Sustainable River Basin Management

Dr. Franziska Steinbruch
Department of Civil Engineering
Indian Institute of Technology, Madras

Module – 02
Lecture - 09
Part – 04

Welcome everybody to Sustainable River Basin Management, module two part two.

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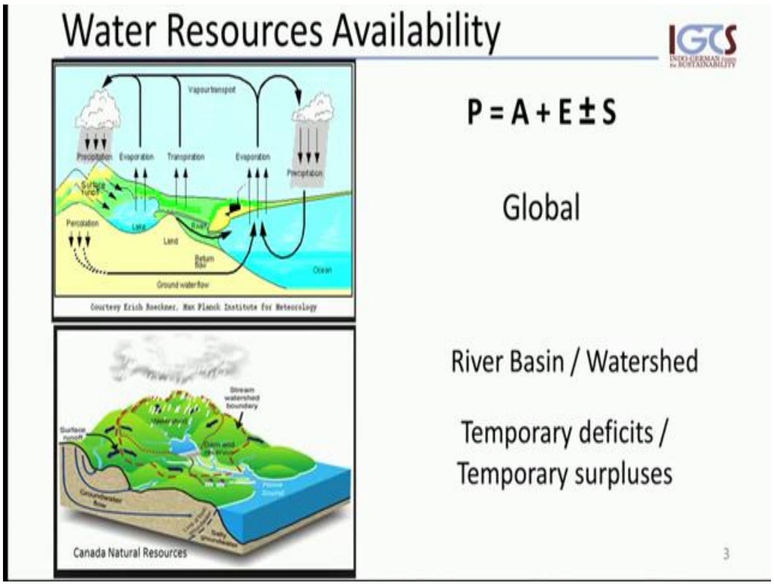

Today, we will be speaking about water resource availability. Let us look back at our water cycle. When we look at the global water cycle, we can apply, this way is simplified equation and estimate water resources at global scale. We come to river basin and especially to watersheds and sub catchments, then it becomes more differentiated. Then, we have to account for temporary deficits and for temporary surpluses for our water resources availability assessments.

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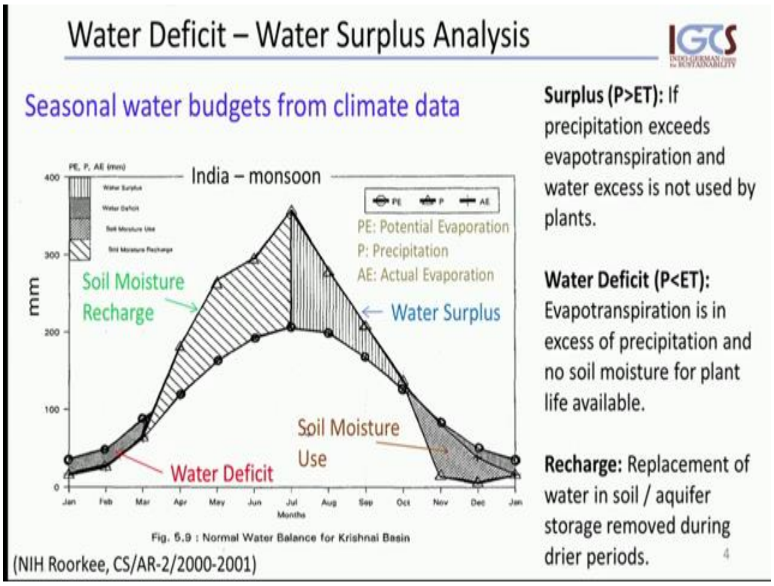

Let us look at one of the ways of analyzing these temporary water deficits and surpluses and the applications. We can derive from climate data, seasonal, water budget in a quite efficient way. I have chosen an example from the report produced by the National Hydrology Institute in Roorkee, just for you to be most familiar with the climate data. And we have here a typical water deficit, water surplus analysis graph, which shows us here one hydrological year and it shows us here millimeters and post evaporation and precipitation data uploaded into one graph.

What we can see is, in this particular case the typical Indian monsoon, one monsoon in this case only occurring here. We have our precipitation data following this line, very steep and our evaporation line following here. And we have, we can see two very remarkable points, which were very important for water availability analysis. One, the point where precipitation starts to exceed our evaporation and this is where soil moisture recharges taking place, begins to take place. It essentially means, that we replace our soil moisture storage.

