GIS Applications in Agriculture

Part 2: overview of applications
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Welcome to this talk on GIS Applications in Agriculture. This is Part 2 of the talk and this focuses on applications of GIS.

My name is Balaji. This talk is presented in collaboration with Mr. G Sreedhar who is a doctoral scholar at IIT-Bombay in India.

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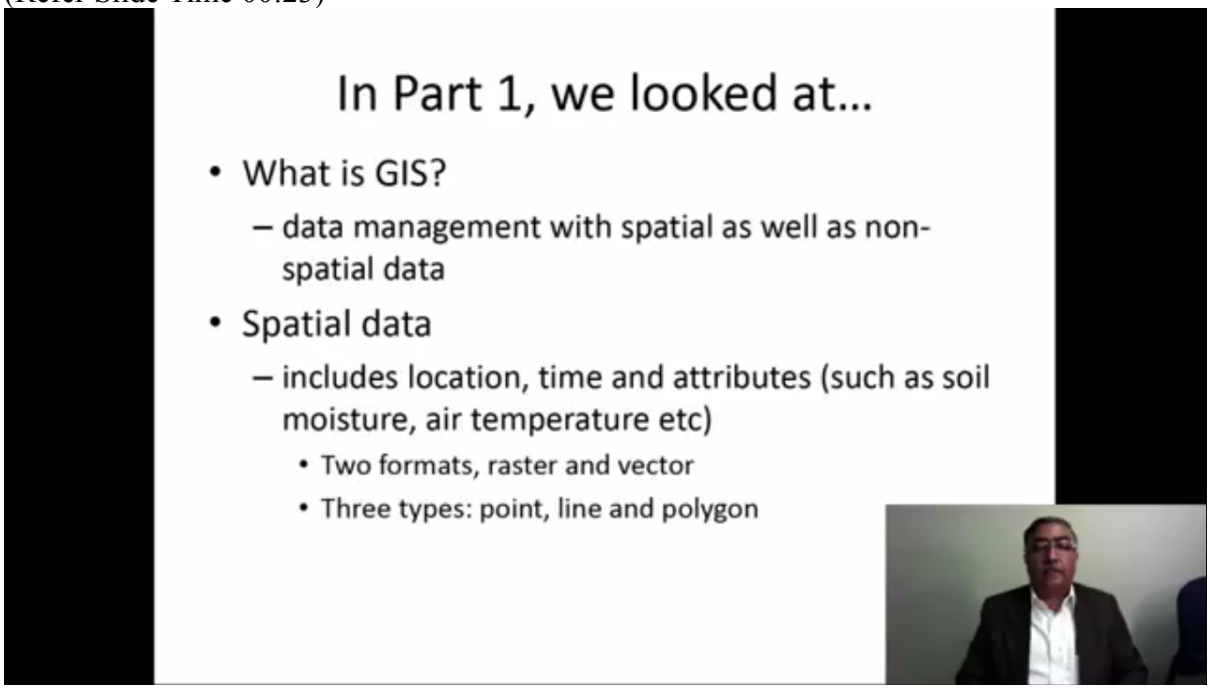

In Part 1, we looked at what is GIS? We looked at GIS as essentially a data management activity with spatial as well as non-spatial data.

Now what is spatial data? We said it includes location, time and attributes such as soil moisture, air temperature and so on. And there were two formats: raster and vector for all spatial data. They were interconvertible. They could be converted from one to another. There were three types of data namely point, line and polygon. These are also interconvertible.

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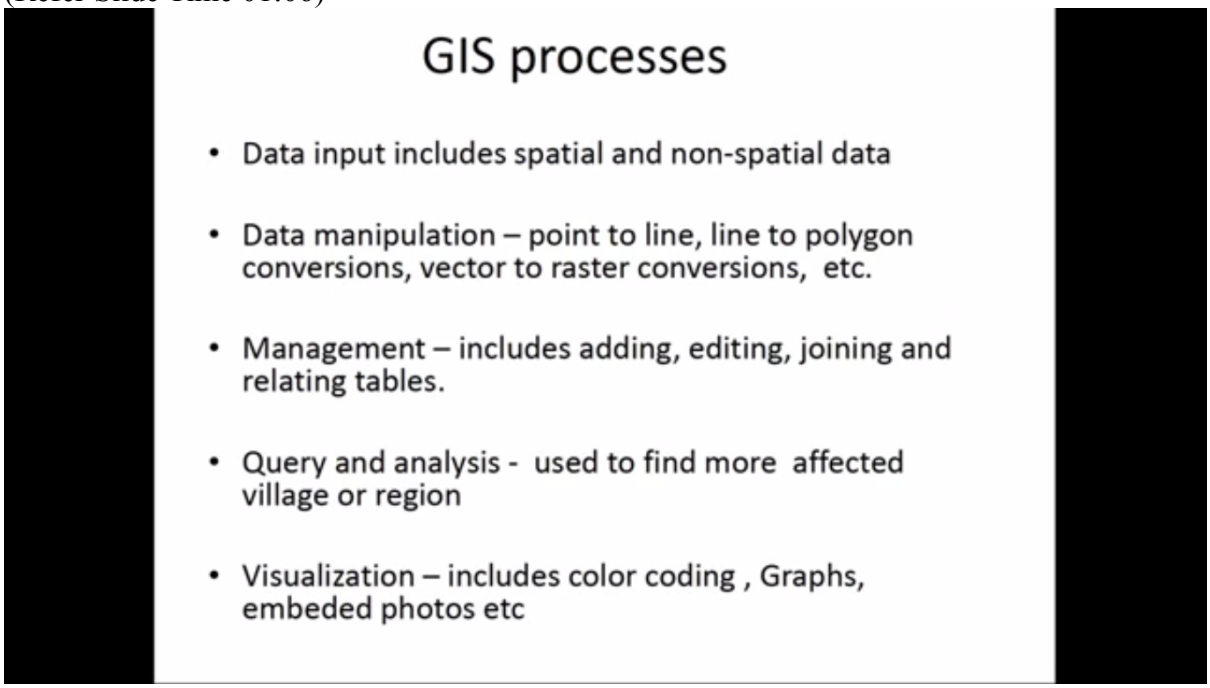

In effect, GIS processes include the following: one is data inputs. It includes spatial and non-spatial data, which we just described. Data manipulation - point to line, line to polygon conversions, vector to raster conversions etc. Management includes adding, editing, joining and relating tables with which you are familiar when you were taught data management.

