Advance Aquaculture Technology
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Lecture 59
Mitigation and Adaptive Strategies (contd)

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Hello everyone, welcome to the 4th lecture material of module 12. In this module environmental conservation of aquaculture normally discussed, we are discussing and the mitigation and adaptive strategies followed by the previous lecture we will be discussed in details. My name is Professor Gourav Dhar Bhowmick, I am from the agricultural and food engineering department of IIT, Kharagpur.

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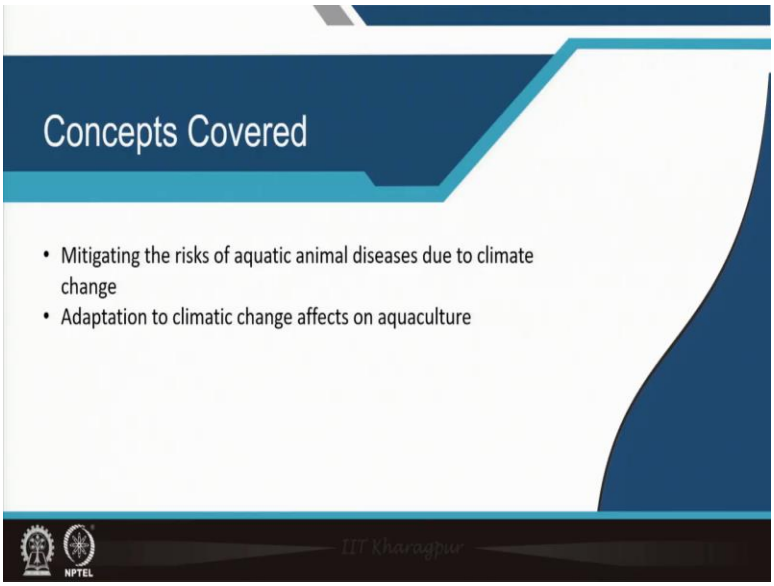

In this particular lecture material we will be discussing about the mitigation of mitigating the risk of aquatic animal disease due to the climate change and also the adaptation to climatic changes effects on the how it affects the aquaculture and aquaculture practices.

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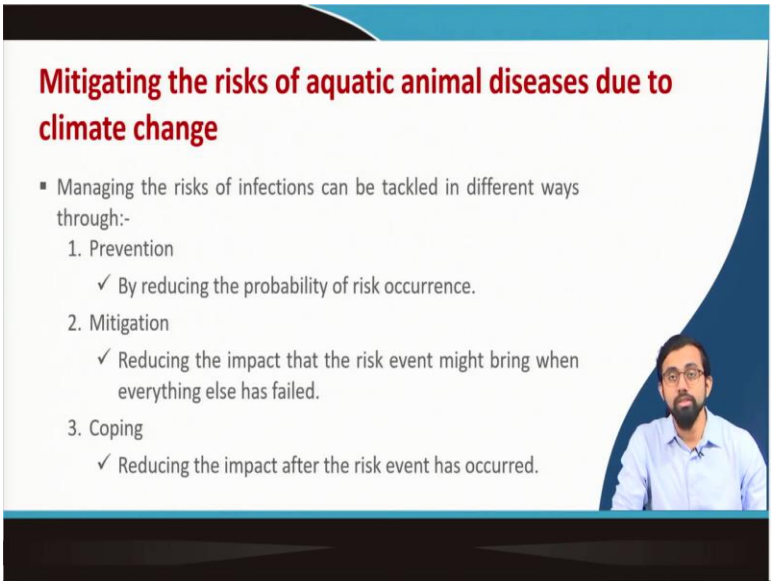

So, to start with, in order to mitigate the risk of aquatic animal disease due to the climate change, it is always better to go ahead with either prevention, mitigation or coping. By prevention, you can reduce the probability of risk occurrence by mitigation, you can reduce the impact that the

risk event might bring when everything else has failed and copying the reducing the impact after the risk event has occurred once.

So, these are the technologies that we normally these are the terms that we normally follow when we discuss about the any mitigation strategies. First is the prevention, mitigation and coping, these are the technology it is not only for aquaculture, but any other strategic development are concerned with this very much involved with these three different parameters.

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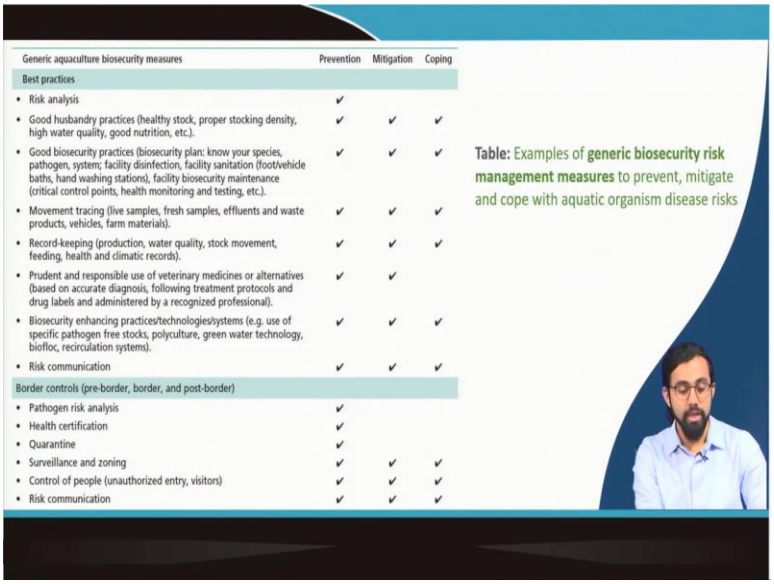

To in order to start with, like in this particular lecture material, I have discussed in tabular form examples of different mitigating, preventing and the coping strategies and how these strategies can be practiced in a for the betterment of your aquaculture produces.

