Geographic Information Systems
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Module No # 01
Lecture No # 05
Introduction (Continued)

Hello and Namaste so today is the fifth lecture of the module 1 wherein basically we would be looking at how we would really create thematic maps? What kind of maps would create? And what are the basically how do we do a data investigation? How do we look at GIS software? What are the software integrations that are needed? So all of these extremely important for you to understand maybe the last part of the information that is actually delivered.

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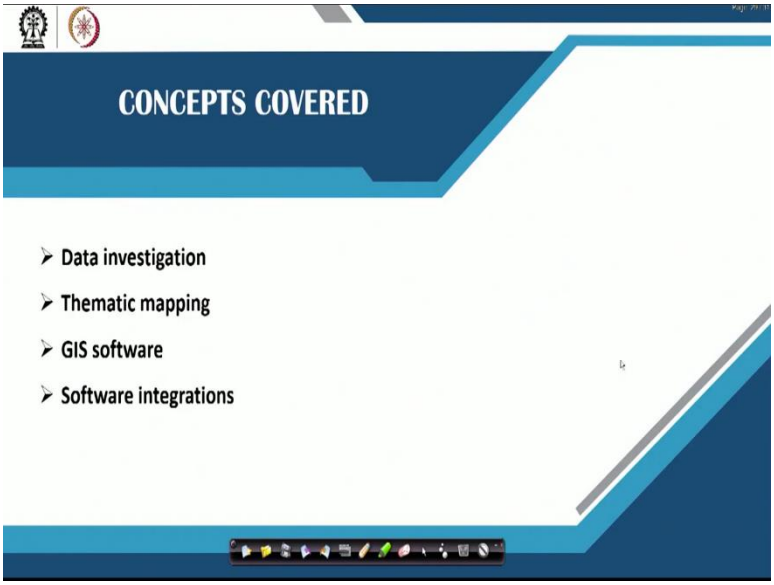

So when I speak about data investigation it is about how and why it is actually necessary to do this. Then when you look at thematic mapping it is to create a theme-based output. For example, whenever you look at any of those data most of the data if it is statistical qualitative, quantitative data. Most of the data may be if I say a quantitative data so this data is in the form of numerical.

So instead of giving numerical for people to understand it may be given in the form of a thematic maps. For example if I am trying to represent the entire India's population based on every state. So instead of giving every state I value something like this if 35 lakhs, 40 lakhs, may be 1 crore,

2 crore, 10 crore, 20 crore, 30 crore. So instead of giving it something like that we try to look at as a thematic maps we give a range.

So for example a city which is between maybe 1 crore to 5 crore population is in this color 5 crore to 10 crore that is what it is called thematic maps. So we look at what are different thematic, i mean what is how the thematic maps looks. We also create thematic maps when we are looking at hands on practical. So we look at software part of it and some integrations that we can do as a software.

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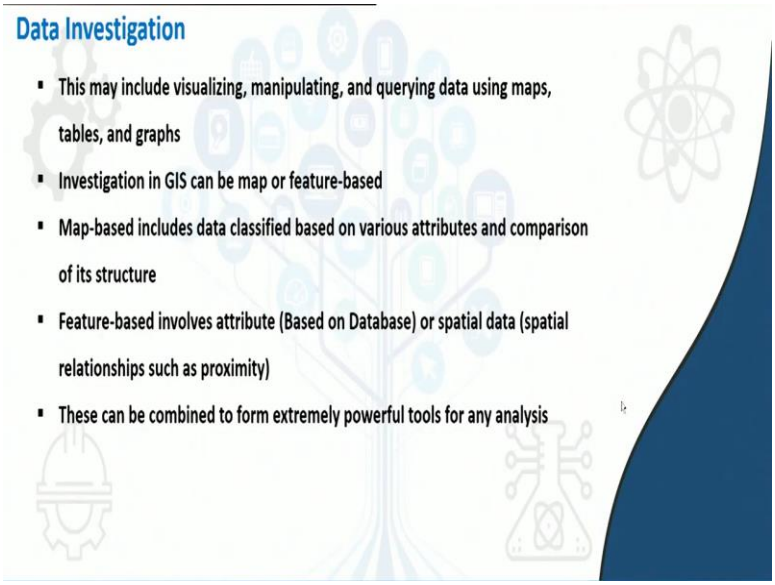

So when we are looking at data investigation the very important part of it is it includes visualization. So when I say visualization so when most of us create data, the data as in the form maybe in the form of numerical, maybe in the form of readings etc., So it has to visualized otherwise you will not be able to understand what is the quality of the data. Is everything correct just by numerical not no ordinary citizens would be able to understand what is that data all about.

