Sustainable River Basin Management

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Module – 05

Lecture - 37

Part 2

Welcome everybody to sustainable river basin management; module 5, part 2.

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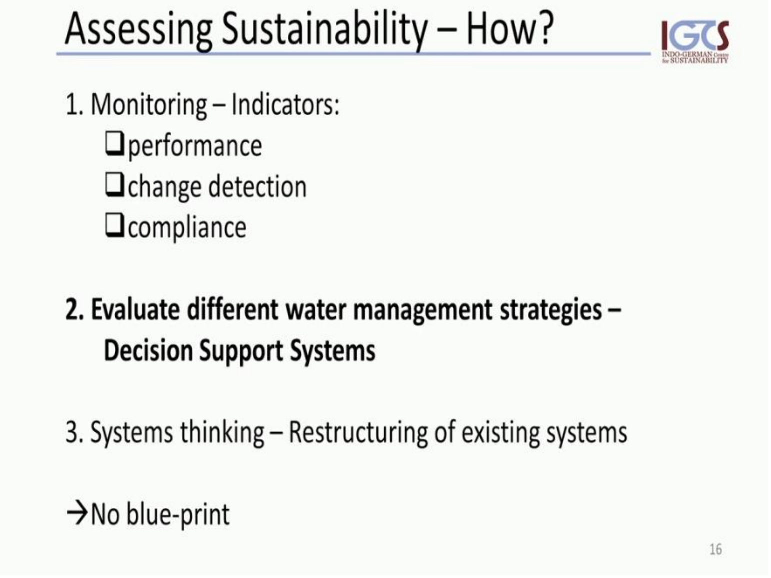

We have been asking the question of how we can assess sustainability, and I want to present to you this time, something about decision support systems.

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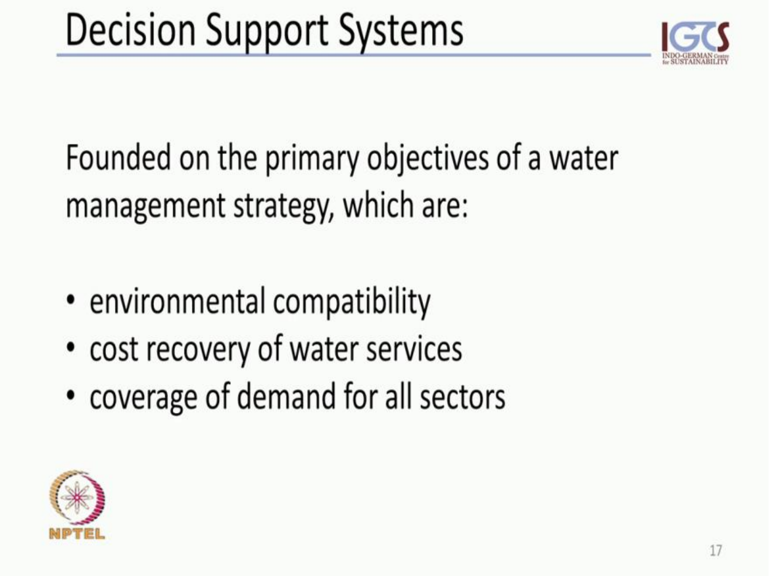

Now, decision support systems are founded on the primary objectives of the overall water management strategy, and those entails the environmental compatibility, the cost recovery of water services and the coverage of demand for all sectors.