And when we reach this top point in our graphical visualization, we reach the point where the soil moisture compartments have been refilled and water surplus is occurring and this water surplus means that we are starting to recharge our groundwater compartment and we may occur, we may observe floods in our region. And then, our precipitation will continuously decrease, whereas our evaporation continuous at this point becomes dominant and this is where our vegetation, from this point onwards our vegetation will start using and survive on our soil moisture contents up to the point where the soil moisture will be used up completely by our plant activity and by our evaporation processes and at that point, we speak of water deficit.

Coming back to our starting point, maximum water deficit is also our so called yielding point. This is when plant life will not be possible anymore, because plants cannot access the remaining amount of soil moisture in our soil moisture, soil compartment. In that, in that case we speak about water deficit.

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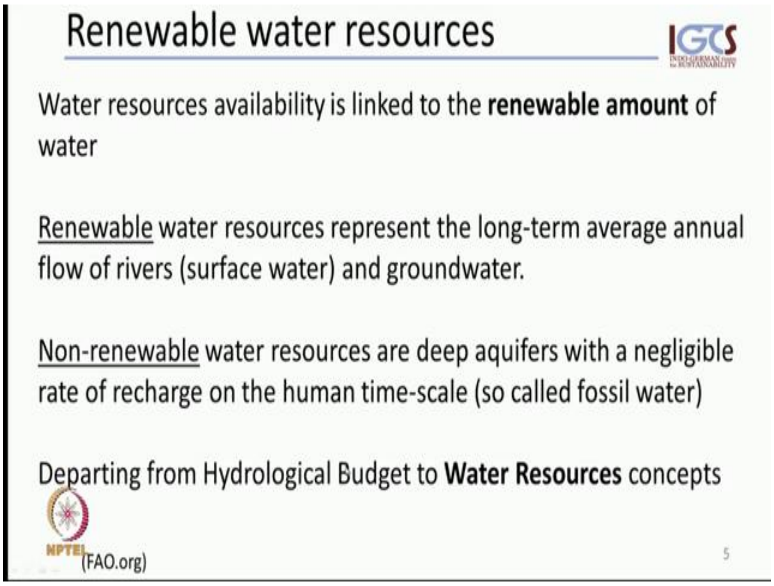

Now, coming to the term renewable water resources. The availability of water resources is essentially, a link to the renewable amount of water and what we mean by renewable water is the resources measured and available over a long term average, float surface flow or in groundwater.

And on the other hand, we also distinguish between non renewable water resources and those are water resources occurring in deep aquifers, deep aquifers or deep sitting groundwater appearing formations where recharge takes place along geological time scales. We also call this fossil water.

And by introducing the term renewable water resources, we are essentially moving into a water resources concept, away from simple hydrological cycle or hydrological budgets.

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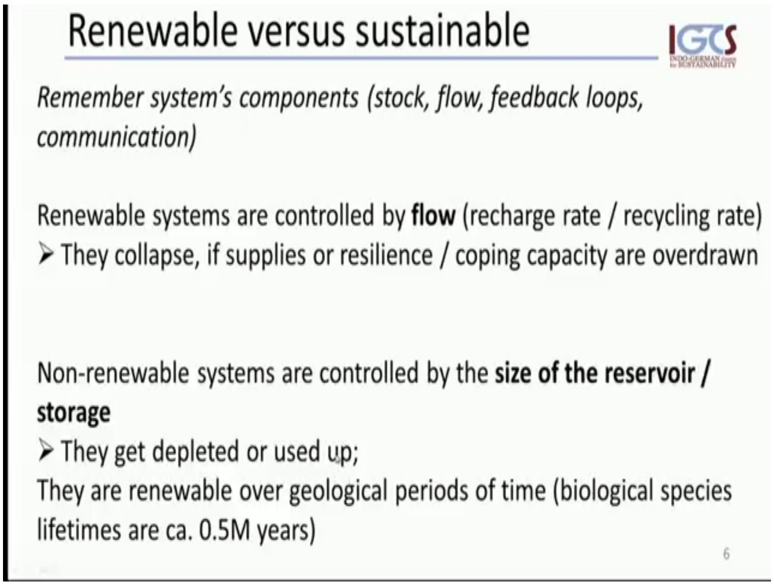

Now, let us ask the question what, what do we mean by renewable and at the same time sustainable. Remember, the systems components that we have talked about earlier of the stock, the flow, feedback loops and communication. Now, renewable systems are essentially controlled by a flow, means the recharge rate, recycling rate, etcetera. And renewable systems collapse or extinct when the supplies are over torn or when the resilience or coping capacity has been over stretched. You can think of any biological matter and in those cases it is more obvious, but the same applies to water resource system.

