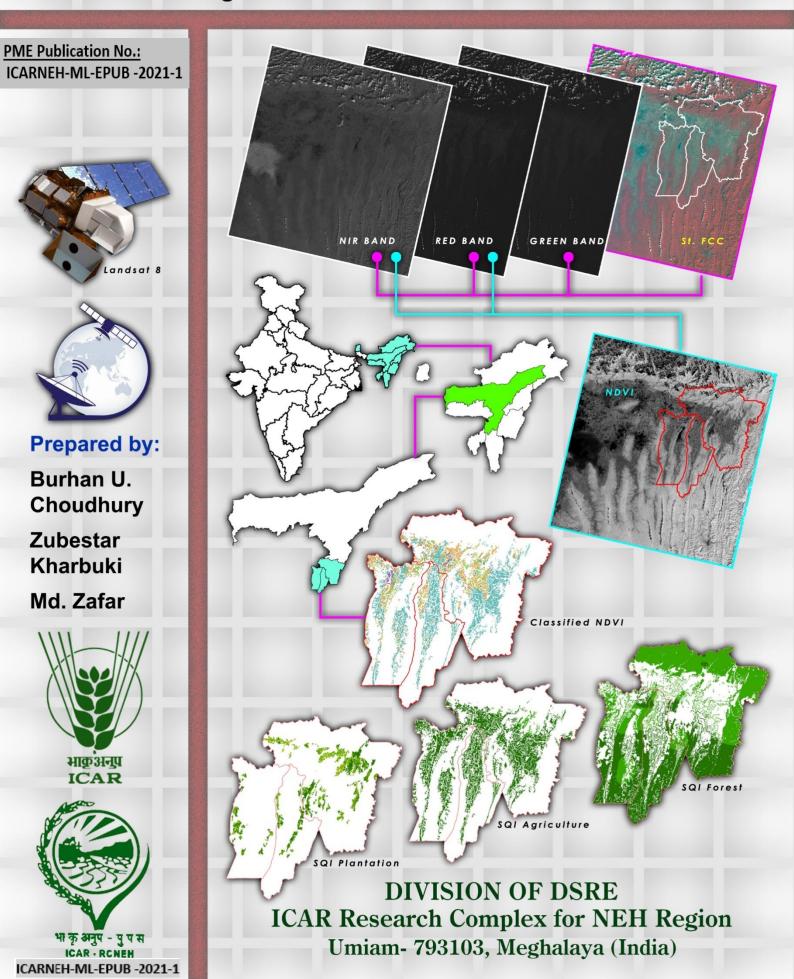
# Exploitation of open source satellite data product and its use in Agricultural Research using ArcGIS E-learning lesson for medium level users



# Exploitation of open source satellite data product and its use in Agricultural Research using ArcGIS

E-learning lesson for medium level users



## **Prepared by:**

Burhan U. Choudhury\* Zubestar Kharbuki Md. Zafar



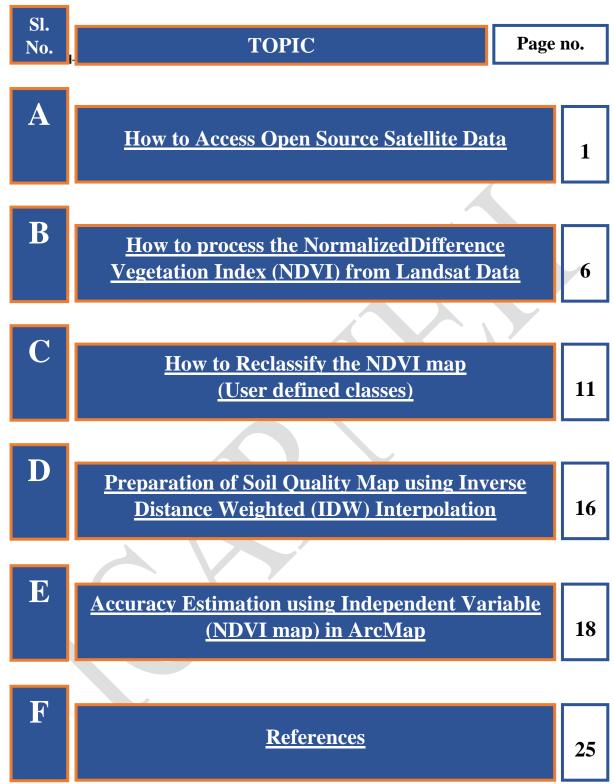
#### DIVISION OF DSRE (SOIL SCIENCE) ICAR Research Complex for NEH Region Umiam- 793103, Meghalaya (India)

\*Corresponding author: burhan.icar@gmail.com (B. U. Choudhury, Principal Scientist)