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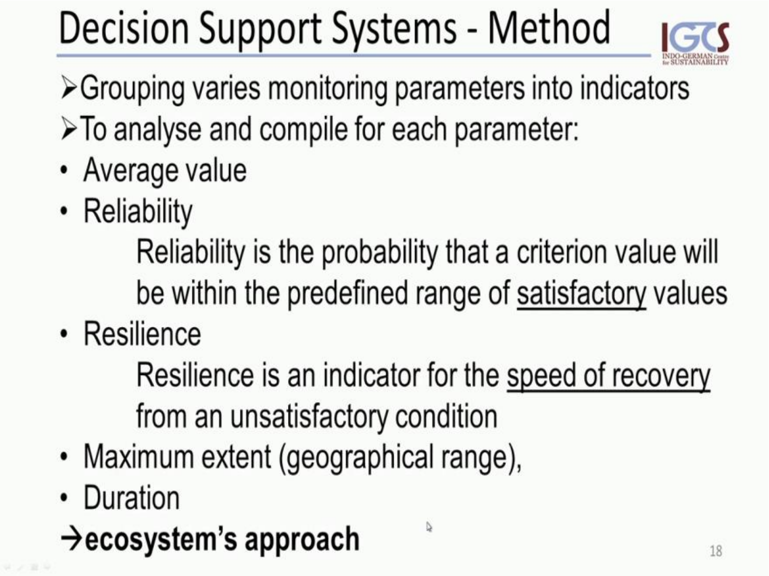

Now, let us look into the methods of decision support systems. It starts or departs from grouping various monitoring parameters into indicators, but in a slightly different way. So, still requires a monitoring system in place; the monitoring of predefined parameters, which are relevant. Those are analyzed and compiled in our each parameter in the following way. We want to know the average value of each of these parameters. You need to know the reliability of each parameter. Reliability would be the probability that a criterion value will be within the predefined range of satisfactory values. This satisfactory here, has to be defined.

It has to be defined within a frame of ecological aspects, ecological functions, also in a frame of cost analysis, in the frame of valuing certain values again, and very much depend on our knowledge also. Then we have to analyze each of these parameters, against its very own resilience. The resilience is an indicator for the speed of recovery from an unsatisfactory condition; that means, we need to understand how these parameters actually, work under different impact conditions and we need to be able to identify what is satisfactory and what is unsatisfactory; when do we have ,when or within a limit or in a range, that is acceptable and when are we actually, moving out of that range and reaching a tipping point, where may be, resilience will be used up and even no recovery, may be possible.

Then one has to analyze again, the maximum extent in terms of geographical range and the duration. It essentially, is weight building on an ecosystems approach and requires substantial knowledge of how parameters interact; is it rather and very often, we do not actually, have all these information available in complex systems. That is the basic concept of such decision support systems towards sustainability and assessments.

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Decision Support Systems - Indicators

Dimension	Basic Indicator
Environment Resources	Dependence on Inter-basin water transfer
	Desalination and reuse percentage
	Groundwater exploitation index
	Non-sustainable water production index
Efficiency	Demand coverage-Animal breeding
	Demand coverage-Domestic demand
	Demand coverage-Environmental demand
	Demand coverage-Hydropower demand
	Demand coverage-Industrial demand
	Demand coverage-Irrigation demand
Economics	Rate of cost recovery

Now, this is showing you an example metrics of a decision support systems; indicator based. We have basic indicators here. We have the dimensions, environment resources the efficiency and economics and then, we have here, indicators which can be determined, either by calculating straight away from data, expressing this in a percentage or by forming out of another subset of parameters and index, something like this; ground water exploitation index or the non sustainable water production index. This already includes a larger amount of parameters and data, which were combined to this non sustainable water production index.

The dependence on inter basin, water transfer for instance, is not a parameter in itself; it is again, it is a composition of various parameters, which then takes us to a definition of dependence on inter basin water transfer. Then on the other hand, we have here, precise values that can be measured and reported like the rate of cost recovery or the demand coverage versus the irrigation demand; those are measurable parameters again. So, this shows us that this is again, very complex and can easily become much more complex and in transparent or difficult to understand individually; may be quite differing between different applications, different river basins, different countries.

