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Lecture - 56

Remote Sensing and GIS Application in agriculture and NRM - Part 02

So, welcome to the lecture on Remote Sensing and GIS Application in agriculture and NRM - Part-2. So, we already in this particular topic we have discussed in 2 lectures, one was introductory then part 1 and today is part 2.

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Today in this lecture, we will be discussing some GIS applications, GIS and remote sensing applications through some case studies, through some real examples and some studies which have been reported in the different type of publications, journals or report. So, these case studies actually will give you a real kind of an understanding that how actually remote sensing and application of GIS tool can help us in the assessment of natural resources and how actually you can represent those information for larger public.

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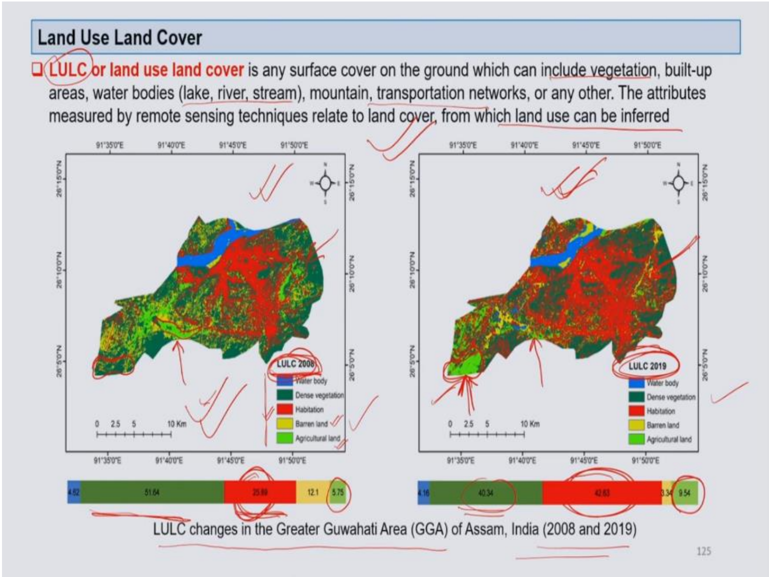

So, when we talk about natural resources and especially utilizing remote sensing and GIS tool, one thing often comes into picture and that is Land Use and Land Cover, in brief we call them as LULC. I am sure many of you might be knowing about these terminologies. Land use and land cover means any surface cover on the ground which includes vegetation, built up areas, water bodies like lake, river or any stream, mountain, transportation networks or any other thing which are there on the ground.

The attributes are measured by remote sensing techniques which are related to land cover and from which the land use can be inferred. So, in this slide you see 2 nice pictures. These are the result of remote sensing data and then application of GIS tools. Now, this is a land use land cover changes in Greater Guwahati area means where actually our institute my institute is located, IIT Guwahati.

So, a study was carried out to see that how land use and land cover change in the Greater Guwahati area in Assam. This is just to give you a real example. And you see here that there are various sections which blue color means water body in 2008. And then we will come to 2009. For time being, please, focus on 2008, how actually it used to look at.

Water body blue color, dense vegetation green color, red is habitation means where people live, yellow barren land and this bright green as you see is agriculture land. Now, try to focus on the agricultural land because agricultural land needs agriculture purpose, need natural resources like fertile soil, water, etcetera.

You look at also little bit on the red part on this map and then vis a vis try to see compare with 2019, very recently. You can see the area of the red color is quite significantly increased in 2019 from 2008. Some, you can see that the agricultural area, particularly in this point, if you see that large amount of agriculture areas still were there but they are not here. But taken by whom?

Taken by habitation. That is one way. Also, if you come here, in this particular corner and compare with current situation, here also you can see that the red patches have taken over this particular agricultural area. Now, you look at the percentage coverage of area. You can see that in 2008, the dense vegetation was 51 percent, here; it is 40 percent in 2019.

Look at the increase of habitation. It was roughly 26 percent. Habitation means houses for people we live. So, it was only around 26 percent in 2008 but by that time it is 2019, it is 43 percent almost. So, imagine that how increase of population in Assam is actually taking a toll on the agriculture as well as the green area. Look at the agricultural area, around 6 percent which has become here in the 2019 has increased to 9.5. Now, there is one point that I would like to discuss specially.

Now, 2 pockets I have shown you where agricultural land has been partly taken over by habitation. But there is one part, where agriculture has suddenly increased and that is the point here, this corner. Now, where form agriculture comes here? Agriculture comes here in the place of dense forest. So, dense forest has been cut and then agriculture has come in.

Now, this is also a point of discussion. There are several debates is taking place across the country and world that is it a good idea to convert forest area into agriculture area, is it a good idea that agricultural areas converted or occupied by habitation as you see in this particular study.

Now, these all actually are point of dialogues, discussion and policy matters. Now, for that kind of discussion, GIS and remote sensing helps. Because when you present this kind of comparative picture of 2008 and 2019 then for the people who takes decision at the parliament or at the assembly, policy makers, lawmakers, they can easily get the clear picture differences in the 10 or 12 years and then they can take a call, no, we are going in a wrong direction, so, we should correct it. So, GIS and remote sensing helps you for these kind of exercises, all right.