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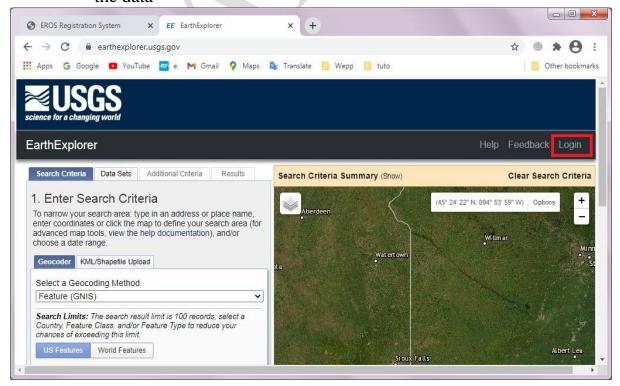


A. How to Access Open Source Satellite Data (Example. Landsat Data for the region Barak Valley, Assam, Northeast India)

**Step I:** Open Google Search and type Earth Explorer and visit the site according to the figure given below

G earth explorer - Goog	gle Search × +			-				- 0	x					
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	EarthExplorer													
	Query and order satellite images, aerial photogra U.S. Geological Survey.	phs, and cartographic products throu	ugh the											
	EarthExplorer Help Index EarthExplorer allows users to search, download, and order	Select Data Set Data Management and Informa Distribution (DMID). EE Help												
	EROS Registration System Query and order satellite images, aerial photographs, and	Feedback If reporting an error, please incl any specific error messages	ude											
1	More results from usgs.gov »													

**Step II:** After opening the website, click on Login on the top right hand side of the window screen. You need an account (registered) to download the data



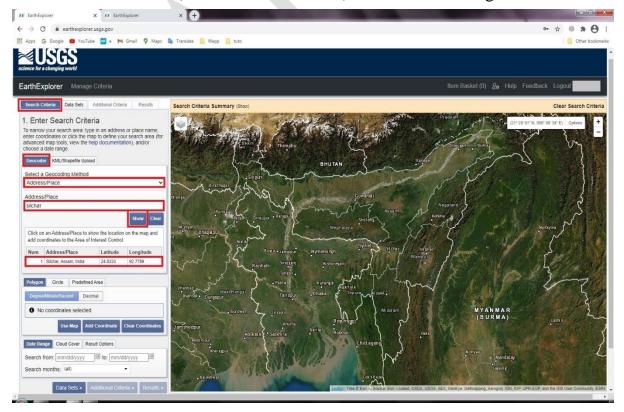
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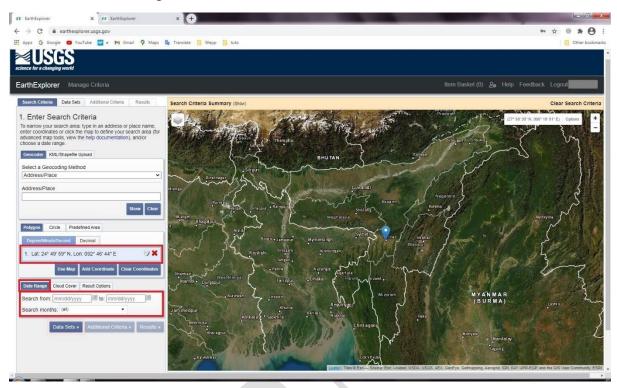
**Step III:** The Login page will appear. To login, Create New Account and Sign in by providing the Registered USGS Username and Registered USGS Password

C EROS Registration System × EE EarthExplorer × +	
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🏢 Apps 💪 Google 💶 YouTube 🔤 e M Gmail 💡 Maps 🧕 Translate 🚦	Wepp 📴 tuto 🛛 🗍 Other bookmarks
science for a changing world	<u>^</u>
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sign in with your existing USGS register	ed username and password
Registered USGS Usernam	e
Registered USGS Password	
Sign In Don't have an acco Create New Acc	

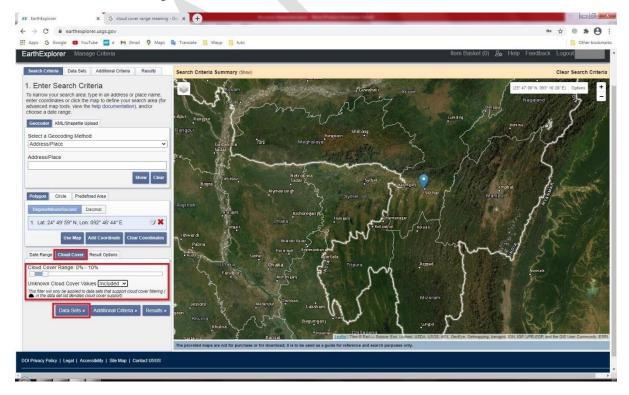
**Step IV:** After login, from the Search Criteria, select a Geo-coding Code as Address/Place and in the Address/Place, type the address name (Silchar) then click on show. The location will appear below and click on it (Silchar, Assam, India) as shown in the figure below.