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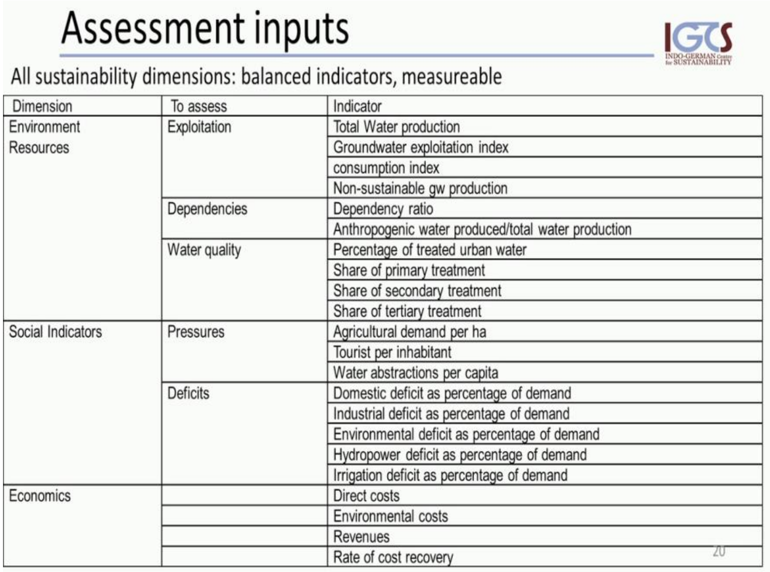
Assessment inputs

All sustainability dimensions: balanced indicators, measureable

Dimension	To assess	Indicator
Environment Resources	Exploitation	Total Water production
		Groundwater exploitation index
		consumption index
		Non-sustainable gw production
	Dependencies	Dependency ratio
		Anthropogenic water produced/total water production
	Water quality	Percentage of treated urban water
		Share of primary treatment
		Share of secondary treatment
		Share of tertiary treatment
Social Indicators	Pressures	Agricultural demand per ha
		Tourist per inhabitant
		Water abstractions per capita
	Deficits	Domestic deficit as percentage of demand
		Industrial deficit as percentage of demand
		Environmental deficit as percentage of demand
		Hydropower deficit as percentage of demand
		Irrigation deficit as percentage of demand
Economics		Direct costs
		Environmental costs
		Revenues
		Rate of cost recovery

The assessment inputs, as an example, including all of the sustainability dimensions and providing balanced indicators, etc. are some measurable. In this example list, we have the environment resource, social indicators, economics; those are assessed to, versus exploitation, dependencies, the water quality, pressures, and deficits and then, we have various parameters, which we can measure. We can obtain from our databases, the social databases, the environmental indirectly, we can obtain environmental resources, dimensions and the economical dimensions and social dimensions from, direct from our existing databases. So, this is an example, where we have on the input side, a quite balanced selection of parameters, which then can give us a balanced or more straight forward assessment result on this side, and the comparison between probably, different years and different regions also.

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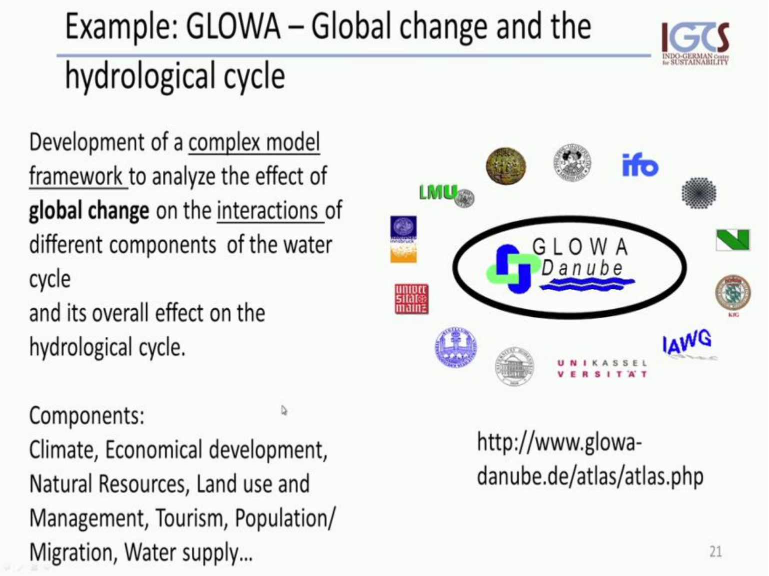

Just to move into very specific example here; this is the GLOWA project, which means Global Change and the hydrological cycle. This is a major undertaking by various institutions, because Europe works together; various institutions from universities to research centers to state actors; this is dealing with. This is an example of the decision support system for the Danube River. Danube River is the major river, catchment river basin in Western Europe.

