## Natural Resources Management (NRM) Professor Sudip Mitra, PhD Centre for Disaster Management & Research (CDMR) Head, School of Agro & Rural Technology (SART) Discipline - Agriculture Engineering Indian Institute of Technology, Guwahati Week - 03 Lecture - 15 Introduction to Integrated Natural Resources Management (INRM)

So, we are now here at the MOOC online course of Natural Resource Management.

(Refer Slide Time: 0:38)

**Integrated Natural Resources Management (INRM)** 

And today we will be discussing Integrated Natural Resources Management, which is popularly known as INRM. So, let us first know about this INRM, what is INRM?

(Refer Slide Time: 0:50)

## Integrated Natural Resources Management (INRM) Integrated natural resource management is a conscious process of incorporating multiple aspects of natural resource use into a system of sustainable management to meet explicit production goals of farmers and other uses (e.g., profitability, risk reduction) as well as goals of the wider community (sustainability). Integrated natural resource management offers a way of doing development-oriented research that aims to simultaneously reduce poverty, increase food security and achieve environmental protection. It is an emerging concept which is understood as 'the responsible and broad-based management of the land, water, forest, and biological resources base – including genes – needed to sustain agricultural productivity, and avert degradation of potential product INRM focuses on ecosystems rather than commodities; on underlying processes (both biophysical and socioeconomic) rather than simple relationships, and on managing the effects of interactions between various elements of an ecosystem.

Integrated natural resource management basically, it is a very conscious process of incorporating multiple aspects of natural resource use into a system for the sustainable management to meet our requirement, our demand. We have already discussed various aspects of NRM and we also discussed that what are the challenges that NRM face and then also we discussed about the various tools and technologies. We have also discussed in great detail about participatory rural appraisal, rapid rural appraisal, how actually we use the various tools for evaluating the natural resources in an area.

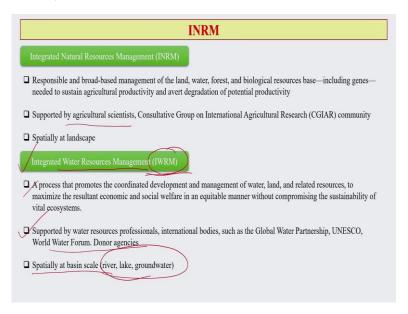
Now INRM provides us an opportunity to manage these natural resource bases in a sustainable manner. Now, let us see that what are the various aspects of INRM, integrated natural resource management. Integrated natural resource management, it offers a way of doing the development oriented research, which aims to simultaneously reduce the poverty, food insecurity and at the same time also tries to achieve the environmental protection. So, in a sense, we try through INRM to take care of our life in a sustainable manner, where we will have enhanced production, agricultural production, we will have enhanced livelihood but on the other hand, we will also take care of the environment that is the essence of INRM.

INRM, it is an emerging concept which is best understood as the responsible and broad based management of land, water, forest, various biological resource bases, including genes, because biodiversity already we know we have discussed how important it is as a natural resources for human civilizations, and for that matter, the entire ecosystem. These are all needed to sustain the agricultural productivity and also to avert the degradation of the potential product that actually we are trying to get out of the system.

INRM also focuses on ecosystems rather than commodities, because it is quite natural, if we focus suppose on a product or on a commodities, then probably a point will come when we may unknowingly neglect the ecosystem, the surrounding environment. We must never forget that resources which are being utilized for the production of various product and commodities are basically the gift of the nature the ecosystem.

So, we must understand the underlying process in an ecosystem, both biophysical and socioeconomic. So, we first try to understand the relationships between these two very important components and how they are interlinked rather than just looking at very simple relationships between A to B or component of an ecosystem. We must look at the picture as a whole and then only INRM, integrated natural resource management will actually stand as it means.

(Refer Slide Time: 4:16)



INRM, remember is also responsible and it is a very broad based management of various resources like land, water, plant, forest and different biological resources and it focuses on the sustainable aspect of natural resource management. So, in one hand, when it helps to enhance the productivity oN the other hand, it also takes care of the nature of the ecosystem.

And these entire process need to be carried out by the community and well guided by agricultural scientist, different experts from non-government organization, government organization, trained personnel who knows how to carry out these integrated natural resource management, in turn, they should also train the community.