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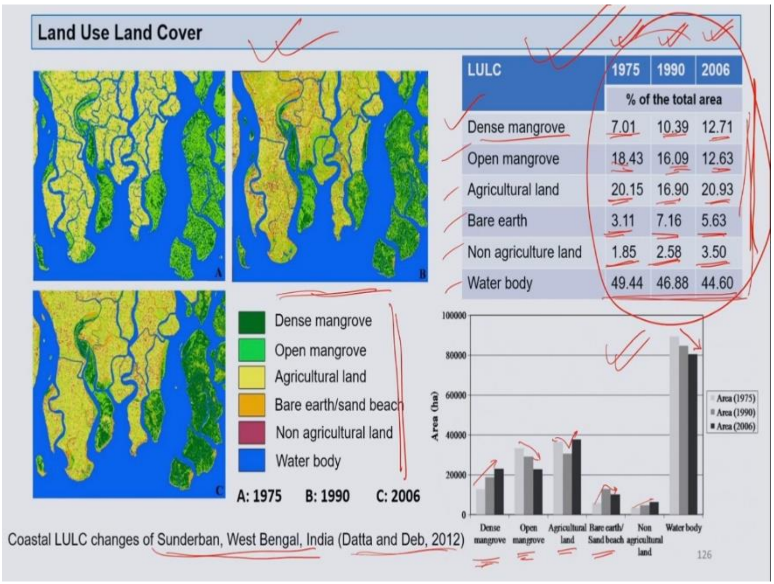

Another example I will give you on LULC and that is from West Bengal. Sundarbans area, very famous. We know that it is famous for mangrove and also many others, very vulnerable ecosystem. Again, there is a study carried out by group of researchers and as you see, look at this particular table. 1975, after 15 years 1990, again after 15, 16 year in 2006. So, every 10 to 15 years, how the area, that particular area of Sundarbans is changing.

Now, for this also remote sensing GIS helps. There are few categories dense mangrove, open mangrove, agriculture land, bare earth, non-agricultural land and water body. So, these are the color symbol for each one of these six different types of LULC. And now you look at the percentage change over this every 10 to 15 years.

Now, one good thing here you see, dense mangrove area is increasing, open mangrove is getting reduced, agricultural land got reduced little bit in 1990 but again has come back. Bare earth means where nothing is there, no vegetation, from 3 it has increased to 7 and then again gone down to 5.6.

Non-agricultural land, almost, 2 percent, around 3 percent and then around 3 and a half percent. So, that is increasing. Because with the increase in population, food demand will increase, then people, they will get into agriculture for their livelihood. So, certainly, you will see a change in the area of agriculture.

Water body. Almost, more or less same, little bit of change has taken place between 1975 and 2006, in the 30 years. So, in a sense, in this area, mangrove area I think that system has done reasonably okay job because you do not see huge differences, I mean negative impacts on the particular this ecosystem. So, as you see that map wise you can present this particular data sets in a very nice manner. So, people again, when you present it in a picture form then it is very easy to understand what is happening in particular area.

Now, the same data sets you can also present in bar diagram and bar diagram gives you much clearer idea that how over the 30 years, how the different ecosystem is changing. Look at here, the same data says it is much more easily to understand dense mangrove is increasing which is a good thing. Open mangrove is reducing but not that significantly.

Agricultural land going up and down. So, that means there is a kind of a regulation or regulatory change is taking place. Bare the earth also has gone off and then again coming down. Nonagricultural land also almost non-significantly increasing. Water body, there is a little decrease in the water body.

So, that may be because of various other regions. But overall, it is not that alarming as of now as you see from these data sets. But our point is not that. What I am trying to share with you is that, that how remote sensing and GIS can help you to understand a system what is going through.

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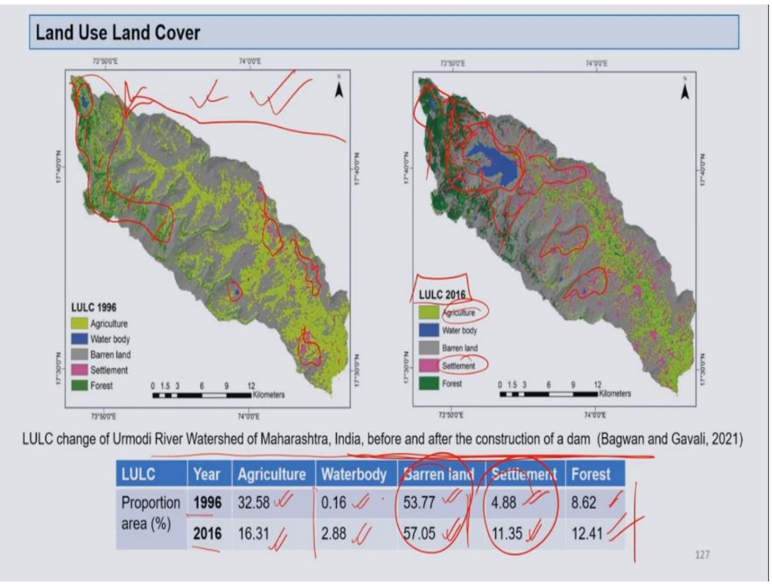

Next example from another part of India, another ecosystem. Maharashtra. And here, the example is that, before and after a dam has been created, how this will affect a particular ecosystem? This map is 1996 before a dam has been created. You can see lot of greenery, lot of agriculture is taking place.