If you are representing a rainfall with certain information, so if it is in form of a visualization information it is easier to interpret for anyone. So you can even give red color for the most very heavy rainfall and subsequently use an RGB format to (()) (03:11) as a blue representing the lowest rainfall. So that gives the information in a much better way much pleasing way and people can understand and interpret it in a much easier way.

So this is about manipulating and next is a querying of a data. So when we look at querying of data I did explain that whatever the size of the data you have whether you have a single data set, multiple data set or multiplicity of the data. So this data can be queried by a single instance. So the single query can be easily done across by building a relationship among them. How do we define relations that is what we have to learn and for the slides?

But when we look at this entire database wherever the data is their wherever it may be somewhere in the central repository so you have to just connect to that data, use the data as a source and you can do a query and do any analysis that is necessary for your interpretation. So investigation in GIS can be map or feature based. I will speak about this it can just the investigation can be based on how do you create maps, different thematic maps, different land use maps, and you the information can be derived based on it but it can be also feature based.

When I say feature based these are the things that are based on the data that is collect in the database. So you based on those features in the database or feature structure in the database you query. So these are investigation based on feature base. So when we look at map based includes any classified information when I say classified based on classes, based on sectors themes and many of them.

So various attributes and comparison of it is structures when I say feature base it is inverse attribute that is based on a database or it can be on a spatial data itself. So spatial relationship is such as proximity etc., So these are the queries for example if I say I have a map of this particular region maybe Kolkata let us say, so if I am sitting at a particular block let us say a block in salt lake region.

So if I am querying that within my 5 kilometer buffer what are the tea shops available for me to have a cup of tea. So this can be easily done using a feature based analysis. So that is called proximity. So I did define the proximity in my previous lectures maybe in third lecture I did even show you about the proximity map. So that is how you create a feature based attribute information or attribute database analysis.

So these are these are some examples of how you do it with feature base. But the very important aspect is map based and feature based both can be combined together. So if these are combined

together then only it becomes an extremely powerful tool for any kind of analysis, name any kind of analysis you can do in both feature based and map based.

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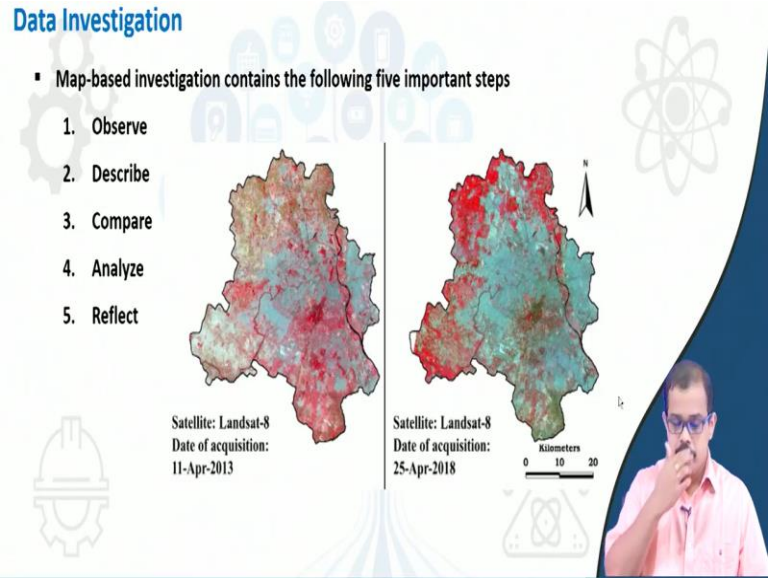

So when I say map based for example when you look at these 2 maps, at the first instance what do you understand? Because when you look at this map the first thing is I have added it as it is a satellite data from Landsat 8 ok. It was acquired on 11 April 2013 and other one is acquired on 25th April 2018. So these are the two datasets. This is the satellite map of Delhi.

So when we look at this normally if anyone who is accustomed to looking at remote sensing data they would very clearly say these are the once those the city region that is there in Delhi. Whereas when you look at the same city region has grown over a year there for the entire Delhi region. If you see this is the entire Delhi. So this is what actually referring as a urban area. So these are some of those maybe (()) (07:43) vegetative region or even the thick vegetative region that are there when you go the field you will understand what kind of vegetative region is there.