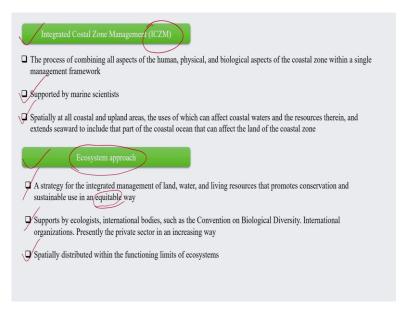
At the end of the day, as we discussed earlier that community who actually are there among this ecosystem, they need to learn how to take care of the natural resources that they are going to use for their well being. I will now slowly go one by one aspect and also take one resources at a time and will try to explain to you that how the concept of integrated natural resource management can be applied.

Let us take first Integrated Water Resources Management, which is known as IWRM. IWRM it is a process which actually encourages a kind of a holistic or coordinated development of water resources, but in conjunction with land and also other resources, because water is linked to almost all other resources natural resources.

So, to get the maximum benefit of out of water and also to be able to manage the water resources as the best possible way is to have a coordinated approach so that the result of this effort will be socially and economically equitable in nature without compromising the sustainability of the ecosystem.

IWRM is supported by water resources professional and various other individuals and organizations across the world and of course within the country. So, these all organizations and individuals they actually come together and work towards IWRM. The scale of this particular approach is basically in basin scale that means river, lake or groundwater largely being taken care of under IWRM.

(Refer Slide Time: 7:05)



Now, the next aspect that I will talk about is Integrated Coastal Zone Management, briefly it is known as ICZM, integrated Coastal Zone Management. what it does, is the process of

combining the all aspects of human, physical and biological aspect of the coastal zone in particular within a single framework.

Suppose, you take the example of the coast in Tamil Nadu or coastal area in Gujarat and elsewhere. So, what you have to do is that, first is the zonation has to be clear. Once you know the zone within that coastal area, then we need to focus on that and then try to bring various aspects of ICZM which again is nothing but the sustainable management of the resources which is available within that coastal zone and the associated livelihood activities and well being of the people will be taken care of.

So, again like IWRM, here in ICZM also we need help assistance from technical person. Time and again, for all the approach I am mentioning one thing, kindly note is that, we need some well trained experts in each of the field. Often it happens is that people take it a little easily because some of the aspects of these approaches already people are doing, so, they think that, okay, it is very easy to carry out, but there are certain subtle aspect of these management practices, which requires the presence, the assistance, the guidance from trained personnel. So, here in for ICZM, we need the support from marine scientists, coastal zone management experts, and then biodiversity experts. So, like that and these are all those things, these people will again like in IWRM and will try to work together and finally train the community which are there in the coastal area. Especially the coastal at all coastal and upland areas, the uses of the coastal water the resources therein the coastal regions is basically is that they actually are important for maintaining the environment of that area.

So, the focus would be that how to manage those coastal region resources in a very sustainable manner, so, that the people residing there in the coastal zone should be able to carry out their regular livelihood activities. But at the same time, the delicate ecosystem of coastal zone should also be taken care of.

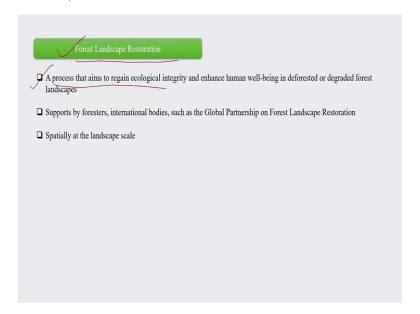
Next I will discuss about ecosystem approach. Many of you might have heard about this approach. Ecosystem approach, basically it is a strategy for the integrated management of all the components of land, water of the ecosystem, living resources, that actually promotes their conservation and sustainable use in an equitable manner. I am sure that you might be observing that the word equitable is coming quite frequently. The resources which are actually given by nature, the issue of equitable share of that, resources is very critical in today's world.

So, in any society or community, ideally, that equitable distribution of resources is critical for a perfect sustainable development of that particular area. So, if from the very beginning this particular aspect of equitable sharing of resources is taken care of, then you will find that in the journey of natural resource management and then actual the development of an area, you will find that you will get most of the time success, probably very few times a failure. So, the equitable sharing aspect, we need to keep in mind which I tell you that may not be a very easy exercise, when you actually go and work on the ground, but we need to ensure it to the best of our capacity.

Second, Ecosystem Approach again, need the support and facilitation from ecologist, international bodies, such as CBD Convention on Biological Diversity, various international, national and local level organization. Presently, there is also a lot of enthusiasm among the private sector to come to join hands with public sectors, and different organization at grass root level as well as the government level to go for ecosystem approach. Because in the world of climate change, now, ecosystem approach is one important path that people increasingly understanding that that could actually help us to make this world a sustainable one.

