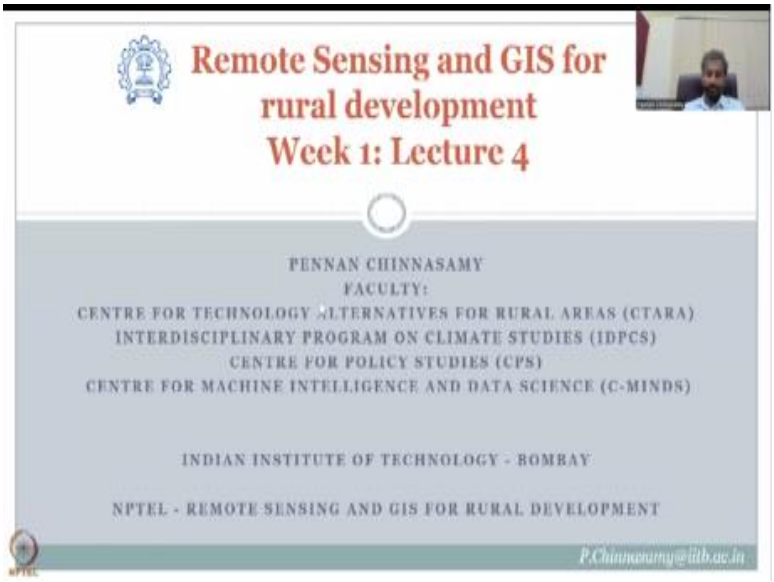
Remote Sensing and GIS for Rural Development
Professor Pennan Chinnasamy
Centre for Technology Alternatives for Rural Areas (CTARA)
Indian Institute of Technology, Bombay
Week 01
Lecture 04
Agriculture and rural infrastructure issues

(Refer Slide Time: 0:16)



Hello everyone. Welcome to today's lecture on Remote Sensing and GIS for Rural Development. This is NPTEL lecture week 1, lecture 4. As I indicated throughout this week, we want to sensitize you on what rural development means, how it is a multidisciplinary approach, and how we need to look at it with different lens so that we understand that remote sensing and GIS can be an effective tool for rural development.

In the past lectures, we have seen examples from water security and its role in rural development. In today's lecture, we will include some learnings from lecture 3, which was on food security for rural development. So, we had water, we had food. How does it get to the public? Through infrastructures and stuff, transportation. So, there are multiple other parameters that are needed for rural development. It may not be as important as water and food, but it does holistically play a role. So, let us look at today's lecture topic.

(Refer Slide Time: 1:59)

As indicated, we want to look at agriculture and rural infrastructure issues. For any development to happen, we need to have optimum infrastructures. As humans evolved and livelihood developed, infrastructure has become a key. Let us take an example. During evolution, humans were mostly segregated along the riverbanks or in forest, the infrastructure was very less.

The most advanced civilizations, which now they are finding, in South India, along the Cauvery Basin and also in the Mohenjo-Daro Harappa in the civilizations, you would have seen infrastructures placed; drainage, roads, etcetera. So, once these are placed, the development happens. Humans began to move from the riverbeds, from the forest into cities, make cities, urban cultures, etcetera. For this, infrastructures was key. However, the rural livelihoods were left behind.

So now, we are going to go back to rural infrastructures and agriculture infrastructure so that they can also develop. This has been taken up very importantly by the Government of India, especially under one ministry, which is called Ministry of Agriculture and Farmers Welfare. And they have created a lot of funds. More specifically the Agri Infrastructure Fund. You could see the logo that has placed below, the government of India's, ministry logo and the subsidy agency on giving funds for agriculture and infrastructure.

So, you have a house picture, and you have a farm and growing crops, etcetera, and you have shelters, or a tractor, everything. So, all of this is inclusive of infrastructure. So, the logo has been very, importantly created, taking into account that agriculture and rural encompasses

domestic houses also, food production, food security as in crop production, and storages for vehicles, transportation, etcetera.

So, as I have mentioned, it is an important aspect of rural entities. For a long time, it has not been given the new credit, but slowly and effectively, the ministry is putting a lot of funds and mobilizing capacity to attain rural development in the agriculture and rural infrastructure area.

Let us look at this infrastructure separated as agriculture and rural. You would see that rural encompasses agriculture, but just for your learning so that you can apply remote sensing and GIS tool later, I would like to differentiate it here. So, you have agriculture infrastructure that includes the water resources. So, water security we have seen in lecture 2 and 3 is mostly on identifying water storage areas, looking at encroachments, those kind of things.

