United Nations Sustainable Development Goals (UN SDGs)
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Lecture 14
SDG 14: Life Below Water Part 1

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Hello, everyone. Welcome to Module 22 in the course of UN SDGs. Well, we are going to discuss SDG 14, that is Life Below Water.

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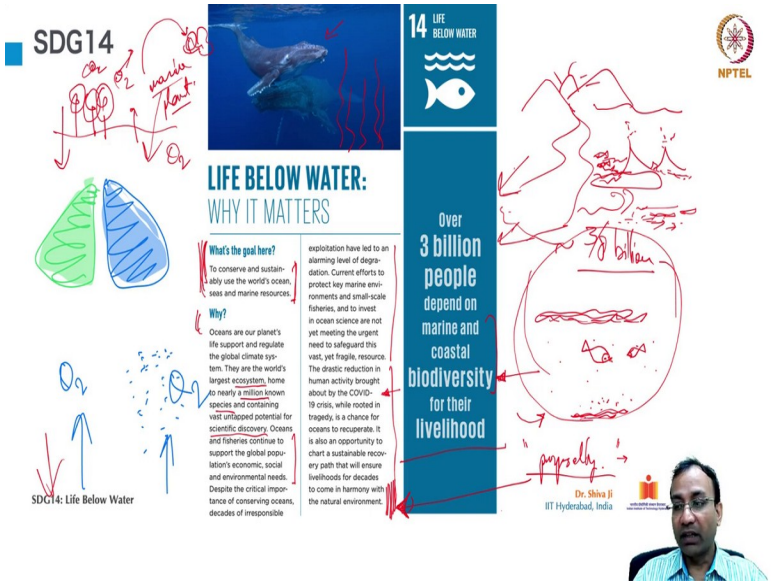

So, well one, before I begin, one interesting fact I would to inform you guys, you may be knowing it already, well, the world has, the Earth has 2 lungs, the 1 lung we are all aware of, trees, forests and the green surface, and all the vegetation which releases O2, which absorbs CO2 and supplies oxygen to our atmosphere, our environment. There is a second lung also, and almost 50-50 percent, they contribute this oxygen to our planet.

That is marine plants. So, inside the ocean, under water, there are several plants and creepers and algae and many such vegetation which flourishes underwater. That also supplies O2 to our planet. So, there are 2 major lungs, you always remember. So, it is not that oceans are not any useful or they are just reservoir of this saline water which we cannot use and all that.

That saline water actually, with the, it becomes vapor and comes to us as cloud and it rains in our place, plus it supplies oxygen, plus it harbors more number of aquatic animals from microbial to the greatest, this blue whale what you are seeing here in this picture, the largest mammal on the planet. So, all of this is possible only inside the oceans, under the water surface, which we usually do not see.

Since we are living on then, surface, we are animals which are we cannot live under water. Well, we can go dive and then again we have to come back. We are not the permanent inhabitants of underwater world. So, we are not so much aware of it plus it is

not as clear as sky on top of us that any time you want you can see what is there, any bird or anything.

So, oceans are in a little, kind of, I do not know off-site, environment off-site world which harbors equal number of species, living species, and a lot of minerals and resources, everything. So, there is too much of information we know and there is a lot yet to be known about our oceans.

But from SDG perspective why we are discussing because that world also is equally important for the planet, for the survival of our planet and its ecological balance. So, one fact over 3 billion people depend on marine and coastal biodiversity for their livelihood. So, we were just discussing about water and marine animals, but even if we do not live underwater, but we depend on it.

You see this fact. Out of 8 billions, 3 billion people, lump sum, depend on oceans for their livelihood. And in that too, very importantly point is put up over here, the biodiversity, the coastal biodiversity, marine and coastal biodiversity. So, what it means, we will discuss in subsequent lectures.

So, why we are discussing, why do we need it, what is the goal with this SDG? To conserve and sustainably use the world's ocean, seas and marine resources. So, that we are not end up destroying in the previous modules. We saw how plastic, rather waste is eventually landing inside the oceans, in the oceans, and it is floating here and there, it is going getting deposited at the bottom of the sea floor, micro plastics, microfibers, they are also kind of getting littered everywhere.

Marine animals are feeding on them. They are ingesting it and in turn, they are getting impacted because of that. And in many cases, it is found now that it is entering into the food chain and it is coming even to the humans, since fish is one of the most consumed items. So, if you see, what we are disturbing, how we are disturbing it, it is coming back to us. So, in a way if you see, it is a cycle. What we are throwing is coming back to us in some way.

So, we need to take care of each and every resource including oceans. That is why we are discussing over here. And not just oceans, any water body, whether it is a river, whether it is a lake somewhere, or maybe finally if it is the oceans. They are all very much important, even underground, aquifers. In yesterday's, the previous lecture, we saw how the rising sea levels are going to contaminate the inland aquifers and kind of make them saline, unusable.

So, we need to keep all of these balances in check so that it does not comes back to us and haunt us. So, let us see why do we need it. Oceans are our planet's life support and regulate the global climate system. They are the world's largest ecosystem, home to nearly a million known species and containing vast untapped potential for scientific discovery.