So, especially in case of ecosystem approach, you will find the area are distributed within the functioning limit of an ecosystem like any other previous ecosystem like coastal and water that I have talked about.

(Refer Slide Time: 12:57)



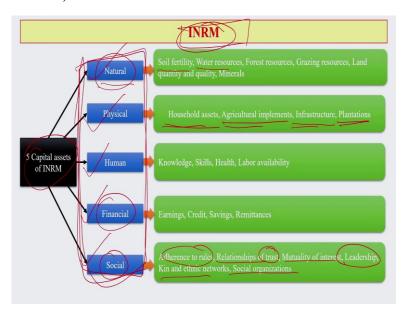
Now, let us come to another important natural resource that is forest. Forest landscape restoration; a lot of debates, a lot of efforts are going on for increasing or at least maintaining

the proper forest coverage in country, in India. And also I am sure that same thing is happening in other parts of the world. So, forest landscape restoration is a process that aims to regain the ecological integrity and enhance human wellbeing in a deforested or degraded forest landscape meaning that this approach forest landscape restoration, it provides us scope opportunity to convert a degraded land into a forested land.

So, that means you basically, take care of the sustainability of an area, you also enhance the possibility of resources or enhancement of livelihood, when you convert a degraded land into a forested land. Now, in this approach what kind of professional help or assistant that may be important. Certainly the foresters would be of great use, international bodies, such as global partnerships on Forest Landscape Restorations are actively involved for this approach. What is the scale in goal for this approach? If you look at that, the especially it works in landscape scale most of the time.

So, having said that, you will see that recent time India is doing reasonably good in maintaining the forest area, in some parts of India we need a little bit extra effort, but overall we are trying our best to maintain the required percentage cover area of forest, we of course, need to do a bit more to keep it in a much better condition.

(Refer Slide Time: 14:55)



Now if you look at the assets of INRM, integrated natural resource management, a very critical slide, so, I would seek your full attention for this particular slide. If you look at that, there are five capital assets that integrated natural resource management has, first one is natural, second physical assets, third human asset, fourth financial assets and the last is social

asset. So, these five assets basically allow one to carry out the integrated natural resource management practices in a meaningful manner. So, let us see that what are these assets, five assets and how actually they work.

First, let us take natural assets. In natural assets, we basically talk about soil fertility, water resources, forest resources, land quantity means amount of area, quality, minerals. So, these are the things, resources which come under natural assets of INRM approach. When you talk about physical assets of INRM, what we actually mean, we mean household assets, we mean agricultural implements like plough, then tractor, seeder, harvester, we mean infrastructure, grain storage, cold storage, plantations. So, these are basically the physical assets within INRM approach.

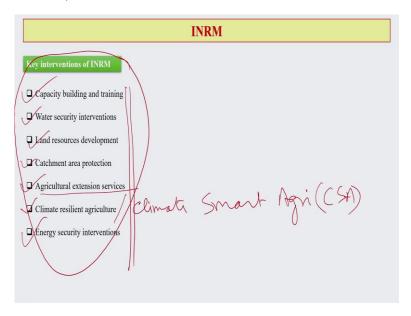
Now, let us come to human assets. So, from the name itself, it is very clear that when you talk about human resources, human assets, we actually mean human resources that mean the knowledge, the skill, the fitness and the availability of individual for maintaining this natural resource base. So, in a sense human asset means, it has to do something with human, individual or group.

Next asset comes is financial, very important here, of course, we talk about the livelihood, the earnings, basically, the credit, the savings, loan, remittances. So, anything which is related with finance money is actually under financial assets within INRM.

Lastly, is the social asset; the most important one in case of the success of INRM is largely associated. All are important, but if your social dynamics social fabric if it is not taken care of and if it has to happen within some rules, relationship of trust, mutual trust is very important of having a success for integrated natural resource management, mutuality of interest. In a community, we can only be successful and we can have proper growth in an area only when we actually take care of almost everybody's interest, it cannot be just one person's interest in a village then definitely it will not be a sustainable.