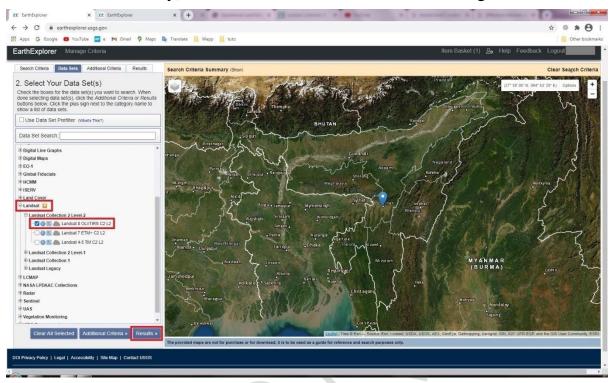
**Step V:** After clicking on the location, the symbol will appear on the goggle map showing the exact location. Go to Data Range tab and select the date range of the data to be downloaded



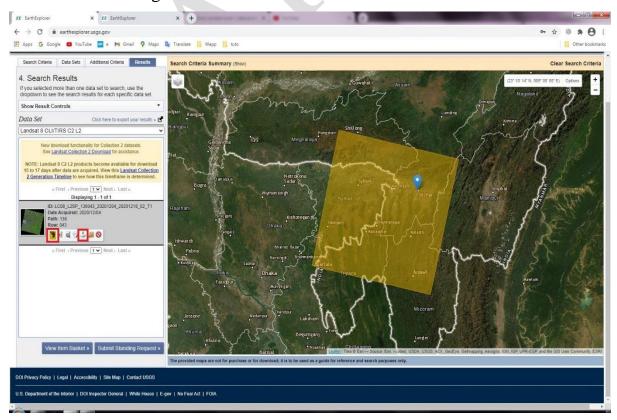
**Step VI:** Select on the Cloud Cover tab and give the cloud cover range of the data to be downloaded. After that, select on the Data Sets as shown in the figure below



**Step VII:** On the Landsat Section, select the Landsat Collection 2 Level 2 and blue tick either the Landsat 8, 7 or 4-5 (depends on data availability), then click on Result as shown in the figure below

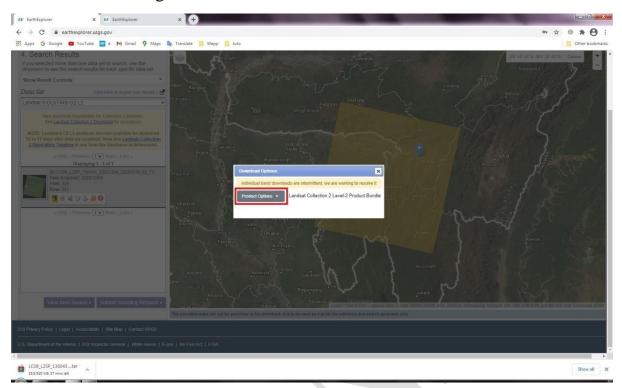


**Step VIII:** To know whether the data covered the area of study or not, click on the foot print icon and it will appear on the map view. To download the data of the Landsat image, click on the download icon as shown in the figure below

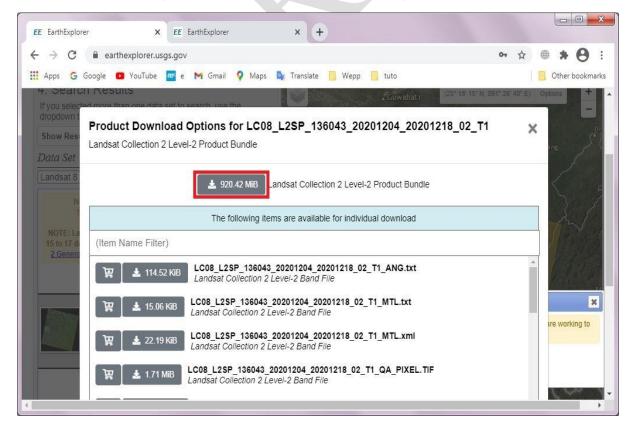


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**Step IX:** Click on the Product Option which appears on the screen as shown in the figure below

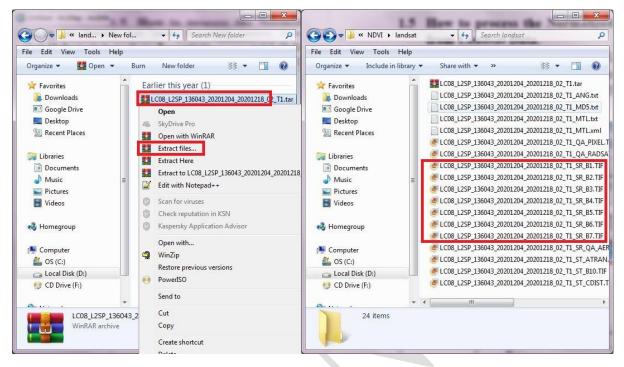


**Step X:** After clicking on the Product Option, again click on the download icon of the Landsat Collection 2 Level-2 Product Bundle as shown in the figure below and the Landsat Image will be downloaded