Query and analysis. So, for example, you want to find a flood affected village or drought affected village or a village otherwise affected by some disaster. You can do query of -- query of -- query and determine that particular village. You can do analysis in a similar way.

Visualization includes color coding, graphs, embedded photos etc. Some of these would be non-spatial data and we give you an exercise in Part 1 to look at Google Maps where you would have understood how non-spatial data is routinely brought into as part of visualization.

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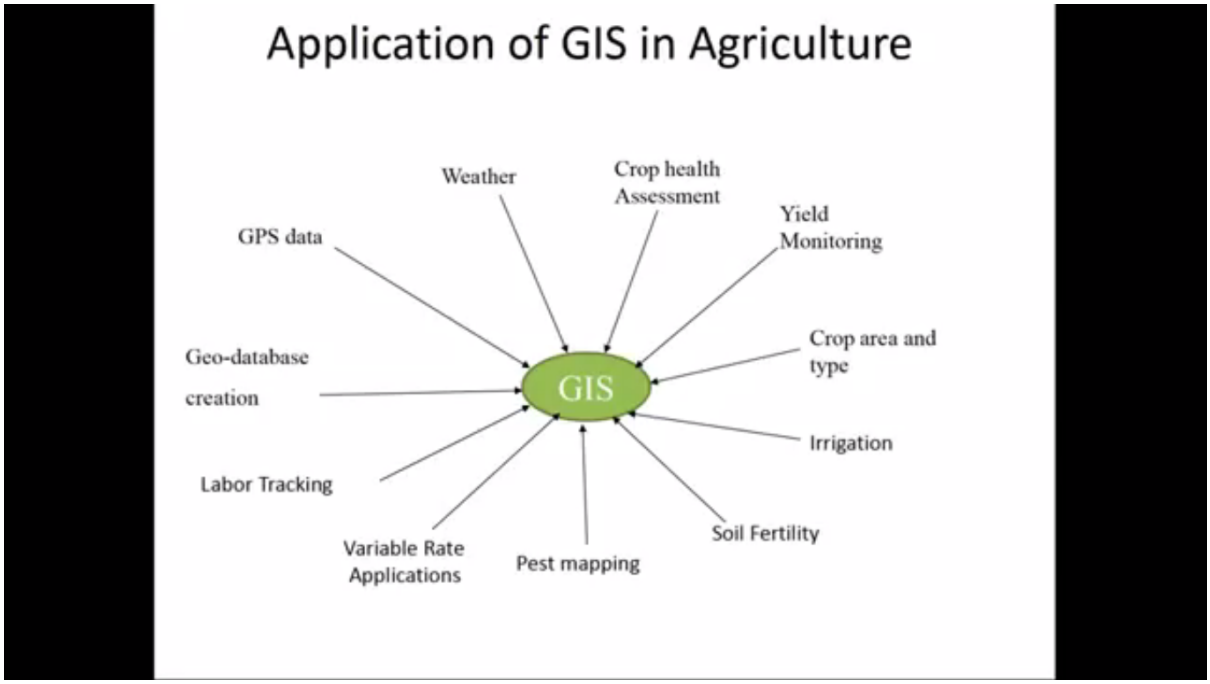

Applications of GIS in Agriculture are actually quite a few. I mean, an important area is yield monitoring. The other area is soil fertility, pest mapping. There are new areas emerging which relate to crop health assessment. GPS, you know, Geographic Positioning System, which is a very very important part of GIS applications in agriculture, it's highly useful in promoting precision farming and geo-database creation is also an important activity. So you should look at the fact that GIS when it comes to applications in agriculture, it is truly multi-dimensional.