You can even find a lake of water bodies here. So somewhere here sorry ok. And this is region which is extremely thickly urbanized. If you see this region this was the urban area but when you see here it is extremely urbanized in 2018 and this is the water body that is flowing across. So when we look at this 2 data's if I say this is from Delhi, so you know what is a geographical location of this data and the most important this is whenever you are looking at the map based investigation first thing is observe what is there in the map? What are those color representing?

So go back to the electromagnetic spectrum and look at how different spectrums there each of the properties of the maps is actually varying. For example, if you are looking at a level 2 classification of a remote sensing data, which mean you have urban water vegetation others. Let us say that is my land use classes which I am trying to understand you have to go back to the spectral sensitivity or the reflectivity of each of these land use classes and look at how in which region actually the reflectivity is good.

So that it can be captured. So when we are looking at the characteristic of the spectral reflectivity based on that you create a composite data which is being represented here ok. So if someone want to understand how it is being done I would suggest to take up a remote sensing course. But as of now just understand this is a composite image ok. So when we have a composite image so we based on what kind of composite it is head has been defined.

We can understand what are these properties that is actually refer into. So that is how we observe, that is the first step of understanding any map-based investigation. Without observing what is the quality of the data how is the data it cannot be in a map-based investigation cannot be done. First step is to look at metadata then come here look at every feature-based data. Then look at what is describes, so if there are some map that has been given to you look at what it describes.

It does not it may not describe only one factor, it may be defining various other factors. So how it is describing what kind of description it has to be looked at in more detailed way. So look at ok let say that if there is road layer that has been overlaid on this in case ok. So what why that is described here what are the description that are there for the map. Why the road layer is overlaid and if there are certain descriptions of that road layer and the analysis that has been done, why it has to be done? Then you can then is a compare.

So when you look at this data and look at this data. In the first thing I did observe here and compare is how the urban growth has happened from 2013 to 2018. So how the first thing is look at observe it, then look at describe it, then look at comparing it. So this gives you the real world information from that data. And remind you that any of this data that you have collected, it is very necessary to do validation on site. If none of this data are validate on site then probably you

are actually giving a garbage output. So if it is really validated the output is really very significant.

So once you compare it the next thing is analyzing it. Why how and why it has happened? That why that process of transformation has happened, is there the industrial area has come up, is there the density of the population has increased, is there because of the housing society have come up or there certain for example development plans that were put in place because of which it came up.

So all of this analysis can be done use using the next part of the information. And finally the reflecting this information in terms of a report or a thematic map or any other kind of a maps is the last part of data investigation. So this is about map the based investigation and when we look at feature based.

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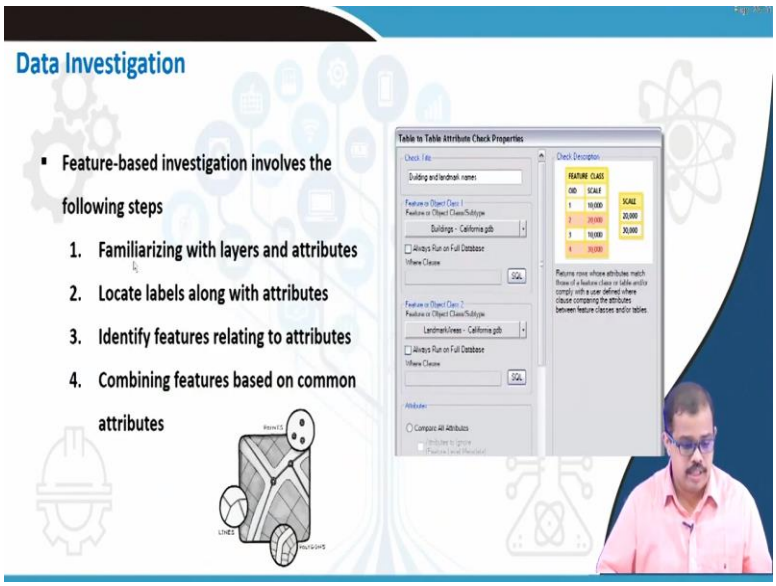

Feature based is first thing is what are the different layers you have ok. So look at the layers and its attributes. Every layer every attribute may not useful to you. So what are the different layers and attributes that are present? What it indicates? What is the format that is there and what kind of information that it gives? So these are the things that you should be familiar with, then locate labels. I did not explain about the labels in my last class, locate those labels which is linked to these attributes.

So once you have located those labels it becomes more easier for you to understand what kind of data it is and how it can be used. Then identify features relating to the attributes. What are the different features and how it can related to the attributes? How this attributes can be an helpful aspect in identifying any of those information in that particular map. Then combine a features based on any common attributes.

