

Natural Resources Management (NRM)
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Technologies for Integrated Natural Resources Management

We will be discussing about different technologies that we should actually know how to utilize those technologies for natural resource management. So, in the previous classes, we have discussed about different tools and techniques that could be used for participatory rural appraisal, but today we will be discussing about tools and technology which we can actually use practically on the field to manage and maintain our natural resources.


So, today's technologies that we will be discussing, it has to do with engineering technologies in relation with soil, water and plant conservation. So, these three are the major natural resources that we need almost in daily basis for our livelihood, for our life, for our basic sustenance of our life.

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Field based technology in NRM: Case studies

Watershed management Kudi village: Madhya Pradesh

Soil type:- Deep medium black soil
Rainfall:- 110 cm approx.
Main river:- Utawali river



Barren land

Problems

- ✓ Less fertile soil
- ✓ Less and uneven rainfall distribution pattern. Post monsoon rainfall scarcity hinders farmers to grow Rabi crops results low productivity
- ✓ Poor infrastructure
- ✓ High population density
- ✓ Low literacy rate

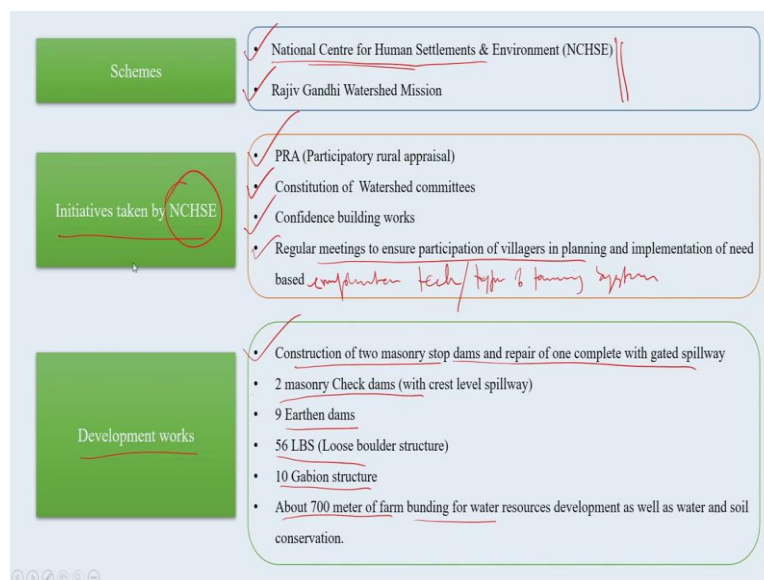
So, I would like to start with the different field based technology that are required for natural resource management. So, in this module, I will be also sharing with you some of the case studies, some case studies where I myself actually was involved and some other case studies which are very successful in one or other way for managing natural resources.

Say for example, the watershed management of Kudi village in Madhya Pradesh. So, if you see that that particular area had some problems and issues before these watershed management practices were carried out, what are those problems it had, less fertile soil, less and uneven rainfall distribution pattern.

So, that means, you had certain issues with also water and when you have some irregular rainfall, then there is some kind of scarcity could arise because your Rabi crop may get affected, the crop which actually you grow in the winter or dry season. Poor infrastructure, high population density, low literacy rate. So, you see the cocktail of different problems, which actually can hinder or reduce the pace of growth of any area.

Now, this particular village, the soil type found to be deep medium black soil, well as you know that black soil is normally considered as reasonably good soil having high organic matter content. Rainfall 110 centimeter approximately, and the main river in that area is Utawali river. And you can see from this picture that how barren is this land. So, in such kind of land to grow certain food crops or any other kinds of crops could be a very big challenge. So, here a good watershed management could be an efficient way to manage the natural resources here soil, water, plant.

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Now, if you see that, what are the schemes actually were available in that particular area. So, you had national center for human settlements and environment NCHSE, Rajiv Gandhi Watershed Missions, these are the two main schemes that were available and working in that particular area. So, utilizing these kinds of government schemes, one can actually carry out

the management practices for natural resources. Now, let us see what were the initiatives were taking in that particular area.

NCHSE have taken some initiatives, of course, they had gone for participatory rural appraisal, they also constituted watershed committees, they tried to build the confidence and then regular meetings and participation of villagers for planning and implementation of various need based implementations of different technology or suppose different type of farming system. So, these are all actually can be utilized for better management of natural resource.