So, here in this table, the examples of generic biosecurity risk management measures are given, like say, risk analysis, if you do the risk analysis, it will give you an additional benefit of the prevention because if you are doing a kind of a prevention it is a prevention strategy.

If you do the good husbandry related practices like the healthy stock, proper stocking density, so, it will give you high water quality good nutrition etcetera. It can help you with the prevention mitigation and the copying as well.

Good biosecurity practices like, when your species it is what type of pathogens are actually it can affected with what it says is facility disinfection, the facility sanitation, the proper biosecurity maintenance and the health monitoring and testing of the all individual workers and as well as the species are very much important.

Movement stressing is very important movement stressing by this way, you can definitely prevent mitigate and it comes under this all this strategic environment. You can do the record keeping like production, water quality, stock movement, feeding health and the climatic records, it will these are the information this is the best practices that has to be followed in aquaculture farm.

So, if you follow this practices, it will give you this, if you see this tick marks are actually showing the strategy which are considered under these particular categories and prevention, mitigation and the coping.

Border controls, like the pre border, border or the post border controls like the pathogenic risk analysis, health certification, quarantine if these are the factors that will help you preventing the spread of the disease or the spread of the any organism aquatic organism disease risk, surveillance and surveillance and joining is possible for mitigation and copying as well. Control of people unauthorized entry visitors and also the risk communication is very important to reduce these different factors.

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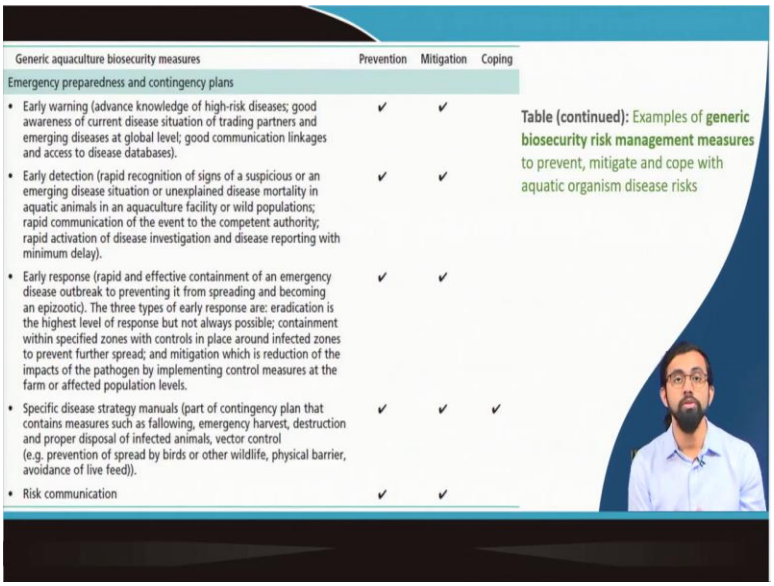

Examples of this this generic risk management practices to prevent mitigate and cope with aquatic organic disease risk, just like previous. The first is emergency preparedness is very important like, early warning. It will help you to prevent and mitigate the, it is mitigating strategy, it will it will help with that because once you have early warning or and also early detection system you can go ahead with the early response.

Once you can do the early response, it will definitely this all these categories will fulfill the demand of mitigating strategy or the demand of prevention strategies. Specific disease strategy manuals has to be there which will help people to cope with the event that we that has already happened and now they can be well prepared, no, it will not repeat in the next time.

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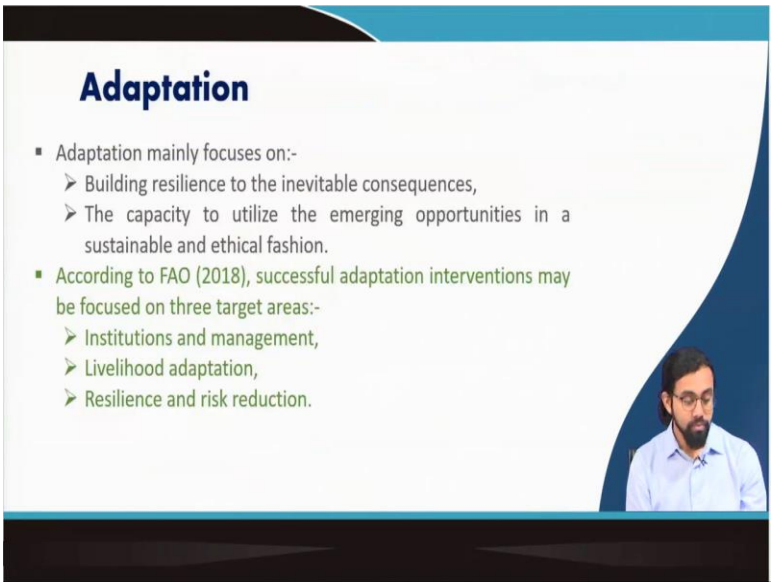

So, after we discuss about all the mitigating strategies and mitigating the developments, that is done in aquaculture, let us discuss about the adaptive strategies, what are the adaptations that you can do in order to make maximum use of the information that is available and make maximum use of the science and the technology to reduce the impact of climate change in the aquaculture sector.