For example if there are certain features which can be combined, which can be indicated with a common attribute you can combine it. That is based on the feature that is what is a specialty of a feature-based investigation. So when you have a feature based investigation couple it with a map based investigation. So that gives you an excellent output and coupled with your surveys or your validation on the ground will actually give you an extremely important dataset or output that can be visualized.

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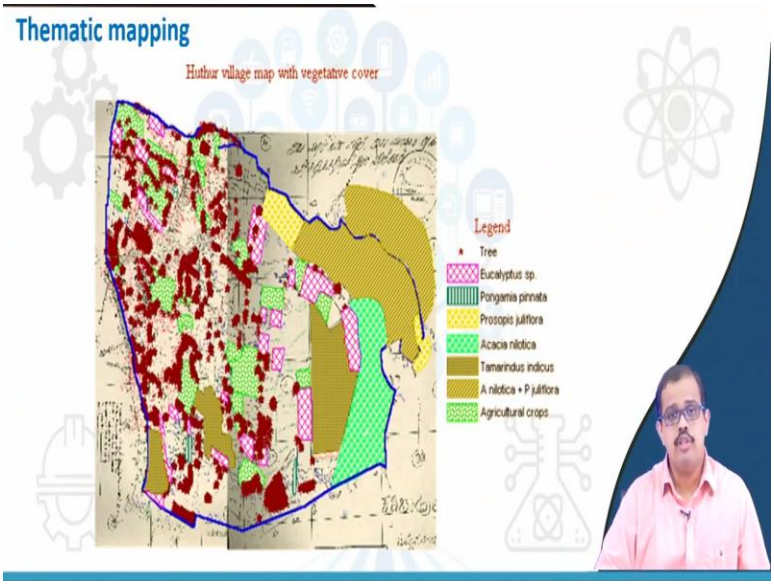

So if someone asks me ok I have done all kind of data generation I have analyzed data I have done everything. What is the last part? The last part is you can put it out in various ways. One is you can put it out of quantitative data, you can put out a data in just a numerical format. But when you look at this any common man can understand it more easily when you have much more a thematic kind of analysis.

Which means you have colors which are actually representing different themes. So for example here there is a thematic map. This is about what are the different trees that are there in this

particular region of a Huthur village and when you look at this if there an agriculture cropping region in this. Now if I create this map let say 1996 if I recreate that map in 2006 and then in 2016 we can see the change that has happened in this particular village.

For example here the pink color shows that eucalyptus species that is there in this particular region. So where it is there can be easily seen so anyone who is looking at this particular map if just by looking at the GIS system can say that ok these are the places where eucalyptus trees is there. There is pongamia species so you can look at this map and say yes, this is the region where the pongamia species is there and when you look at acacia, acacia is also available in this region now in a greater extent.

So that it can be easily identified. Instead if you just give a plain map or a quantity figure it people do not know geographical where it is located. How what is the extent that is located. So when you look at temporal data maybe a data that is spanning maybe 20, 25 years so you will not able to understand how either it is degraded how it has improved what are the change that has happened all these things cannot be possible.

But once you create this a thematic map right, so once you have created this thematic map it is very easy to understand what kind of data you have what are the changes that is happening and what is the information that has to be supplied. So the steps represents the number of trees that are there other than these species that is mentioned here. So for example this tamarindus indicus in which is the major part of this region you can see here it is all these are tamrindus indicus.

So when you are looking at this you get a feel that ok this is there in this region and if you go to the field and locate this information properly validate information this can be a very important information for any of those for maybe forest department or an horticulture department. So this is how the thematic mapping is done and is extremely useful in terms of looking at the change, looking at giving information to the user, giving information to a common man and a can be extremely handy.

