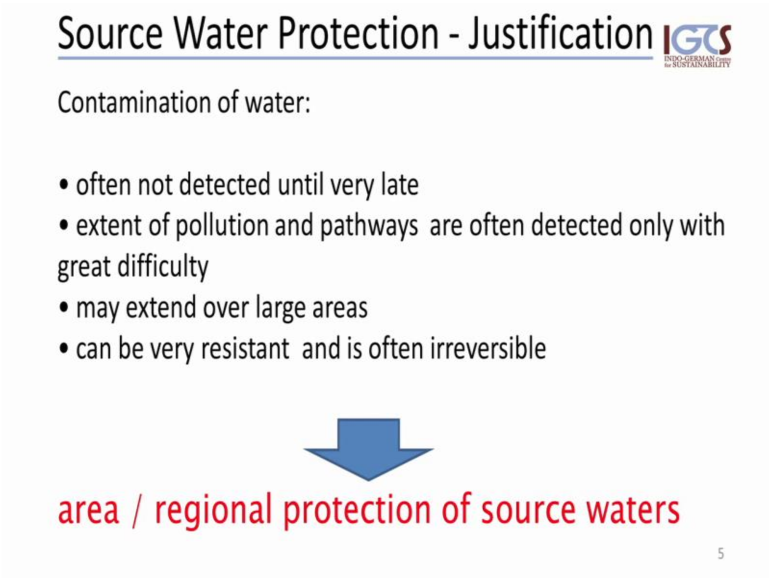

Now, why do we want to do source water protection in the first place? It is to for the reason that contaminated water is often, not detected until very late. The extent of pollution and pathways are often, detected only with very great difficulty.

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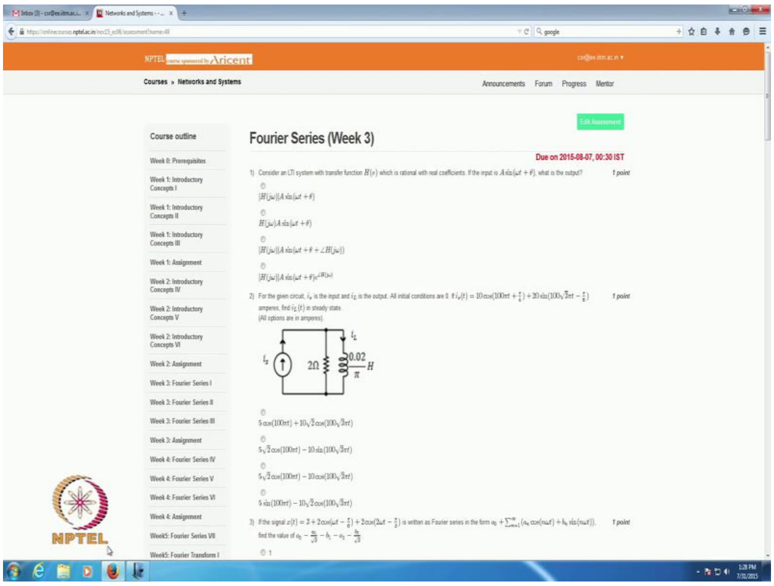

It can be very resistant and very often irreversible. This one (refer Time: 02:08).

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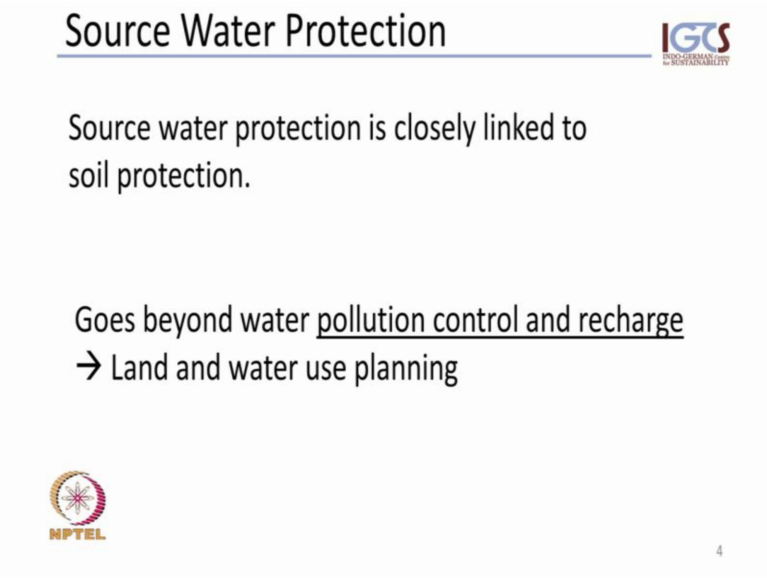