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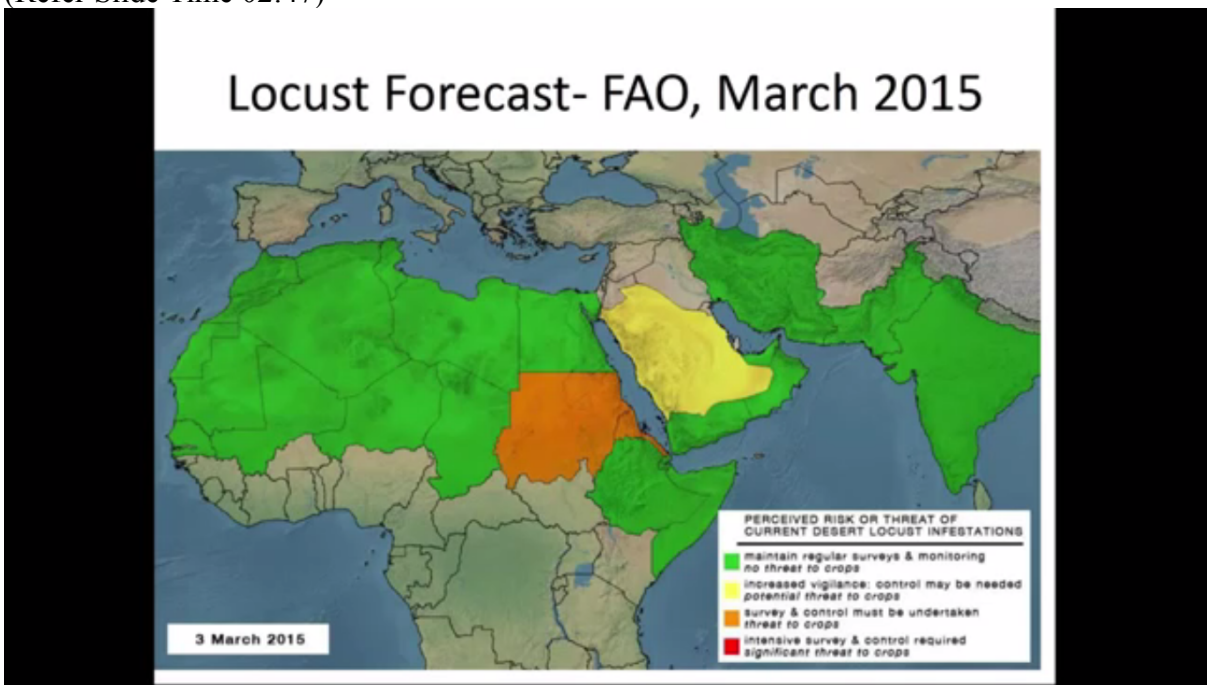

Now let's take an example. Here is a locust forecast provided by FAO, the Food and Agriculture Organization of the United States of which practically every country on Earth is a member. The FAO provided this forecast as you can see in March 2015 because locust is a

major pest, causes immense damages to crops in many countries and locust forecasting has been a major activity of FAO.

What this map shows, I mean, besides the color codes is a huge region ranging from Atlantic coast all the way to the Bay of Bengal and Indian Ocean. It's a huge region covering many, many countries and billions of people and it's in a single map they are able to provide some kind of assessment of perceived risk or threat of current desert locust infestations.

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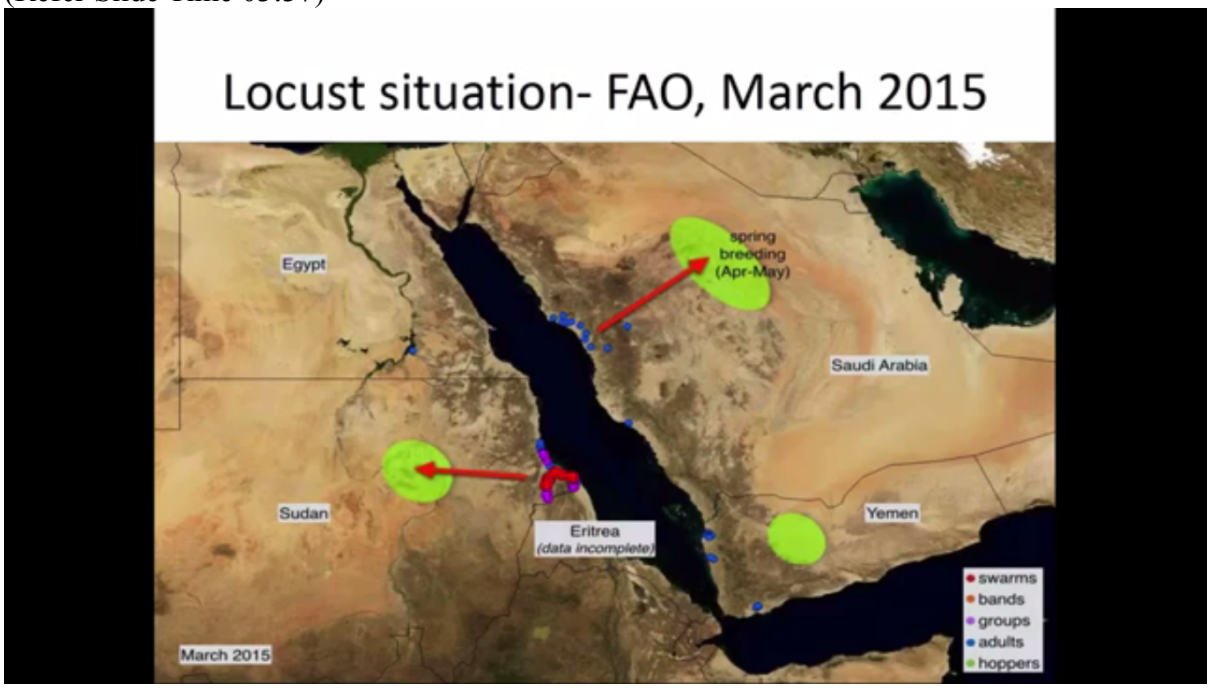

And here in this map, the same set of data is presented for a smaller region and you find that as the region becomes smaller, finer and finer data becomes finer and finer representations are possible. Now you can see, for example, in this map swamps, bands, groups, adults etc., which you could not easily represent in a region in a much larger regional map and that brings us to one very, very important lesson, the Micro-Regional Monitoring.