Adaptation, it mainly focuses on the building the resilience to the inevitable consequences, that it will anyway come with time. You cannot reduce it is like scientifically or statistically it is not it is impossible. So, in that case, you have to go ahead with the adaptive strategy.

What is adaptive strategy first to start with, just suppose you are going from desert area like in a very hot climate to a cold climate, you will definitely fall sick, we have to have some adaptations timeline, we have to have some acclimatization, a timeline period, that acclimatization period or that adaptation period is required for your body to get in cope with this new situation. So, that is what we call adaptation.

So, you have to adapt with the new situation new climatic condition and this adaptation strategies are very much important when you know that some inhabitable consequences are there and it will come no matter what statistically it is saying that after a certain period of time it will be there it will have not for sure.

So, in this type of cases, the adaptation strategies are the best to be followed. It also has the capacity to utilize the emerging opportunities in a more sustainable and ethical fashion. According to the Food and Agriculture Organization 2018 the successful adaptation interventions mainly focused on three target areas. The first one is the institutions and the management, livelihood adaptation, and resilience and the risk reduction.

So, in this way, you can adapt to new situation fast from the policy maker's point of view, second, your individuality third is the is like the how to say like the doctor's point of view, just to give you an example to make it make you understand much better way. Institute, the policymakers, what they are doing livelihood, what you are helping, how you are helping and third, suppose you are already affected with something. So, what is the structure what is the medical structure that is available to help you to get rid of it, this is the adaptation strategy that you need to follow.

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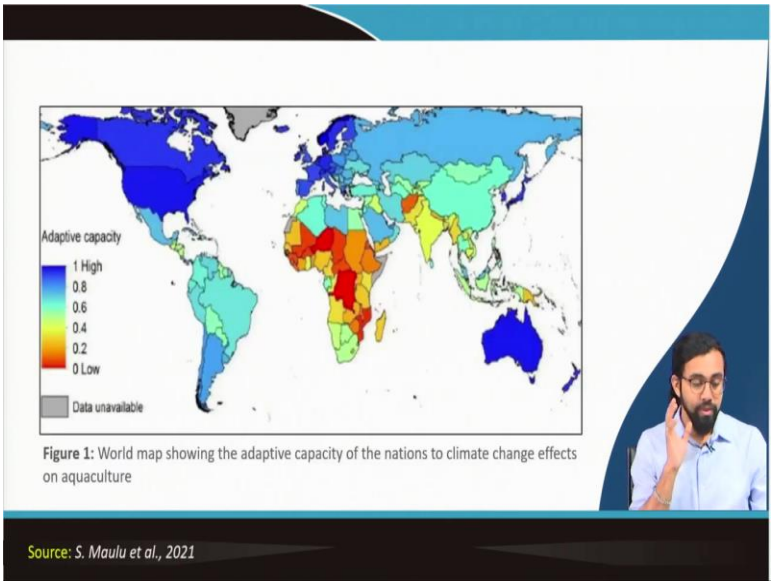

This is the situation in world's scenario according to the *Maulu*, 2021 this paper they have mentioned that this map is showing the adaptive capacity of the nations to change in any climatic situations on aquaculture.

If you see the situation if you see the places like USA or Australia there New Zealand, they are in very much in good condition they can they have some capacity, they have already developed

the capacity to adapt to the changes in the climatic situation only for aquaculture point of view, I am not talking in general.

Cases like, like situations in India is also almost in the average, above average, if you go to the African countries, their situation is very hard for them even the adaptive capacity if they follow like still it is hard for them to meet the goal. It is very hard for them to they can somehow manage the situation that is going to happen in in these places very soon.

Because the climatic changes are very much visible, it is happening and it is actually affecting these places like anything, because most of all, this is in the almost in equator region and it is it is bonding like anything with time because of the this greenhouse effect.

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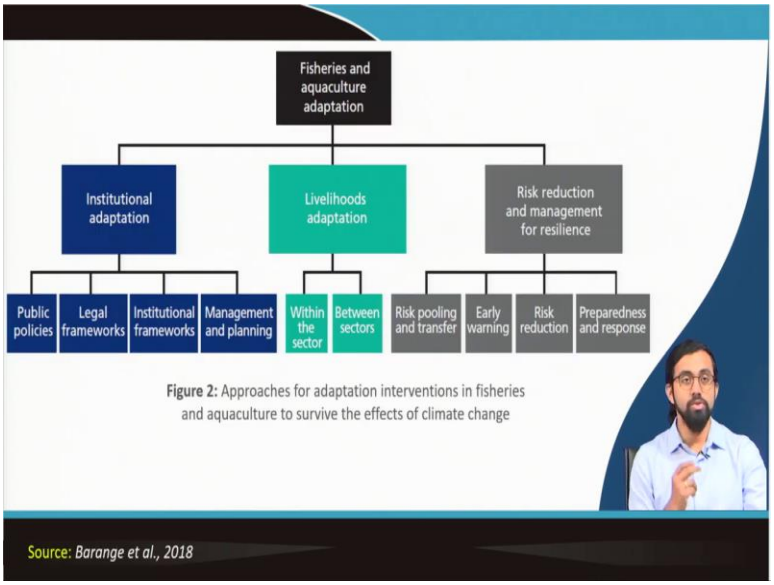

So, as we discuss these different three target areas to start with the first if you see the institutional adaptation, we have public policies, the policymakers can design a policy that will that has to be followed by each and every citizen of that particular country or area.