As I said, we do not know everything about our oceans. There is a lot yet to be discovered, yet to be seen. Even in terms of it possibilities where we can exploit it for our use, that resource consumption I am talking about, but if not resource, just to know it as a part of our world, what it is, just simple curiosity to know things, our nature itself.

So, even from that perspective, what kind of species are there, how many are there, how is their life system, how they are surviving in such, we feel that is, as if it is an odd kind of an environment to live in, but even at the bottom of ocean floor which may be thousands of feet below, thousands of meters below, there is flourishing life and other local life forms.

Even in inside the oceans there are volcanic instances, volcanoes actually erupt even inside these things, and there is a huge deposits and emissions of sulfur and other obnoxious compounds. Even in these in a inhospitable environments, with so much of heat and pressure, there are marine life forms which are surviving. So, is it a very unique place from the perspective of knowing it out. So, how, in what kind of conditions life is possible, I think oceans give us a lot of clues to for our understanding.

Oceans and fisheries continue to support the global populations, economic, social and environmental needs. So, from different countries, our societies are dependent on seafood, fisheries, if you see. And majorly, that comes from rivers, lakes and oceans.

Despite the critical importance of conserving oceans, decades of irresponsible exploitation have led to an alarming level of degradation.

Current efforts to protect key marine environments and small scale fisheries and to invest in ocean science are most yet meeting the urgent need to safeguard this vast yet fragile resource. The drastic reduction in human activity brought about the COVID-19 crisis while rooted in tragedy is a chance for oceans to recuperate. It also, it is also an opportunity to chart a sustainable recovery path that will ensure livelihoods for decades to come in harmony with the natural environment.

So, if you see, well COVID-19 was definitely an unfortunate incident in the human history but since a majority of the human activities came to a halt, a sudden halt , nature got a nice break, you can see, you can say, to recuperate, to heal itself kind of. So, human activity kind of stopped for a while in oceans also, and that gave a small brief time for oceans to recover from the constant exploitation and exertions that human society actually puts it in.

But that was a short life thing, again we are back to the normal, and again, regular exploitation has started everywhere. But it is important to witness that that brief moment and actually gave us a clue that nature's own healing capacity actually works and given a chance, it can heal itself. It can go back to its original natural state of affairs, state of conditions. So, why not give this chance purposefully?

Because we also want our natural elements and systems to work stable, to be in at, run at a comfortable pace and their own natural pace and all. So, why not do this purposefully, to allow them a breathing space, allow them a recovery phase so that they can heal on their own. So, yeah, that is the point of discussion over here.

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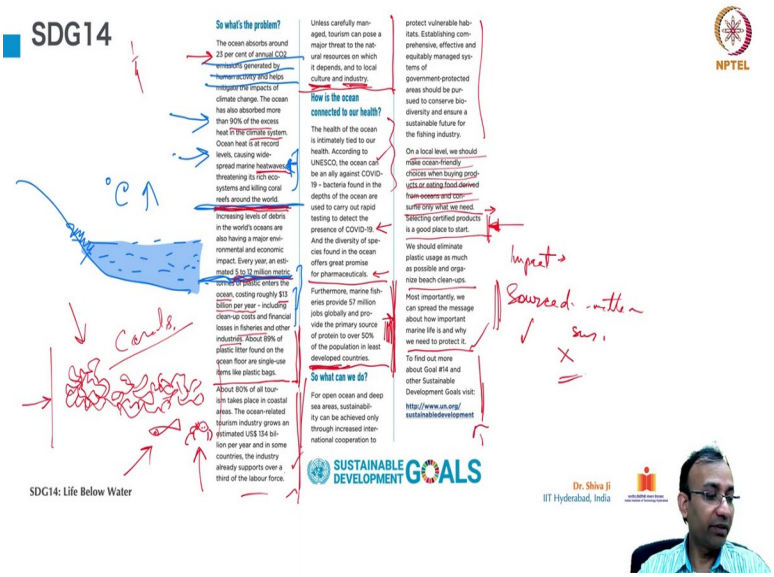

So, what is the problem in this whole thing, if you see. The ocean absorbs around 23 percent of annual CO2 emissions generated by human activity. So, close to a quarter. And helps mitigate the impacts of climate change. The ocean has also absorbed more than 90 percent of the excess heat in the climate systems. So, you see not just the things what we discussed, oceans are actually heat absorbers also.

So, you can see it has a oceans are the cushions, they are the buffer zones which are allowing our atmosphere to not get heated so much. But yeah, if they are getting heated, again, there may be some problem arising in oceans itself, it is not that they will not change after so much of heat absorption. If it is going to happen in an excessive rate, definitely there may be some issues.

You may be knowing, if the rising temperatures, it might prove uncomfortable to the creatures over there or maybe other things, maybe rise in the, I do not know, salinity or anything else. So, all of those things, ocean heat is at record levels causing widespread marine heat waves. So, you see this. Threatening its rich ecosystems and killing coral reef around the world.