And for non renewable systems, those are controlled by the size of the reservoir or the size of the storage that we have available and by using those storages, those reservoirs, they get depleted or eventually used, completely used up. Those are, if we break it down, also renewable. However, over geological periods of time, just keep in mind, biological species have generally a lifetime of about half a million years.

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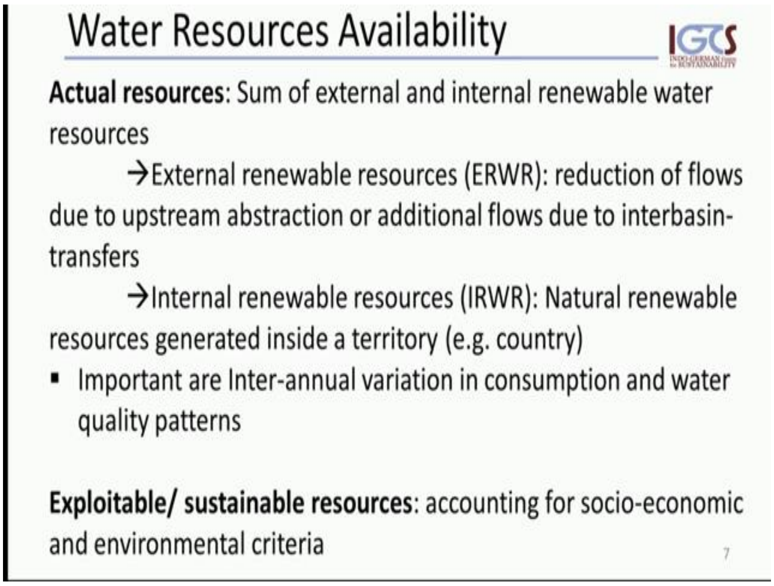

Now, if we want to know, conduct water resource availability assessments, we are working with, we have to work out our actual resources. And the actual water resources are the sum of the external and the internal renewable water resources, where we mean by external renewable resources the amount for that has to be will be taken out by an upstream user, an upstream country for instance, or the amounts of for that may be at a two, our internal, our internal flows due to inter basin transfers. And on the other hand, our internal renewable resources are those natural renewable water resources, which are generated by rainfall inside a specific territory, example a country.

Now, important is, when we come up with actual water resources amounts, that those very, very much over years, over seasons and for that reason we have to build into inter annual variations. This in terms of consumption and in terms of water quality patterns. Just think of agriculture taking place as in catchment area, some areas maybe a seasonal climate variations, certain areas will be under ((Refer Time: 09:03)), requires irrigation and at sometimes there will be after the harvest, harvesting season, and rainy season, where no irrigation is taking place, at that place water is required. Same applies to water quality.

Now, in addition to these actual resources we then have to differentiate the so called exploitable, nowadays more used term sustainable, water resources and in those we have to account for the socioeconomic and environmental bounding conditions of a region.

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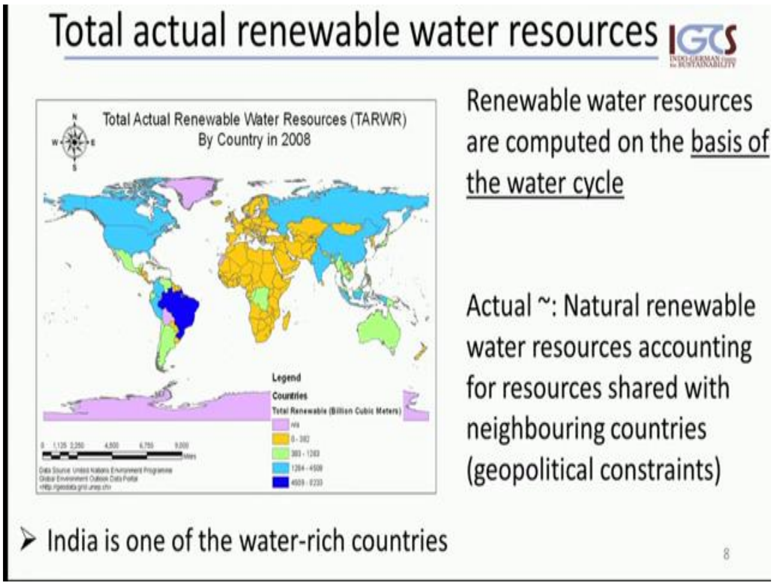

Now, let us look at one global example, which shows our total actual renewable water resources in 2008. And what we see here in the scale is often purple, more data and orange, low amounts of total actual renewable water resources to that blue, fairly high total actual renewable water resources.

