Remote Sensing and GIS for Rural Development
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Week 2
Lecture No 04
Remote Sensing for Rural Infrastructures

Hello everyone, welcome to the NPTEL course on Remote Sensing and GIS for Rural Development. This is week 2, lecture 4. In the lecture 3, we looked at Remote Sensing and GIS has a tool for rural development in the sectors of water crop yield. We did say that, we will also introduce it in the infrastructure theme. Since infrastructure can be broken into multiple sub themes we have kept it as a separate lecture. So, let us get into lecture 4 of week 2.

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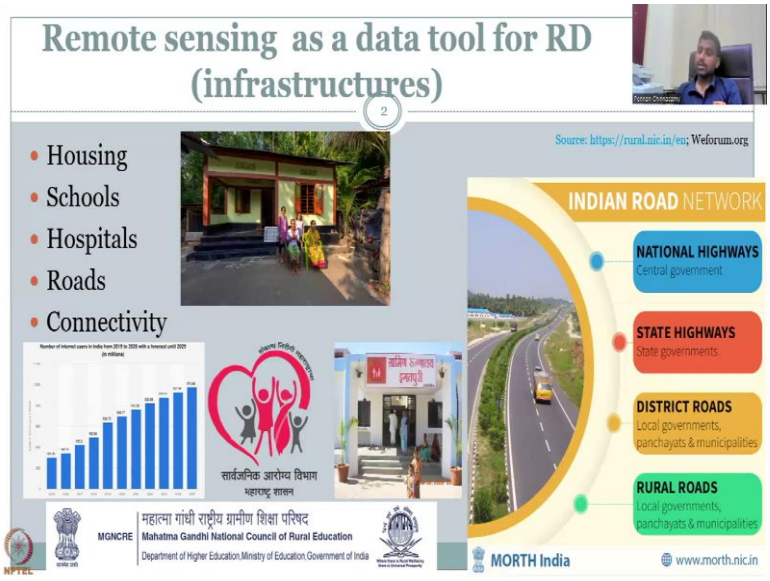

This remote sensing has varied applications for rural development infrastructures. So, there are infrastructures that are needed for rural development. In week 1, we have already given some snippets, some examples of how to use these infrastructures for rural development. In today's lecture I will also reiterate some of these, while we look at the examples. Let us say first housing, a good housing is needed to sustained rural development for a long term.

If you look at the current climate change scenarios especially floods, flash floods houses are washed away and along the coastal regions there is always a fear of losing the houses to incursion of seawater. Because sea level is rising, if you look at Bangladesh and other places. So, you would see like big flood comes and along the coastal regions houses are washed away.

So, housing becomes a very important aspect of rural development, be it with climate or without climate you do need a house to live basic amenities water, food, housing. So, water and food we discussed in the last lecture, in today's we are discussing on the infrastructure and of the infrastructure the most important housing. And unlike your cities where you can have alternate housing, it is not available in rural areas, especially tribal areas, areas along the forest borders, there is a need for better housing, excuse me.

So, we will look at that aspect for example the rural development ministry or ministry of rural development which I explained in the first week's lecture has already invested in multiple programs for building these rural houses. These are very unique because it is not along your major highways, it is along not along your electric power grids or water lines because people are staying in a particular region, where they have their field, agricultural field and or where the water is available for their livelihood, rural livelihood. They cannot commute like they do not have a bus, train like in Mumbai you catch a train to go into the city and come out for work it is not available.

So, the best they could do is stay very close to their livelihood options farming, forest aquaculture, fish, cattle rearing, rearing is very important they have to take it to different different patches the sheep, goat, and cattle I am talking across India, so all these are very important. So, what happens is their houses are somewhere along those lines and not along the major roads and major water supply for drinking or electricity.

So, these houses are carefully done by the ministry, if you could see there is also a solar panel and there could be a water purification filter but mostly these areas may have good water like maybe they are using river water and boiling and drinking, but if they the government has identified pollutants the best thing to do is filters. And lot of rural filters are being introduced for water drinking.

So, these kind of housing schemes are available in the Ministry. Next is schools, so once you have good houses for your livelihood options the next generation, the children the kids they have to go to school, they have to get some knowledge from the schooling levels and for that school is needed. They cannot commute far away nor can they take online classes like NPTEL because of power issues or Internet issues et cetera. They can download the material and come and see but not as easily as in a city.