Legal Framework has to be prepared institutional frameworks and management and planning has to be done. Always remember, only your idea does not make any sense you have revolutionary ideas but you do not know how to execute does not make any sense.

You have to know that your ideas are good, you have developed the frameworks perfect, but you have to have a proper management team and proper planning and who will execute that idea, so, this comes under the institutional adaptation.

Then there comes the livelihood adaptation, like within the sector and between the sectors, then comes the risk reduction and the management of resilience management for the resilience like risk pooling or the transfer early morning early adaptation risk reduction and the preparedness and the response. So, all these approaches are considered under that adaptation interventions for in fisheries and aquaculture sectors to survive to any kind of any other efforts of the climatic changes.

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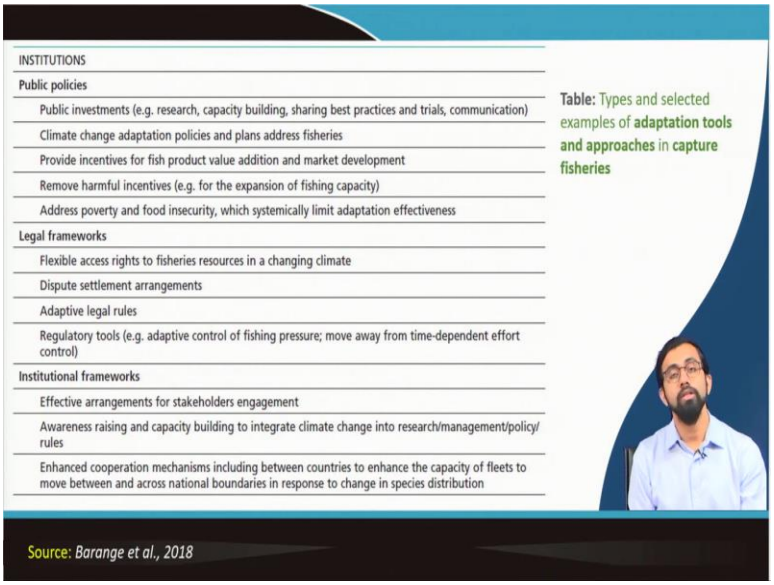

What are the type of the examples of this adaptation tools or approaches for capture fisheries? So, we will start discussing first is capture fisheries then I will go to the culture fisher and aquaculture.

So, how in the capture fisheries when you go and capture the fishes from the wild stock, what should be the, what are the adaptation tools and approaches that you have to follow to make it more sustainable. Like public policies like, public investment, like research capacity building sharing the best practices and the trials and the communications are very important.

These different policies and plans should be should be there which are actually very much following the climate change adaptation rules to address in to address the fishery sector, it has to be when a policymaker should provide the incentives for fish product value addition in the market development it has to be you have to remove the harmful incentives like the example the expansion of the fishing capacity it has to address the poverty in the food security issues and which systematically limit the adaptation effectiveness.

So, all these parameters has to be addressed by the policymakers to go ahead with this is the standard policies or institutional job for in order to go ahead with the climate change adaptation in aquaculture sector.

Legal framework, like flexible access to access rights to fisheries resources, in a changing climate, Dispute Settlement Agreement has to be there proper adaptive legal rules has to be followed or you have to formulated regulatory tool has to be there, which will take care of this legal framework, institutional framework, what is the effective management for all the stakeholders like in an Institute in a particular company or industry.

Awareness raising and the capacity building to integrate the climate change into research management and the policy on the roots enhance the cooperation mechanism including between the countries and also inside the countries as well to enhance the capacity of fleets to move between and across national boundaries to respond any change in species distribution, this is in terms of institutional framework that is important.

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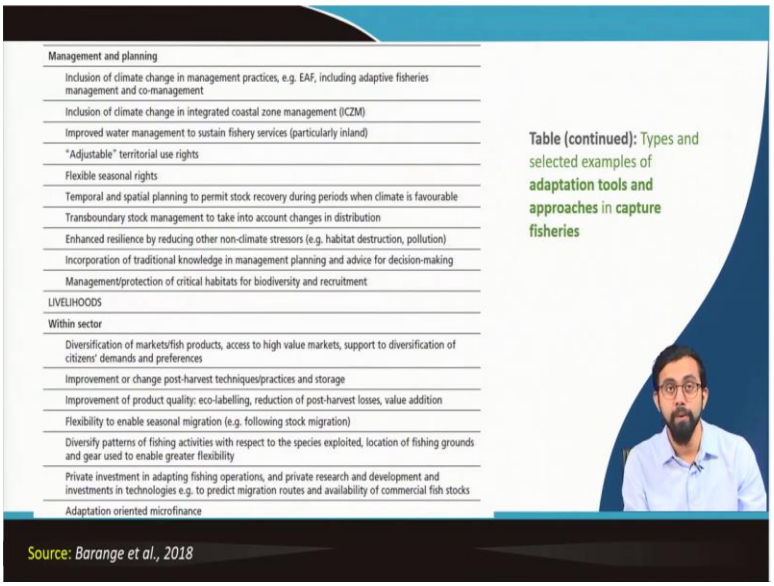

In terms of the, the to continue with this, like, what is the institution goal like management and planning, as I already discussed, all the frameworks are only done in pen and paper ways, you have to have a proper management team who take care of this, this execution of this plan.