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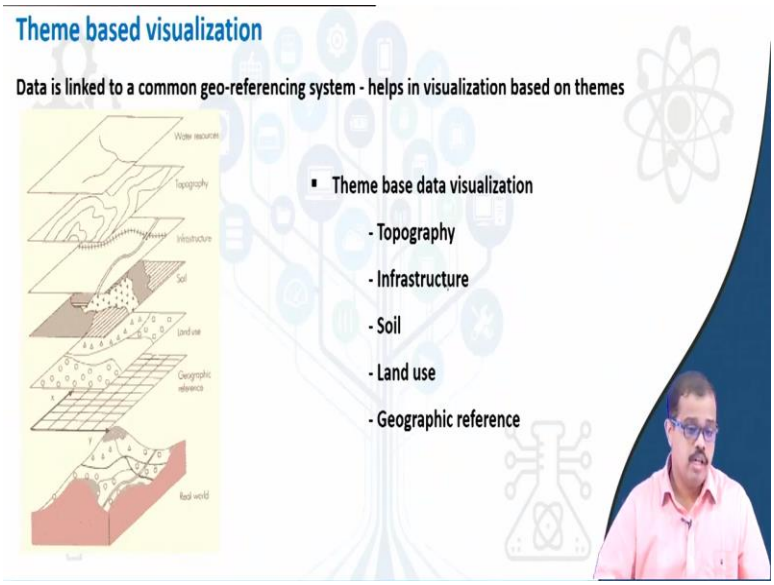

If you are looking at theme-based information for example people say ok. You have one large image as looking at temporal data so that is fine. So but theme based information also can be used for visualization of various aspects. For example visualization having a topography, infrastructures, soil, land use, geographic reference anything that you name. For example on your left hand side you are looking at one of the images which is actually representing how this information can be extremely useful when you are looking at theme based visualization.

For example you have this real world that is the normal let say it is normal region in IIT Kharagpur. So when you look at this you have one layer that we have already generated a geographic reference that is very important part of the first layer. Then you have land use, this also have same geographic reference and it is representing what is a different land uses in the campus. It has buildings, it has trees, it has parks, it has open spaces ok.

So it has some agricultural crop, cropping region so all these things is represented in the land use. Then you have soil, what kinds of soil is there in which part of the campus is represented here. Then there is a infrastructure, if there is road infrastructure, if there is rail infrastructure, rail infrastructure is right next to the campus, there is a lot of road infrastructure inside the campus, extremely good infrastructure so that is also that can that is mentioned here.

Then the topographical analysis, when you see this all this data are linked with the common geographical reference which means all of these have a common geographical reference which

actually helps in theme based visualization, theme based analysis, theme based outputs. So if someone wants to clearly locate a any place in the campus where the next infrastructure can come, if they can look drill down the entire dataset ok.

So they can easily identify where the infrastructure is there? Where you have forest? Where you have extremely important structures and where the new infrastructure has to be placed? So it is much easier for a decision maker to understand what kind of infrastructure is there and how do you develop this?

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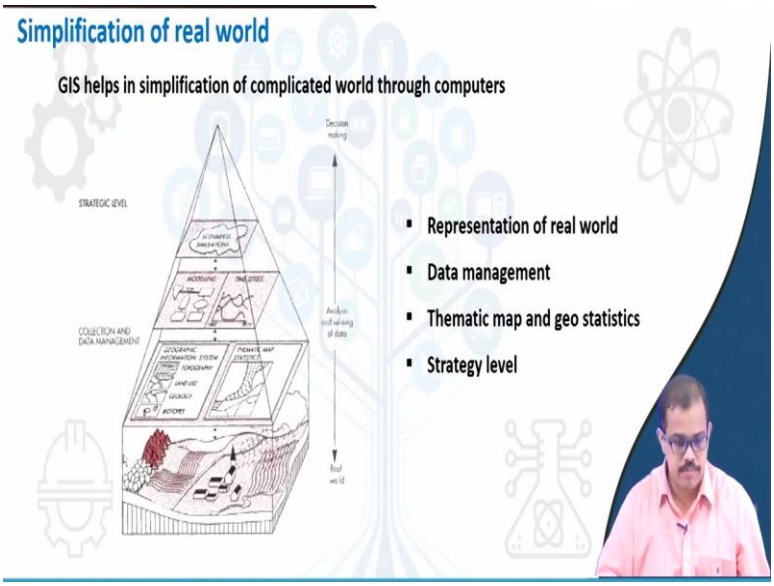

So it actual GIS actually simplifies the real world just as maps. You can create a real world in terms of maps, look at maps you understand the real world. So one very important thing it is it can handle data management in a very good way it Thematic maps geo statistics can be easily done with all of this layers strategic level assessment can be easily done. So, I was explaining about these layers so if you see the figure on the left hand side that is a real world.

When you have thematic map that is already generated for example as I did take example of topography, land use, geology, soil maps then any of other thematic maps along with maybe certain other scenarios of for example if what if in case there is an infrastructure that comes up in this region. What is the change that happens? What if there is plantation that happens?