Now, what we can see here is, that actually India is one of the water rich countries. If you only account for the total actual renewable water resources, it is one of the upper 10 so called water rich countries. So, keep in mind that those renewable water resource are computed on the basis of the water cycle and I cannot emphasize small strongly enough this is the basis base on water cycle.

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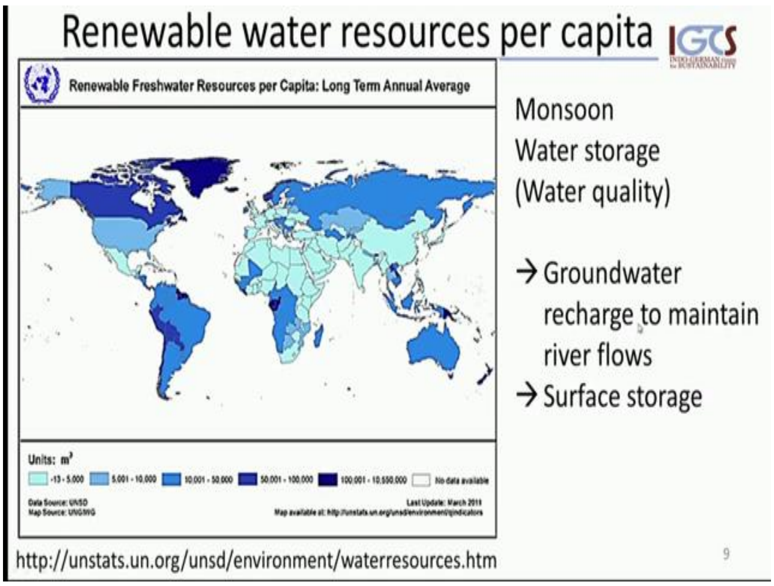

Now, this picture changes very much when we look at the renewable water resources per capita. And we have here the statistics provided from this UN data base, which I suggest you to check out yourself and also you make use of this for your own studies. What you can see here is, that the scale is from a light blue to dark blue, light blue very low, very low amount of renewable fresh water resource per capita and dark blue fairly high and we see, that India is very much on the lower end in this case. How is this possible?

Few rough explanations could be get you to the specific, very specific climatic conditions or monsoons. Some of the parts of the country receive only one monsoon, some others two monsoon periods and water storage and link to the water storage, water quality. So, if we have a very short, but intense rainfall season, not all of the water can essentially will be stored and remain available for later use in the country. So, what this also implies, that lots need to be done in groundwater recharge. Remember, that groundwater contributes to our runoff. It maintains river flows and to surface storages.

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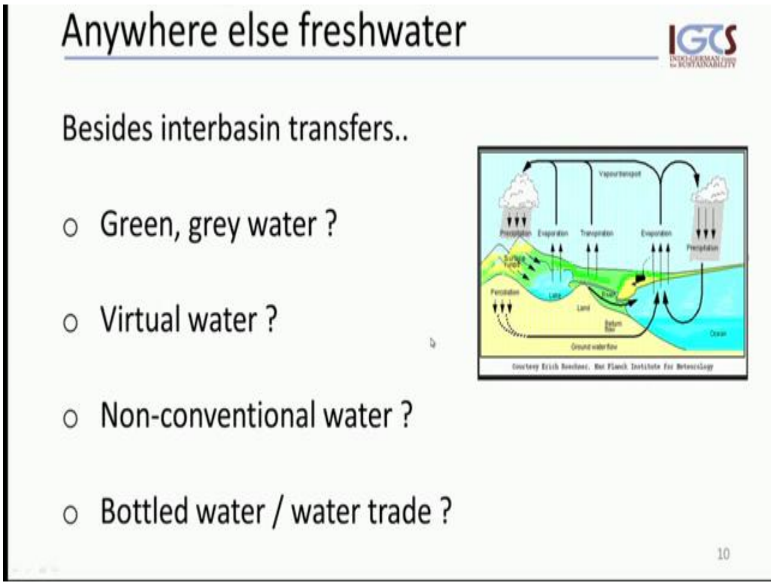

Now, we can ask ourselves, if we have what we have in terms of water renewable water fresh water resources. What else if this water is not available? Where can we find additional water? Is there a way to find the additional water? One solution could be inter-basin transfers. We may get water from transfer water, so pipes or canals from other water rich, water surplus region to user it in our basin.