Here this is resources as an infrastructure. For example, irrigation cannas, lakes and bunds. So, these are manmade lakes opposed to, natural lakes. Bunds which prevent water from fill overfilling out, of the canal area, or protect your irrigation and keep the water inside the field. So, these are infrastructures that are needed for water resources. The biggest infrastructure is your dams. So, hydro dams are there for power, but also they store water, and that water is slowly released by irrigation. So, this performs a key agriculture infrastructure.

Also, there is two aspects, centralized and decentralized. Centralized is like a dam, and you hold all the water at one point and then slowly distribute it, whereas a decentralized approach could be like small check dams, where instead of one large dam, you are putting it in different locations as a decentralized approach. So, this agriculture infrastructure has become a very, very key aspect of development.

What else comes under agriculture infrastructure? Land development. When we discussed food security, we mentioned that to increase the food production and crop yield, we need to intensify the crops, or we also need to increase the yield. And the least component was to get more land for agriculture. And that comes under land for development. Basically, the idea is to take barren land, deforested land and convert it into sustainable practices like agro forestry, where you have a forest and some agricultural activities, or you take a barren land and create agriculture in it.

So, if you go to, the regions that I worked in, Dahod and other, places in Gujarat, you could see some stretches of barren land, and they have become barren because the water resource

was not there, or the soil fertility was down. So you could create some infrastructures to develop this land for agriculture. So, land development goes into rural development because it develops the economy, it develops the crop yield, etcetera.

The other agriculture infrastructures would include agricultural equipment, which as you see from the logo bottom, that is a van for transporting agricultural produce and a van that can bring in fuel for the agricultural pumps, fertilizers, pesticides, and even labour. Because sometimes if you do not have labour, you go to different villages and bring people manual labor, and then you use it in your field. So, this agricultural equipment is also a part of rural infrastructures.

Missionary to be specific is also included and information systems. So, missionary could include your tractors, your harvesters, etcetera, because everyone cannot buy an harvester. It is a huge machine. However, you can rent it through agriculture infrastructure schemes or a village panchayat might have it, and you can share it between your farmers in your village.

Information system is more on data and data acquisitions. Nowadays, farmers are also brought under the smart farming umbrella where data and advisories are given to farmers through their mobile phones, through TV and radio media. And this information is used by farmers to understand climate scenarios, to understand flood warnings, drought warnings, and plan agricultural activities.

So, for example, if you know there is a flood coming, the farmer would lessen the crop area or use a different type of crop, which is resistant to floods. Another way, if the prediction is very high for a drought, then ensure putting crops for a 100 acres. The farmer can, the village as a unit can plan for 50 acres so they can share the resources more effectively. So, this is where data is converted to information and information is used to take a decisions.

The final one is the center part that you could see in the logo building infrastructures. So, this is also part of agricultural infrastructure, wherein building infrastructures include greenhouses, warehouses, small industries connected with agricultural production. For example, you will have some, post-processing of, harvested food crops, and then packaging rice dehulling, millet, dehulling, or making jaggery or making ragi flour. All these can be small industries that are connected to agriculture production, rather than taking your millet or your rice and dehulling in a bigger industry, they can do it where they harvest it, because the hull is also used for other aspects of oil agriculture or oil production.

Greenhouses can also be differentiated as nurseries and a greenhouse just to grow crops. So, if you grow in certain areas, along Maharashtra, you will see a lot of horticulture in greenhouses because there is a big demand for fruits for the Mumbai city. And the fruits cannot grow every season because, Mumbai, for example, Maharashtra has a very good rainfall season and then followed by, hot summers and stuff, windy, three months or not, etcetera.

So, having the same fruit throughout the year, the demand is high because Mumbai is a very vibrant, demanding society, which requires lot of fruit and spinach and stuff, which cannot be produced every month in the normal setting. So, a greenhouse can be erected. These crops can be grown in a sheltered environment. The price is high. Mumbai can pay the price, but the produce is needed, so that produce can come from greenhouses, which is protected from the climate elements. And inside they can have even water supply, sunlight, artificial sunlight, supply, et cetera.

Warehouses are houses, as I said, you can store your equipment for sharing, your, houses for pumps and other oils and other things. So, mostly missionary storing and sharing for between farmers. Silos and tanks are mostly for food crop storage. So, once you have harvested it, sometimes the market is so low that the farmers will are reluctant to sell it. They know, and they know for sure within 10 days, the price will go three times higher. So, what they will do, they will store it. They prefer to store it or later harvest the crop.