What are the changes that needs to be done elsewhere what if there is a residential complex that comes up here or a maybe a shopping region that comes up in this particularly. What are the changes that is happen? That is what you can look at this strategic level. Before planning that infrastructure on the ground. So this is where the simplification of the real world can happen with using a GIS.

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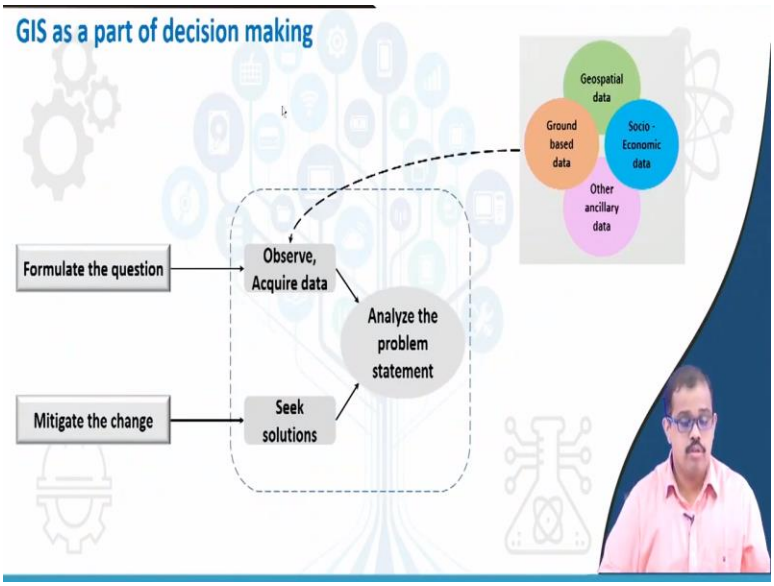

So when I say GIS is always a part of decision making. Any decision that has to be taken would GIS would be a part of it. First thing is the formulating a question then observe or acquire data. So when you are trying to look at any of the GIS system first thing as I did speak in the previous class is acquiring the data. So then analyzing a problems so when you are observing the data it can be ground based data, it can be ancillary data, it can be social economic data, it can be geospatial data. So all of this data spatial and non spatial data come into it.

So once you have observed the data you analyze the problem, you seek a solution and you mitigate the change. So this is how a entire change of this how the GIS will extremely useful. So GIS is gives you this data generation of the data and acquisition of data can be done and data can be stored, data can be analyzed for solutions and finally planning to mitigate the change. That is how GIS is a part of decision-making process.

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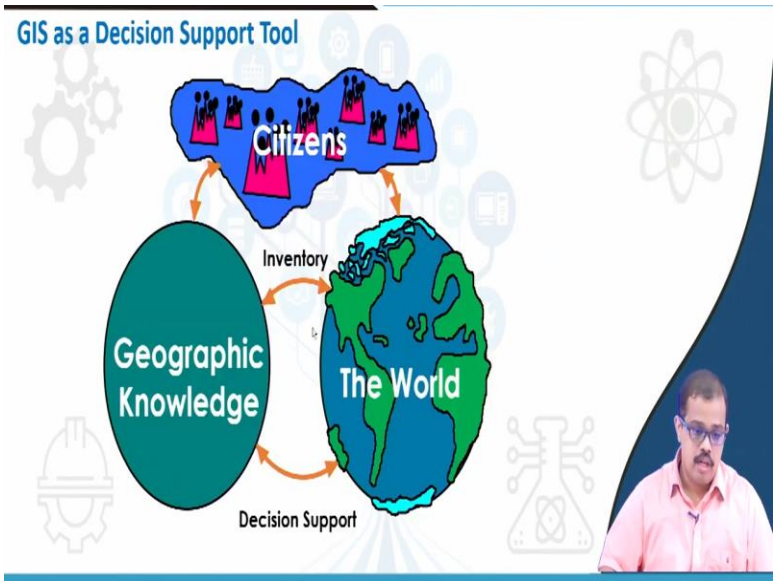

Now database a GIS can be a decision support system as I said for example let us say that we have certain geographic datasets we are planning an infrastructure. So when we are looking at the infrastructure we look at how if incase this infrastructure comes. What kind of change that will happen? Let us say there is a certain green region extremely good, so it would become extremely necessary at certain point of time that you have to get certain infrastructure only at that place. So in case you let say you get a you plan infrastructure there.

So GIS can help to understand if that infrastructure comes in that place in the surrounding regions. What are the things that may change? For example, let us say there is a housing complex that has come up in that will come up in that region. So housing complex need a needs to have certain amenities that is that supports that entire housing complex. So what are those amenities? Where it may be placed?