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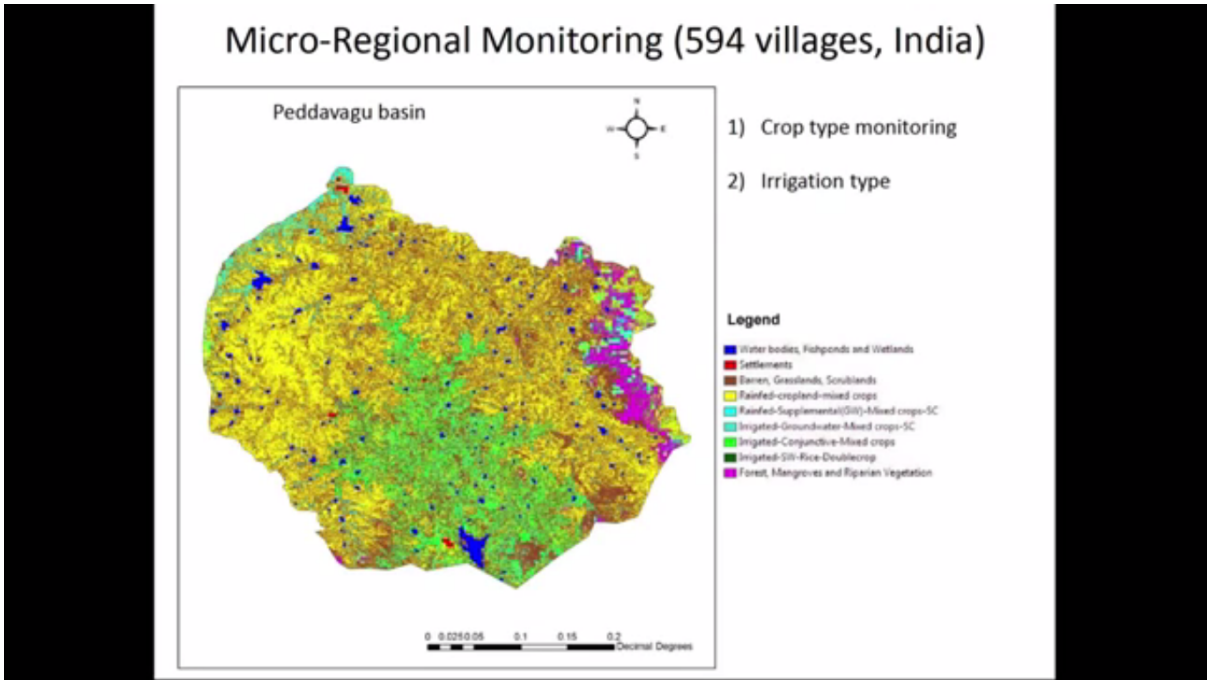

We are dealing with developing countries and developing countries, the most decisions are made by small farmers when it comes to production. They make it either in conjunction with government inputs or with other similar institutional inputs, but they by and large make it in a micro-regional setting, micro-regional context. Therefore, providing information in the form of micro-regional GIS outputs is important.

And here is, for example, my colleague Mr. Sreedhar and I have worked on this idea of River Basin covering 594 villages in south central India. In this you are able to see through the legend a variety of water bodies. You can also see a variety of crop types and a variety of irrigation types. All that is available only in a map which is operating on this scale. This is why micro-regional monitor -- micro-regional level work in GIS is very, very important if you want to make sense to very large number of small farmers.

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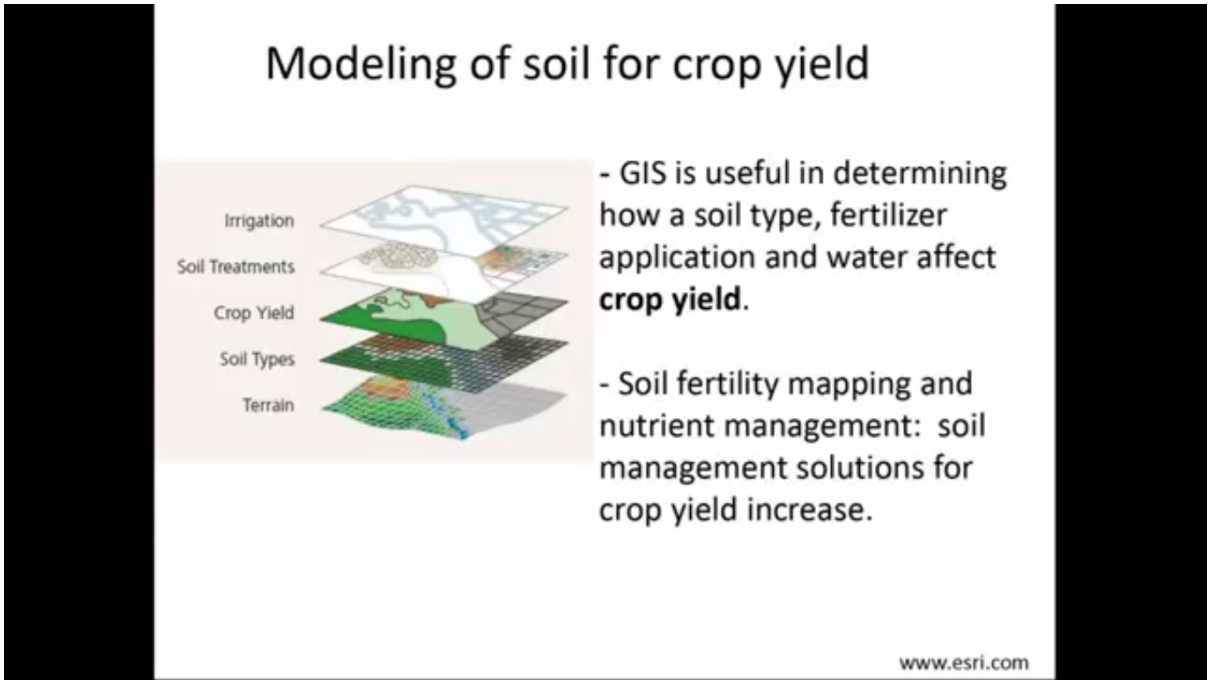

And modeling of soil for crop field, for example, is a major, major application of GIS. For example, you can use GIS to determine how a soil type, fertilizer application and water are tend to affect crop field. You can see multiple layers in this particular system and this is slowly becoming a major activity, namely soil fertility mapping and nutrient management. This is -- this can become an important solution for crop yield database. As more and more countries are worried about the increasing costs of fertilizers as inputs into agriculture, tools like this are getting more and more important.