It was, the objective of this undertaking, was to develop a complex model framework to analyze the effect of global change on the interactions of the different components of the water cycle and the overall effect on the hydrological cycle; one big in this specific case of, example case of the Danube river. The components which were included into this complex model framework, included climate, economical development, natural resources, land use, land use management, tourism, population numbers, population migration, water supply and many others. So, it is indeed a very complex and cost cutting framework and requiring a huge number of background data.

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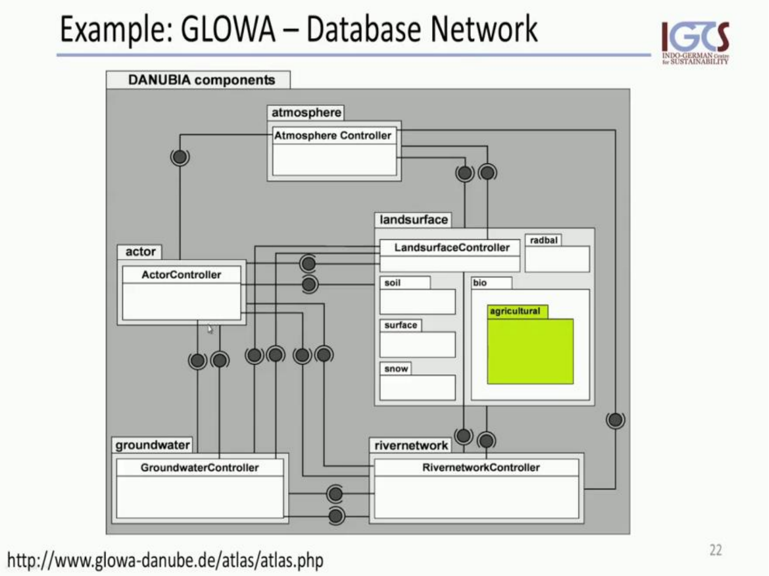

So, the database network of this system looks in a generic way like this. We have the actor or the controller; this could be a politician; it could be also a water, a river basin organization sitting here, accessing this information and inputting information into it or taking actions in the way of allocating water or suggesting the construction of a new water treatment facility for instance, or suggesting certain water priority projects in a region or the turndown of certain industries, because they would have or they do have a very negative impact on water and land in this Danube region.

Then we have the link to the different compartments; the atmosphere and the natural components of damage control; what happens in our atmosphere is one of the water cycle compartments. We have our terrestrial component, dealing with the land surface, all of the different aspects influencing land surface; that could be soil; it could be terrain topography; it could be snow cover; the biosphere; our base land uses specifically, agriculture and so on. So, this is our surface system, including the different spheres; hydrosphere, biosphere, land surface and then, we have separated, single that out from the land surface, the hydrological component, the river metrics, the lake systems as influencing what is possible and what is happening on our land surface; what are the options and then, singled out again, our ground water subsurface water component or ground water, connected directly to our river systems, but treated as a separate subsystems component. So, we have the different hubs here, and the linkages between those; the different compartments and different human actors in this.

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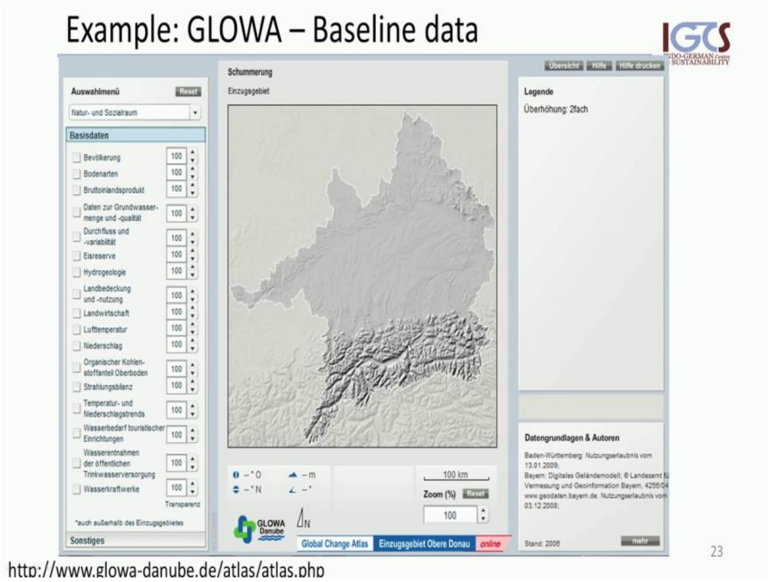