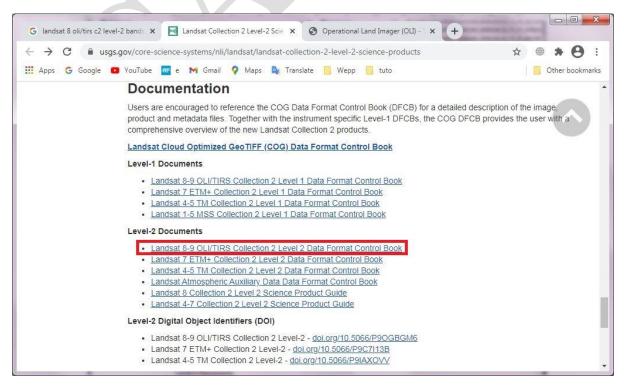


## B. How to process the Normalized Difference Vegetation Index (NDVI) from Landsat Data

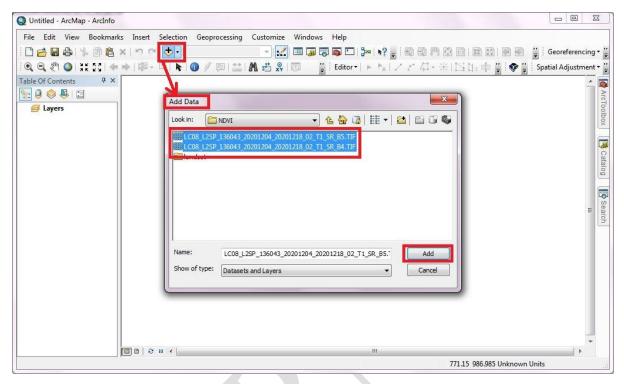
Step I: Extract the downloaded Landsat Data to a Specific location



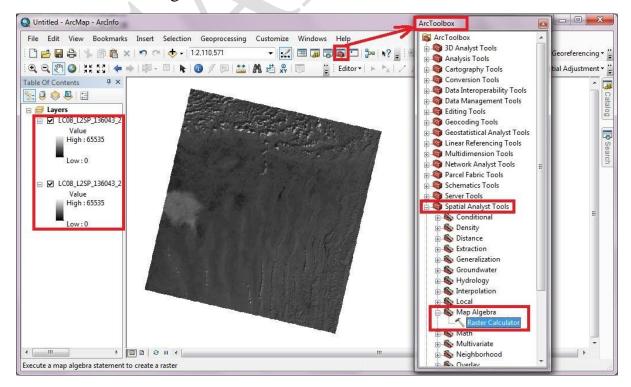
Step II:To process the NDVI, it requirestwo bands (NIR and Red). To<br/>identify which band number is NIR and Red of the Landsat Data,<br/>go to Landsat 8-9 OLI/TIRS Collection 2 Level 2 Data Format<br/>Control Book (<a href="https://www.usgs.gov/core-science-systems/nli/landsat/landsat-collection-2-level-2-science-products">https://www.usgs.gov/core-science-</a><br/>systems/nli/landsat/landsat-collection-2-level-2-science-products).<br/>The NIR band is B5 and the Red band is B4



**Step III:** Add the NIR band and the Red band to ArcMap by clicking on the Add Data icon. The window of Add Data will appear on the screen and add the B5 (NIR band) and B4 (Red band), then click on Add as shown in the figure below



**Step IV:** The NIR and Red bands will appear on the Data View. Go to ArcToolbox icon and select on Spatial Analyst Tools. Select on the Map Algebra and double click on the Raster Calculator as shown in the figure below

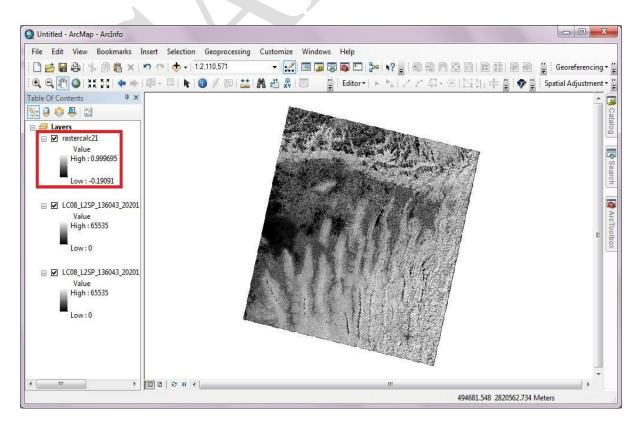


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**Step V:** The Raster calculator will appear on the screen. Using the Formula of NDVI, double click the NIR band and Red band which are in the Map Algebra expression to add in the section (below the Map Algebra expression) as shown in the figure below. The NDVI value should range from -1 to +1 and the formula is given below