So, schools are very very important because they have been their literacy rate is always less in rural villages compared to urban centers and one of the reasons is the accessibility to

school is a issue you cannot walk three hours to go to school, people have done that, a lot of students still walk a lot of kilometers to go to school in rural villages. It is because schooling cannot also be catered to one person because as incurred cost but on the other hand they should not be let out of the system. So, what can be done?

So, mapping through remote sensing helps. These are very very important schemes by the Mahatma Gandhi National Council of rural education, which also ties up with the ministry of rural development. After that hospitals, traditional medicine is still practiced in some rural villages, however there is always a need of hospitals, clinics, public health service. So, India is very proud that during the Covid vaccination program villagers were also vaccinated and that was achieved through these rural hospitals.

So, the location and monitoring of these village hospitals health care clinics or it is called by different names in different states because there is a state agency and a central agency, these rural help infrastructures have to be mapped. So, that the people load how much people come in and go can be accessed and how to supply medicine and other infrastructure can be met.

So, there is an examples of putting houses in correct locations but not climatically correct locations. So, there has been moved but schools and hospitals also in the past there has been put in locations where people did not use it because it is too far inaccessible and with other issues, these can be greatly avoided if it is mapped.

The final thing that connects everything together is roads. So, from house to school if it is a good road is there schools can be occupied, again a house to hospitals if the road is good they can quickly go and get health care and most importantly roads also provide transportation of their produce the livelihood options that they do could be crops it could be your milk, dairy products, the aquaculture, cattle whatever it is, in terms of sheep, goat, chicken, poultry everything needs a transportation.

And that transportation is through National highways, State highways, District roads, and Rural roads. The green part the rural roads is less documented because National highways it is very well documented even Google Map picks it up, there are stores where the if you use it you pay, so the quality is monitored, the accuracy of the map of the roads are all monitored.

Then when you come to State highways, some state governments do monitor it very well as per national standards, but also depending on the budgets, there are different status of State highways. District roads comes under the local governments, panchayat and municipalities,

whereas the rural roads come under the local governments and mostly the panchayat, if the rural is concurring to a municipality it does 50-50 percent but mostly the panchayats, gram panchayats they take care of it. They do not have the capacity to put it as a map.

So, for example if you use your right services or Google Maps to go to these villages, it will be enabled as unnamed road, but if you go to the village, there is a name for the road. There is a specific name but it will be on the map as an unnamed road and sometimes the road is not officially on the map but when you go there, there is a road. It may be going through a public property or a private property like public as in school grounds it will go through or in a private it will go through a particular person's land, the land owner was generous that people can use it they do not care maybe it is a barren land.

So, they did not do much it is not a official road which means like paved road or cement or tar put road, it is a just a barren land. However, if we map these school children can go to school fast, because school in rural is not as cumbersome or cannot be as loaded as in urban cities because after school the children have to come back and work in the village farms.

So, my father would still after college and school go to his farm and pick vegetables, put water, apply irrigation water for the field and all it takes considerable time. So, when I in my leave days I used to experience that when I go in summer and holidays I do the manual labor it is painstaking. So, understanding that the load, the curriculum and the timing of the school is limited, after school, maybe after lunch they will come back play and then take part in the family's agricultural activities.

In some cases or most cases they wake up very very early in the morning, help the parents in the field and then get ready to go to school. There are a lot of dropouts because of the rural conditions they have to support the family. So, they may be dropping out of school to take care of the farmland, however if the school connectivity is good then children can come back to school faster, learn and then go back if needed to help the farms, the priorities are like that. Correct, they have to run the farms. So, education is good but at the end of the day they still have to help their parents.

So, connectivity is not only in the roads but also your communication devices. The government has put a lot of emphasis and budgets on giving advisories to farmers using the agriculture universities, KVKS and IMD kind of advisories. However, if the rural house does not have cell phone connectivity, then the advisory that comes to the phone is delayed let us

say for a coastal community the advisor is do not go to the see, because there is a flood growing, there is a big flood coming.

However, if the advisory is not received in time and the fisherman goes into the sea there are high chances that they will be caught up in the cyclone, storm et cetera. So, this connectivity is very important for their livelihood, also for this course and this Covid, the last two years has clearly indicated that when there was a big lockdown, schools had to still continue and they continued using good connectivity.