I am repeating; let us talk about source water protection and why we wanted to use that. Very often, contamination of water is not detected until, very late. It, in many cases, comes along with an extended pollution and pathways, which are detected only with very great difficulty. The contamination may extend over very large areas and may be very resistant, and in many cases be irreversible; difficult to clean up. For that reason, we opt for regional or areal protection of the source waters.

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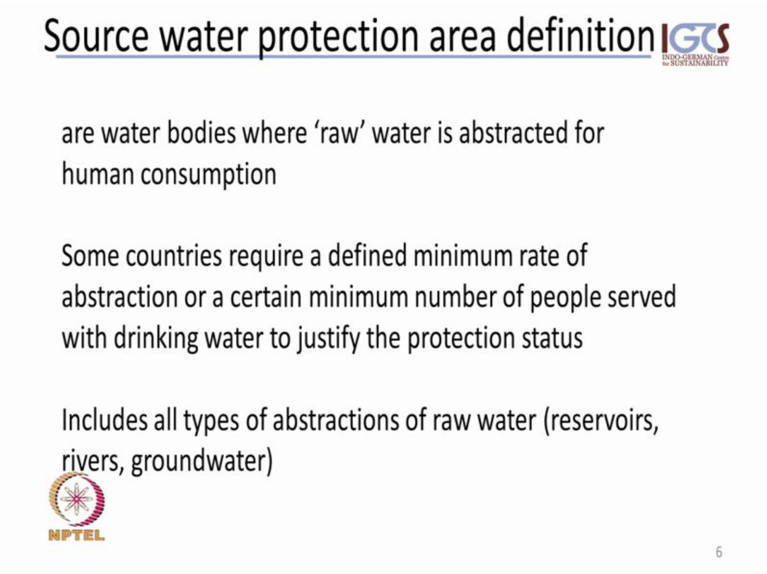

Now, we have been using source water protection, and the definition for source water protection area is that we are looking at a water body from which, raw water is abstracted for human consumption. The term raw water means that it is untreated water, which still has to be treated to be safe for human consumption. Some countries require for source water protection area, defined minimum rate of abstraction or certain minimum number of people that should be served this drinking water so that, protection areas can be declared and are justifiable. It includes all types of abstractions of raw water, which means it includes surface water bodies, reservoirs, rivers as, well as sub surface water, ground water.

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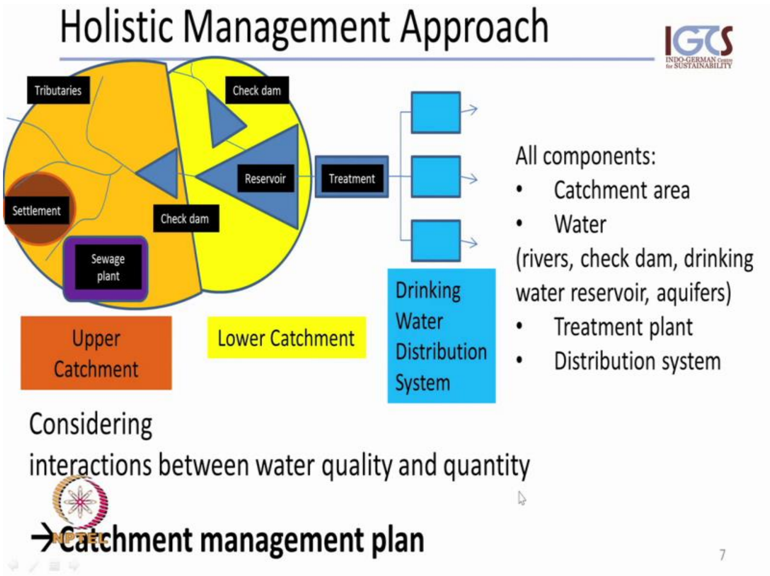