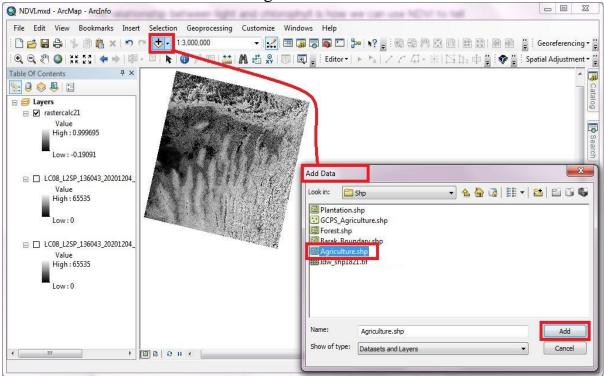
	NDVI =	$\frac{(\text{NIR} - \text{Red})}{(\text{NIR} + \text{Red})}$		
	NDVI =	(B5 - B4) (B5 + B4)		
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("LC08_L2SP_136043_20201204_200" "LC08_L2SP_136043_20201204_202"	1 2 3 - < 0 . + ( 201218_02_T1_SR_B5.TIF" + 01218_02_T1_SR_B4.TIF"))	<= ^ Log 10 ) ~ Log2 Mod	•	Python syntax in a calculator-like interface.
Output raster C: \Users\ICA\Documents\ArcGIS\Del	ault.gdb\rastercalc21		đ	
	OK Cance	el Environments		Tool Help

The Rastercalc21 is the Normalized Difference Vegetation Index (NDVI)

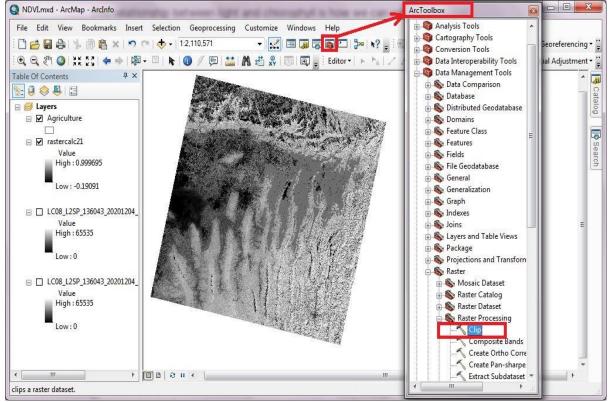


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**Step VI:** To clip/subset the NDVI (rastercalc21) with the targeted boundary layer, Go to Add Data icon andadd the boundary layer of the study area as shown in the figure below



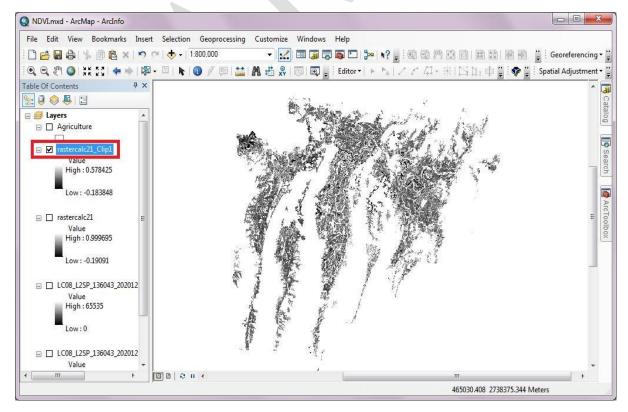
**Step VII:** After adding the boundary layer, go to ArcToolbox. Within the Data Management, select on Raster and Raster Processing, then double click on Clip as shown in the figure below



**Step VIII:** The Clip window screen will appear. Input the raster layer i.e. the NDVI layer (rastercalc21) and the Output Extent i.e. the boundary layer of the study area (barak\_boundary). Check the use input features for clipping the geometry and select Okay as shown in the figure below

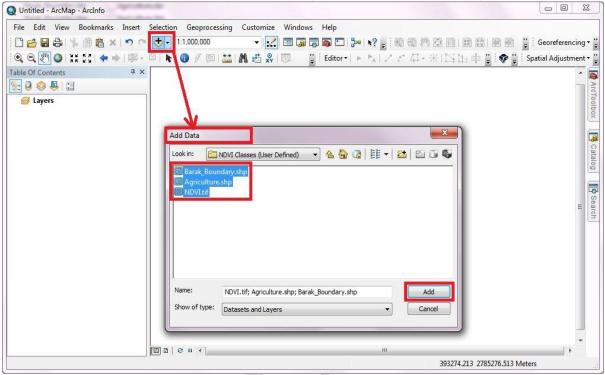
Input Raster rastercalc21			-			Use Input Features for
Output Extent (opti	onal)		-			Clipping Geometry
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Rectangle	Y Maximum					(opdonal)
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K Minimum	X Maximum				- 1	the output extent,
	420660.995130		519077.288492			you have the option to clip the
	Y Minimum					raster by the extent of the
		2668336.738374	Clear			feature <mark>class or by</mark> the polygon
🔽 Use Input Featu	res for Clipping Geometry (optiona	l)				perimeter.
Output Raster Data	set					<ul> <li>Unchecked-</li> </ul>
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NoData Value (optio	nal)				+ +	III