But looking at the water cycle there might be also some additional sources and you may have about these concepts between water, the grey water, the virtual water. You may have heard about non-conventional water and also about bottled water, water mining, water trade. So, what about those thing is, this is really an additional fresh water source if we could build on.

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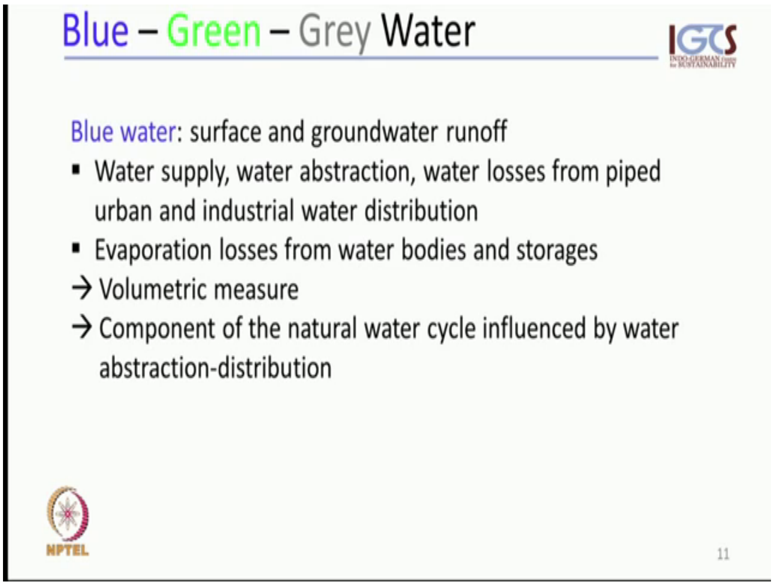

Let us look at blue, green and the grey water concepts. What do you mean by blue water is essentially, all the surface and groundwater runoff. You have seen this in our, in our water balance discussion. So, and where we can save water is and water supply in the way we conduct water abstraction to manage our water losses from pipe systems and from other water distributions systems and we may manage our evaporation losses from water bodies and storages. This is how we can measure and also influence our blue water.

So, this is a real field where we can do something. We can measure it volumetrically and it is part of the water cycle and influenced by, simply by water abstraction and distribution.

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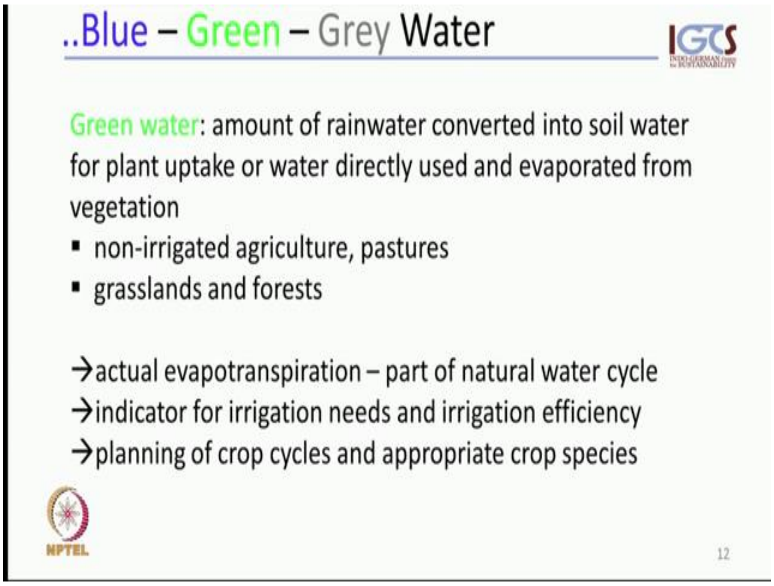

Now, looking at the green water component, what is meant by green water is the amount of rainwater that is converted into soil water for plant uptake or for water that is directly used and evaporated from the vegetation. So, you see, that this is not water that we can visibly catch or see. It is water, it is water that is bound in the soil and water that is taken into, built into vegetation, into plant material.