How it may be placed whether how it affects that particular region? All of this can be understood with the GIS with using all your map support. So with that it means to say that you are actually capturing the entire support system of that process. You are designing the entire support system based on that support system a decision would be arrived at. How is that decision arrived? As up to the decision maker to understand what the kind of process change and how it is implemented. So with this it may be an effective support tool in order to understand how what are the changes that are happening in the real world.

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So when we look at all of these the one thing that student ask? Sir what are the GIS software that are available. So if let say you want to buy some commercial software's you have enough research fund to buy commercial software's then you have extremely good software something like is Arc-GIS, ESRI Arc- GIS as I said it is extremely good it can handle any kind of data, any data, any big data small data whatever it is that is available even it can connect to online data repositories collect data from it analyze the data.

So GIS is extremely good in terms of looking at data. So it is from the environmental system research institute this software can be used. Then you have AutoCAD Map3D and Autodesk Geospatial has become a very promising software in terms of deriving geographic information. Then you have Bently map which can you give you map based inputs in terms of how geospatial data is used for map in decision making.

Then you have Intergraph hexagon Geospatial which has gotten Geo-Media. Geo-Media is extremely capable of analyzing the geospatial data. So if someone wants to look at very advanced models, advanced instances of work in geo-media can come in handy. Then you have Blue Marble Global Mapper nowadays people have started using global mapper in a very large way extremely efficient.

Pitney Bowes map MapInfo is another geo software which is extremely good. In terms of incase you want to have a simple interface and look at various aspects of GIS tools then map info can

be one which can help you out. Then you have Maptitude is another software which actually specializes in tools, different geographic information science-based tools so that can be used.

Then you have their TerrSet clark labs. So this was previously called as IDRISI but now it is called as Terrset. TerrSet is in factly in fact one of the comprehensive software's which has both the capability of using any kind of models. Data models that are available in GIS system and can be extremely handy when you are trying to even model and visualize a particular environment or a particular system. So the IDRISI or Terrset can be extremely useful.

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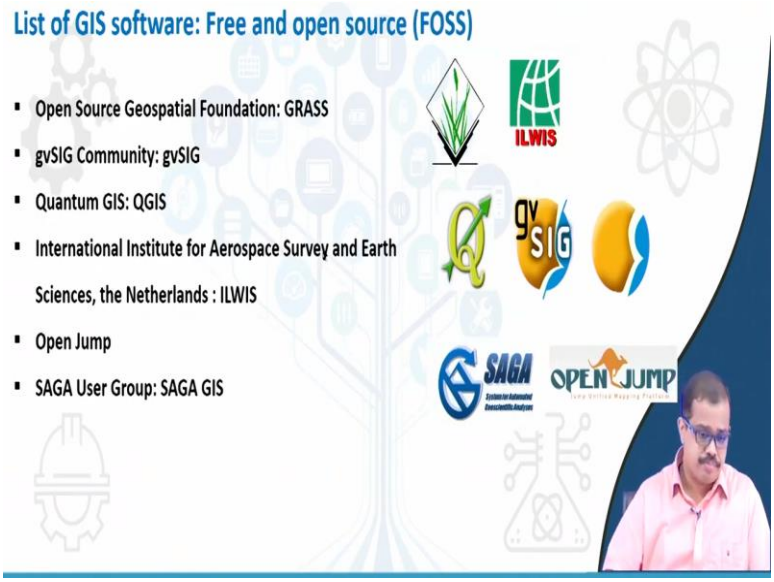

And coming to the next set is the open source software the very well known the most funded and developed software is GRASS so it is from open source geospatial foundation. So GRASS is one software which can handle any kind of data very efficiently. So if someone wants to learn how to handle a remote sensing data. How to handle a geographic information data? GRASS is one tool that everyone has to learn because it rather than commercial software which is under a packet so you input the data you output you get an output whereas GRASS will give deliver a stepwise data output.

Which means to say that to learn how the data is transformed from data to information. So that is where the GRASS is extremely handy. So the other good software is gvSIG but do you say that kind of very close ended group but it can be used for various aspect. Quantum GIS is another

software which I would recommend everyone to use here it has extremely every capability of any commercial software, anything you name it. So quantum GIS can actually handle.

Then you have ILWIS was one of the first those software which were developed which were extremely handy in handling the geospatial information. Open jump is another software if someone is interested in advanced analysis open jump and SAGA GIS are quite efficient in handling any type of geospatial data. But I would say is GRASS and gvSIG some of the best combinations that you can have in the geographic information system development of our understanding of geography information system.