So, one of the major impacts of this is the loss of coral reefs. Corals, you may be aware of, these are organic living beings which usually occur in the ocean sea beds. And they actually form a huge colonies, if you Google. So, you will see the largest coral reef exists

in the Great Barrier Reef of Australia, I think next to the Australian coast. And there are several other reefs present around the world.

They harbor a huge number of other living beings including fish and crabs and all of those things. There are several thousands and millions of species actually thrive in the vicinity of these corals. If you search the videos on YouTube on NGC and Discovery or other channels, you will see very interesting living places. Sometimes when we go scuba diving and underwater swimming and all, who would not nice clean environment with a lot of species floating and roaming around.

But this rise in temperatures is putting a threat to this whole coral reefs. And if coral reefs are gone, if they are damaged, if they go dead, all of those other supporting life forms, they are also going to simply die. So, this will be a huge disaster which we will be, not be witnessing directly because it is living under water, but yes occasionally, if you visit some places so you can still notice the changes which have occurred in the last few decades and half a century.

So, such, actually studies and case studies actually inform us about this devastation which is taking place because of the human activity. Increasing levels of debris in the world's ocean are also having a major environmental and economic impact. Every year, an estimated 5 to 12 million metric tons of plastic enter the ocean. You see this number, 5 to 12 million metric tons, costing roughly 13 billion US dollars per year including cleanup costs and financial losses in fisheries and other industries.

About 89 percent of plastic litter found on the ocean floor are single-use items plastic bags. You see why single-use plastics are getting discouraged from usage is for these reasons, because they are actually uses, period, time, is very short but they remain in the ecosystem for a long, long time, in some cases hundreds of years, in some cases thousands of years also.

Well, that is definitely not what we desire because if it gets deposited at such a rate, soon all of these oceans and water bodies, rivers, lakes, they are going to get filled up with all of these waste, and subsequently, the marine life existence is also threatened. They will also end up dying. So, such a catastrophic situation.

About 80 percent of all tourism takes place in coastal areas. The ocean related tourism industry grows at an estimated 134 billion US dollars per year and in some countries, the industry already supports over a third of the labor force. Unless carefully managed, tourism can pose a major threat to the natural resources on which it depends, and to local culture and industry.

So, well tourism is nice, going places and seeing them, but now in the later years, it has become an industry in itself, and with the over activity of tourism, there is an impact directly coming from this industry on the natural resources, on the natural elements. Like, beaches, if you go, they are overcrowded, they are always in pressure. If you go to any other place in mountains, now those places are also very much under pressure and those kind of situations.

So, well definitely that is not what we desire. So, that is the thing. Unless carefully manage, tourism can pose a major threat to natural resources. So, it is posing a threat to the natural resources and now it is threatening the ecological whole imbalance. So, that is not something what anyone would desire because if that ecosystem actually breaks, the tourism itself is going to get kind of destroyed, the whole thing from that place.

Plus that decision is going to hinder build the culture of that local place and the whole industry, which are, other supporting industries which are dependent on that. How is the ocean connected to our health? The health of the ocean is intimately tied to our health. According to UNESCO, the ocean can be an ally against COVID-19 bacteria found in the depths of the ocean are used to carry out rapid testing to detect the presence of COVID-19. And the diversity of a species found in the ocean offers great promise for pharmaceuticals.

Several applications, if you see even in pharmaceuticals, even for taking clues for the COVID-19 and other such pandemic or disease or viruses and bacteria which might come and haunt our human society, so UNESCO has been conducting such analysis and their results is in front of us. Furthermore, marine fisheries provide 57 million jobs globally, and provides the primary source of protein for O2, over 50 percent of population in least developed countries.

So, if you see even for the well-being of the human society and feeding them, a huge percentage of people depend on fish related items. So, you see primary source of protein to over 50 of the populations. So, more than half of the population from low developed countries, because this is where, this is the place where there is a scarcity, there is the more need of resources, even food, the most basic requirement, most basic need of anyone.

So, there also, more than 50 people depend on ocean related seafood items for their protein and other requirements. So, it is such an important source. If that source actually gets threatened, directly that section of society actually gets threatened. Well, what can be done? For open ocean and deep sea areas, sustainability can be achieved only through increased international cooperation to protect vulnerable habitats.

Establishing comprehensive, effective and equitably managed systems of government protected areas should be pursued to conserve biodiversity and ensure a sustainable future for fishing industry. On a local level, we should make ocean-friendly choices when buying products or eating food derived from oceans and consume only what we need. One should not go for over consumerism, and one should actually care for what they are eating and from which source this has been procured and received. Selecting certified products is a good place to start.

So, responsible consumerism is an important factor over here. So, not just because of their impact on environment and other things, how it is sourced is also an equal matter of concern from sustainability point of view. So, managed sea resource is, definitely should be promoted compared to a non-managed one.

So, one should be very selective and choosy while buying the product, whether it is coming from a managed resource, in a responsible way or is it sourced from somewhere in an irresponsible way. We should eliminate plastic usage as much as possible and organize beach cleanups. Most importantly, we can spread the message about how important marine life is and why we need to protect it. More details can refer here.