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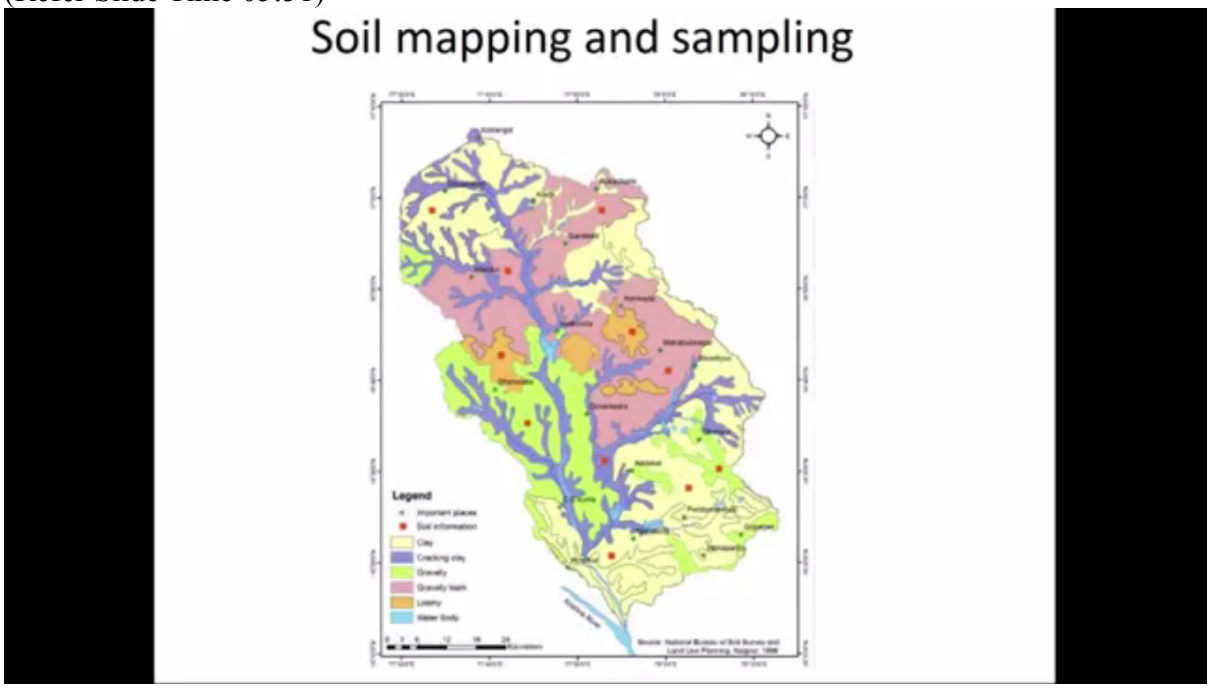

The other is soil mapping and sampling. Again, my colleague Sreedhar and I have worked on a very, very micro level to arrive at this kind of a map. You can see again we have covered just a few hundred villages and you can see very wide variety of soil types here which allows

a local decision maker or even a farming -- farmers association to arrive at some sensible conclusions on their own.

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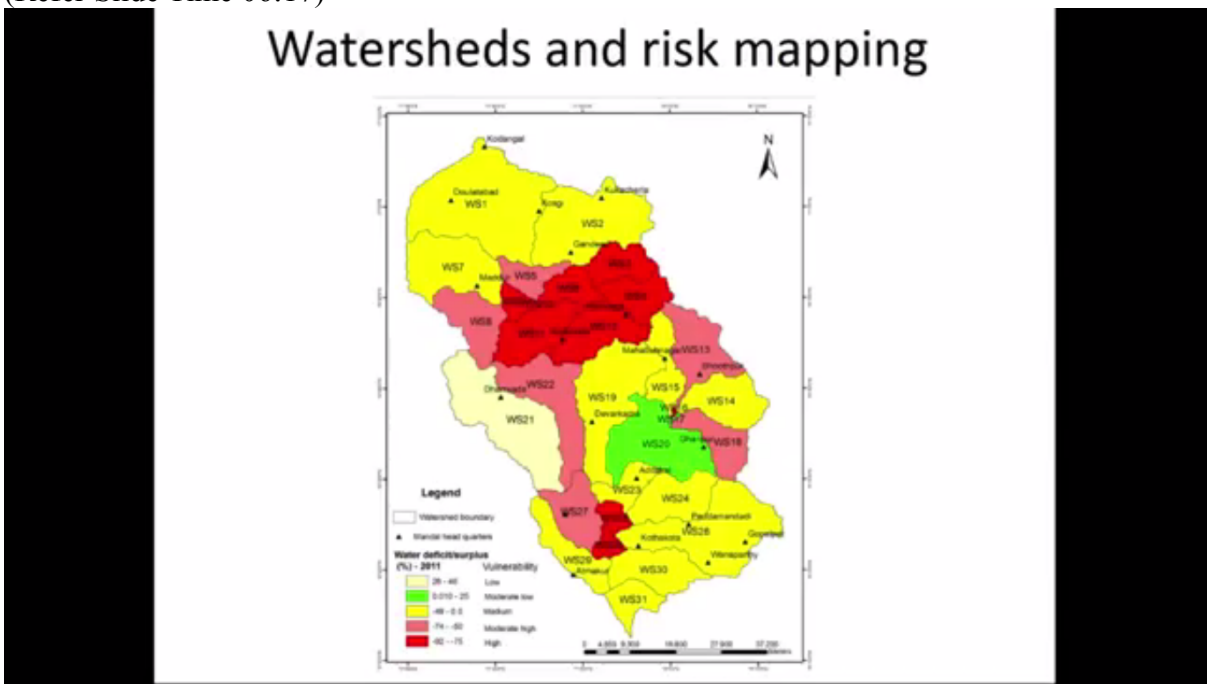