Now, how can we achieve something like source water protection? This has been done through holistic management approach, where we include all of the components of the water resources. This includes the catchment area as well as the water, as well the treatment plant and distribution system. When we talk about water, we mean rivers, the check dams, drinking water reservoirs, aquifers; all of the compartments accommodating, hosting water. Visualize, we looking at an upper catchment area, where some activities may take place, where we have rivers and tributaries.

We may have certain towns, villages, some industries, any source of land use and we may have even sewage plants here; then we usually, may have a lower catchment, where we have may be, a drinking water reservoir, which will be before the water process into the drinking water reservoir, it will pass through check dams, where most of the silt and sediments will be deposited and then, from the drinking water reservoir, it will be abstracted and taken to a treatment plant and from there, it enters a drinking water distribution system to reach the end users. Now, all those has to consider the entire access between water quality and quantity; those of the components are settled down in the so called catchment management plan.

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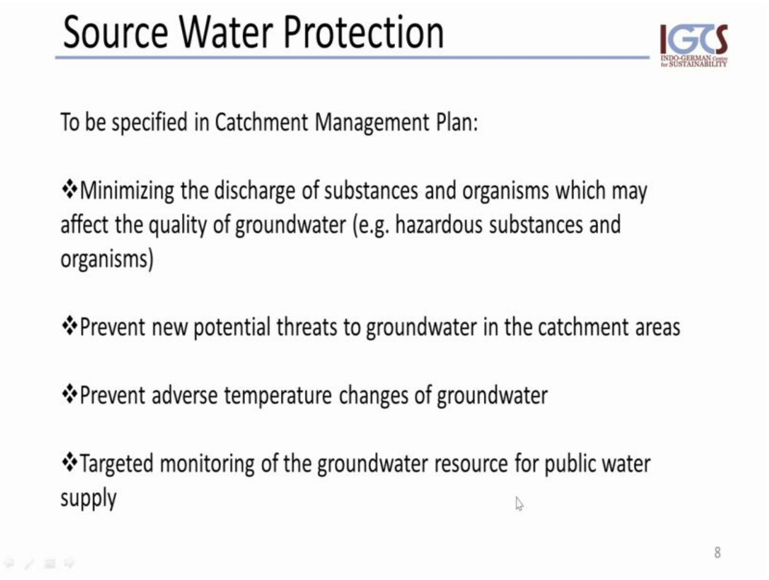

Now, let us look into source water protection and the components, which should be specified in such a catchment management plan. There should be a clear understanding on minimizing the discharge of substances and organisms, which may affect the quality of ground water. Those could be hazardous substances, chemicals for instance, but it could also include or should include organisms. It should prevent new potential threats to ground water in the catchment areas. There should be measures, which prevent at which temperature changes of ground water, and there should be a targeted monitoring of ground water resources for the public water supply.