Later harvesting can impact the quality of the crop. So, normally they harvest in tank, and then they store it. They want to store it in silos and tanks, and those silos and tanks come under building infrastructure. These silos and tanks require a lot of instrumentation and energy and power. All these energy and power also come under agriculture infrastructure. For example, power needs to be supplied to keep the humility under control in these silos and tanks. Otherwise, with excess moisture, the crop will lose.

The last is energy production for and from agriculture, which means how do you give energy to agricultural activities is also part of infrastructure. So, key thing is you do not see nowadays power towers in cities. It is under the ground cables. But in villages, you cannot do that. So, there is towers, some big grid, and then from the grid, it goes to small poles, and then the poles are connected to your electrical equipment or, or a small powerhouse from where you can, take power for your pumps, for your other electrically operated systems.

So, there is a lot of energy that is needed for agriculture, and that can be supplied effectively using agriculture infrastructure. So, that infrastructure, the grids, the poles, wiring, everything comes under power for agriculture. The second aspect is there is also an energy that can be made from agriculture, and that is also an infrastructure. For example, biogas.

A biogas plant is a, a big container where people collect the, for example, cow down. They take the cow down and also the based water and etcetera, mix it well and put it into these containers, which is air locked and kept under a pressure. And with that pressure and some microbial activity, you do get a biogas. And that gas can be used for (cons), consumption, using pipes which are connected, to the rural cooking stoves and stuff. Or it could also be sold.

But right now, the quantity is not as big to be sold in market. However, the local entities argo get gas because we do not have enough firewood and other sources for cooking in villages. In those days, there was enough, firewood and cow dung, patties we call for cooking. But nowadays it is not enough as, as, now the population is high, the food demand is high, etcetera.

So, for that, there is a good demand for biogas because again, it is going to raise, and this is more effective rather than, making patties and drying it, and then using, or we call cow dung cakes and then burning it, for, in chulas. So, rather than that, biogas is well used. So, all of this comes under agriculture, infrastructure. Agriculture, waste management, which is part of the biogas, idea I was giving, is also part of the agriculture infrastructure.

Another part of agriculture waste management system is how do you convert the waste into product? For example, you harvest rice. There is a lot of husk that is remaining. You harvest corn, there is a lot of stock. The stick, the leaves, and all those are remaining. How do you manage it? India has been known for, especially the north parts has been known for stubble burning, which is after they harvest, they burn the crop, the residue crop, so that they can prepare the land for the next harvest or next farming, that is very unsustainable.

You are actually burning the nutrients, and more importantly, the pollution, air pollution is so high. So, Delhi, pollution is really affected by stubble burning. This happens elsewhere also. So, for example, Indonesia, when they burn, Singapore and Malaysia have really bad air quality warnings. So, how do you convert that into a resource, is what agriculture waste management is about. And that requires agriculture infrastructure.

(Refer Slide Time: 19:33)

What are the issues? So, we have discussed about our infrastructure. Let us look at these issues. One, we discussed about the water resources and how do you build small check dams and, wells, big domestic wells for public water supply, and all these, tower and big storage tanks for water. All these common agriculture and water resources in rural areas.

There are a lot of issues, defunct irrigation structures, which means people have not managed it, or climate extremes have demolished it like a big flood, and it has been broken. Again, there is no management, after the flood. And so they become defunct. Defunct is it cannot be used optimally. For example, like this, you can see, a huge check dam that has been built across this stream or river network. However, it has been, bro, half as in broken. So, once it is broken, that is, there is no use for this unless, and otherwise the full thing exists. So, that is one.

The next one is you see a well and the well on the sides, and there are root zones and, and roots coming out. And more importantly, rocks and are all falling inside. So, there is less management and the well depth has increased. So, these are also part of defunct water storage structures. There is a lot of encroachments. So, if you have these check dams and water, there is a pathway through which water comes.

So, let us take a tank. A tank is a big structure which stores water and water flows from all directions. So, unless and otherwise water flows and comes into the tank, you can use it. If you do not, if you block all these pathways where water can come, then it is an issue. So, that is called encroachments; limited maintenance. I have spoken about if people do not maintain it, it is lost.

So, for example, when these are built, it is built by the government hoping that the people who are using it will take care of it. There is no budget for maintenance. There is a budget for building it. The people who are using it should take priority, take ownership, and then maintain it. But that does not happen. So, there is a good idea to map all these structures and give the government so that they can know where development can happen.