Inclusion of the climate change in the management practices are very much important you have to include the integrated Coastal Zone Management Systems, you can improve the water management to sustain the fishery services adjustable territorial use right what is adjustable territorial use rights is like, as I discussed, suppose your country is suppose India and Bangladesh, Bangladesh is sharing its border sharing its border and their exclusive economic zone is also divided in a certain way.

So, this exclusive economic zone is the place where that particular country can go and it can kind showcase its own right in that in the whatever the resources that they can have from that water body.

Suppose in a particular moment of time, your fishing vessel would not be able to find out enough fish school of fish there and they will they know that the according to the satellite images and all the data they understand that it is there in the some other countries border.

Suppose, if you have a proper interaction proper policy exchange between the these countries, so, what will happen we can definitely go and we can use that territory for that particular purpose and on behalf of that you have to give some other right to the other country as well, so it is like a mutual understanding has to be developed.

Flexible, seasonal right has to be there temporal and spatial planning to permit the stock recovery during any period of time when climate is favorable and the transboundary stock management to take into account the changes in distribution, this transboundary stock management is the same way like the mutual maintain this international policy thingies they will it has to be properly executed with the help of the policymakers discussion between the two different or three different or multiple countries in between multiple countries.

Now, if we start from the institution to the livelihood, what should be the factor what should be the adaptive strategies that people should follow in their livelihood to go ahead when discuss about the capture fisheries.

Diversification of the market and the fish products and access to high value market and the support to a diversification of the citizen's demand and preferences improvement in the post harvest techniques. After you capture the fish you have to take care of the techniques which you can follow to harvest maximum use of it to utilize maximum part of it.

For that what do you need to do in order to improve the post harvest techniques what is post harvest technique after you catch your fish it has to be done it has to be chilled, it has to be cooled down it has to be cured for long amount of for longer shelf life then you it has it will go to the processing industry it will be chop down it will be deboned or that different part of it will be used for different other purposes. Whole of this structure this post harvest technology has to be very well suited very well developed to increase the livelihood increase this it will be considered under this adaptation tools and approaches for capture fisheries.

The flexibility has to be there to enable the seasonal migrations, we have to diversify the patterns of fishing activities like with respect to the species that you are exploited location and the fishing grounds and the geared that is used for enable the greater flexibility.

Private investment in adapting the fishing operations and private research and development and investment in technologies are required adaptation oriented microfinance has to be given and must be supported by the individual basis not the government side and government side they are doing in their best now you have to make sure that what you have to do what are the strategy that you can do follow to reduce the further considered as a further adaptive tools for your capture fishery technology sector.

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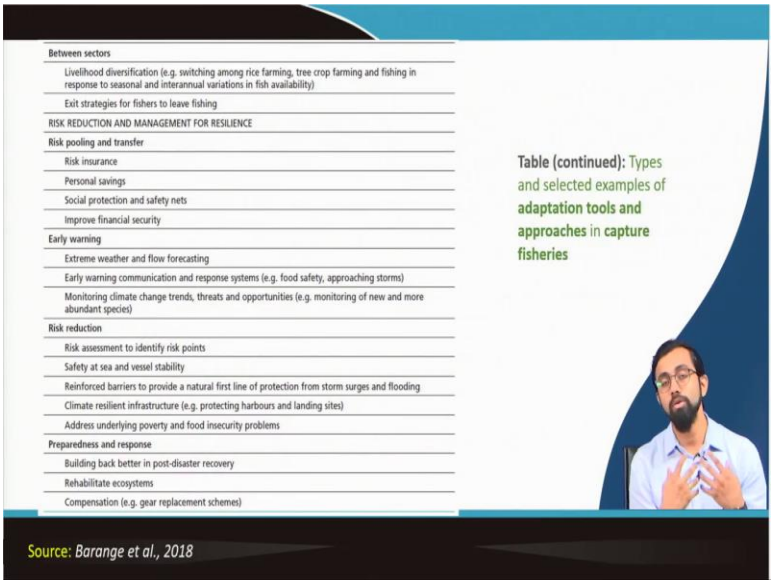

Between the sector like the livelihood diversification like the switching among rice farming Tree, crop farming and fishing in response to seasonal and inter annual variations in fish availability exists strategies for fishers to leave fishing that is very important, you have to have a proper strategy you cannot just simply say no you are not allowed to do capture fisheries from today onwards what they will do, they have to provide with some they have to be provided with some additional like some alternate job or alternate way of living their life like some way the how by which he can he or she can earn some money for their living.

Third and most important is the risk reduction in the management for the resilience, you can do the risk pooling on the transport risk insurance, personal savings, social protection and the safety nets improve the financial security early morning you can have the extreme weather or flow forecasting from it can be developed and which will give you some excess time in hand to be

prepared with the situation and all that is coming anyway that is in imminent, it is coming for sure.