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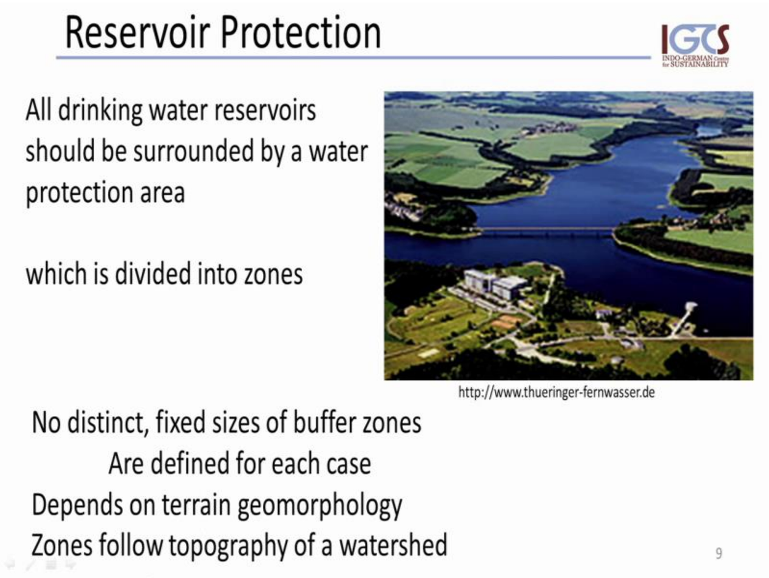

Now, let us look into how these sources of protection take place in reality for surface water components; the reservoir protection. This is just an example of a water reservoir here, a large artificial lake and we can see various land uses here; some villages; there is a bridge crossing this drinking water reservoir and we have agriculture taking place here. Then we have some infrastructure here, related to the maintenance of the water reservoir and for water treatment as an abstraction point. Now, all of these drinking water reservoirs should be surrounded by water protection area. What we can see also in this case is there is a green belt, going around this reservoir here, which is specifically, kept as a protection zone; the first protection zone.

There is no specific size or distinct fixed size, given for the extent of such buffer zones. They are usually defined on a case by case basis, depending on terrain, geomorphology, and depending on the topography of water shed. There are however, some countries which have legal provisions for fixed buffer zone, which something for instance, 200 meters from the mean water level height land inwards as a protected zone or something similar 200 meters, 100 meters. Some have half a kilometer as a buffer zone, but many also just keep this open and flexible as per terrain topography and geomorphology.

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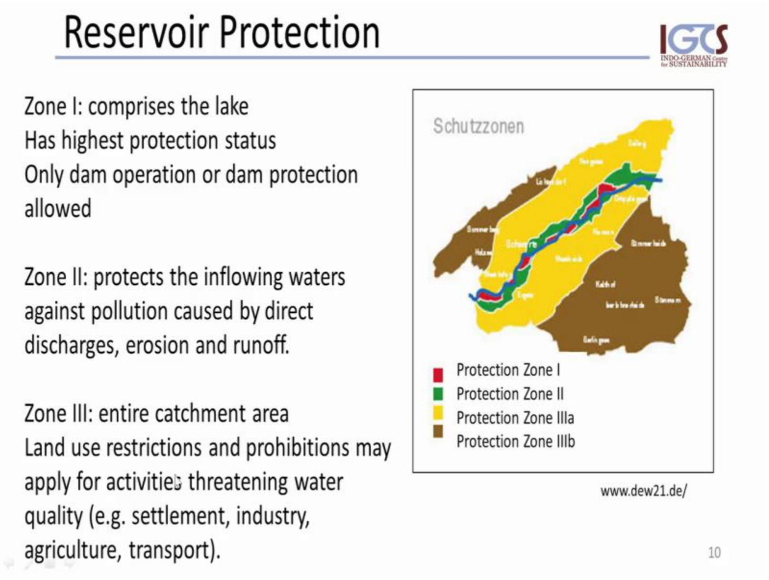

Now, how can this look like in a map or in a sheet of paper? We have here the different protection zones 1, 2 and 3. So, it is divided into a and b, and we have zone 1, comprising the lake, which has the highest protection status. Only dam operation or dam protection will be allowed. We have the second zone, which protects the inflowing waters against pollution, caused by direct discharges or erosion and runoff and potentially, being flushed into our reservoir. We have zone 3, which includes the entire catchment area. So, this means that land use restrictions and prohibitions may apply for activities, which potentially, threaten the water quality. So, certain sizes of settlements may be restricted. Then certain industries, agriculture, transportation may be restricted and this in the catchment area, where such a water reservoir occurs.