So, essentially, if we are talking about the water in non-irrigated agriculture in a pasture from a human perspective, in grasslands and forests from a general ecological respective. Now, this is translated into actual evapotranspiration and it is part of our natural water cycle. We can measure this although it is not routine measurement, however it simply indicates irrigation needs and also it is a measure of irrigation efficiency and it simply helps to plan crop cycles or appropriate the selection of appropriate crop species for a region.

So, we can influence that green water component is fair, but not in a way of obtaining fresh water for us for drinking water purposes, simply helping us to improve in agriculture.

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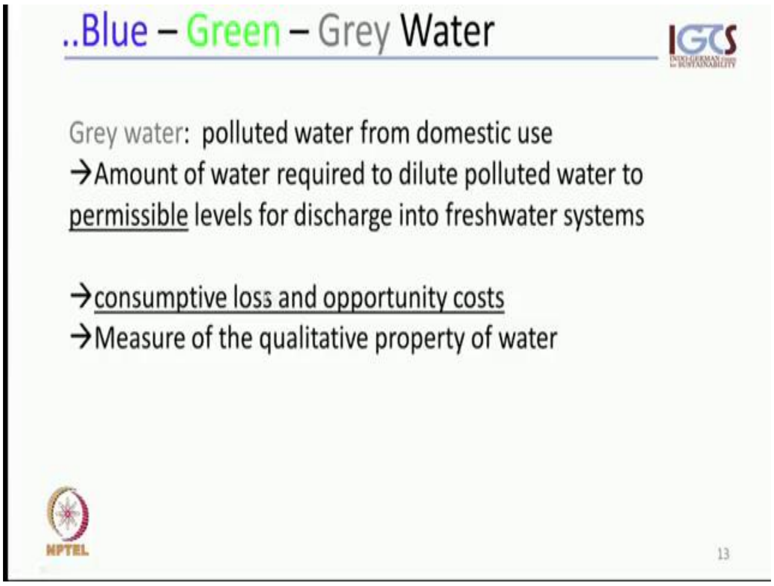

Let us look at the grey water component lastly and this is essentially polluted water. What is meant by, meant from this? It is polluted water from domestic use and we account for that in a form of the amount of water required to dilute polluted water to permissible levels for discharge in fresh water systems. So, what we mean by permissible is very, it is a very stretchable flexible term here, it depends on legislation, if there is any legislation in place, how it has been implemented. We will come back to this at a later stage, but what we see is, that it is a measure of qualitative properties of water.

So, we are not increasing the availability as such. We are just differentiating between qualitative properties and it can be coined into financial figure, into consumptive losses and into opportunity costs. We will come back to these concepts at a later stage. It is very important.

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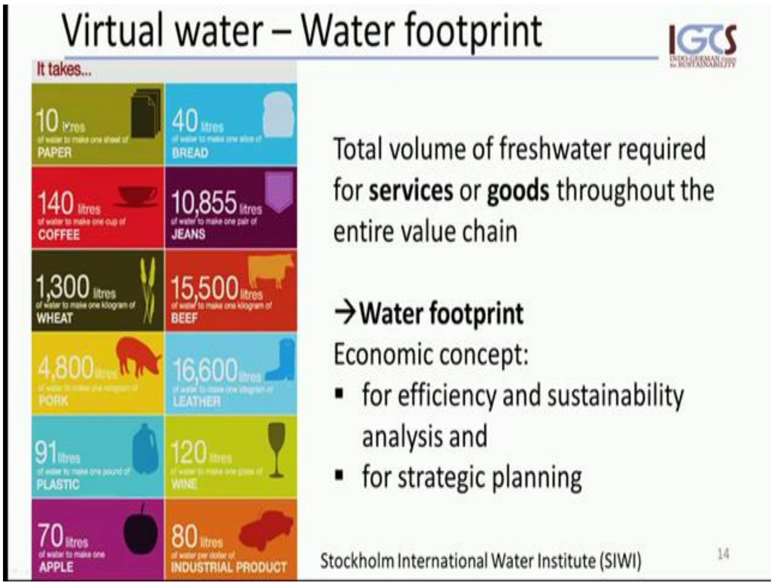

Now, what you may have heard about also is in what the question is, could be an additional water source is virtual water. And what we mean by virtual water is the entire volume of fresh water that is required for service or good throughout the entire value chain. This means, from production to processing, harvesting, processing, manufacturing, transportation, consumption and waste dispersive or reuse. This entire chain we are using water openly or less obvious and this can be accounted for and the concept for that is also called water footprint, but this is essentially an economic concept.