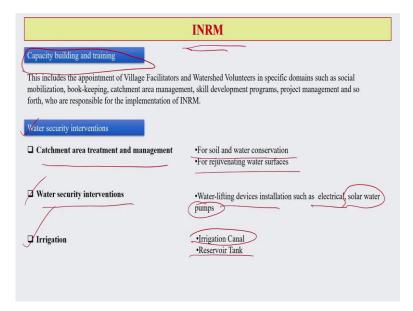
Leadership; critically important for INRM approach, kin and ethnic networks, social organization, self help group, community interactions, all those things actually come under social assets within INRM framework. So, your INRM integrated natural resource management approach, the ingredients for its success, lie on these five asset. So, whenever we go with INRM approach, please note that we need to ensure that these five assets are present with us. And that is the right time to initiate the INRM approach in any area.

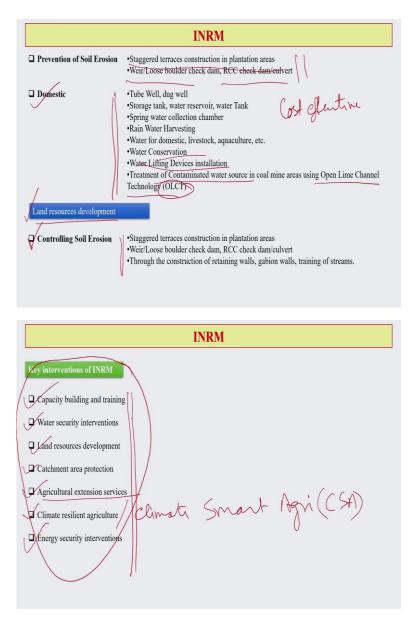
(Refer Slide Time: 19:01)



Now few key intervention that I would like to discuss here. Key intervention of integrated natural resource management, which you could think of first is of course, capacity building and training. That is the most important starting point Water security intervention, land resources development, catchment area protection, agricultural extension services, now, climate resilient agriculture or sometime we also call it as climate smart agriculture, CSA. Then, energy security intervention. So, these are basically the key interventions of INRM, INRM when will be initiated in an area basically, we will be looking at these sets of intervention in an area.

(Refer Slide Time: 19:59)





Now, if you look at that what are the different, so, I will go basically few of these key intervention I will take and explain to you that how actually INRM can go ahead. So, let us take water security intervention. So, water security intervention, what actually we could do under INRM, of course, we need to take care of catchment area treatment and its management. So, catchment area, I am sure that all of you understand it. So, we will discuss catchment area once again in great detail when we will discuss about watershed management in one of the lecture in maybe next one.

So, catchment area treatment and management is actually take care of soil and water conservation different measures and we do it for rejuvenating the water in an area. Then comes water security interventions like water lifting devices installation such as electrical or solar pump. Solar pump is becoming now very popular in many places in India. Irrigation,

yes, we already have a strong network of irrigation canal, reservoir tanks or many other ways that water security intervention can take place under INRM.

But one more important thing that as I said that the beginning of INRM it starts with capacity building and training. So, the capacity building and training is to as you understand from the term itself to enhance the people skill and this actually could include a kind of a training and skill development by external expert or you developed the village people or village youth also as a trainer so, we call the training of trainees. So, they can be trained in various domains such as social mobilization, book keeping, catchment area development, various kinds of skill development, project management. So, these all capacity building and training should be the first step of INRM approach.

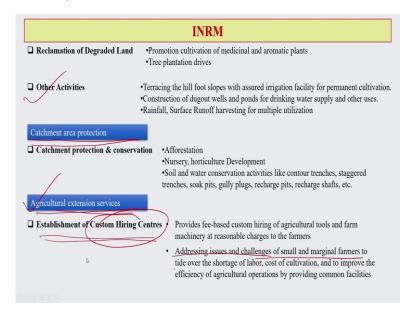
So, within also this water security intervention, we could also take care of soil erosion, which is a major problem in many parts of our country. Soil erosion can take place in various ways through wind, through water; we know that there are various types of erosion can take place. So, there are various ways again to take care of soil erosion, I will be discussing great detail in the coming lectures, staggered terraces, construction, plantation, pasture development, you can use of weir or lose boulder check dam, RCC check dam, gabion structure; there are various engineering structures also can be put in for prevention of soil erosion.

At domestic level we can go for tube well, dug well, small storage tank, pond, rainwater harvesting, we can go for water conservation practices also at household level, small lifting devices also can be installed. Treatment of contaminated water especially in mining areas using open line channel technology which we call OLCT is getting a lot of attention these days.

There are various other technologies also are available at domestic level, but the best way to look at the domestic level is to utilize the resources or processes that are available within that particular community. This is not only cost effective, but also people may not need much training or much awareness because they are already living with these kind of techniques or these kind of instruments or machines within that particular community.