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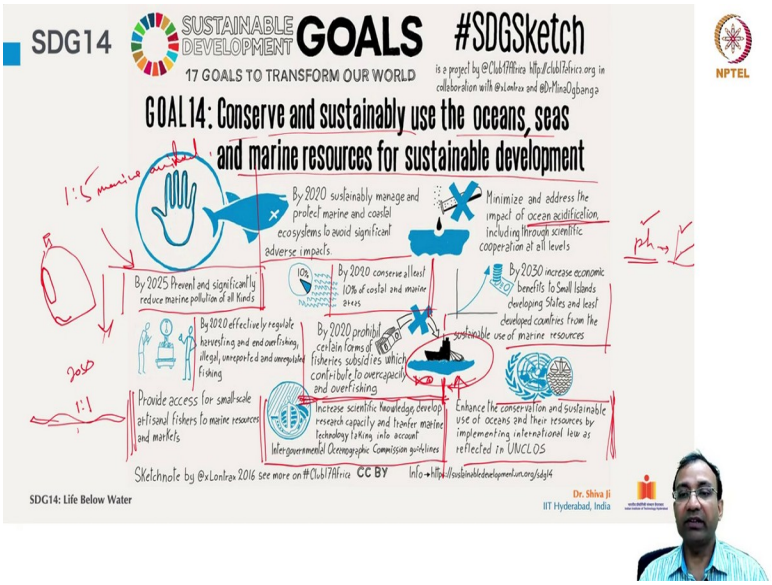

So, let us see some goals. So, conserve and sustainably use the oceans seas and marine resources for sustainable development. By 2020, sustainably managed and, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts. By 2025, prevent and significantly reduce marine pollution of all kinds.

So, we saw as per some studies, just few years back a number of plastic items thrown in the oceans is in the ratio of 1 to 5 marine animal, marine life, which is increasing very fast and it is estimated that by 2050 that percentage is going to be 1 is to 1. So much of pollution in volumes it is reaching to the ocean. So, that needs to be checked at all cost, and that is what precisely this target actually talks about.

By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing, provide access for small scale artisanal fissures to marine resources and markets. By 2020, conserve at least 10 percent of coastal and marine areas, conservation. By 2020, prohibit certain forms of fisheries subsidies which contribute to over capacity and overfishing.

So, the rate at which these resources can actually come, the fish, fish, it is kind of a giving birth to the new generation then again new generation, then again new generation. So, if you kill all of them, what is going to, well, how is the new generation going to come up. One of the major question of about overfishing.

So, if you do not allow fresh to remain there and grow naturally, the whole place is going to get exhausted of that species, particular species. And that again will pose a problem, not just there will be scarcity of the original resource, but what happens to the ecosystem of that place which is underwater. If there is no fish, all other life forms which are not a part of their internal food chain will also get destroyed.

Increased scientific knowledge, develop research capacity and transfer marine technology taking into account intergovernmental oceanographic commission guidelines. So, help each other, share these technologies and let everyone be part of such exercises. Minimize and address the impact of ocean acidification, including through scientific cooperation, at all levels.

So, this is also one of the major challenges which is threatening all the species because the pH level at which saline water actually has remained for such a long time is now gradually changing. So, that change is definitely going to hinder with the life forms because they are accustomed to this pH, and if it is changing they may or may not able to be cope-up so fast, such a fast change. So, this may actually prove fatal to the entire species.

By 2030, increase economic benefits to small islands, developing states and least developed countries from the sustainable use of marine resources. Lastly, enhance the conservation and sustainable use of oceans and their resources by implementing international laws as related, as reflected in UN clause.

So, there are frameworks and mechanisms in place so that these conservation efforts and other sustainable practices and implementation policies et cetera can be actually driven down that frameworks. So, these should be followed by more and more countries and member states.

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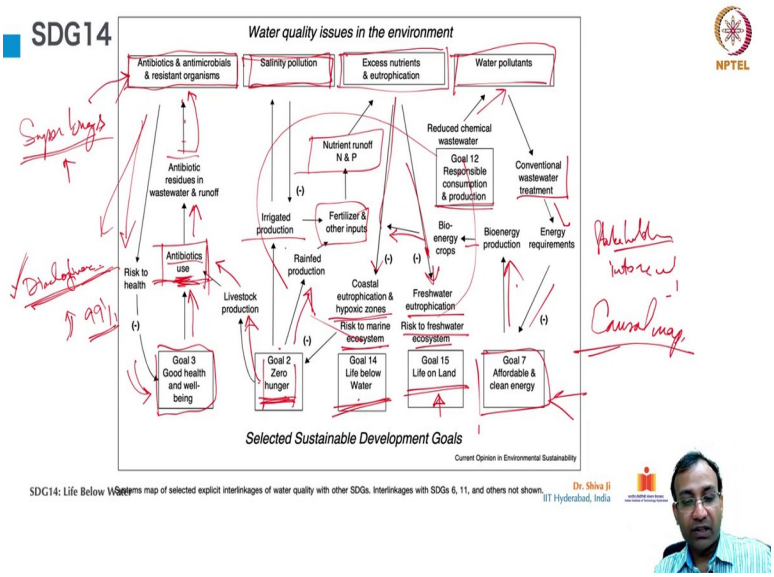