Of course, there is barren land that area is like that. But you can see lot of green patches. But if you see the forest area is very sparse here in this zone. Particularly, in this patch. But otherwise, agriculture is quite clearly visible in 1996. Settlement is concentrated largely in these few pockets in its sparse manner.

Now, in 2016, after 20 years, 2 decades, how things have changed, especially, after the dam has been created. This data table will give you a much clearer idea. But here you can easily see that the green component agriculture has drastically got reduced, settlement has increased. You see here. So, these are some new areas where settlement has come up.

Water body, you can see here, in this figure, only in 2 pockets is visible clearly. But in this picture you see a new water body that because of the dam and that is why the dam has been created. So, water body has got increased. But normally anticipate that when water body increases, so agriculture will increase. But here you see that earlier it used to be agriculture in this area, look at this picture here.

Now, this area has come barren, but dense forest has taken place here. Agriculture has gone out. The alarm is that even after your dam the barren land has increases. From the picture it is visible. Now, let us see the data. 1996, 2016. Agriculture clearly visible, around 33 percent, almost come down to half 16 percent. Water body, very less, less than 1. Here it has increased.

Of course, dam has done some good job. Barren land, it was 54 percent. Now, it has increased by almost 3 to 4 percent, 57 percent. So, that means this is a concern. Settlement, around 5 percent, increase to around 11.5 percent almost. Quite significant increase. Forest, as you saw that the dense forest has come up here. This is on good signal but the concern is here. Settlement and increase of barren land. If dam is there, you anticipate that there will be more agriculture but somehow that has not taken place.

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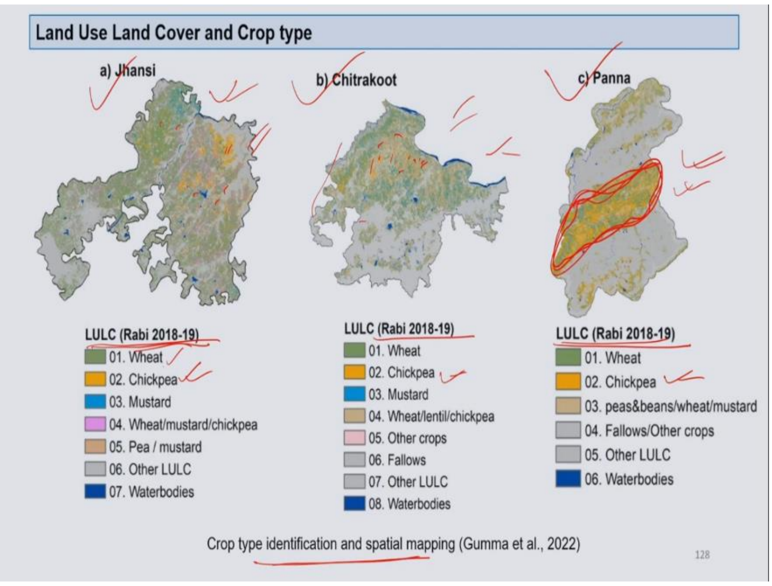

Few more examples on LULC. Jhansi, Chitrakoot, Panna. Now, here, this particular map shows, it talks about different types of crops. So, how different types of crops actually, you can actually present through GIS and remote sensing using different colors because that again will give policymakers a very clear-cut idea about what is happening in a particular area.

So, in this exercise, all the Rabi crops for all these 3 areas have been taken exactly same time, so that you can compare with these 3 different places at a time. Same season, same type of crop has been taken, almost same, similarity. So, let us now see that how in 3 different place, they are differently distributed.

Let us take wheat, for example. Greenish color, you see lot of wheat here in this picture, relatively less here and far less here. Next, the chickpea, all 3 has chickpea. Now, this from picture you can clearly see that concentration of chickpea, even though in a very small pocket but looks very high in Panna, very spurs in Jhansi and Chitrakoot.

Overall area you can only understand when you see the numbers in a data in table form. This helps you to understand the area, which area the distribution is high and how it is actually spread over the entire area, as you see here. This the here, it is sparse, here also chickpeas sparse. But clearly in Panna, it is concentrated in this pocket; there must be some reason for that. So, this is how things helps to understand.