So, local use of local knowledge is critical for INRM at the domestic level. Let us now look at another important resource development or management and that is land resource development. So, again erosion, we just mentioned the previous case. So, controlling soil erosion is a challenge and we discussed that what are the different ways can be carried out.

(Refer Slide Time: 24:34)



Reclamation of degraded land by various means by afforestation or by growing cultivating medicinal aromatic plant, tree plantation various ways that you can actually basically take care of the degraded land and if you can convert as I discussed in the previous slide, from degraded to a forest line, certainly you are going to enhance not only the natural resource base, betterment of ecosystem, but also possibility of enhancement of livelihood. Other activities can be terracing, construction of dugout wells and ponds, rainfall and surface runoff can be reduced by different kinds of structures that we already discussed in the previous slide.

Next comes your catchment area protection, a very important and this particular aspect we will be discussing in great detail when we talk about watershed management. So, catchment protection and conservation is critical for not only water resources management but also for soil or land resource management.

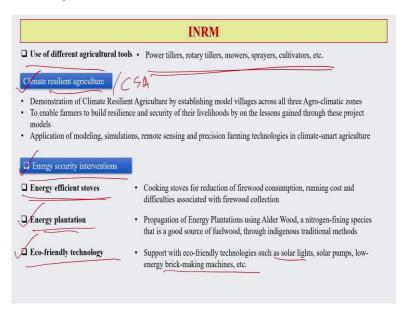
So, afforestation, nursery, horticulture development, soil and water conservation activities like contour trenches, staggered trenches, soak pits, gully plugs, recharge pits, recharge shafts, they are various technologies. So, these can be utilized again, these all those things I will be discussing in watershed management lecture.

Agricultural extension service, the next important aspect of INRM. Establishment of a good network of extension services is critical for any kind of initiative and so for INRM. So, these days, there are also a lot of initiatives are going on for establishing custom hiring centers, what is those, because these provide actually fee based guide custom hiring, so, you pay a little bit and you get tools or machines or farm machinery a reasonable charge.

So, in that case, you may not require to buy a costly implements and especially these days, some of the farmers they prefer to grow crops in one season, the other season they prefer to work something else. For them, it could be a very good options to hire the required machineries and other aspects that are required for the agriculture practices.

Then, addressing the issues and challenges for small and marginal farmers over the shortage of labor, cost of cultivation practices, and then to improve the overall agricultural operation by providing advanced knowledge of agricultural practices and common facilities through these custom hiring centers can also increase the success of INRM.

(Refer Slide Time: 27:30)



Uses of different agricultural tools like these are the tools which also can be used for efficient management of natural resources.

Now, let us come to climate resilient agriculture or climate smart agriculture. So, demonstration of climate resilient agriculture can be carried out by selecting few model villages and then train the farmers then how to carry out these climate resilient agricultural practices.

To make the farmers, to be able to carry out these things, there is a significant amount of training is required by expert personnel. So, that needs to be also taken care of. Application of high end technologies like modeling, simulation, remote sensing, precision farming technologies can also be used for climate smart agriculture.

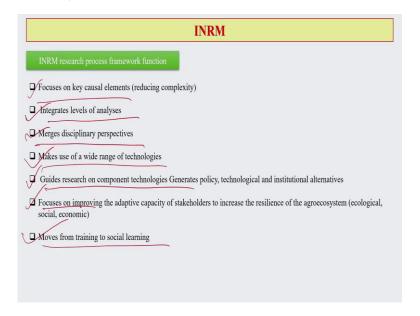
The benefit of technology now has to reach at the ground for the farmers. So, that is one thing that under integrated natural resource management, we need to ensure. Energy security intervention, any activity that you carry it at the field level demand some amount of energy and this energy production also has a link with climate and climate change.

So, it is very important for INRM to look at the energy security intervention or options very carefully. There are a lot of institutes in India, they are coming out with energy efficient stoves, energy efficient burners. In our IIT, Guwahati, some of the labs faculty and students they have worked on this also. So, cooking stoves, efficient burners, they are basically what it does, that it reduceS the requirement of energy or rather I would say that it actually promotes efficient cooking. So, utilizing less energy for more outcomes.

Then energy plantation is another aspect which is going on across the country and world and you may be well aware of different energy plantation. So, fuelwood is in some cases is also important, but energy plantation, one thing we have to keep in mind, it should not be carried out at the cost of agricultural food crops or valuable agricultural crops. So, that has to be also taken care of.