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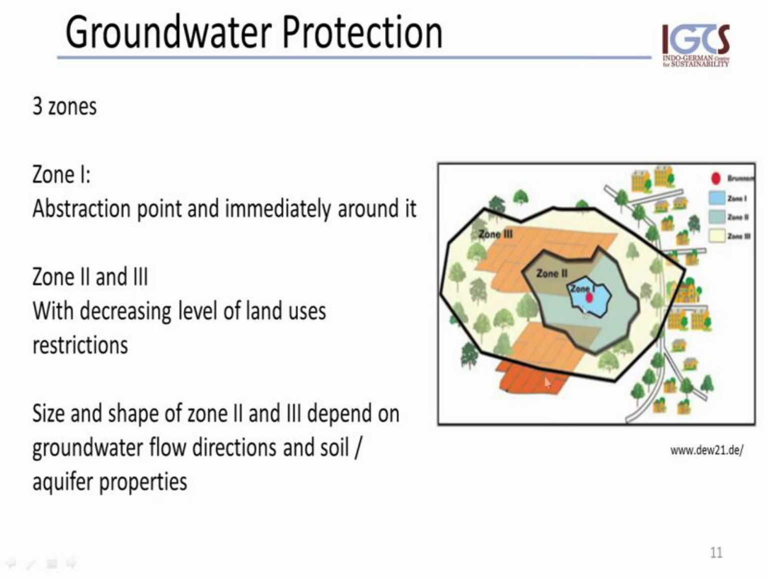

Now, the concept for ground water protection is similar, but little bit different. We will see why. This is an example map of such a zoning concept for ground water protection, where this red dot here, indicates the location of our bore well. We have suction point and then, we have again zone 1, zone 2 and zone 3 to it with different land uses here, and also, infrastructure, roads, settlements and so on in those areas. Now, abstractions on the zone 1 corresponds to the abstraction point itself, and the immediate area around it. The zone 2 and 3 will differ in shape. We will look into this now. There will be different land use restrictions, applicable as we move further away from the abstraction point. What we can see here is also that there is not, again not a single shape, which we apply to the size of the zoning. The zoning is basically, depending on ground water flow directions and on soil and aquifer properties.

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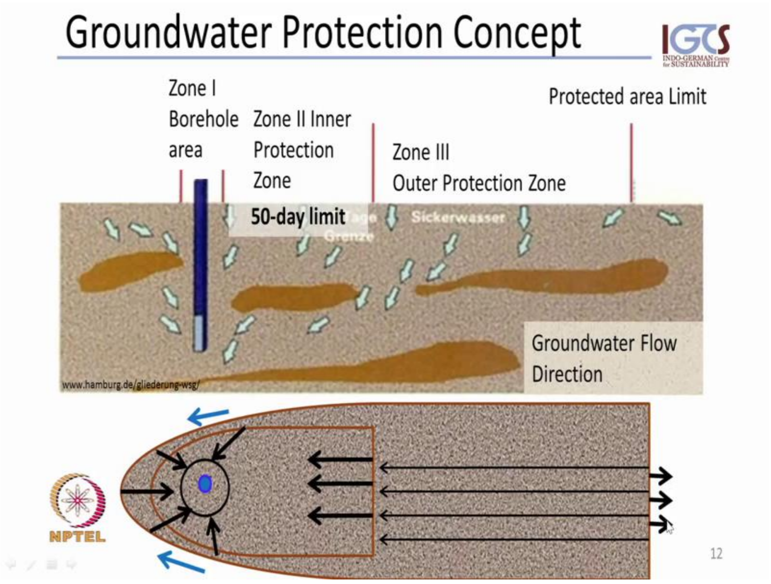

Let us look into this in detail. Now, we have our aquifer system here. We have a bore well sitting here; this blue symbol here. Then we have blue arrows, indicating our flow directions, our ground water flow direction, our recharge taking place in various places. As we start abstracting water, we are increasingly drawing water from, also from the downstream areas of our ground water flow direction and accordingly, there will be zone 1, the area immediately around our bore well. Then we will have our zone 2 as the so called inner protection zone or more commonly, used is the term 50 day limit.