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Land Use Land Cover and Crop type (Continue)

LULC and crop type	Jhansi (area ha)	Chitrakoot (area ha)	Panna (area ha)
Wheat	180306	49145	117001
Chickpea	37992	16150	80772
Mustard	18412	14543	
Wheat/lentil/chickpea		42265	
Wheat/mustard/chickpea	38442		
Peas & beans/lentil/wheat/mustard			28758
Peas/mustard	5751		
Other crops		6326	
Fallow/mixed crops		17528	
Fallow/other crops			68304
Other classes	220559	152314	410824
Water bodies	5728	10095	
Water bodies /wetlands/fallow			5542

No direct information was given about LULC and crop area

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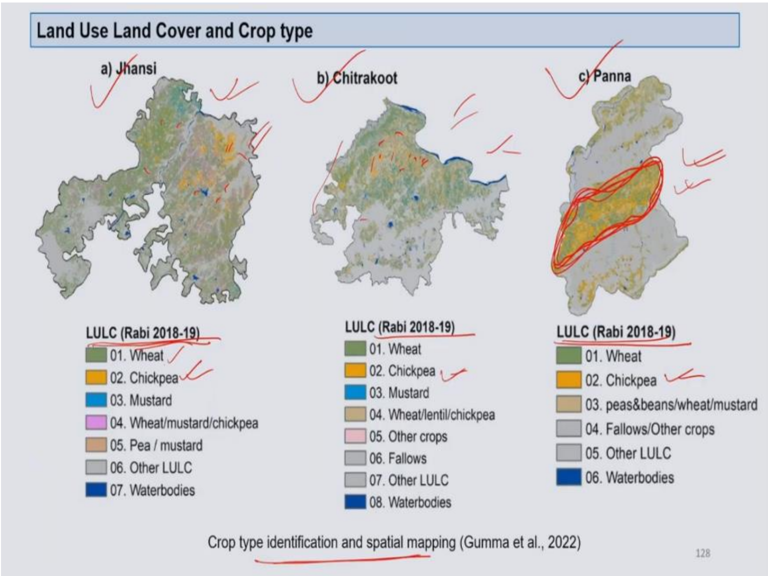

Now, here, this is the table that I was talking about to look at the chickpea. In chickpea, we just now saw, no, that your Panna has concentrated this area, these 2 Chitrakoot and Jhansi as sparse. So, let us see how it is. So, chickpeas in Jhansi are around 37000 or 38000 roughly area in hectares. Chitrakoot 16000 hectare. Panna you see that 80000 hectares.

So, this is clear from the picture also that Panna is concentrated heavily in this pocket for chickpeas. This is how remote sensing and GIS can help you. So, you can actually take the information, you can collect and collect from a long distance. You do need not to go to a particular area. Sitting here in Guwahati I can actually through remote sensing and GIS data can actually analyze the present situation anywhere in India. That is the beauty of this technology.

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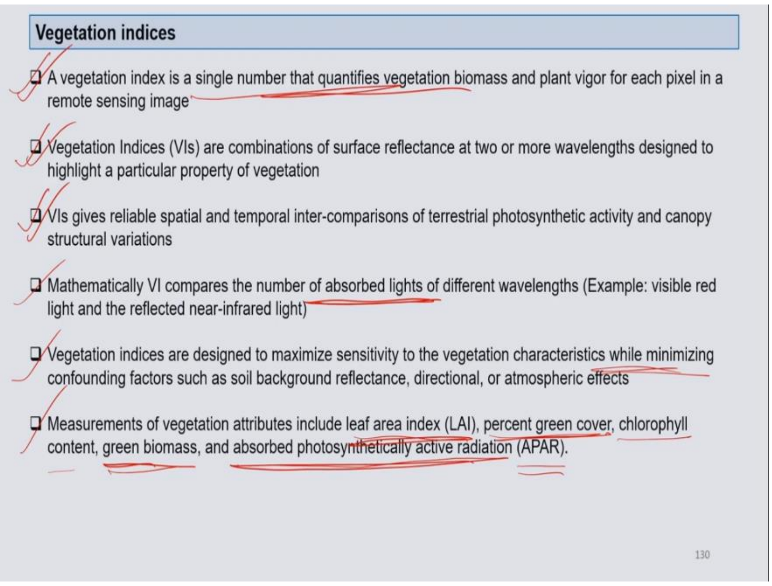

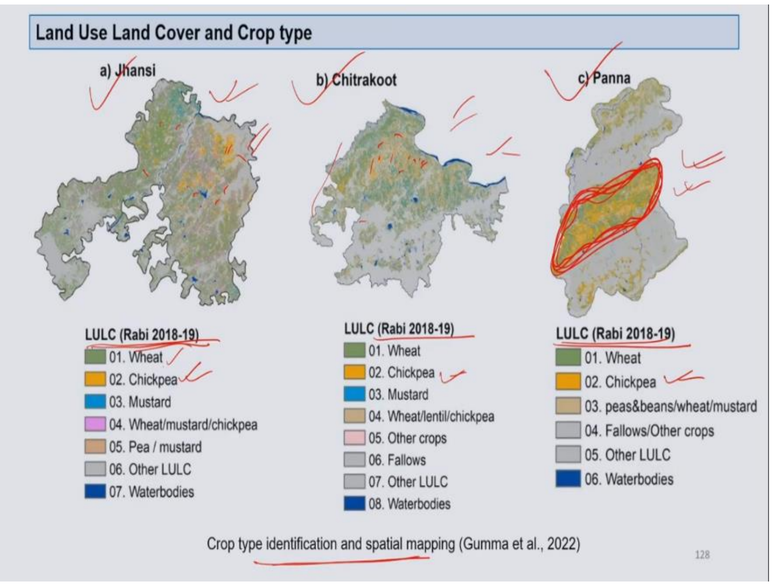

Next, what actually do we use for this kind of mapping? what technique? So, the vegetation indices is a single number that quantifies the biomass or vegetation for each pixel in a remote sensing image, that image that we get from satellites. So, in each pixel, the vegetation index is a number that quantifies the biomass of the plants or vegetation.