The other area is for drought monitoring because climate change is increasingly accepted as a major risk and drought is a major, major phenomenon that affects millions and millions of people and it's now seen to be an integral aspect of climate change. We should be able to use GIS to help people understand how vulnerable they are to drought in a particular season. And here is one effort and the area has been divided into watersheds and watersheds have been identified on the basis of their vulnerability and not just vulnerability, this is based on surface water availability, which in turn is based on rainfall. All these can now be put to a very good -- GIS can be put to very good use in representing all these things to policymakers whether at the local level or at a higher level.

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Now what are the important GIS software? There are two classes of software. There is commercial proprietary ones and there are open source ones. In commercial proprietary ones, ArcGIS is a very popular one. Expensive. It's more for -- it is used for vector, vector datasets. ERDAS IMAGINE is for raster datasets. IDRISI can work with both and IDRISI is considered to be more affordable. It's used in many developing countries.

In terms of open source, ILWIS at ITC, Netherlands is a free source and it has been available since 2012 in a big way. Quantum GIS, which is now called QGIS is an Open Source software, which has enormous potential for use in agriculture.

And I also want to mention Elshayal, which is a desktop client recently developed in Egypt in the Arab world to work with Google Maps and I believe this has also a great deal of potential in agriculture.

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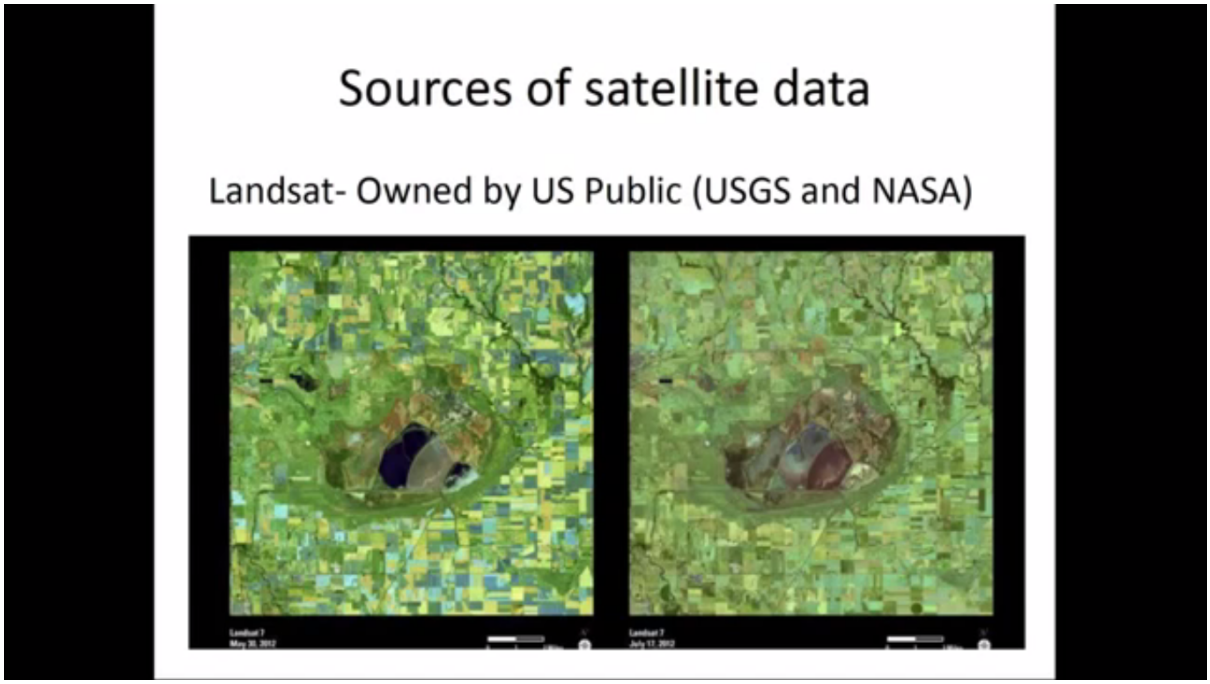

Now what are the sources of satellite data? Landsat is the one of the most important sources owned by US government, US public and it's operated by US Geological Survey and NASA. And as you can see here, their maps are of very, very -- their outputs are of very, very high quality. It shows how in a short time of no more than seven weeks you find how a lake is drying up due to drought in a particular part in the United States.