So, it gives us economic figures, which help us to improve our efficiency and contact the sustainability analysis and we can use this for strategic planning. So, this is not as such giving us additional amount of water that we will have instantly immediately available.

Now, this footprint just summarized in a, in a few examples. What this means is visualized here. This is a figure from Stockholm International Water Institute. You can check out more literature on their site. And what you can see, if you compare this with other sources we will see, that those figures were very, quite a bit and what you can also see is, that it is not very easy to compare one item with the other. So, once, in one cases, in some cases we speak here of liters that are used for number of one individual animal, at other time we speak of liters of wine to put use and the other time it is an individual bread or something else. So, the units wary very much and we are not readily able to compare one thing against another one.

But, this gives us an idea of sum of the amounts, but those large numbers can really not tell us that this is the problem compared to something else, where the number here is appearing small. So, keep this in mind when you read such information.

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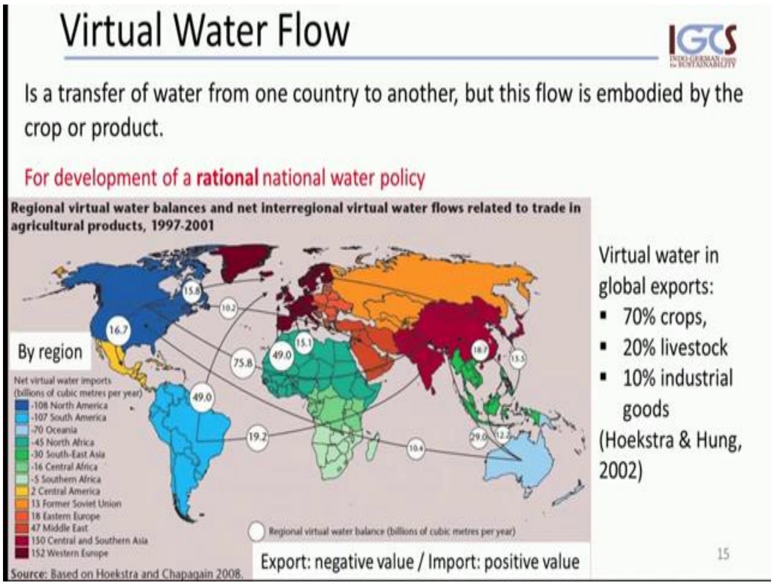

Now, what the virtual water flow concept can be applied in a, in a different way, which can be quite useful and I want to demonstrate it to you here when we apply this to a transfer of water from one country to another. This is again virtual water. So, water embodied in products and because most of our water is a virtual water, is incorporated in crops 70 percent globally, 20 percent in livestock and the rest in industrial goods, we will be looking at a figure showing us the regional virtual water balance by region for a corporate, for agriculture product trade.

And what we can see here is a scale from a positive blue, dark blue to a highly negative dark red, whereas blue, the blue positive means an export from this region to another region, whereas the red means an import of virtual water into that specific region. If we see, that the world essentially in, is divided into large regions, which export water, means virtual water, where lot of production, of agriculture production takes places and where this virtual water, water is moved from this region and exported and used in some other regions and some region import a lot of water in addition to their internal renewable available water.

Now, what is this useful for? Essentially, it is, it can help to develop a rational national water policy. Basically, as you want to put your water your available water resources into an agriculture product or you want to apply in based on other uses, which maybe need less of your country's available water resources.

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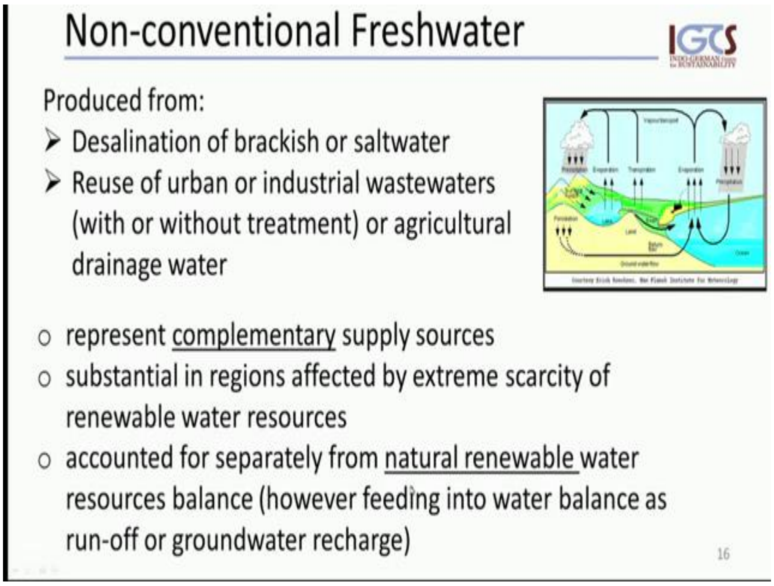