Eco-friendly technology, of course, we need to promote the technologies which are in sync with ecosystem sustainable ecosystem. So, any technology which has a chance of damaging the our ecosystem, we need to really be concerned and we should take care of that, fix that or we need to bring in certain technology like solar based technologies, biogas based technologies for eco-friendly management of system.

(Refer Slide Time: 30:47)



So, these are few important aspects under INRM that we can think of to do it in an appropriate manner. Now, INRM research process, there is a framework which actually can be utilized for appropriate management of this INRM activity. So, what are the research process frameworks that we should be actually aware of?

So, first is that focuses on key causal elements means, what are the main reasons for crisis of natural resource management is happening. So, find out those reasons first. Integrates the levels of analysis at every level whatever analysis we are carrying out, try to integrate them, try to find out that how best that this integration of different analysis can actually promote the sustainable management of natural resource management.

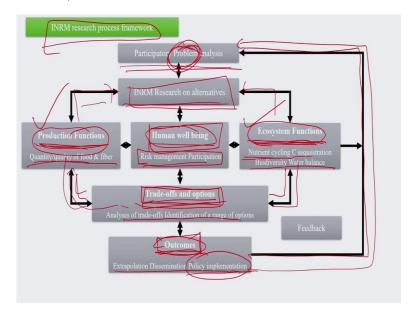
Then merges the disciplinary perspectives into INRM, very critical. When I say disciplinary perspective means engineering sciences, then social sciences, all those disciplines actually should come together and work for the betterment or better way of managing natural resource management. INRM actually looks for that. So, we also should be able to make use of the wide range of technologies that are available with us, find out that which is the technologies has less energy requirement, or which are the energy efficient technology that can be brought in under the umbrella of INRM.

It also guides the research on component technologies, which actually could generate policy technological or institutional alternatives as well. So, INRM and if you see that it, the research process framework also could focus on improving the adaptive capacity of each stakeholder, why, this is to increase the resilience of the agro ecosystem means the people living there, the society, the economic, the financial aspect of that.

So, again, if you go back and think about those five assets, that I just discussed, so those five assets, human assets, social assets, financial assets, these are so important that every moment we need to keep that in mind, if we can keep those five assets in maintaining the natural resource management, we are almost sure that we would be having a successful integrated natural resource management in place.

So, training, we already discussed the training, capacity building, farmers to farmers learning, that is another concept that is being encouraged now. A farmer will learn much easier, much better way from another farmer. So, probably that could be a way that a group of smart farmers can be trained first, and then they become the trainers and they will teach another group of farmers and that is the way the process will continue.

(Refer Slide Time: 34:06)



Finally, that we will talk about INRM research process framework a little bit about that, how it actually can work. So, if you see that participatory problem that comes from the community and from the village, so, we need to look at that how actually this problem can be analyzed and then we should look at the INRM research alternatives to address that particular problem. And to do that, ecosystem functions can be utilized or production function. So, these two can actually help your INRM research on alternatives because those can provide certain solutions to the problems that you have had for a particular community or area.

So, these are all done for human wellbeing. So, when human comes in picture, there would be certain amount of risk involved into that. So, this risk is involved. So, we need to also think about trade-offs and options means if we do X then what happens, if we do Y then what happen? So, analysis of trade-offs and identification of range of options is very important for the overall success of INRM process.

The final outcome is that we would actually extrapolate the learnings from the field to policy development and policy implementation. So, this policy if it is implemented, this will finally take care of the problem that we got in hand from this particular level means trade-offs and options, searching the feedback will be both way.

So, it can come from production system to trade-offs and from trade-offs also the some feedback can go to the production system, same way for ecosystem functioning. If you see that in case of production function, we are talking about quantity and quality of food and

fiber, fodder etc whereas an ecosystem functions we are talking about nutrient cycling, carbon sequestration, biodiversity, water balance, etc.

So, in a sense, INRM research process framework, as you see that it works at the community level from where the problems comes in hand, then you actually try to start research or finding out different alternatives options. And to do that, you need to look at mainly on two different functions, one is ecosystem function, and the other is production function, because these are the two critical, one side as I said that your product commodity on the other side is your environment.

So, these two things will come in and from there basically we are trying to find out the human wellbeing. Then how to go there? Then you comes to trade-off options, where your various options and the feedback goes back to the functions, both the functions and from here, then you get ultimately a result in hand which goes for policy making. Once the policy is formulated, then basically it will take care of the problem that came from the ground. So, this is all in overall, the integrated natural resource management framework.