Now, let us see what are the development works actually were carried out in that particular area? They constructed 2 masonry stop dams and repair one complete with gated spillway. They also build 2 masonry check dams, 9 Earthen dams, 56 loose boulder structure, 10 Gabion structure, about 700 meter of farm bunding also they carried out and these all are carried out under this one scheme.

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Major outcomes

- ✓ Improvement in ground water level and enhanced availability of surface water during post monsoon period resulted in increase in irrigation potential.
- ✓ Area under irrigation expanded from 46.4 ha area owned by 9 farmers to 305 ha owned by 90 farmers.
- ✓ Cropped area in Kharif and Rabi seasons increased by 57% and 185% respectively

Season	Year	Area (ha)	Total crop Production (Qt)	Crop productivity (Qt/ha)
Kharif	1997	215.0	2150	10
	2003	338.0	3380	10
Rabi	1997	107.5	1290	12
	2003	305.0	6100	20

Handwritten notes: (C.W.D) → Water level up. Post monsoon good irrigation.

What are the major outcomes of utilizing these schemes for natural resource management through watershed management? First, there was an improvement in the groundwater level and enhanced availability of surface water during post monsoon period because that is the critical period. Once the monsoon goes off, even though you get lots of rain, but if the rain is not stored, then right after monsoon, you might face a problem of water for the next crop. So, if your groundwater is recharged, then you have a chance for doing irrigation if it requires.

Another outcome area under irrigation expanded from 46.4 hectare which have owned by 9 farmers to 305 hectares owned by 90 farmers. So, this is a huge jump.

So from 46 hectare, it has become now 300, 5 hectare under irrigation, where was 9 farmers who had the beneficiary for irrigation. Now there are 90 farmers. What is the other major outcome? Cropped area of Kharif and Rabi seasons increased by 57 and 185 percent respectively, significant jump.

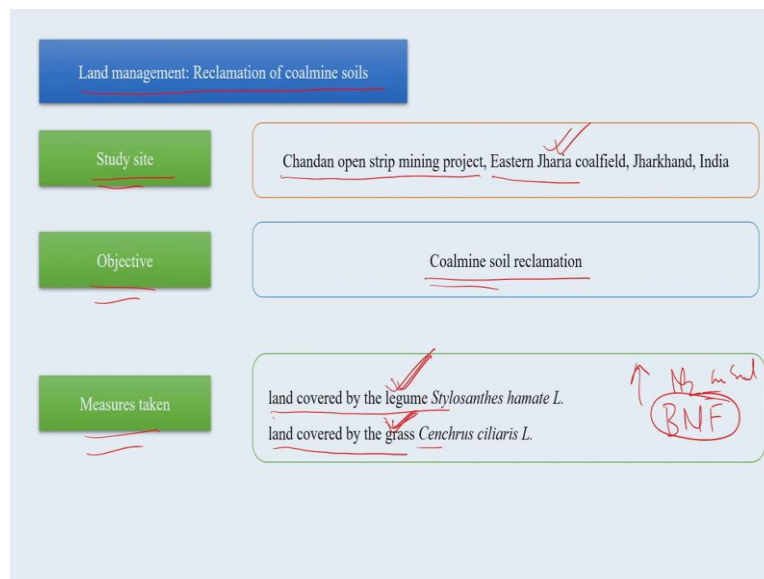
So, you see that if a proper management like in this case, watershed management practices has been carried out, so, you can basically change the life of the poor people at the rural area. So, increase of 57 percent and 185 percent is really something significant and can change the life of those poor farmers.

So, these are some data that actually has been taken from that particular case study. You can see that in 1997 for Kharif crop which is mainly based on rainfall, Rabi crop means winter crop. So, if you see that in Kharif crop, so 215 hectare was in 1997 and that has increased to 338 hectare, total crop production 2150 quintals roughly around 2000 quintal from there it has increased to 3400 quintal. Crop productivity, though remain same, because here the area has increased. So, your total production also got increased.

If you come to Rabi 1997, there was only 107 hectare of land having total crop production roughly around 1300 quintal, crop productivity was 12 but see the jump in Rabi crop. 2003 the area increased to 305 hectare and total production gone to 6001; almost 6 times increased and productivity also increased from 12 to 20 quintal per hectare. And this was possible because post monsoon, you got good irrigation. Post monsoon, you got good irrigation, why? Because groundwater got recharged. Why? Because you had watershed management and watershed management help you basically to restore and manage the water in a better manner.