Early warning communication the response system has to be developed monitoring this climate change trends like threats and opportunities that has to be developed and the properly you can use the satellite data and satellite images and that can be used for forecasting this optical remote sensing or the synthetic aperture the data is nowadays even used like I am saying just the difference remote sensing data can be used for forecasting the different oceanic events and any water you like I mean the water body events and that will help to those capture fishers fishermen to design to plan accordingly.

Other than that, this risk reduction and preparedness and the response is very much important you have to proper discuss about the building proper, better post for post disaster recovery and rehabilitation system ecosystem has to be developed compensation has to be there from individual basis.

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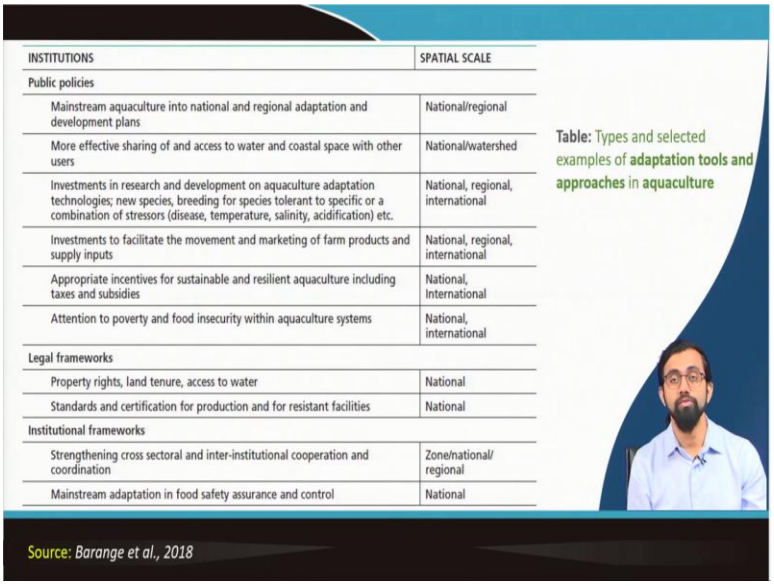

So, from the last couple of slides we were discussing about the all these adaptation tools and approaches for capture fisheries, what will happen to aquaculture. Now, let us select culture fisheries, in case of aquaculture the public policies, it is almost the same like the design is the same, because the only difference is one is capture and culture one culture one also in the public

policies has to be almost same it has to be depending on like the proper mainstream aquaculture into the national and regional adaptation and their development plan has to be there, it can be done in national basis or regional basis.

More affecting sharing of an access of water and the coastal space with other users investment in research and development of aquaculture adaptation technologies like new species breeding for species taller into the specific conditions, investment to facilitate the movement and marketing of farm product and the supply inputs in between them attention on the attention of to poverty, poverty and food security within the aquaculture systems, all these things has to be done in a special scale of national international or regional basis.

And this framework will give this I mean, like this policies and has to be developed to which acts as a very basic tool for this very basic adaptation tool for aquaculture any kind of aquaculture practices.

Legal frameworks, like property rights, land tenure and access to water has to be the standards and the certification for production or for resilient facilities has to be the designed, institutional framework, like strengthening cross border, cross sector and the inter institutional cooperation and coordination, mainstream adaptation to food safety assurance and control is it has to be there, it is like very important from your industry industrial point of view, that you are adhering to all the national regulations and regional regulations.

So, otherwise, what will happen, they will simply close your industry after a while, it will just a matter of time that they will come and they will inspect and they will close your industry.

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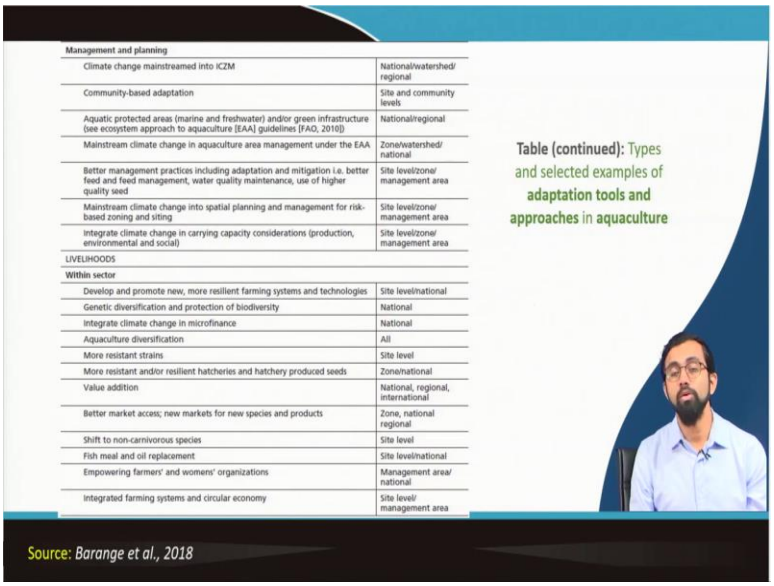