**Step IX:** The clip NDVI layer (rastercalc21\_clip) will appear on the Data View of the ArcMap

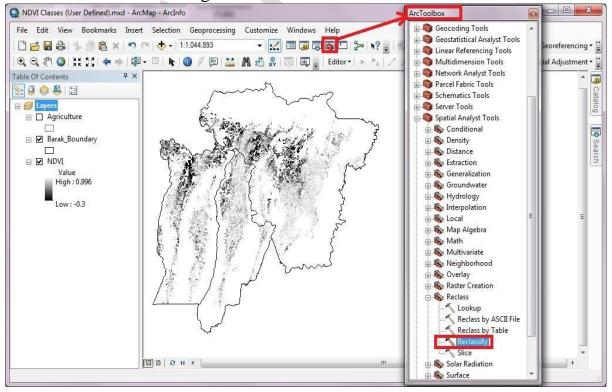


#### C. How to Reclassify the NDVI (user defined classes)

**Step I:** Open ArcMap and go to Add Data icon to add the shape file (vector layer) and the NDVI (raster layer) as shown in the figure below



**Step II:** After adding the layer. Go to Arc Toolbox icon and on Spatial Analyst Tools select Re-class, then double click on Reclassify as shown in the figure below



**Step III:** The Reclassify window will appear on the screen, input the NDVI layer and select on Classify as shown in the figure below

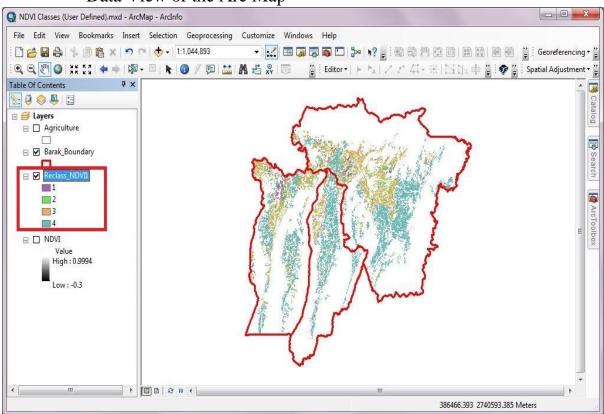
NDVI Reclass field Value			- <u>-</u>	The input raster to be reclassified.
Reclassification Old values	New values			
	0 Cla 1 Cla 2 Cla 3 Cla 4 Cla 4 Cla 4 Cla 4 Cla 4 Cla 6 Cla 6 Cla 7	Classify		
0.151958 - 0.155268	1	Unique		
0.155268 - 0.158578	2	Unique		
0.158578 - 0.161888	3	878	E	
0.161888 - 0.165198	4	Add Entry		
0.165198 - 0.168508	5			
0.168508 - 0.171818	6	Delete Entries		
0.171818 - 0.175128	7			
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C:\Users\ICA\Documents\ArcGI	S\Default.odb\Reclass	NDVI4		
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Change missing values to No.	)ata (optional)		*	

**Step IV:** The classification window will appear on the screen. On the classes, select the number of classes and in the Break Values, input the class intervals, then select Okay as shown in the figure below

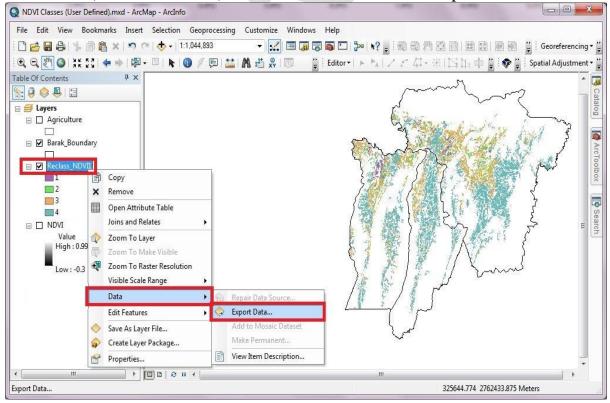
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1000								
2025 ALSO 123	0	4000011 0.34	111111111111 8000005 0.67	1999998 0.99	599999:	< <u>ш</u> ОК		

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**Step V:** The Reclassify, Raster image (Reclass\_tif43) will appear on the Data View of the Arc Map



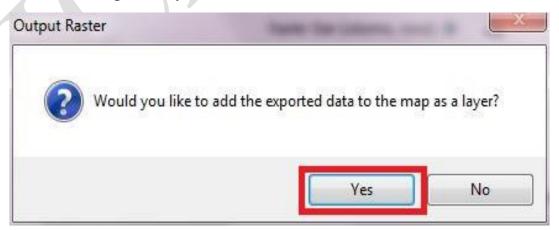
**Step VI:** To extract the Reclassify NDVI, right click on theReclassify NDVI (Reclass\_NDVI1) and on the Data, select the Export Data