We will have our zone 3, corresponding to the outer protection zone from the bore well and up to the limit of our catchment, our ground water catchment area. So, what we see that these three zones extend upstream of our ground water flow direction, and very much depend on how fast this water is moving from the infiltration point, towards our abstraction. We can imagine that this is changed or influenced by the amount of water that is being taken, abstracted, and pumped from such a bore well. Now, if we look at this scheme from vertical position, we have our bore well here, and this inner abstraction zone will be fairly fixed and predictable.

It will be just about 10 meters, 6 to 10 meters around the bore well in a regular shape to protect immediate return flows. Then we have our 50 day limit, according to our abstraction range and ground water flow velocities. Then we have an outer protection zone, which corresponds to the catchment boundary indicated by these arrows.

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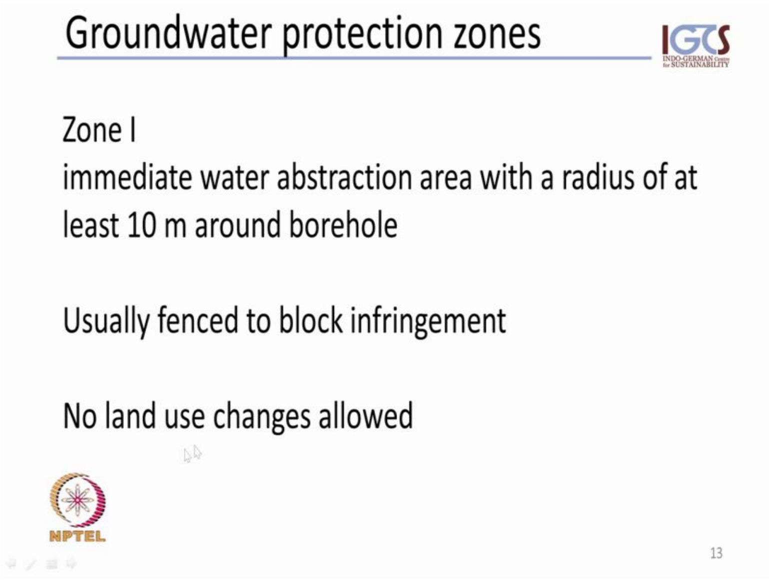

Now, the zone 1, as I said about 10 meters around the bore well; usually, it is just 6 meters. It is usually fenced to block infringement and to avoid that people park in next to the bore well or to the laundries, next to the bore well and so on. Then there should usually be no land use changes, allowed in the area. Important is that there is no land use changes.

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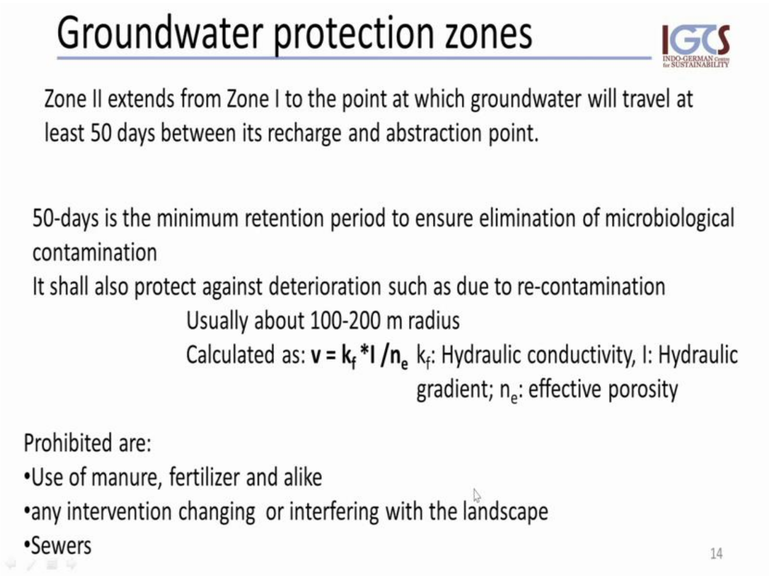

The zone 2 extends from zone 1 to the point at which, ground water will travel at least 50 days, between recharge and abstraction. That 50 day limit comes at; this is the minimum retention period to eliminate micro biological contamination and usually, bacteria which will be infiltrating through the soil, moving through the soil layers, towards an abstraction point, will be depth appear in 50 days. In some rare cases, this will not be efficient enough and in such circumstances, a 200 days limit may be necessary. It also shall protect against the deterioration, such as recontamination, return flows for instance, taking or polluting, re-polluting water by retailers through our aquifer system to the abstraction point.