Vegetation indices or VIs are combination of surface reflectance at 2 or more wavelengths designed for highlighting a particular property of a vegetation. If you recall at the very beginning of remote sensing, first introductory lecture we discussed about different kind of reflectance.

So, VI actually helps us to understand the crop biomass or plant biomass. VIs also gives reliable spatial and temporal inter-compositions of terrestrial photosynthetic activity and these all also will give you the canopy differences. So, suppose, a plant has, a large biomass and has a huge canopy, you can easily differentiate from VI's, vegetation indices where you have a big plant and where you have a small plant on the basis of the canopy as well.

Mathematically, vegetation index compares the number of absorbed light which are coming from different wavelengths, as for example visible range, infrared, whatever that we have discussed in the previous classes. Vegetation indices are designed to maximize the sensitivity to the vegetation characteristics while minimizing the confounding factors such as your background reflectance from the soil or the directional effects or atmospheric effects.

In atmosphere, if there are lot of moisture or dust particle, aerosols, so, they will also effect. So, finally, the measurements of these vegetation attributes include your leaf area index (LAI), percentage green cover, chlorophyll content, green biomass and absorbed photosynthetically active radiation which we call as APAR, is a very very important phenomena in the field of GIS remote sensing. APAR. Now, how we calculate all these vegetation indices? Each one of these has different formula to calculate.

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Vegetation indices

VI types	Mathematical expressions	
Ratio Vegetation Index (RVI)	$RVI = \frac{\rho_{NIR}}{\rho_R}$	NIR = Near Infrared R = Red
Difference Vegetation Index (DVI)	$DVI = \rho_{NIR} - \rho_R$	
Normalized Difference Vegetation Index (NDVI)	$NDVI = \frac{\rho_{NIR} - \rho_R}{\rho_{NIR} + \rho_R}$	$0 \le NDVI \le 1$
Soil Adjusted Vegetation Index (SAVI)	$SAVI = \left[\frac{\rho_{NIR} - \rho_R}{\rho_{NIR} + \rho_R + L}\right](1 + L)$	$L = 0.5$ L = correction factor for soil brightness $L = 0$, very high vegetation cover $L = 1$, very low vegetation cover
Enhanced Vegetation Index (EVI)	$EVI = \frac{G(\rho_{NIR} - \rho_R)}{\rho_{NIR} + C_1\rho_R - C_2\rho_B + L}$	B = Blue $C_1 = 6$, $C_2 = 7.5$, L = 1, G = 2.5 $-1 \le EVI \le 1$ For health vegetation (practically) $0.2 \le EVI \le 0.8$

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Now, let us start with the simplest one. RVI or Ratio of Vegetation Index. RVI, we can calculate with this formula

RVI is equals to Rho NIR divided by Rho R

where NIR is near infrared wavelength and R stands for red.

Then we have DVI, Difference Vegetation Index. DVI you can calculate through this formula

DVI is equals to Rho NIR minus Rho R

again near infrared minus red.

Then comes the most heard about on in a popular index that is NDVI, Normalized Difference Vegetation Index. Most of you might have heard about this. NDVI is calculated using this formula

NDVI is equals to Rho NIR minus Rho R divided by Rho NIR plus Rho R

where the NDVI value is lie between 1 and 0.

Next comes Soil Adjusted Vegetation Index of SAVI. Now, SAVI we can calculate through this formula,

SAVI is equals to (Rho NIR minus Rho R divided by Rho NIR plus Rho R plus L) multiplied by (1 plus L)

Now, what is L? L is the correction factor for your soil brightness. L if is zero, very high vegetation cover, if L is 1 then very low vegetation cover.

Enhanced Vegetation Index or EVI, you calculate using this formula.

EVI is equals to g multiplied by Rho NIR minus Rho R divided by Rho NIR plus C1 multiplied by Rho R minus C2 mutiplied by rho B plus L

What does this means? B stands for blue, C_1 for 6, C_2 7.5, L 1, G is equal to 2.5. For wavelength, when you calculate your health vegetation, so then you get EVI value between 0.8 and 0.2. Otherwise, the EVI value will lies between plus 1 and minus 1.