Step VII: The Export Raster Data window will appear on the screen. On the Location section, select the folder to save the raster data and give the name (eg. Reclass\_NDVI\_Agri) on the name section, then click on Save

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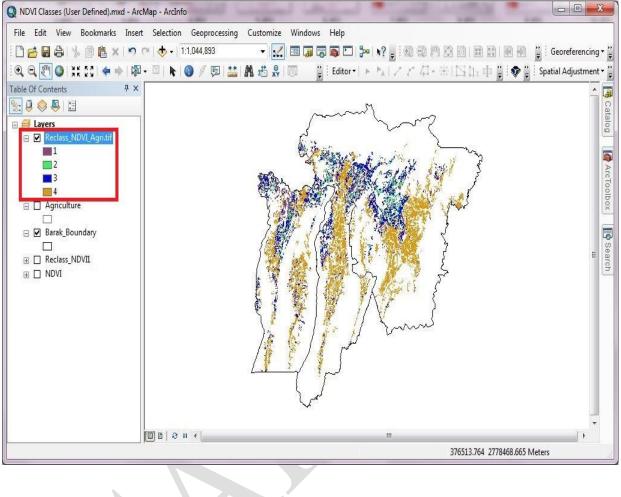
**Step VIII:** The Output Raster window will appear. To add the exported data to the map as a layer, click Yes



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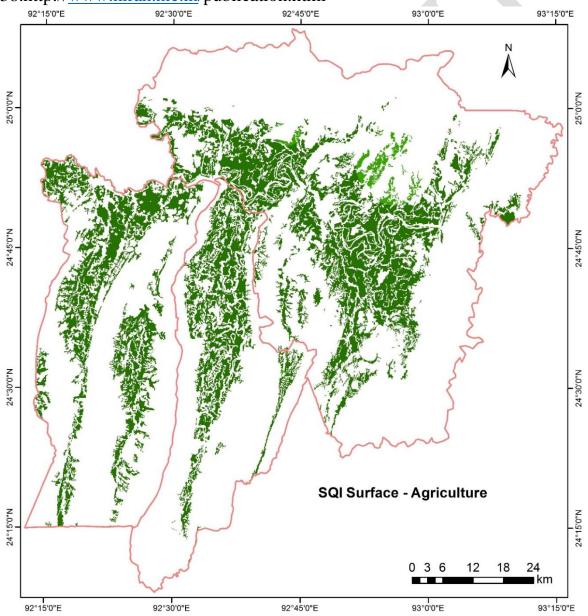
**Step IX:** The exported data (Reclass\_NDVI\_Agri) will appear on the Data View as shown in the figure below



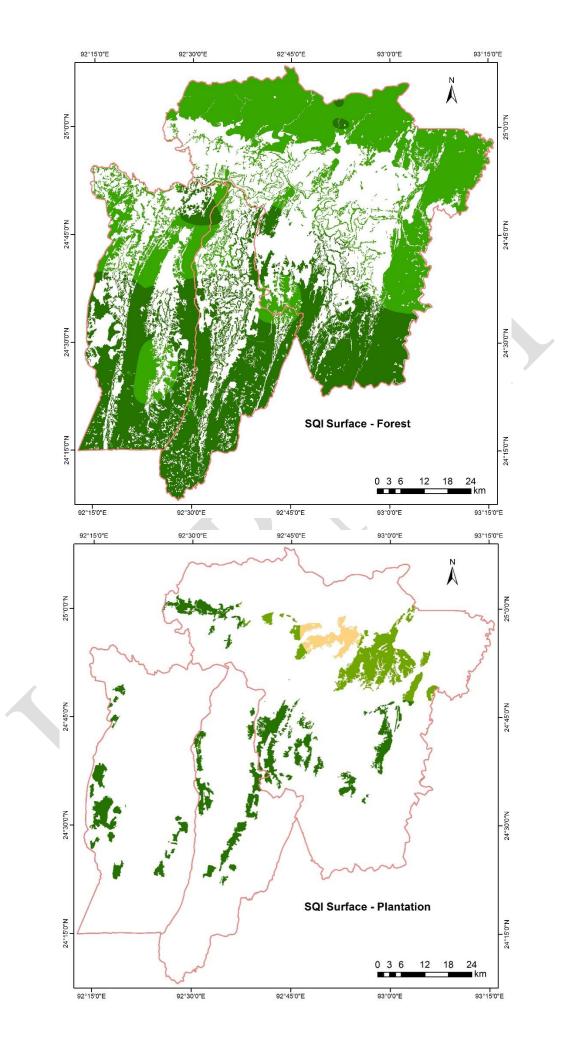
## D. Preparation of Soil Quality Map using Inverse Distance Weighted (IDW) Interpolation

To prepare the Soil Quality Index (SQI) Maps for surface soils of Agriculture, Plantation and Forestland uses, follow the procedure as given in the E-Learning lesson for beginners in agricultural sciences (Reference cited below)