There is a usual cool (refer Time: 16:20) of 100 to 200 meters of radius, where as you have seen, it is not a circle itself; it is following flow directions, but it can be calculated very precisely, calculating flow velocity from the hydraulic conductivity; we have hydraulic gradient and knowing the effective porosity of our aquifer. So, we have parameters, necessary about our water and about our aquifer system itself, which we can obtain from geological limits or from pumping tests, conducted on our abstraction point or on abstraction points in the near vicinity.

What is not allowed in zone 2 is prohibited is the use of fertilizers or manure or any herbicides or pesticides or things like this, and any intervention that would change or interfere with the landscape. What you mean by this is that our landscape helps our water moves through the aquifer. It usually becomes, it is cleaned as a cleaning effect and a filtering effect taking place. So, that is why we wanted ecosystem, the landscape to be functioning to conduct exactly this role.

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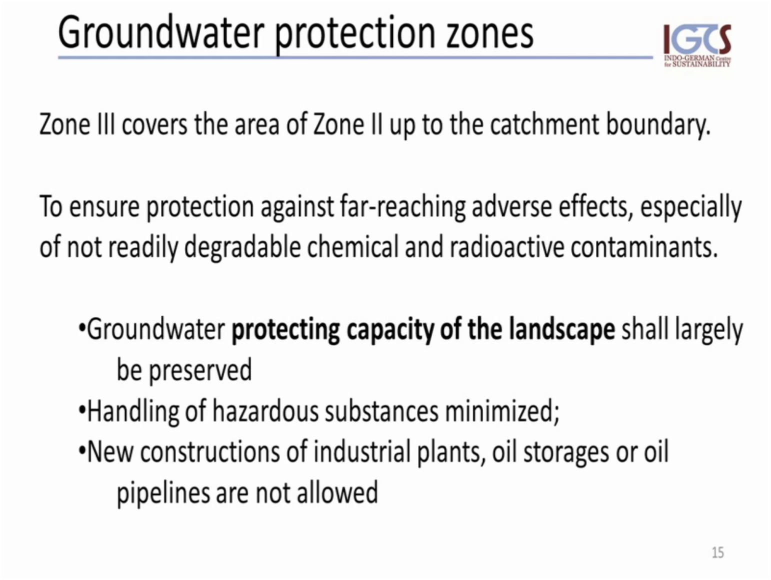

Now, the zone 3 covers the area of zone 2 up to the catchment boundary. This shall ensure the protection against far reaching adverse effects especially, of not readily degradable chemical and radioactive contaminants, which would travel long distances and remain over long periods of time in our water bodies. We want to protect the landscape capacity, which will attenuate and remediate contamination and any effects on our ground water. So, hazardous substances shall be handled with lake here or minimized. There should not be any new construction of industrial plants, oil storages or oil pipelines, allowed in that zone.