Land development, less understanding on land development or sustainable land development. So, that is a critical issue in agriculture infrastructures. People want to just demolish and, say it is going to be converted to agriculture land. That is not easy, and that is not correct. Like for example, you cannot cut forest and then use it for agriculture.

Agricultural equipment, missionary and information systems. There is lot of data analysis needed. There is need of data to look at what kind of equipments is needed, how many people are going to share, and what other Return Of Investment ROI. So, for this, there is a need of data which does not exist. For the building of infrastructure, energy and waste management, there is lack of funds. As I said, it is very important system, agricultural systems, but the government cannot pay everything by themselves.

So, normally there is a subsidy given, 70 percent paid by the government, 20 percent paid by the people, and 10 percent from private agencies. So, there is always, a give and take, the percentages differ, but there is always lack of funds and where to put it. For example, this check dam, if you put it near a particular person's land, then the, the owner of the land gets more water.

But no one will give their land for the river channel because they are losing the land. They want it next to the land, but not on the land. So, these kind of issues are there. That is what donation is about and the regions where to build infrastructures. There is always data gap that exists. So, how to take care of the data gap, how to analyse the data with available data is key. And for that, this remote sensing and GIS course will definitely help.

(Refer Slide Time: 24:03)

The next thing is rural infrastructure. So, we have looked about agriculture infrastructures, in the remaining time for today, let us look at rural infrastructures. So, there is an agriculture infrastructure, and that is always part of rural infrastructure. But on top of that, the non-agricultural thing can be added, especially domestic. So, the rural entities needs are combined here as rural infrastructure and issues.

Let us take for example, the rural water supply. Please understand that the rural population gets much, much less water compared to an urban population. It is called litter per capita per day, LPCD. So, the rural water supply is always less and has increased its connectivity through the very, important schemes, ambitious screening schemes by the government of India.

We have a rural water supply scheme through the Jal Jeevan mission, but supply needs to increase. So, there is pipe connection, but there is some issues with water supply, which means how much water is coming in. Issues not due to the processing of the water, but the availability of water. Because if the lake or the dam is running out of water, where will the water come from? The pipe. So, that is part of the rural water infrastructure.

For example, these pipes, storages, et cetera. So, there is still, even though pipe supply exists, you could still see kids and especially girl children walking with, pots and, buckets and, these kind of storage containers to fetch water and then come clean the vessels and then go to school. So, mostly they lose their school time. They are tired, they cannot read well. So, this affects the, especially the women's empowerment. And there is a lot of studies on this. So, it is very, very important.

Rural housing. Still, lot of people live in makeshift houses, mud houses, which do not stand for a flood. So, there is always a need to build sustainable houses. Where to build, how to build this kind of remote sensing course can exist. So, schemes exist, but needs to be extended to all regions because, there needs to be a map where to build these structures. And then the rural water storages is also different. So, there is a supply through pipes, and I have already explained that there is also a storage need.

So, you have these containers to store water, but are they placed in right locations so that it is accessible to the kids? You cannot have it kilometers away or only for 10 population, 10 households you can put one storage and then 50 households have to walk to this 10 location is not correct. So, there is some kind of mapping exercise that needs to go to bring optimum water, and can it be placed near a location where water supply is high? For example, there is a groundwater availability. All it needs is a groundwater pump. So, you can put a good groundwater pump, pump it to the storage, people can take it from the storage unit.

The last and most important thing is rural hospital schools and daycares. These are building infrastructures. In a lot of locations still, the rural hospitals are limited or challenged because of construction issues. The schools are in not proper conditions. At least in my parts, when I go to the field visits, you could see that the rural schools are not maintained properly. It was built well. However, the maintenance should have been started by the public who are using it. So, there is no budgets for these schools to maintain.

Daycares are important. You could see here still, women working with their kids tied to them, during tea plantation or agricultural activities. However, that is not good. The, if there is enough daycares, then the kids can go there, play, eat a good anganwadi food, and then get nutrition, get rest, rather than going with the mother for this work. So, on one side, the mother has to work, but also take care of the kid for daycare can help for that.

So, connectivity during Covid was really bad. The rural, connectivity as an internet connectivity. So, that is why schools had really faced a problem and children had to work kilometers to just get good signal and tower to take classes. This is, a rural doctor, who also an anganwadi location, where you can see that, there is a ration with nutrition food packed for people. But are they placed in right locations so that is accessible for the people is key. Location and access accessibility is always key.