Now, this requires a lot of baseline data as you can imagine when you want to cover all these different themes or topics that I listed before, and this is just to show you an insight. You can go online yourself and go through this database on your own. Take time, because it is very detailed and very (refer Time: 13:47), where I just want to provide a clue. This is the catchment here, and this shows just the topography. Then you have various possibilities to visualize base components from population to soil, to GDP, ground water quality.

Just take these example; hydro geology, land cover and so on, the different water sectors, climate data, solar radiation, organic carbon in soils and so on. So, all these can be visualized here, and it can also be combined and visualized in a combined manner, where we can already not only visualize in a one to one way, our baseline data, but by combining various different sets; we can intersect them and create information from that, which helps us to already take decisions. So, this is indeed a kind of decision support system, which help somebody, who would come from a water background to put together information from the economic sectors, from the social sectors and obtain additional new information to take on decisions.

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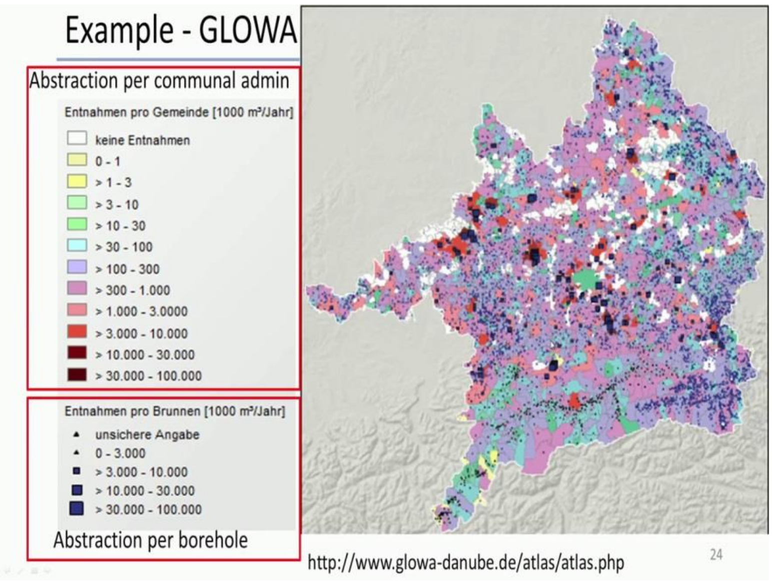

Another example of this that shows us the level of detail here; we have here the patches of showing us the abstraction per communal administration. This means that an individual village or a small town or city council can use that database and see, and zoom into his or her specific jurisdiction, and obtain information such as the abstraction, in and around that community area, that administrative area. So, this is extremely detailed at a very detailed level that indeed can help; not just to visualize something, but to take decisions on a local scale.

We have in addition here, combined with this, the abstraction per bore well; bore well for water drinking water supply or irrigation. Again, we have here, the different classifications of how much has been abstracted per year in cubic meter, and we can see some of the areas, where there is a lot of abstraction taking place; some regions and somewhere, we have less or even white blank areas here, is not there is no information, but in this case, this means white area; there is no abstraction taking place. So, we have areas, where for some reason, there is no abstraction; could be a protected area; it could be that those areas are served by some other regions.

There are pipeline systems, distribution systems serving those areas. So, there are probably, various reason for why there is no abstraction taking place in those specific areas here. So, important here to take home is really, the level of detail. So, it is not a nice picture or yet another map; it is indeed something that takes us down to individual villages, individual communities and become very useful not just for water manager at river basin scale, but to the individual administrative, small administrative level here.