So your groundwater got recharged. So, when groundwater got recharged, you have the opportunity to increase your irrigation and that is why productivity also gone increased and of course production by 6 times. So, this is one case study to show you the importance of good or efficient natural resource management here largely the management of water that I have shared with you.

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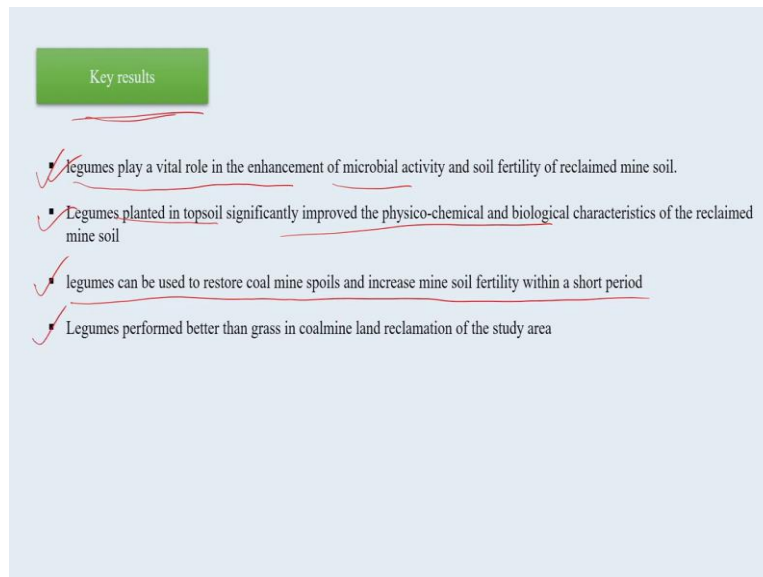


Now look at the land management aspect. Now we know that saline or sodic soil then if some area has mining activities, so those areas soil actually lose its productivity and it becomes challenging for farmers, poor farmers to grow food in that kind of condition literally impossible because soil completely loses its fertility.

Now, what to do in that kind of condition? So, the study site was Chandan open strip mining project. It is in Jharia coalfield which is in Jharkhand. Jharia is known for coal mining, what is the objective? Objective was to reclaim the coal mine area soil near Jharia. Raniganj Jharia is famous coal mine area.

So, what are the measures taken? The land were covered by legume and legume enhances nitrogen in soil through biological nitrogen fixation we call BNF. It is a natural process because legume has a process a capacity to capture biological nitrogen and thus enhance the soil nitrogen content. Land also were covered by grass. So, these two small measures, one is growing legume and one is covering grass simple measure, but that measure also can give you significant result.

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Key results

- ✓ Legumes play a vital role in the enhancement of microbial activity and soil fertility of reclaimed mine soil.
- ✓ Legumes planted in topsoil significantly improved the physico-chemical and biological characteristics of the reclaimed mine soil
- ✓ Legumes can be used to restore coal mine spoils and increase mine soil fertility within a short period
- ✓ Legumes performed better than grass in coalmine land reclamation of the study area

And let us see that how these two simple steps have changed the coal mine area of soil. Legumes it play a vital role in enhancement of microbial activity, soil fertility as I just said that it has its inherent potential to capture nitrogen biologically through nodule in the root system, I will not get into that, because that will go in a different topic, but as of now, you try to understand that legume plant has a natural capacity to capture nitrogen biologically and thus it helps to enhance the nitrogen content in soil.

In soil, if you can increase nitrogen, carbon, phosphorus, all these nutrient content then definitely soil will be better if soil is better than your crop that you produce will be better, if crop is better, if it contains good nutrient which come from the soil only. And then when you eat those food crops, then we also get good nutrients from the soil.

That is why it should be clear in our entire mind that the nutrient in our entire body the sustainability of our health and body system is largely depending on soil because every milligram of nutrient that we have in our body, it comes from soil, because foods are grown in soil.