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Vegetation Indices types	Mathematical expressions	
Optimized Soil Adjusted Vegetation Index (OSAVI)	$OSAVI = \frac{\rho_{NIR} - \rho_R}{\rho_{NIR} + \rho_R + L}$	L = 0.16
Transformed Vegetation Index (TVI)	$TVI = \sqrt{\left(\frac{\rho_{NIR} - \rho_R}{\rho_{NIR} + \rho_R}\right) + 0.5}$ $TVI = \sqrt{NDVI + 0.5}$	
Vegetation condition index (VCI)	$VCI = \left(\frac{NDVI_j - NDVI_{min}}{NDVI_{max} - NDVI_{min}}\right) \times 100$	$NDVI_j$= NDVI for jth month or week $NDVI_{min}$= long-term (e.g., 30 years) minimum NDVI for j^{th} month or week; $NDVI_{max}$= long-term (e.g., 30 years) maximum NDVI for j^{th} month or week; VCI = 0: poor vegetation VCI = 50%: Fair vegetation VCI = 100%: Optimal vegetation
Modified Soil Adjusted Vegetation Index (MSAVI)	$MSAVI = \frac{\left[2\rho_{NIR} + 1 - \sqrt{(2\rho_{NIR} + 1)^2 - 8(\rho_{NIR} - \rho_R)}\right]}{2}$	
Normalized Difference Moisture index (NDMI)	$NDMI = \frac{\rho_{NIR} - \rho_{SWIR}}{\rho_{NIR} + \rho_{SWIR}}$	SWIR = Short Wave Infrared $-1 \leq NDMI \leq 1$

Next, OSAVI, Optimized Soil Adjusted Vegetation Index. Here, L value we considered as 0.16. Transform vegetation TVI, same, you use NIR and R wavelength value,

TVI is equals to within rootover Rho NIR minus Rho R divided by Rho NIR plus Rho R plus five

Then you calculate the TVI from NDVI value. Basically, you get

TVI is equals to rootover NDVI plus five

Then comes Vegetation Condition Index or VCI. Again, you use NDVI's to come to VCIs.

VCI I equals to NDVI j minus NDVI min divided by NDVI max minus NDVI min multiplied by 100

$NDVI_j$ stands for that NDVI for jth month or jth week. NDVI minimum is a long term like is, for example, 30 years of minimum NDVI for jth month, a particular month or week for continuous 30 years.

Suppose, you have taken say July of any year 30 years, you have observed that July month data only. NDVI max long term, again, for 30 years. Here, maximum NDVI for jth month and week that you calculate. VCI is zero then poor vegetation, VCI is 50 percent when fair vegetation, VCI is 100 percent when you have optimal vegetation.

So, next comes Modified Soil Adjusted Vegetation Index or MSAVI. You can calculate utilizing this formula.

This is pretty simple. You only need NIR and R.

MSAVI is equals to 2 mutiplied by Rho NIR plus 1 minus rootover 2 multiplied by Rho NIR plus 1 whole square minus 8 multiplied by Rho NIR minus Rho R divided by two

Then comes NDMI, Normalized Difference Moisture Index. So, NDMI, again, you can calculate using this very simple formula.

NDMI is equals to Rho NIR minus Rho SWIR divided by Rho NIR plus Rho SWIR

Where SWIR means for Short Wave Infra-Red and NDMI value ranges between minus1 to plus 1.

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Vegetation indices

Vegetation Indices types	Mathematical expressions	
Normalized Difference Water index (NDWI)	$NDWI = \frac{\rho_G - \rho_{NIR}}{\rho_G + \rho_{NIR}}$	$-1 \leq NDWI \leq 1$ G = Green Water surface $0.2 \leq NDWI \leq 1$ Flooding, humidity $0 \leq NDWI \leq 0.2$ Moderate drought, non-aqueous surfaces $-0.3 \leq NDWI \leq 0$ Drought, non-aqueous surfaces $-1 \leq NDWI \leq -0.3$
Global Environmental Monitoring Index (GEMI)	$GEMI = \eta(1 - 0.25\eta) - \left(\frac{\rho_R - 0.125}{1 - \rho_R}\right)$ $\eta = \frac{[2(\rho_{NIR}^2 - \rho_R^2) + 1.5\rho_{NIR} + 0.5\rho_R]}{\rho_{NIR} + \rho_R + 0.5}$	
Normalized Difference Red Edge Index (NDRE)	$NDRE = \frac{\rho_{NIR} - \rho_{RE}}{\rho_{NIR} + \rho_{RE}}$	Bare soil or a developing crop $-1 \leq NDRE \leq 0.2$ Unhealthy plant or immature crop $0.2 \leq NDRE \leq 0.6$ healthy, mature, ripening crops $0.6 \leq NDRE \leq 1$ RE = Red edge light (715 to 720 nm)

Next, Normalized Difference Water Index, NDWI.

NDWI is equals to Rho

NDWI is equals to Rho G minus Rho NIR divided by Rho G plus Rho NIR

Again, you can use it from NIR data. Here ρ_G, G stands for green surfaces, green water surfaces where you calculate the flooding or the humidity conditions of NDWI you consider value between 0.2 to 0. In case of water surface, water you calculate it and you consider it the value between 1 and 0.2, moderate drought or non-aqua surfaces you will have 0 and minus 3. And if it is drought means where there is moisture is almost negligible, the value is minus3 and minus1, between that range it actually stays.

So, next comes GEMI, Global Environmental Monitoring Index, you can calculate using this formula.