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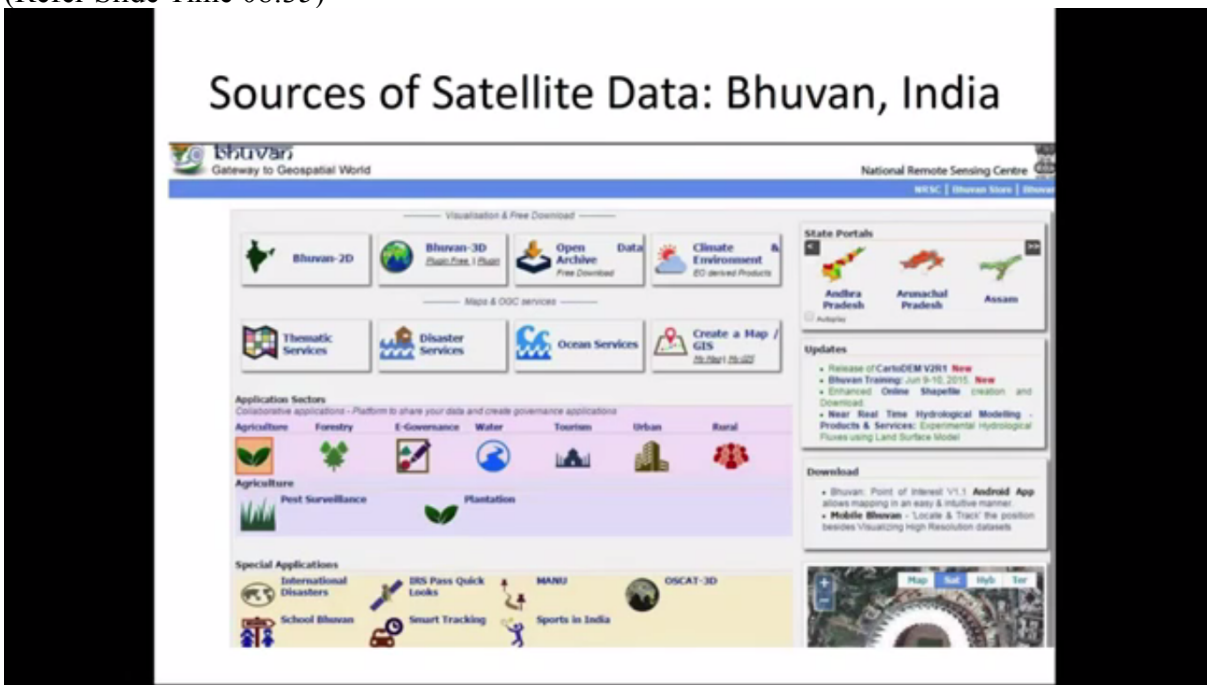

And among developing countries Bhuvan, which is an Indian product, it's also available. It focuses much more on India and this is also available. A wide variety of datasets are available for free download. This also something some of you can make use of for building your own outputs.

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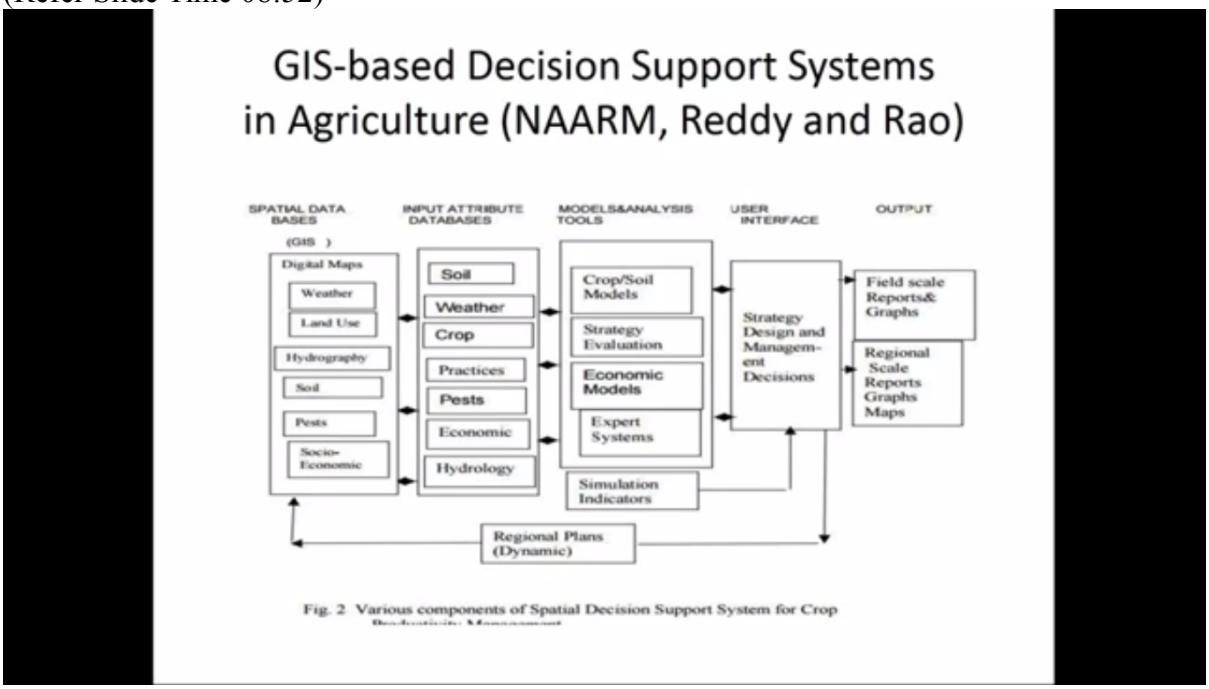

Now GIS-based decision support systems in agriculture are becoming increasingly important. My colleagues Mr. late Dr. Reddy and Dr. N H Rao have been very active in this area. And as you can see in the left side they have identified digital maps as well as input attribute databases and the type of decisions they can support. They've worked, of course, more at a regional level, but I believe this can be scaled to work at micro-regional level as well.