Management and planning	
Climate change mainstreamed into ICZM	National/watershed/ regional
Community-based adaptation	Site and community levels
Aquatic protected areas (marine and freshwater) and/or green infrastructure (see ecosystem approach to aquaculture [EAA] guidelines [FAO, 2010])	National/regional
Mainstream climate change in aquaculture area management under the EAA	Zone/watershed/ national
Better management practices including adaptation and mitigation i.e. better feed and feed management, water quality maintenance, use of higher quality seed	Site level/zone/ management area
Mainstream climate change into spatial planning and management for risk-based zoning and siting	Site level/zone/ management area
Integrate climate change in carrying capacity considerations (production, environmental and social)	Site level/zone/ management area
LIVELIHOODS	
Within sector	
Develop and promote new, more resilient farming systems and technologies	Site level/national
Genetic diversification and protection of biodiversity	National
Integrate climate change in microfinance	National
Aquaculture diversification	All
More resistant strains	Site level
More resistant and/or resilient hatcheries and hatchery produced seeds	Zone/national
Value addition	National, regional, international
Better market access; new markets for new species and products	Zone, national regional
Shift to non-carnivorous species	Site level
Fish meal and oil replacement	Site level/national
Empowering farmers' and womens' organizations	Management area/ national
Integrated farming systems and circular economy	Site level/ management area

Type and the like, in case of management and planning point of view this climate change mainstream into this ICZMS the community based adaptation has to be there, the integration, the integration of this climate changes in carrying capacity considerations, production and environmental and social point of view.

And in terms of livelihood, if we talk about ourselves what will happen within the sector, you have to develop and promote new and more resilient farming systems and technology, more aquaculture diversification, integrated integrate the climate change in microfinance, more resilient strains has to be introduced, more resistance and the resilient hatcheries has to be designed and hatchery produced seed has to be has to have very high resilience in any climatic changes shift to non carnivorous species is better fish meal and all replacement is possible.

All these things, which are even you can go for integrated farming systems and polycultures in circular economy based systems design, all these things will help you reducing the climate change affects like anything in aquaculture point of view.

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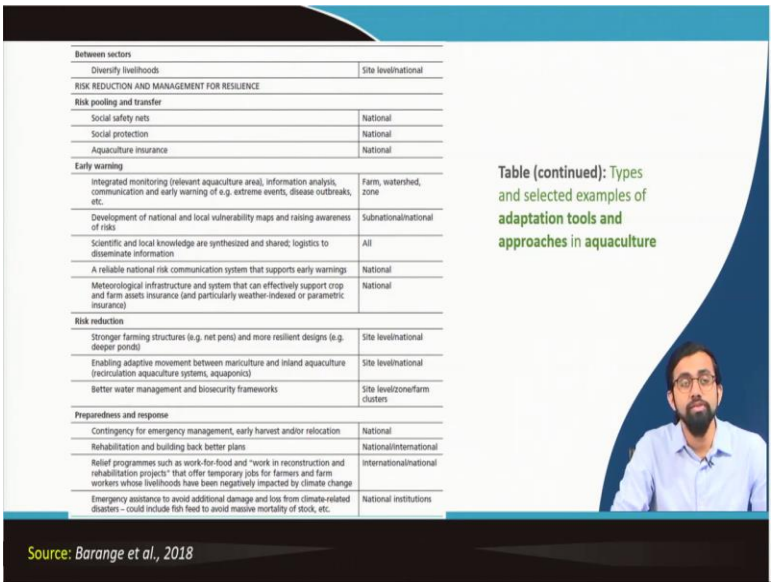

Between a sector if I talk about the diversity, diversify the livelihoods is better very important site this is can be as low as the site level to as high as the international level. Risk reduction on the management for resilience if we talk about the especially the risk pooling and transfer is important social safety here social protection is very important for the people who are working in that particular area.

Early warning, this is very important, you have to know the problems that you are going to deal with in the very near future there and based on that risk reduction strategies has to be developed stronger farming structures proper adaptive movement and between the Mari culture and the inland aquaculture techniques, better water management, practice water biosecurity and the frameworks and has to be developed.

Preparedness and Response is very important, how prepare you or how better you can respond to any unwanted situations that may rise if you are not following the proper technologies. So, this emergency assistance to avoid the additional damage or loss of climate related disasters could include the fish feed to avoid the massive mortality of stock.

So, in general, all these techniques, all these tools and approaches that I am discussing, you have to remember one thing that it is always people say that prevention is better than cure, so prevention is obviously okay and in order to go for prevention, it is adaptation is one of the

major strategy by which you can prevent any kind of wrongdoings or any kind of say like in a disaster or calamities.

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This is the these are the discussions that we have today is mainly I want you to understand how these different factors how these different strategies and adaptive technologies can be followed from institutional point of view to individual point of view, and it can go up to the limit of like, you cannot just simply blame the policymakers and do nothing.

It is not only policymakers they can do even definitely their job is the maximum they can develop some criteria, they can formulate the regulation laws and regulations, that has to be followed this laws and regulations has to be signed or has to be, well, it has to be designed with well versed with the discussion with the scientist and the experts on that field that particular field.

Because you may think, because the problem with us is like, we are very much susceptible to changes, people do not like changes, if you want to have some changes, you have to it will take some generations to come to that stage, the same thing is happening, we are very much used to inform your our earlier generations and all they are very much used to exploit the earth like anything without thinking about the consequences.

Now, we start thinking about the consequences and people discussing about the whatever the consequences are now, for the last couple of decades, people are thinking about what should how we can mitigate these problems, how we can go ahead and kind of reverse this situation.