Suppose in lockdown there was no cell phone networks, how would the classes been run even IITs we did all of the classes in online mode because we could not have a students in campus during the peak lockdown. So, exams were conducted online. So, all this requires high bandwidth or at least good quality bandwidth, which is not available in rural entities. Think about this if there is a connection given and there is a big population feeding on to that connection the cost of the connection comes down per person.

Because to set up a tower and give connection there is a cost let us say 5000 rupees 10 people will share it, it is 500 per person but in a rural village, there will be only two for that particular area coverage and they cannot afford 2500. So, affordability of the good connection is also there and that is where there is a government connectivity given to rural villages and that has to be also mapped.

So, these are the key infrastructures there is multiple more but as the government has indicated I am pulling it out from their reports these are very very important for Rural Development. So, now let us see how the number of intern users in India has increased in millions and it is a good linear curve, every year you know see increase. And most of them are from urban centers, however the rural entities are also catching on.

They are coming to get good education through internet services and also for leisure you can see a lot of apps being used video apps, they show the videos or dancing, songs, culture, cooking from villages have been taken in a phone and then they broadcast on an app. Since we cannot promote an app I am not saying the name but you know which apps are used for sharing of videos and stuff. So, this is very important to understand that, that has also become a livelihood for them and for that livelihood there is a need for good connectivity.

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Let us say how the government has been using GIS and remote sensing for specific purpose of housing status and geotagging. So, there is this website dashboard, if you go on to the minister of rural development, you can look at how many houses through the government scheme people have been registered, how many of them have been built and geotagged. Geotagged means at a particular location the house presence is confirmed using a picture and with the geo coordinates which is that location, let us say an address a geology GIS address and that address is put in the database and this is the dashboard that comes up.

So, now the government officer can see, how many of rural population have requested these housings schemes under the housing scheme, how many houses have been requested, how many have been built and then geotag. This this eliminates the corruption, this eliminates the middlemen, who try to trick the villagers by saying that okay I will get you the house but they do not get the house.

So, here farmers and rural villagers can go to these banks get the money, build the house, and they have to show when the inspection comes how the house is ready and how it looks like. Once it is approved, it gets geotagged and goes into the system. The next is housing sanction how many houses have been sanctioned and how is this completed. Because the budget is not released as a lump sum, they will give 50 first and then you have to build and once you show some progress and the geotag is done the next 20-30 percent and then the last 20 percent.

This is to avoid also people using this money for livelihood options there has been cases where people took the money invested in agriculture or invested in their children's marriage, higher education, bought a bike, something, but that was not the reason for the scheme, the

scheme is to provide housing. So, the government said how do I manage this kind of illegal activities.

For that, this geotagging GIS based remote sensing based helps basically at the location the villager has registered for a house and they have been sanctioned. So, the blue and the pink money has been given. So, now has the site the area where the person is being is building the house has been geotag or put it in the GIS database, if it is green if it has been put in the geo database, then you can easily use satellite to look down on that particular point and see if the house is made.

Sometimes there is a tree covering those are very less number of outliers we can remove but most of the time the houses can be seen. Because 10 by 10 meter resolution is a pixel, 10 by 10 and 10 by 10 definitely you will get a house bigger than that. So, if you look at when the beneficiary was registered, let us say 2010 the beneficiary registered the site was geotag 2010, the money was given 2011 and the house claims to be built in 2015, so 5 years, 2010 to 2015 this database has been populated.

Now I can run the remote sensing data before that let us say 2008, 2007. I can look at that specific location and I will not find a house and now I can take a data from 2016 and if I find a house they have completed it. This we can do with zero cost only the manpower for the person who is doing this, salary is enough. But think about going to the ground and checking each and every house that is very expensive time consuming and there are places where people will wrongly enter the details there could be a lot of data massaging. So, to avoid all of that we will say that, no we will we can use remote sensing.

So, I have given you a clear example of how remote sensing and GIS can aid here, it can also aid in the other infrastructures that we have discussed. So, one is the housing, yes you can look at the beneficiaries, the schemes et cetera and you can also look at where you can build a house.

For example, if a 2010 data remote sensing data shows floods and 2015 they are building the house in that area or proposing to build then we can warn the government saying that no as per the data this land has been flooded, so please do not build. Why would the people not know this because they tend to forget. So, exact locations where the flood happened, how thick the water came they will not know, but remote sensing captures it, how the extent of the flood, why the flood happened is it a normal flood or a 100 year flood everything is documented.