The last thing, which, I would like to stress on is the sanitation. Sanitation comes from water. If you have clean good water, you can clean yourself. Keep healthy, keep needs so that

diseases do not occur. Especially diarrhoea has been a big cause, for child mortality in rural India. It is very, shocking. So, that aspect can be brought down considerably if we can map the water resources and from where the water can be supplied to the rural villages.

The last is rural roads. On this segment, you could see the last picture here, which is right next to the rural roads. Lot of roads have been lost due to erosion, rivers cutting through, dust and rough roughness. So, typical problems on gravel roads, but that is what you can find mostly in rural villages. The maintenance is bad or sometimes it is quickly done, not properly laid.

So, it has to be mapped. It has to be mapped, because these are the roads that bring food produced from rural entities to cities and villages. So it is very important to construct these rural roads and map them to sustainable locations so that you can, access these roads through is. And these are the roads that also supply to your transportation needs. Buses, which can take you to hospitals, schools, daycares, and most importantly, the food produce from the villages to the market.

So, I remember when I was in my village days, when I was going to college, the same bus, which is at 6ix o'clock or 6:30, the bus would take the early early school going kids and college going students like me along with all the produces from the local village. So, the bus would be having only half the seats and half was kept for people to put the produce to go to market. It was a special bus that ran in the morning.

So, I would say that my village was blessed with good road and good bus connectivity. Maybe extra buses could have been released, but that depends on the route and the use, use of the buses. But there are many, many villages without this connectivity, the road has to be well maintained, and once the road comes up, the bus and bus stops can come, and that can create more connectivity from the rural village to the market.

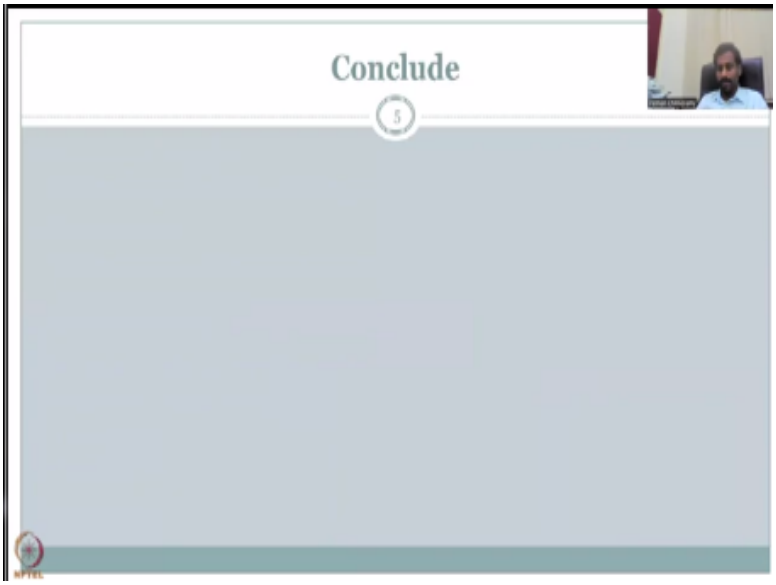
Higher education for the kids, better hospitals. The, the rural hospitals are good, but for example, you need to do a surgery. You need to do some, higher end activity for medicals, you have to come test, blood test, ECGs, and specialists. For consultants, you need to come to the city. So for that, there should be good rural roads. I cannot stress the fact about roads. Roads are, as important as any other rural infrastructure.

We, will be had very good rail connectivity. The, the rail connectivity was very good because of the business opportunities that the British wanted to do. So, this was pre-independence rail

connections I am saying. They laid a lot of rail roads. Why? Because they wanted to connect all the parts of India for business. But right now we need to concentrate on creating local business and local rural development for which rural roads are important.

And as I mentioned, these roads also connect you to the train stations and other stations that take you elsewhere across India. So, this is important, these are the rural infrastructures which are part of agriculture, but on the overall, it is also for health, storage, education, accessibility, communication, et cetera. It is also part of it.

(Refer Slide Time: 33:39)



So, with this, I would like to stop today's lecture. We have looked at rural infrastructures and agriculture infrastructures. Agriculture is a subset of rural infrastructures, and it is a very specific on food production, whereas agriculture infrastructure could encompass everything along with most importantly, the rural population. With this, I would like to stop today's lecture, I will see you in the next lecture. Bye.