So, related to water quality issues in the environment. So, what can go wrong and how if you see and how our SDGs are related to this. So, let us see, look at this chart. Antibiotics and antimicrobials and resistant organisms. So, you may be knowing, these medicines antibiotics and antimicrobials, their usage has risen several fold in the recent years and decades. And eventually, those compounds after it gets excreted from our body actually, they reach to the sewer line and from sewer line they go to the soil or maybe some water body and eventually they will end up in the bigger water bodies lakes, rivers and oceans.

And there, it does not ends, the story does not end there. The other microbial and other aquatic animals life forms, they actually absorb these chemicals and then it will become problematic thing for that because they are not actually supposed to have a exposure of such chemicals. Plus even microbial life, if they are continuously getting such doses of these medicines, they are developing their own resistance, even bacterias and viruses et cetera and they are getting in more fatal.

So, you may have heard of him super bugs and all. So, that is the category of microbial life forms which are becoming resistant to such compounds, such medicines. And if somebody eventually contracts that superbug, it will be very difficult to treat this superbug because it is already resistant to that drug which is meant for treating it. So,

what happens in that case? So it is a very dilemmatic situation, how to go about the consumption of these medicines also.

So, from here, if you see, it poses risk to health and then risk directly to our good health and well-being, and then again if you see, now we are for good health and well-being, we are using in antibiotics, again this is going into the run-off water and again it is reaching to this thing. So, this is the cycle which is happening right now in this loop, if you see.

So, the more the uses, greater the potential greater the rate at which this will be absorbed by these life forms, and very soon, there will be many of them will be resistant and it will be very difficult for us to catch up. Another related to this one, salinity population, pollution if you see. So, this has direct impact on irrigation, agriculture. And which is directly actually related to the Goal 2, that is zero hunger, poverty also.

And from here, again it is dependent on livestock cattle and other animals which are part of domestic life or agricultural practices and all. They also sometimes use such medicines. You may be aware of the diclofenac, one compound which was actually used as a pain reliever in the animals and some treating some other health conditions also. And there was a time when this actually compound, this medicine was used en masse.

And when these animals actually died, vultures fed on them and that medicine actually proved very much fatal to those vultures, and almost 99 percent of vultures from Indian subcontinent and in other countries also, they simply died. They vanished, almost vanished. Now, there are very few number of vultures left living in the remote areas. Otherwise, from the other rural and other town areas, actually this population has, is almost completely gone. So, that is the direct use often one compound.

So, the moment it was brought to notice actually, this consumption was actually restricted. And restoration of vulture species is a kind of getting promoted. So, there are several initiatives going on to bring them back. But still, it has not kind of succeeded in its goal yet. So, such a catastrophe, we are talking about what can happen after mindless use often medicines and chemical compounds and stuff.

From here, again, rain dependence, monsoon, natural water cycles dependence, and fertilizer and other inputs, nutrient runoff from this and then either an excess of nutrients or maybe not a total loss of nutrient, both situations are possible. If water is runoff thing is not managed properly. And then again from here, you can see these 2 arrows, which talks about postal eutrophication and hypoxic zones where there may be lack of oxygen or maybe excess of maybe CO2 or maybe other kind of things. So, bringing in an imbalance of something, some sort.

Even excess is also not good, even scarcity is also not good. So, that balance is very much essential, maintaining that sweet spot for balanced life sustenance which poses to risk to marine ecosystem and then again direct impact on SDG 14: Life Below Water. The other repercussion, fresh water eutrophication, risk to fresh water ecosystem, and life on land. So, this can happen at the in the water bodies on the land surface also, like rivers, lakes then the underground aquifers. And the life forms which are living on land will directly get impacted.

Then another this thing you can see from other water pollutants, what can happen the conventional wastewater treatments, energy requirements, then it is directly related to affordable clean energy, bioenergy production from this one, bioenergy crops, again that is, will lead to agriculture portion on this side, in the middle. Responsible consumption from here, reduced chemical waste water which is directly connected to water pollution and so.

So, it is a, kind of you can, interrelationship that causal map kind of thing which gives you a picture of important stakeholders and their interconnectedness, how they are interconnected, how they are interacting with each other and what relationship they share with each other and one impacts another then that impacts 2 more things and so on. So, that interrelationship, we can understand.

Nothing stands in isolation. If you see, any of these the stakeholders, nodes I mentioned here, they are not sitting in isolation. They are interrelated. So, if something goes wrong with one, there will be repercussions several degrees later in the overall chain. So, just one important part to explain here.