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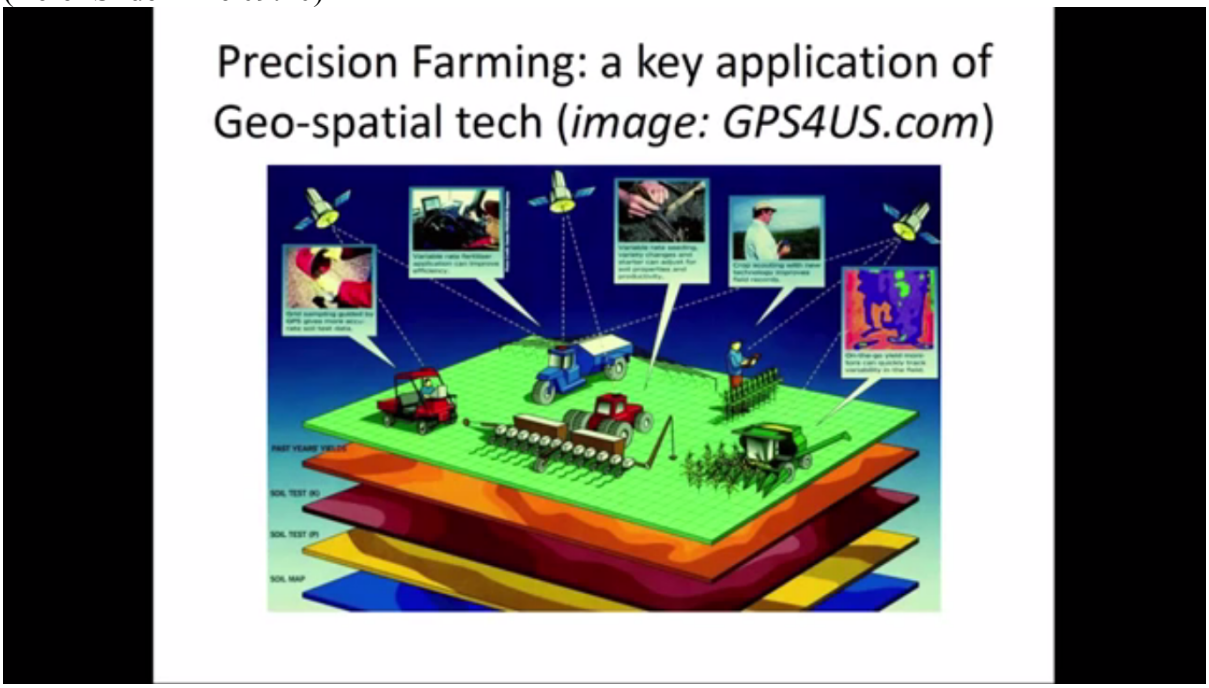

Precision farming is going to be a key application of geo-spatial technology and at this time, it is capital intensive. It requires a lot of inputs that come from capital intensive processes and from high technology applications, but we should be able to envision precision farming for

small farmers at which time many of you who are doing this course should be experts in GIS applications in agriculture.

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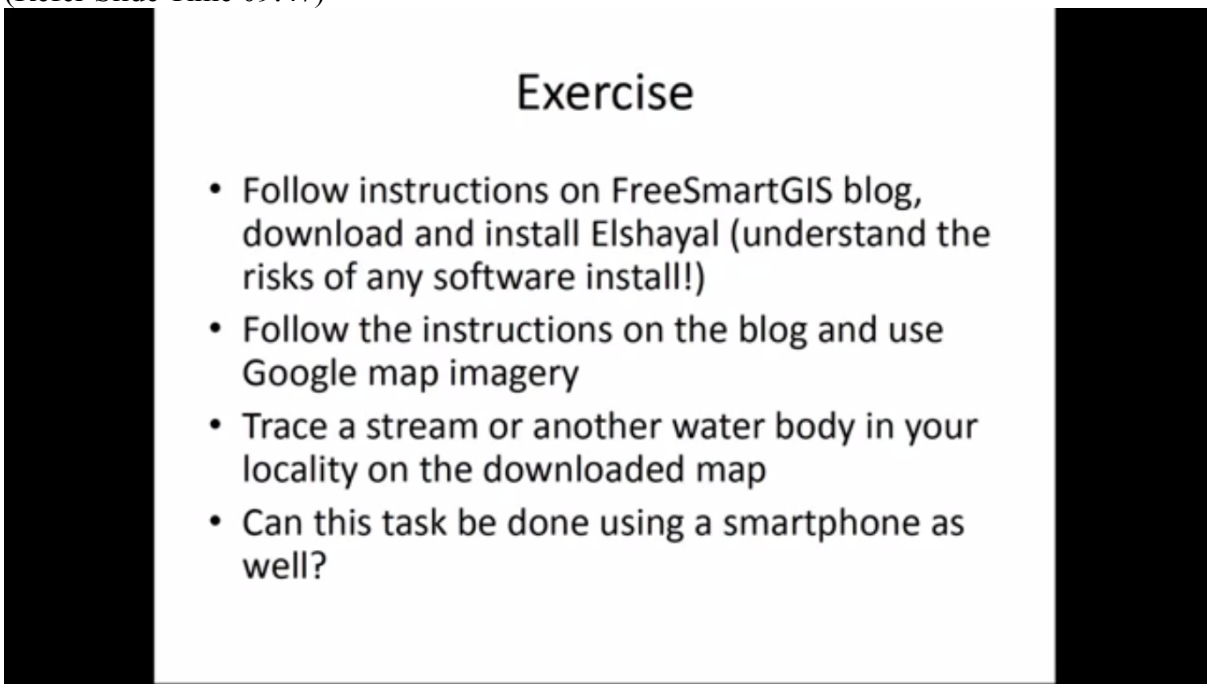

So now I thought I can conclude this part too with offering you some ideas on exercises. You should go to this FreeSmartGIS blog and download and install Elshayal.

And remember that whenever -- irrespective of the software, whenever you download and use software, there are always risks involved. Please understand them before you do so and after you download, follow the instructions on the blog and Google Map -- and use Google Map imagery. Trace a stream or another water body in your locality on the downloaded map. Now just look at the possibility of doing this in a smartphone as well.

This is an open-ended exercise. It carries no grade, but I thought you could try this and it will probably give you an idea of what GIS can offer as a potential support for agriculture for small farmers.

Thank you.