Well some of you might argue with me that I also take non-veg, I also take say chicken, fine, but if you look at even those chickens also surviving on what, grains only. So that means they are also getting energy from where from grains, food grains and those grains are grown again in soil. So, my just point is to tell that if you can take care of soil, if you can able to manage the nutrient content of soil, soil will take care of your health.

Because our most of the nutrient and energy that we actually derive from food and those most of the foods come from soil. Indirectly or directly we will find that there is a link with soil, soil nutrient ultimately gets into our body system.

Now, legumes planted in topsoil significantly improved the physico-chemical and biological characteristics of the soil. In this case, a mining area soil which is I mean, you can easily guess that a coal mine area soil will be is polluted and not actually suitable for growing crops. But if you grow grass and legume, you can actually regulate or reduce the harmful effects on those soils.

Legumes can be used to restore coal mining soil and increase the mine soil fertility within a very short period of time. Legumes perform better than grass in coal mine, land reclamation of this particular study area; it has been found that legume is better than even grass.

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Forest management

Study site Sundarban, West Bengal, India

Problems

Biodiversity are being threatened because of

- ✓ Reclamation of deltaic island for human use
- ✓ Deforestation, erosion and unwanted accretion
- ✓ Salinity invasion
- ✓ Non judicious exploitation of fishes
- ✓ Floral and other faunal components
- ✓ Ecotourism, bioinvation and pollution
- ✓ Global climate change

Bay of Bengal
Sea

But even only growing grass can also stop another soil problem that is erosion. So, if you keep the mining soil area barren, then definitely there will be much more problem you will have the issue of soil loss. If there is strong wind or rain comes in, if your soil is barren, then it will take away the topsoil. So, if you put some grass then it can reduce the loss of the soil.

Now let us come to another natural resources that is forest, so, forest management. I will share another case study about forest management. Sundarban all of you know, Royal Bengal Tiger, it is famous for that, it is in West Bengal.

So, that particular study area had some problem, what are those problem their biodiversity is threatened, because of what, reclamation of deltaic island for human use means for our use for our good. So, this kind of deltaic one island is being reclaimed for human use.

Deforestation for making house or for something some other purpose related to our survival and our well being deforestation takes place. So, erosion will take place, unwanted accretion. Then salinity, not judicious exploitation of fishes is a big issue there. So, people actually suppose they fish more than what actually they can consume, or they can sell.

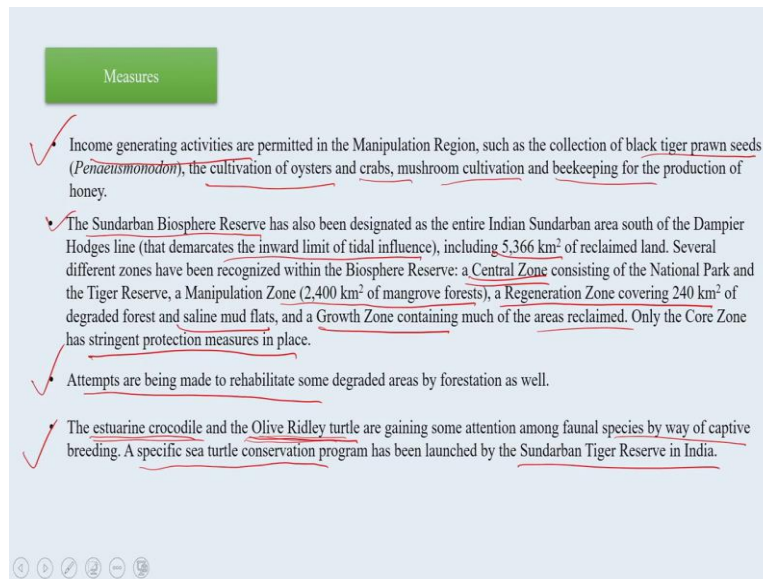
So, that is why it is a non judicious exploitation, and it actually was observed that in some cases, people do fishing so much in the extra amount, that ultimately neither they can consume, neither nor can they sell. So, ultimately, some of the fish actually get rotten. So, instead of that, it is better that you actually do fishing only that much, which is required for your consumption and probably for your business.

Floral and other faunal components are also under threat. Because when you cut trees and clean an island for our for human consumption or human need, then definitely the flora and fauna of that area will be disturbed.