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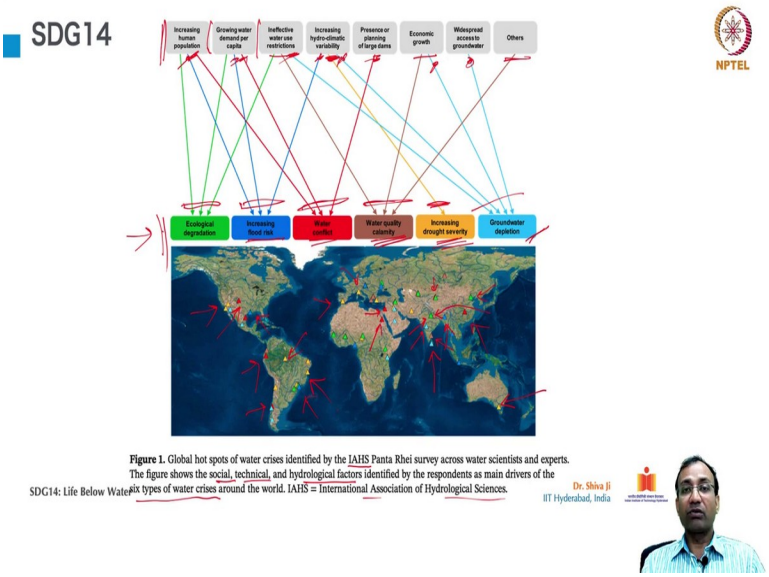

So, some global hotspots, you can see, of water crisis identified by IAHS Panta Rhei survey across water scientists and experts. The figure shows the social, technical and hydrological factors identified by the respondents as main drivers of the 6 type of water crisis around the world, International Association of Hydrological Sciences.

So, what are those 6 types of water crisis? So, you can see over here, ecological degradation shown by green, increased, increasing flood risk by blue, water conflict by red, this water quality calamity by this brown, and increasing drought severity by this yellow, and the groundwater depletion by this light blue.

So, you can see the different hotspots, water quality calamity you can see in this Gangetic plain and ecological degradation here. Again also, I think that also in the Gangetic plain. In Deccan, we see this light blue, groundwater depletion. The water table is going down very fast, and Sri Lanka also is in the same situation.

And in the coastal, in eastern coast of India in the Southern India, I think Tamil Nadu and Andhra Pradesh and these places, also we see water quality calamity. So, that is the Indian situation. In Northeast India, we see increased flood risk, we see this dark blue. And rest of the world, if you see, in China, there are many greens, that means ecological degradation is happening, so much of pollution et cetera.

And a water conflict here, it is, it looks there is one red and there are few reds here in the Middle East and the northeastern Africa. And in the U.S also there is water conflict in 2 places in Latin America also, in Chile also I see one spot, in China, it is also there at 2 or, 2, 3 locations. Increasing drought severity, if you see, yellow, this is there in the Southern Australia, several parts of Africa, including Brazil, the Amazon area is really surprising that the water scarcity, water severity in the middle of Amazon forest.

And West Coast of U.S., and southern Europe in many locations and so on. Increased flood risk in the New Orleans Arctic region, here on this side also, Europe also a few instances, Indonesia, few in Africa. So, if you see, the direct relationship between increased human population growing water demand per capita and ineffective water use restrictions for ecological degradation, then for the blue, increased flood risk, human population growing water demand per capita and increase hydro climatic variability, for these reds, water conflict, increased human population, decreasing ground water table, presence of planning of large dams.

So, dams are actually a good source of electricity, power generation, but they have their own ecological impacts also. They end up storing a huge volume of water behind the dam and depriving river of its water downstream. Plus, it kind of accumulates a huge bulk of mass, destabilizing the tectonic plates. Plus, it may kind of inundate hundreds and thousands of villages and towns also in its catchment area. So, number of things. Plus, it brings a complete halt to the natural flow of water in the river.

It almost kind of a divides the river into different segments, and naturally, river is not designed to live in segments. So, slowly, it starts killing the river itself. So, that is one of the worst form of power generation. Sometime it is referred as good solution, but if you study the after effects of hydroelectric power plants, they have huge consequences on the environment aspects. So, I suppose, water dams must be discouraged.

Then we have these 3 browns, ineffective water use restrictions, economic growth and others. Then yellow for drought severity, there is an increased hydroclimatic variability, directly related to that. And for groundwater depletion and ineffective water use restriction and increasing human population also I think is responsible because

hydroclimatic variability then economy growth, widespread access to groundwater et cetera et cetera.

So, this is a scenario you can briefly see. Well, these represent major events happening in these locations across the world, but there may be more and more smaller scale issues going on at various places, which also needs our attention.