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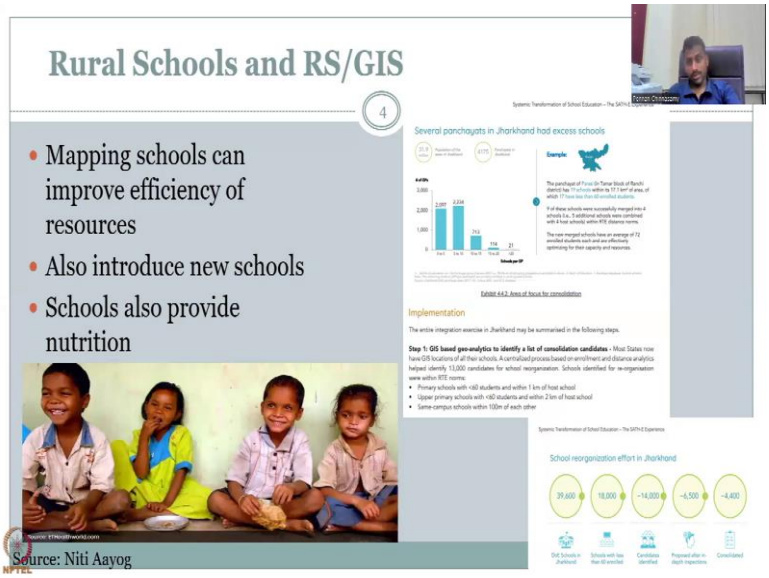

Let us see how remote sensing can be used for rural schools. Mapping of schools can improve efficiency of resources, when I say resources it includes the infrastructure to build the schools like the money that is invested to build the schools and also the manpower that is supplied to these schools, teachers, caretakers, books, which are other resources that are given food, nutrition packets, water, electricity, computers, if you go to rural villages you do see computers with internet. All these resources can be mapped and used effectively.

Let us take an example from the Jharkhand state. This report by the government says that several panchayats in Jharkhand had too many schools then needed. Every school had a budget as I said a headmaster, teacher, but if there is no students coming and there are too many then the population that is needing here it is a waste of the budget and the budget is taxpayers money.

So, you could see how they have used GIS to identify the population and within 1 kilometer how many schools are there. Let us say in a radius in a circle here for two schools here and that radius is within 2 kilometers or 1 kilometer, 1 kilometer people do drop in cycles and motorbikes, if it is too long they will not do it.

If there are two schools and the population is right in the center and the schools are on opposite direction, then the kid can go down or up, maybe 100 meters difference that is it, but it is a waste because for that small hamlet you do not need two schools, one school is enough and that is what they found.

They found that they did not need so many schools and some schools were in excess. So, they merged the schools, which means the teachers were asked to go to that school and then the budget that was given here food and everything was given to the other school this land was used for other resources but the infrastructure is almost doubled.

So, now students have two computers instead of one-one at each corner. Now in one school two computers they can use it well and teachers and others to run more classes. So, this is a case of Jharkhand, where there is excess schools. But mostly it is the other way around, you will find places where there is no schools, but the population exists. The government may not be tracking the population as I said if there is a nomadic population, which means the villagers the rural people travel from one place to the other because they are taking the cattle taking the sheep they also need to be counted in this system.

So, the best way is to introduce new schools and that is also mapped. So, if you could see here you can also map the schools as per the government agency. So, here you have DOE schools department of education schools, how many numbers, schools with less than 60 enroll which is not that beneficial for the government. Candidates identified proposed new learning centers in-depth classes skill development and then they consolidate. So, you can do all these exercises in a GIS remote sensing based environment.

Also please do not forget that schools are also a place where the children get midday meals, it is a very very important scheme by the government, Tamil Nadu has shown one of the first states to introduce this they have shown tremendous uptake of this program and the nutrition value, nutrition data shows high positivity because of the scheme. They have also introduced the egg scheme in the lunch very very long time ago.

And this helped a lot of kids to come to school, because just for that food they were working in the farms, I told you the previous example also, they have to work in the farms but right now they are getting good food and also nutritious food and then study, so they come. They are not given just to come eat and go, they have to attend school and take this and my father is the same thing. So, he went to school only for lunch, that was the enticing part which means all the small kids they would go very happy to school because they are going to get a one meal for that day, one good meal.