People, there are a lot of discussions going on there a lot of blaming blame game is going on. But actually, if you are not taking your footstep at this moment right now, whatever you are sitting there, otherwise, you will face the consequences from for sure and there will be a point which we will be called the point of no return.

No matter how better you go ahead with the adaptation strategies, mitigation strategies, all the retrofitting of the new instrument new technology with the old obsoleted like the notorious ones, but still, you cannot revise it, we revive it back to its earlier situations, that point we call the point of no return.

This point of no return is based on different criteria like you can based on the climatic situation based on the carbon dioxide, presence of the carbon dioxide load in the atmosphere based on the presence of different other obnoxious gaseous present in the atmosphere. So, this point of no return will come for sure and before that, we need to work on it to, to delay it as much as possible for our future generations to survive better.

In aquaculture it is very important because we, as we discussed, we cannot just survive without having food. And the future food is definitely this, this aquaculture and the aquaculture that will definitely serve the larger scale of humanity in a very recent scale of operations if I talk about.

Therefore, the adaptation has to be focused to build a resilience to the inevitable consequences that we may face and develop the capacity to utilize the emerging opportunities in a sustainable in an ethical fashion. That is what we discussed today. And that is the very nice conclusion that I can make out of the discussions that I have in this particular lecture material.

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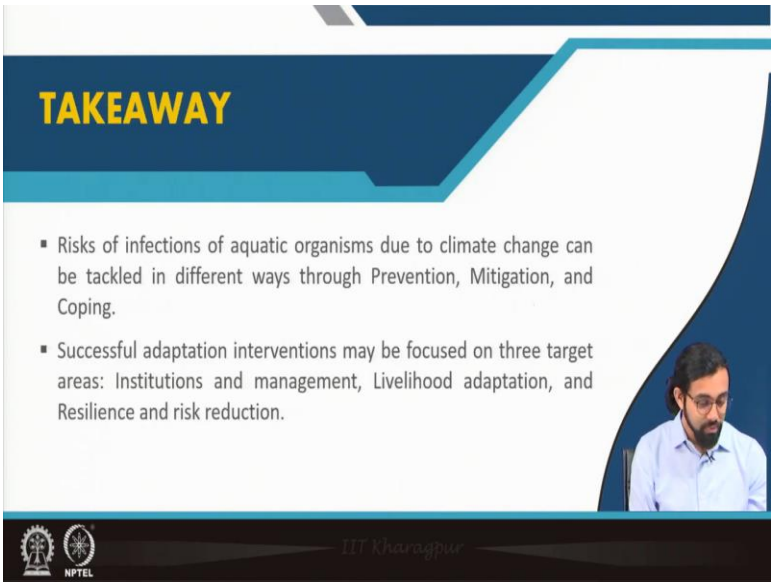

What are the takeaways from this lecture, the risk of infection of aquatic organisms due to climate change can be tackled in different ways of prevention, mitigation and coping. We discussed about the successful adaptation interventions that can be focused in three target areas, institutional management, livelihood adaptation, and resilience and risk reduction strategies.

We discussed about all these different target areas for capture fisheries as well as cultural fisheries I mean, like the aquaculture practices in general. I hope you understand this material much a better way and if you have any doubt, definitely I would really ask you to go and go to the particular slide stop it, pause the video, read it carefully.

If you do not understand Google it and try to understand what is it all about, I am telling you, it is very interesting and you will be very much at this aquaculture enthusiast once you got to know about all these factors. It is not only related to aquaculture it is environment it is our own world in general.

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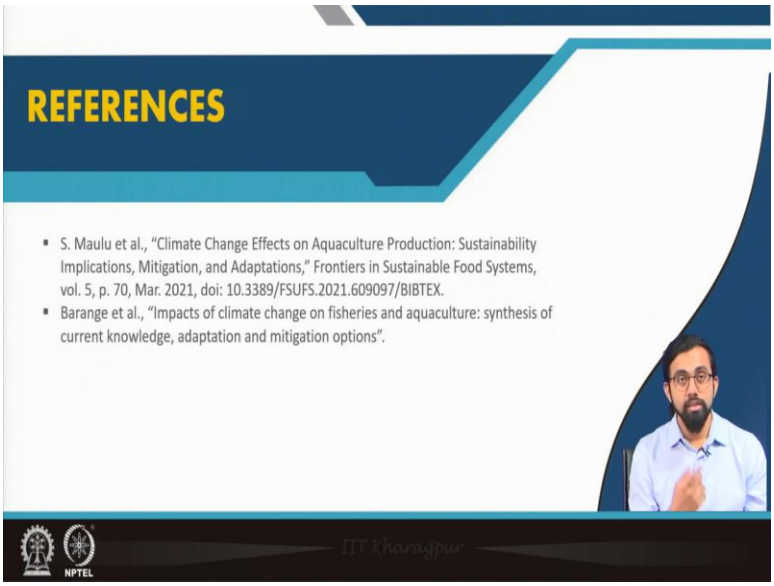

These are the references that you should follow to get more details about it and to get more information about the strategies and all that we normally follow in this kind of sectors. I hope you get to know some a very truthful information for you and you will definitely behave the same way and you will definitely teach your next generation or your fellow members fellow, so or citizens too with the knowledge that you have gained with this lecture. Thank you so much. We will discuss we will continue this discussion with this mitigating strategies in the coming lecture as well. Till then, thank you so much.