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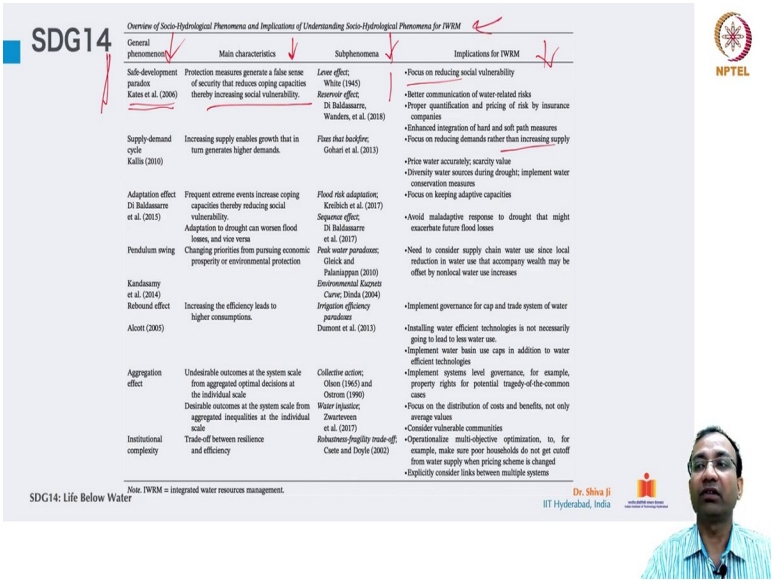

So, overview of social hydrological phenomena and implications of understanding social hydrological phenomena of IWRM. So, through this, you can understand this column represents a general phenomena, main characteristics of those, sub-phenomena and implications for IWRM. So, safe sustainable paradox, you can differ from here, main characteristic, protection measures generate a false sense of security that reduces coping capability thereby increasing social vulnerability.

And focus on reducing social vulnerability, better communication of water related risk, proper quantification, enhanced integration of hard and soft path measures, focus on reducing demand rather than increasing supply et cetera, et cetera. So, maybe you can go through this in detail and for more information maybe you can search for this term.

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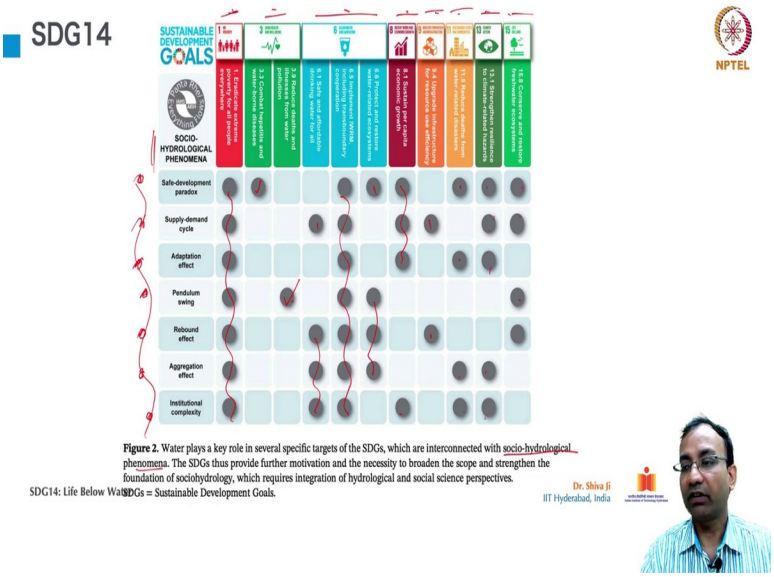

So, again social hydrological phenomena related to some of these SDGs. So, no poverty directly related, good health, of course life, clean water and sanitation, and then decent work, infrastructure, city development, climate action and life on land. On the left side, there are these phenomenons. Safe development paradox, supply chain, supply-demand cycle, adaptation effect, pendulum swing, rebound effect, aggregation effect, institutional complexity.

All of these, if you hear, if you see in this poverty, no poverty SDG, it is there. So, if you see, water plays a key role in several specific targets of SDGs which are interconnected with socio-hydrological phenomena. The SDGs thus provide further motivation and the necessity to broaden the scope and strengthen the foundation of socio-hydrology which requires integration of hydrological and social science perspective.

In good health, it touches here, and reduced deaths and illness, pendulum swing. Similarly, in the clean water, there are many which are getting, actually test. Then here, then in city infrastructure also we have 4, then climate action, we have 5, and then life on land, there are 4.

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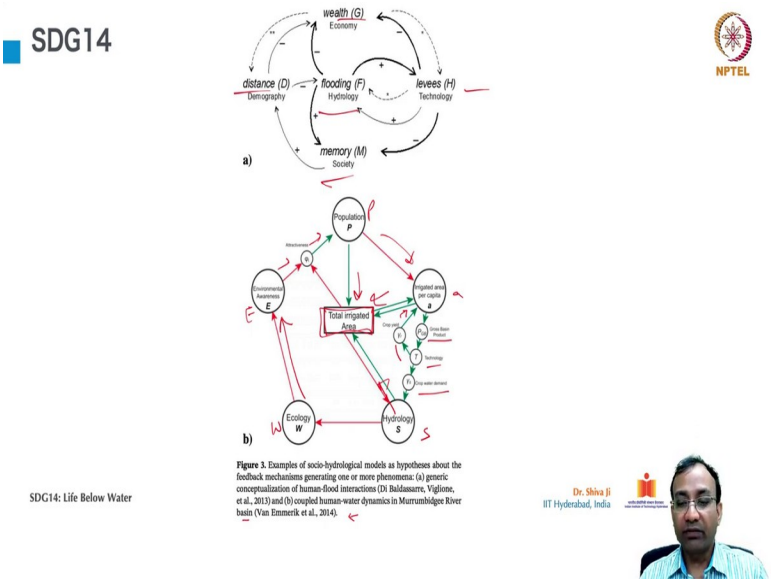