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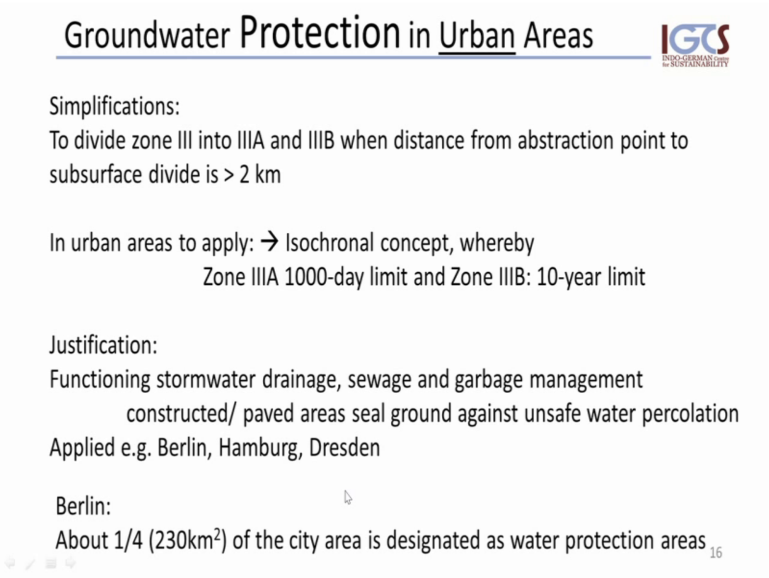

So, there are several constructions, which may interfere with other human activities. So, it is a question of paralities in those cases again. Now, how can those work in urban areas? We know that many urban areas depend on ground water entirely, and not all of the parameters of aquifer, geophysical parameters are always available and known. For that reason, a slight simplification is used in urban areas. First of all, zone 3 is divided into two zones. Whenever the distance from the abstraction point to the sub surface divide is larger than two kilometers, then we use a so called isochronal concept, whereby the inner zone of zone 3 would be corresponding to a 1000 day limit, which is the time for a water drop to infiltrate and move through the water body to our abstraction point and the outer zone of zone 3 would be 10 year limit.

In that way, we can exclude large areas, which would be may be part of ground water catchment zone, and can remove them from the set restrictions; restrictions, which are applicable to the zone 3 otherwise. So, the justification for this is that it assumes that as a functioning strom water drainage in some urban areas, as there is a proper functioning sewage and garbage management system that most of the area is built up or paved and so to say received from unwanted and unsafe water infiltration from water percolation. Examples of such ground water protection, zoning and dependency of cities from ground water or the cities of Berlin Hamburg and Dresden; just examples from Germany; larger cities in Germany and just to give you a feeling for that the extent of such protection areas. One quarter of the area, city area of Berlin is designated as water protection area. So, it is very much feasible and applied.

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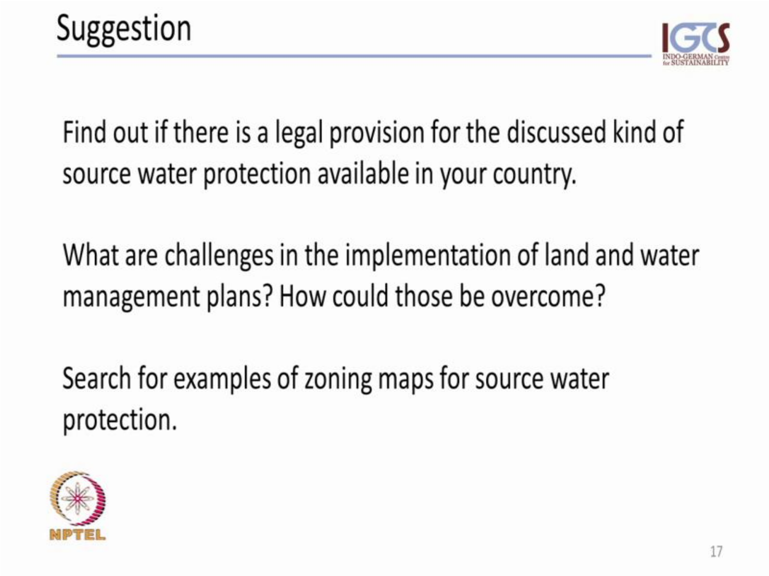

Now, the suggestion for you before we conclude for today; this you should find out if there is a legal provision for the discussed kind of source water protection, available in your country. What are the challenges in the implementation of land and water management plans? How could those be overcome and you should search for example maps, for zoning maps for source water protection. You could find them online and many countries, who use such concepts and you can get examples, including reports about how these zoning maps were produced.

With this, we close for today and we see as next time again.