Morning they will skip normally, dinner is very very small things they had, but the lunch was good. So, my father would go there, but eventually because they sit in school and hear and learn they pick up education. So, my father was a PhD but this school, this rural school is still

where he started. So, I am, so proud that this is very very important nutrition and education are given both in rural schools you do not find that in city schools city people do have money. So, they bring their own tiffin boxes or you will have to pay very very excess fees for lunch but this is free, covered by the government.

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The next is hospitals, so remote sensing can help in setting up new hospitals as I said population are moving, the same examples are, just now remove the schools and put hospitals for a population, you should know how much hospitals are needed. For example, if 30 people you cannot have a 10 beded hospital, you have to have more, if many many villages are there.

Understanding diseases and mapping reasons. So, this comes very interestingly and very importantly in locations where there is high diseases and if it is mapped, for example there are regions where dengue is high, malaria is high. Kerala border, Western Ghats where there is tremendous amount of rainfall water stagnation there is malaria. So, if you do not have enough malaria care centers, health centers then people are subjected to this disease and lot of deaths are happening.

So, for this, there is importance of identifying the locations and mapping the disease and with the maps propose new hospitals. Also these maps can help in giving supplies how much load of supplies do you need and aids, aids as in funds to put infrastructures, oxygen et cetera. In fact, there are government which have put these kind of dashboards, how many OPDs, how many beds, how many of them are occupied. So, these kind of dashboards can be done on a computer screen because there is a GIS bag running, where it has a location the intake of

patients, the supply of medicines et cetera even the blood bank and how much liters of blood are stored all are documented.

And also it creates new schemes like this. So, there are not for profit hospitals also as per the NITI Aayogs report and the key statement that this book also makes is that there is a need for mapping locations, hotspots, where you can put these hospitals. Again the hospitals need power supply, need water supply, so this can be mapped on a GIS. Some remote sensing data can be used but GIS is very very key.

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The last for today is your Mobility with data. I have already explained in the first two slides that Mobility gives you more resources both in and out. So, in is, farmers get fertilizers, pesticides, books, educational materials and then medicines, supplies et cetera but also more

more important the flux is more on the other side. So, farmers give the food for the entire nation, clothing, cotton everything goes.

So, that resources have to go through urban mobility, the mobility also helps us in tracking the markets and storage, where the market demand is high. For example, if there is a big export of onions which we do a lot, there is a big price for onions outside. So, there is good need of farmers to grow extra onions and then send it to ports like Chennai, Mumbai, Kolkata and from there, there are central storage containers to other parts of the world.

So, this needs understanding of markets and storage. Support and aids I have mentioned. So, all this needs connecting rural to cities vice versa, cities to rural or rural to cities both are same, same road, you do not put one road. So, both ways the government has understood this in West India is part of the government wing and they have said that more and more roads will be introduce in the Pradhan Mantri Gram Sadak Yojana PMGSY Ph-3, where it focuses on enhancing new India's Rural Road connectivity.

They vision India to be growing along with rural. So, in the past maybe the rural entities were not growing as much and that happens a lot you could see city is growing faster rural stays the same, the wage, the health, the resources water all is the same for the 10 years, but now the government is taking notice that it is not correct to grow one part and then suffer the other part. So, to make that happen because more rural connectivity.

And NITI Aayog's white papers have come up, books have come up on transforming India's mobility you could see down, it includes everything from small scale buses, planes, trains and also the EV sector, electric vehicles are going to come big in India but you need to know where to put the recharge stations how the roads are good enough because these EV vehicles, electric vehicles do not have long range for a particular price. So, to support that they have to be recharged quite often 200 kilometers 140 kilometers and for that there should be recharge stations.

And a lot of data is needed for this assessing the need for connecting people, improving passenger and transportation is needed and that has been done through data. Sometimes we do not have good observed data and in those cases remote sensing and GIS helps. You could see how the roads are mapped, I have discussed that in the previous lectures, roads, channels are mapped and from there we can do more mapping with this I would like to conclude today's lecture. And this book also gives a very good indicator of the vision of New India.

And how to look at agriculture and rural development inside a lot of the concepts that I discussed on GIS remote sensing have been discussed, with this I will see you in the next class. Thank you.