So, again to elaborate on that, the examples of social hydrological models as hypothesis about the feedback mechanism generating one or more phenomena. Generic concept relation of human-flood interaction and coupled human water dynamics in Murrumbidgee River basin. So, this is from this researcher, maybe you can refer for more details. So, see how they have made this diagram, this causal map we have discussed earlier.

Population, P, then irrigated area per capita, hydrology, ecology, environmental awareness and total irrigated area. So, see, ecology, ecological awareness, attractiveness, population, irrigated area per capita, that leads to gross basin product, technology, crop water demand, crop yield, then again it goes back to that irrigated area, total irrigated area is in the middle which is directly connected to hydrology, per capita irrigation, population and all of this.

So, how it kind of know impacts. So, flooding, levees, wealth, distance, memory. So, you can see this plus and minus relationships where it kind of aids and where it kind of creates summer negative situation.

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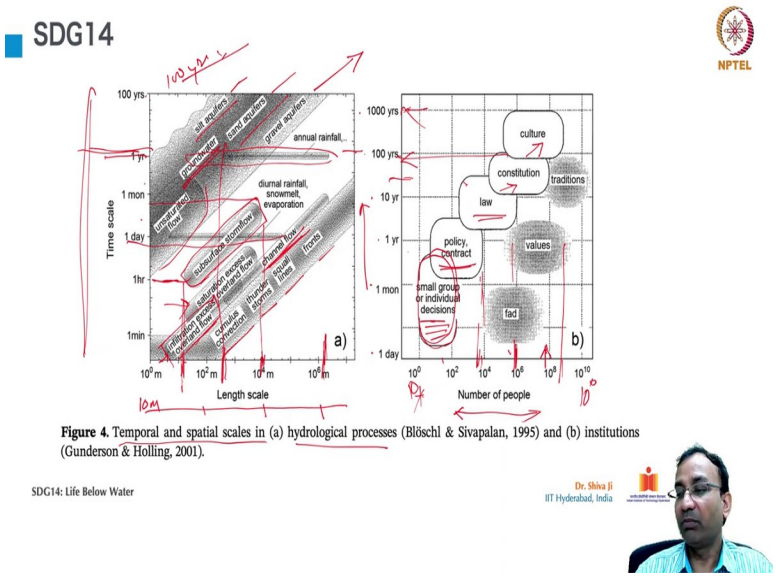

Another, on that scale this is an interesting table which talks about temporal and spatial scales in hydrological processes. So, you can see this is the length scale, 10 to the power 0, that means 10 meter, and 10 to the power 2, 10 to the power 4, 10 to the power 6 meter. And then on this side we have a 1 minute, 1 hour, 1 day, 1 month, 1 year, 100 years time scale.

So, on what time scale and on what length do you call water bodies what name, what names do you give. And what kind of forms they take. So, from, if you see, here infiltration excess overland flow. If some rain actually happened, so you observe running water. So, in this length actually it can take place.

And further to that, it becomes cumulus convection, then it becomes thunderstorm. If it lasts this, then square lines, fronts. Then if it goes for longer length and a longer in time duration, like 1 day or something, it becomes a channel flow. Then we have subsurface storm flow in this range, from 1 hour to 1 month. And in the length of maybe 50 meters to maybe 10 to the power 4 meters, 10 kilometers or so.

And then we have unsaturated flow ground water here, 1 year at least, level should be maintained and at the scale of, length of this 10 to the power 2, a little more. Sand aquifers, even 10 to the power 4, silt aquifers, 10 to the power 2 and plus in that region.

And then annual rainfall if you see, this is, this pattern which is drawn over here, this is the length in which it can take place, and cycle of 1 year.

If it goes above that, then it becomes a center aquifer and sand aquifers, gravel aquifers. So living for a longer period of time, like, on a scale of 100 years or more. So, this is that chart. And how do you call culture, society and all of that. So, the number of people on this scale, 10 to the power 0, 10, to 10 to the power 10. And duration on this side, 1 day, 1 month, 1 year, 10 year, 100 year, 1,000 years.

So, if it is a small group of people and lasting, these are, the things are lasting maybe over a month or less than a year, it will be a small group or individual decisions. 1 year and number of people participating more than 10 to the power 2, policy contract, it becomes law if it is there for over 10 years period, with 10 to the power 4 and more people participating up to the 10 to the power 6.

Then it becomes Constitution if it lasts for even more than that, like 100 years, on that time scale with more number of people falling, 10 to power 8. And if it goes beyond that also, then becomes culture, spanning up to 1,000 years time span and people becoming part up to the 10 to the power 8, and even more.