GEMI is equals to neta multiplied by (1 minus 0.25 multiplied by neta) minus (Rho R minus 0.125 divided by 1 minus Rho R)

Where again, near infrared and red wavelengths information works quite nicely. Next comes Normalize Difference Red Edge Index NDRE. Once again here, near infrared information helps you. Now, Red Edge index actually you carry out it for soil or land health condition monitoring.

If you have bare soil or just crop is about to grow NDRE value will range between minus 1 to 0.2. Unhealthy plant or immature crop, suppose, you have crop in a very mature stage then your NDRE value will be between 0.2 and 0.6. Healthy, mature or ripening, ripen, mature harvesting stage then your NDRI value will be between 0.6 and 1. So, if you get NDRE value in that area then your crops are supposed to be in healthy, mature or almost ready to be harvested. So, the RE value, the red edge light is considered between 715 to 720 nanometer.

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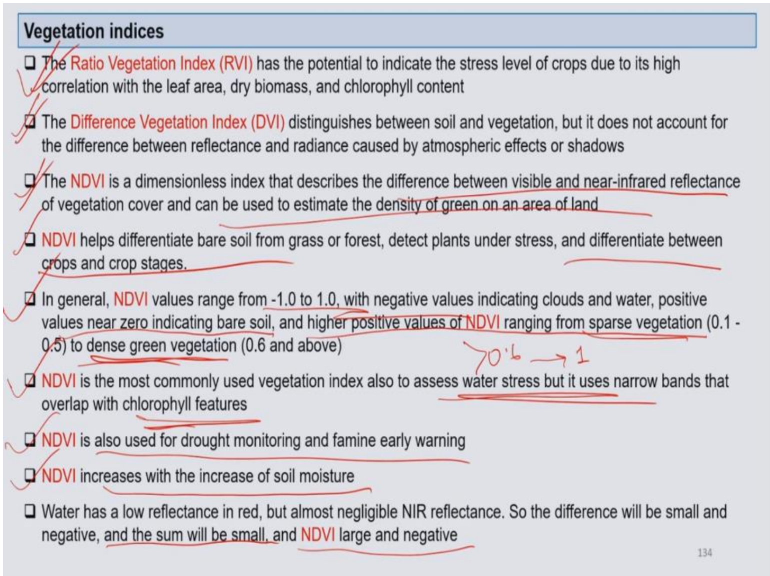

Now, so many vegetation indexes I mentioned in last couple of minutes. So, for you it is just that you try to just remember some of them that these are the different indexes, to understand the applicability of this, you need especially remote sensing or GIS course for that. Now, all these vegetation indices like RVI, this has the potential to indicate the stress level of crops due to suppose its high correlation with the leaf area, dry biomass and also chlorophyll content.

RVI can give you some indication that in that corner of a field, there is some problem, the plant is going through some stress. So, even not going into the field you can actually tell that this is happening. DVI, it helps in distinguishing between soil and vegetation or crops or plants but it does not account for the difference between the reflectance and the radians caused by the atmospheric effects, various atmospherics effects or shadows for any reason.

So, that it cannot give you. NDVI is a dimensionless index and it describes the difference between the visible and near infrared reflectance of vegetation cover and NDVI can be used to estimate the density of green area. On any place, how much area is actually green, NDVI helps you. And that is why I said that NDVI is one of the most popular index in remote sensing people use it.

NDVI also helps differentiating bare soil or barren land from grassland or forest or plants vegetation. It can also helps you differentiating between different crops and crop stages. Suppose, rice. Transplantation stages green, maturity stages golden yellow. So, you see it can clearly capture that through NDVI.

NDVI values as I say that it ranges between minus 1 to 1, with negative values indicating clouds and water, positive values near zero indicates bare soil, higher positive values ranging from 0.1 to 0.5, it gives sparse vegetation. And if you have dense vegetation then it will be above 0.6, greater than 0.6 but can go up to 1.

NDVI is also the most commonly used vegetation index to assess water stress but it uses narrow bands and that overlap with the chlorophyll features of a plant. NDVI is also used for drought monitoring and feminine early warning and so on so forth. NDVI increases with the increase of soil moisture because water has a low reflectance in red but almost negligible in NIR reflectance.

So, the difference will be small and largely negative. So, the sum also will be small. The sum also will be small and NDVI large and negative. So, what happen is that if in the field, suppose, if you irrigate the field or suppose rainfall suddenly takes place in an area automatically you will see that you are getting higher NDVI. So, that is an indication the moisture level has suddenly gone up in a particular area.