Ecotourism, bioinvasion and pollution, now. Ecotourism if it is done in a very technical way, in a very sustainable manner, it can have both effect tourism plus also ecosystem restoration, but if it is not done in an appropriate manner, there is a chance that it could actually create the cases of bioinvasion and it can also create pollution.

So, you can see that if you go Sundarban area some parts of there, you will find that lot of plastics and lots of waste material by the tourists is actually dropped there. So, even though there are notices and notification, but still people do that. And then on top of that, as Sundarban is near Bay of Bengal and Bay of Bengal like any other seas is under some kind of effect by global climate change. So, these are the problems in hand.

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Measures

- ✓ Income generating activities are permitted in the Manipulation Region, such as the collection of black tiger prawn seeds (*Penaeus monodon*), the cultivation of oysters and crabs, mushroom cultivation and beekeeping for the production of honey.
- ✓ The Sundarban Biosphere Reserve has also been designated as the entire Indian Sundarban area south of the Dampier Hodges line (that demarcates the inward limit of tidal influence), including 5,366 km² of reclaimed land. Several different zones have been recognized within the Biosphere Reserve: a Central Zone consisting of the National Park and the Tiger Reserve, a Manipulation Zone (2,400 km² of mangrove forests), a Regeneration Zone covering 240 km² of degraded forest and saline mud flats, and a Growth Zone containing much of the areas reclaimed. Only the Core Zone has stringent protection measures in place.
- ✓ Attempts are being made to rehabilitate some degraded areas by forestation as well.
- ✓ The estuarine crocodile and the Olive Ridley turtle are gaining some attention among faunal species by way of captive breeding. A specific sea turtle conservation program has been launched by the Sundarban Tiger Reserve in India.

And let us see that what are the measures were taken in this particular site to maintain various natural resources. First, income generating activities are permitted in the manipulated region, such as the collection of black tiger prawns, seeds, and then cultivation of wasters, crabs, mushroom cultivation, and beekeeping. So, all those things income generating activities have been permitted in some pockets of this beautiful part of our country.

Then Sundarban Biosphere Reserve has also been designated as the entire Indian Sundarban area or south of Dampier Hodges line. So, that demarcates the inward limit of tidal influence, which includes around almost 5400 square kilometer of reclaimed land, so several zones have been recognized within this Biosphere Reserve.

So, to name a few a central zone, a central zone which consists of National Park and a Tiger Reserve, then a manipulation zone, roughly around 2004 square kilometer of mangrove forest. Then a regeneration zone covering around 240 kilometer square kilometer of degraded forest and saline mud flats and a growth zone containing much of the areas that had been reclaimed.

So, only the core zone has stringent protection measures in place, but rest of the areas are not protected in that manner. So, the core area as of now is being somehow protected from various negative activities. Attempts are also being made to rehabilitate some of the degraded areas by planting trees and going for different forestation programs.

Then the estuarine crocodile and the olive ridley turtle, which is famous, you might have heard about that are somehow gaining some attention among the faunal species. So, some of

the individual and some of the NGOs are quite actively working in that area to somehow protect this very beautiful species, animal species fauna, in that particular area. A specific sea turtle conservation program has also been launched by the Sundarban Tiger Reserve in India. So, you see that there are lots of initiatives or measures have been carried out to take care of this particular place in Sundarban.

So, in this class, what I actually wanted to discuss with you is to give you some real case studies, through which I wanted to just share with you that there are ways, there are means available with us, not only technologies, but also various government schemes, which we can actually utilize to manage our natural resources, land, soil, water, biodiversity. So, these all are possible provided that we have a very smart plan in hand and we need to converge various schemes that are operating in different parts of our country.

And in particular, if you consider a single site, where do you want to focus on, you first need to find out that what are the different government schemes are working in that particular area, which has some kind of scopes or some kind of avenue to take care of natural resources. So, your job would be to leverage that. So, link your plan, exercises, implementation plan with those avenues mentioned in those schemes. Then you must work with the community as well as the other stakeholders like the state government departments, the NGOs and individuals working on the field.

Remember, only through government effort or initiative, managing the natural resources is almost impossible. As a citizen, every one of us has also responsibility to take care of this. And I am hopeful that looking at these three case studies that I have shared with you, I hope you understand that this is possible, we can make it provided again I say that we have a smart plan in hand and we are ready to work with all the stakeholder present in that particular location. So, we will follow up this discussion in the next section of my lecture.