Now, let us look at the non-conventional fresh water I had listed before and look into this global water cycle again. What you mean by non-conventional fresh water is the water that comes out of desalination of saltwater. We are essentially tapping our oceans for that purpose and to reuse of urban and industrial waste waters. This could be treated or not treated and that includes agriculture drainage water wherever it is being collected.

Now, sinking of this, we have been looking at water balance or water budget always from a fresh water perspective, we have not really factored into our water budgets or water, local water balances, saline ocean water component. And there are reasons for that. So, this non-conventional freshwater is considered to be simply a complementary supply resource. So, it is a source in an emergency, it is a source of water that can ease an extreme situation.

But, it can, should not be considered as long to a freshwater source supply source, it has become very important in some regions, which are affected by extreme scarcity of renewable water resources. This non-conventional freshwater has to be accounted for separately from our natural renewable water resource balance, from our freshwater cycle although it eventually will be a feeding back into our freshwater cycle in the form of waste water. It will generate run-off and it will potentially recharge our groundwater.

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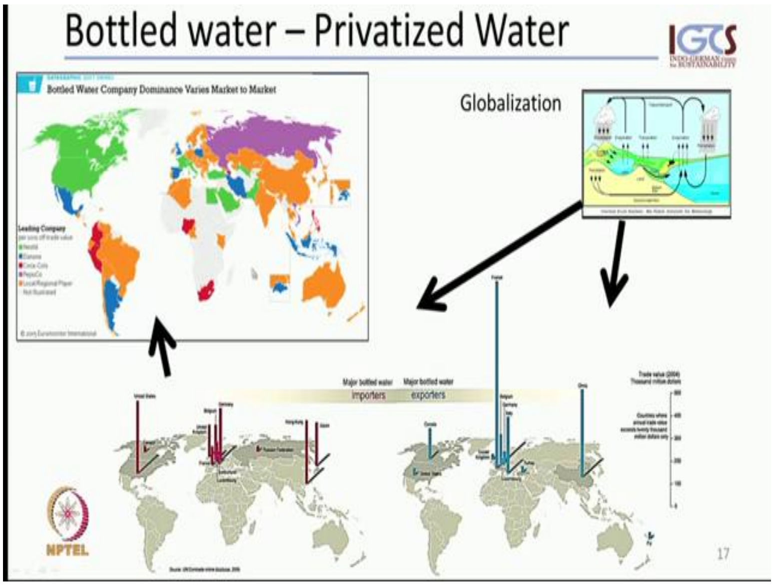

And finally, let us reflect upon bottled water and I am putting next to this term bottled water, the privatized water. So, bottled water means, that it is water put into a container and sold as such as a, as a good through private enterprises, private operators.

So, we remove our water from our water cycle by putting it to, by packaging it that becomes a privatized becomes an economic good. Now, what this means in a globalized world is that we can take water from anywhere, any point on our glob and package it here, transport it and send it somewhere else where people will consume it.

And this is being reflected in this map here, which shows our water bottling exporters or exporting countries and there are very few countries dominating this export market of bottled water although some of the data may not be complete. And then, we obviously will have importing countries where this bottled water, bottled water containers will be sold again. And again, there are only few countries where, which consume those bottles and you can see, that some of the large exporters here, not essentially be the importers of it, some even import other water from other regions. So, it becomes, it shows, that water availability will be reduced in those areas, transferring water from one part of the world to another part.

So, the bottling mechanism and privatized mechanism of it, so it disturbs our freshwater budgeting, but also disturbs our water tight spaces in many cases and our water accounting in general. So, this is very critical and something that is very much on the rise and needs a lot of attention. Once we have those importing and exporting mechanism in place for global, at the global scale, then we can see the number, just a very few number of bottling companies which dominate this market, this business.

And what you can see is, that essentially, again over world has been divided into some domains where these large corporates operate very much independent of any water catchment, any water balances or any freshwater availability or country, water necessaries or priorities. So, this is very critical and we should keep this in mind when we talk about sustainable water management in the next.

And thank you for your attention and I see you next time again.