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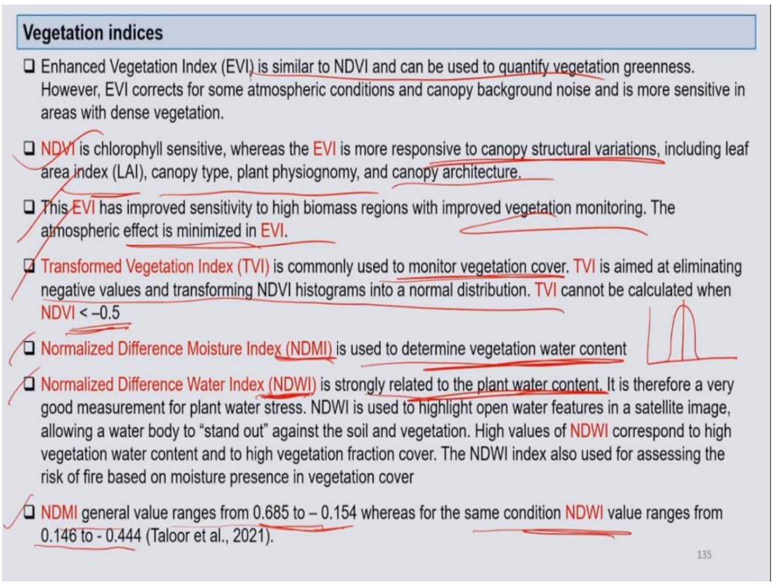

Then EVI, EVI is almost similar to NDVI and can be used to quantify the vegetations cover greenness, density of forest. This also helps in correcting some atmospheric conditions. In remote sensing, atmospheric condition is a very important aspect. Because its reflectance can be affected by the different constituents in the atmosphere. The background noise also can be corrected by using EVI.

NDVI is chlorophyll sensitive whereas EVI is more responsive to canopy structural variation and that includes your leaf area index, canopy type, plant physiology, canopy architecture. EVI has also improved sensitivity to high biomass region forest areas with improved vegetation monitoring. The atmospheric effect, as just now I said that it gets minimized in case of EVI.

Transform Vegetation Index, (TVI). TVI is commonly used to monitor vegetation cover. It largely helps eliminating the negative values and transforming the NDVI histogram into normal distribution. So, it helps in normal distribution. TVI cannot be calculated when your NDVI value comes less than minus 0.5.

Next, NDMI is used for determining the vegetation water content. NDWI is strongly related to plant water content and that is why NDWI can be used to understand if plant is going through under water stress or not. So, to understand in a field, suppose rice plant, we all know it requires so much of water. If there is less water and plant is running out of water NDWI can help you to give an early warning. NDMI moisture index general value ranges from 0.685 to 0.154 whereas for the same condition NDWI value ranges from 0.146 to 0.444.

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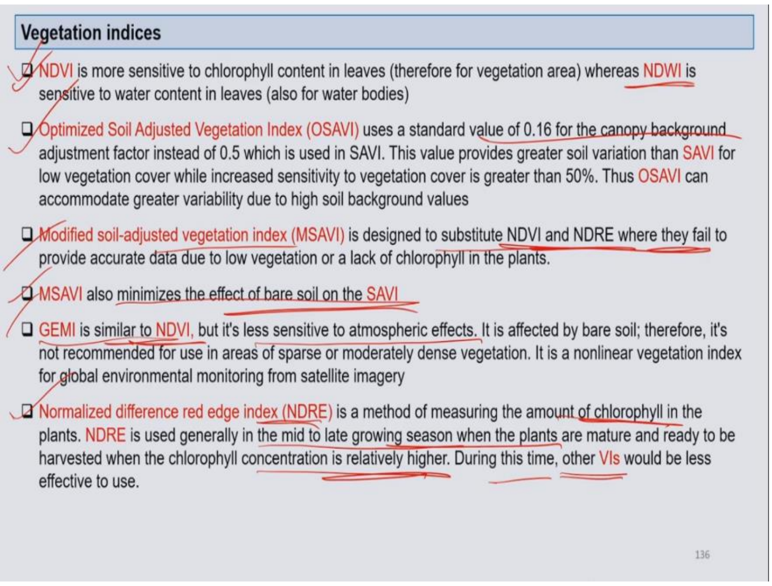

Then NDVI is more sensitive to chlorophyll content in the leaves whereas NDWI is sensitive to the water content in the leaves and that is why if plant is running out of water NDWI will be better index. Optimized Soil Adjusted Vegetation Index, OSAVI. We discussed through previous slides that it uses a standard value of 0.16 for the canopy background adjustment factor instead of 0.5 which is generally used for SAVI.

Modified Soil Adjusted Vegetation Index, again, it is designed to substitute NDVI and NDRE where they fail to provide us accurate data due to suppose low vegetation or a lack of chlorophyll in the plants. In that kind of condition MSAVI will help you. MSAVI also minimize is the effect of bare soil on SAVI.

Then comes GEMI. GEMI is almost similar to NDVI but it is less sensitive to atmospheric effect. GEMI is more affected by bare soil and that is why GEMI should not be used for areas where vegetation is very less. Most of barren land GEMI may not be a good index to use for. NDRE, Normalized Difference Red Edge Index is a method of measuring the amount of chlorophyll in the plants.

It can be used generally in the mid to late growing season when the plants are mature. Imagine the rice field. I am sure most of about rice growth stages. It takes around 90 days. You transplant very light green and then it tailoring stage, deep green. So, rice 90 days it gives a clearly different stages.

So, NDRE is used generally in the mid to late growing season when the plants are mature and ready to be harvested and when the chlorophyll concentration is relatively higher. And during this time your other vegetation index would be less effective. Only NDRE can help you in such conditions.