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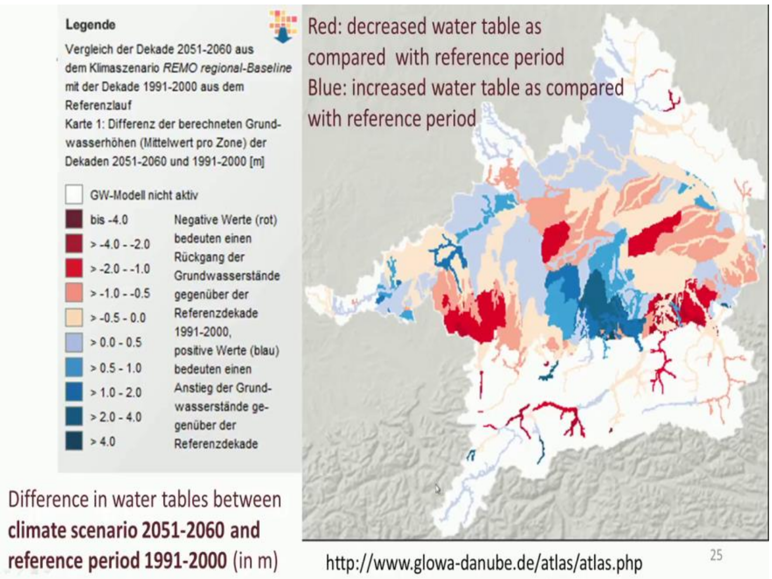

Now, another example, which lets, we had another dimension that we were missing in the previous examples that I showed to you on monitoring and assessing indicators. Here, this shows us the catchment again, and the differences in water tables between the climate scenario of 2051 to 2060; a ten year period and a reference period, where they are monitoring data available from 1991 to 2000, and the change in meter. In this case, the red part here; all the red boxes indicate a decrease in water table, compared to the reference period.

The blue suggests an increase in water table, compared to all the reference period. This is now, very interesting to see how these different stretches of the river, where we do not have an area of coverage; we have stretches of the river or the river systems, where we can see how the water tables will be negatively impacted other parts, where the water table will see a positive impact. Then we have area coverage for some of those, where we see in larger parts, affecting sub catchments or watersheds and this negative impact, large decrease, and a very large decrease in the water table. Then we have other watersheds here, where we would expect an increase in water table. So, there might be different reasons for this to happen and it is in all of the cases that you can see here; you can get additional background reports to it.

We do not have only the maps, where you can click and add, or visualize additional baseline data, but you can also click through the system and obtain additional reports that were produced for each of these maps. So, the map is just an interface, which gives us sort of an output, a final product, but still as a user, we have access also to the more detailed scientific background link to it. In this specific case, the white areas are areas, where this ground water model was not active and for that reason, this calculation could not be done.

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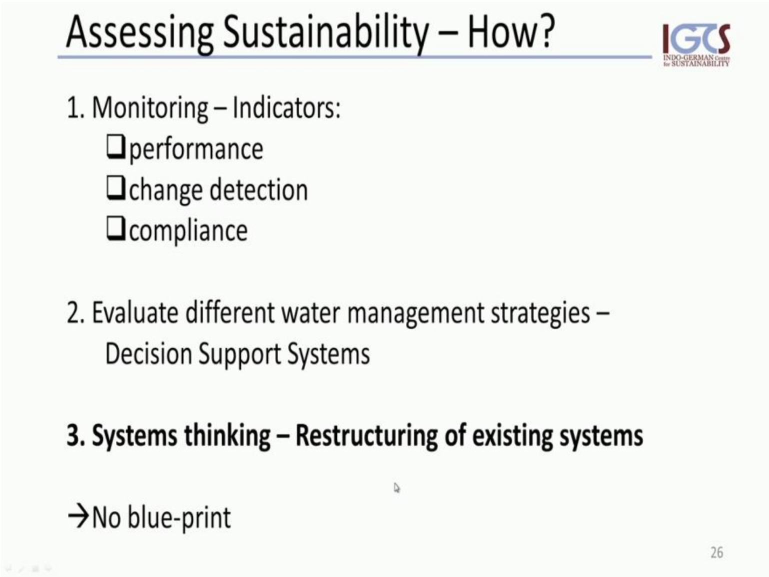

Now, let us move to the third part of our options of assessing sustainability; the systems thinking, which leads us to the restructuring of existing systems.