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So in case you want to integrate GIS web and any wireless information technology, then you have Google earth. So Google earth is a one of those places where you can learn I would suggest everyone to download Google earth look at Google earth there is a host of information that is there. Please download 3D version of Bhuvan and look at it. It is it gives you lot of information lot of data that is available. Then you have skybox imaging. So these are certain places where you can get a huge lot of data.

So this an screen of a Microsoft visual earth so this also kind of web based browsing system where you can understand visualize different earth scape's in using a browser.

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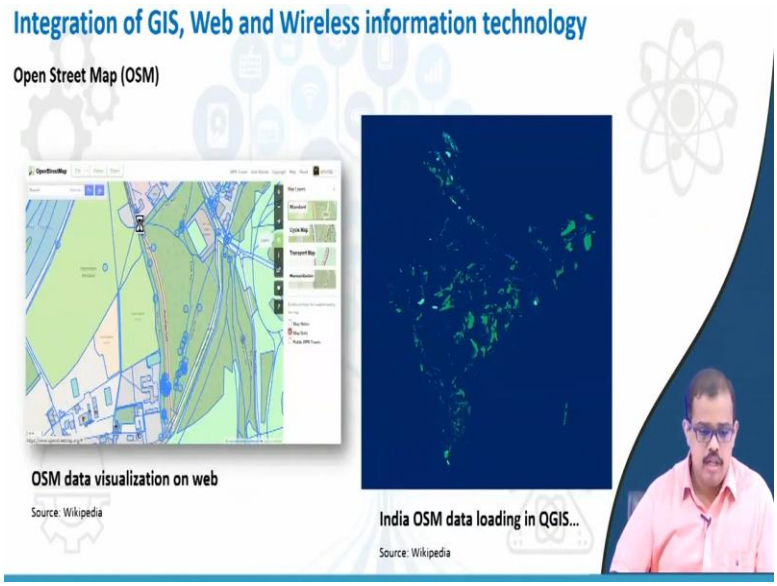

So I have already spoken about Open Street Maps here. So on your right hand side when as I speak you can see the data that is there on the India Open Street Maps. That is that you can load it directly on to your QGIS. So just loading on to your QGIS then extract this data from the QGIS for your analysis can be done with all this data. So data is available there so you have a software's which is capable of extracting this data. So that is what is most necessary of today's context.

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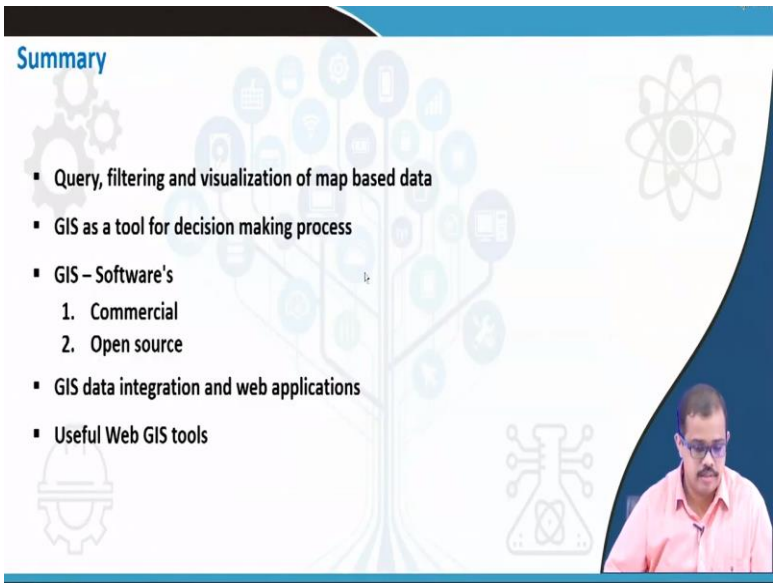

So we have learnt as a summary we have learnt today what is what do you mean by query? What do you mean by filtering and visualization of map-based data? We have seen how GIS can be a process of decision making and we have looked at GIS software's both commercial and open

source software's. And how the data integration can be done with web applications for example Google earth or Microsoft visual web-based applications.

I would say please go back look at all these web applications or some time even if you are looking on a mobile data maybe it takes a bit of time to load. But it is very useful to see this application. So that you understand how GIS data is there. So finally we ended class with useful web tools web GIS tools. I would have also taken up some the aspects of web GIS. How do you actually build it in my last class of this particular course. So thank you very much.