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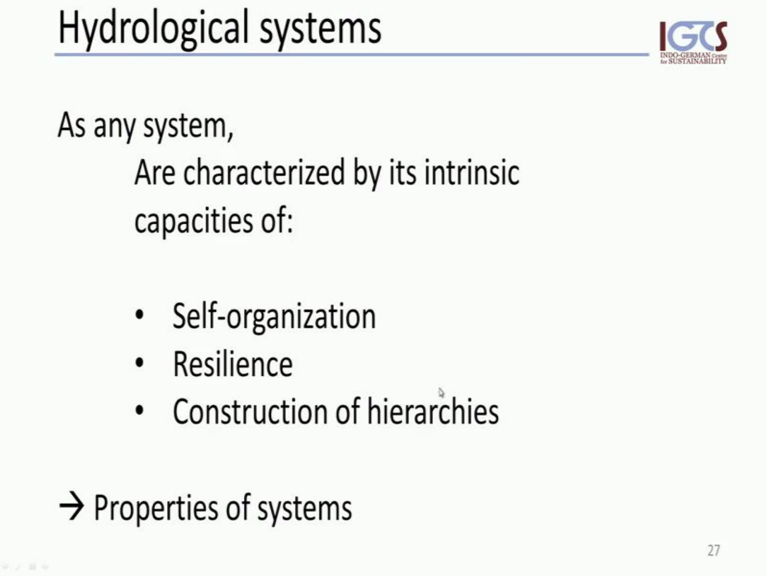

Let us think of the hydrological systems. As any other systems, the hydrological systems are characterized by an intrinsic capacity of self-organization, of resilience and of construction of hierarchies. Those are typical properties of a system and if you break apart of a system away, it is capable of restructuring itself and being able to recover or to work on, and function as a system fully, with all of the capabilities. Then we have a system only if there are hierarchies in place.

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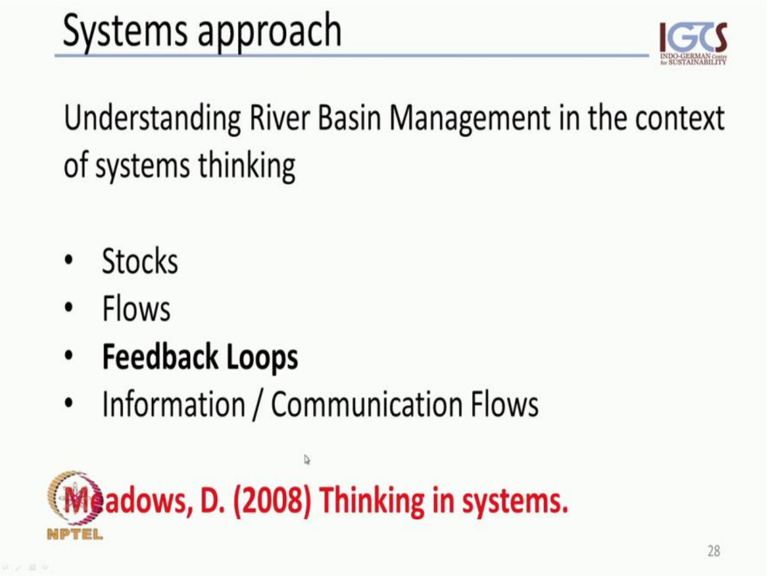

Now, the systems approach is important, because we can understand river basin management better when we use that frame. So, remember what we talked about earlier when I introduced this concept to you that systems components or stocks flows, feedback loops and information communication flows. We talked about these stocks and flows earlier. What I want to focus on now, as a slightly different; I want to focus on feedback loops and attached to the feedback loops on traps. I recommend you very warmly, to get a hold of this book here, written by Meadows; Thinking in systems. It is very helpful to understand systems functioning and also, very useful to help rethinking how river basin management can be done. With this, I want to leave you now, and come into the systems thinking in more detail next time.