Citation: Choudhury, B.U., Kharbuki, Z., and Zafar, Md. 2021. Map soil using Arc GIS (v.2010.2): E-Learning lesson for beginners in agricultural **ICAR** NEH sciences. Research Complex for Region. Ref. No. **ICARNEH/KIRAN** E-Pub/2021/Jan-01 Pages: 1-38.http://www.kiran.nic.in/publication.html



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#### E. Accuracy Estimation of SQI maps using Independent Variable (NDVI map) in ArcMap

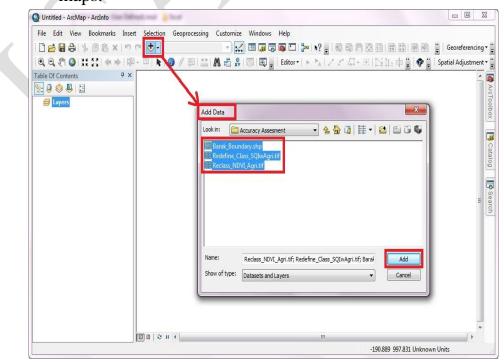
Accuracy of the SQI map generated can be assessed y error/confusion matrix and KAPPA analysis. The error matrix is the standard wethod used to assess classification accuracy. KAPPA analysis is discrete multivariate technique which calculates the producer's and user's overall accuracy, as well as the Kappaaccuracy level. The accuracy of the SQI map can also be assessed by overlaying the geo-referenced ground truth points (GCPs) representing different SQI classes collected over the study area.

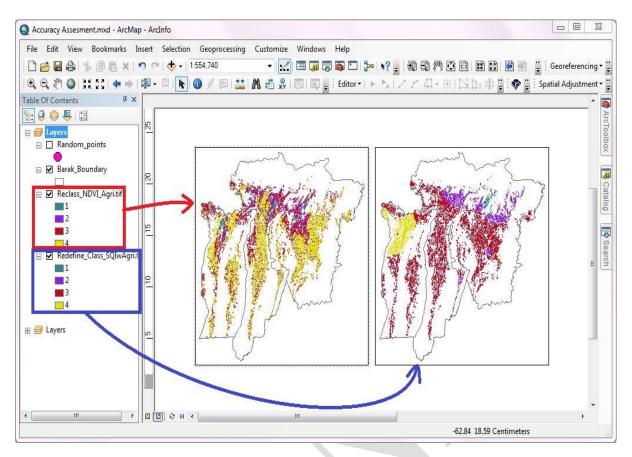
Kappa Coefficient (KC) by using the formula given below.

Kappa Coefficient (K) =  $\frac{(DA - AA)}{(1 - AA)}$ Where DA = disagreement; AA= agreement

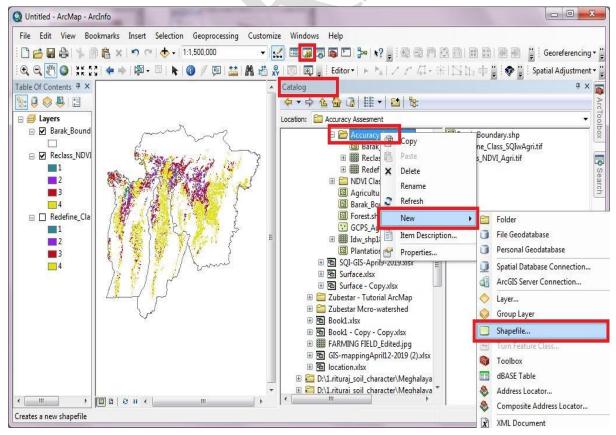
To determine the accuracy of SQI classification, a sample of pixel was selected on the classified map and their class identity was compared with the ground reference data. Then calculate the Kappa Coefficient (KC). The Kappa classes can be interpreted as follows: values  $\leq 0$  as indicating no agreement, 0.01–0.20 as none to slight, 0.21–0.40 as fair, 0.41– 0.60 as moderate, 0.61–0.80 as substantial, and 0.81–1.00 as almost perfect agreement(Congalton and Green, 1999).

**Step I:** Open Arc Map and go to Add Data as shown in the figure below. Add the vector layer (Barak Boundary) and the raster layer of i.e. Normalized Difference Vegetation Index (Reclass\_NDVI\_Agri) and the SQI Agriculture (Redefine\_Class\_SQIAgri) to check the accuracy of classification of SQI Agriculture map with the NDVI maps.





**Step II:** Go to Catalog icon and select the location to save the shape file. Right click on the location and on New select Shape file to create the point shape file for accuracy estimation.



**Step III:** The Create New Shape File, window will appear on the screen. Give the name of the shape file (Randoms\_points) and on feature type, select point. Select edit and the Spatial Reference Properties will appear and then select the predefined coordinate system according to the location of the study area. Select Okay and the Randoms\_point will appear as a layer in the Data View.

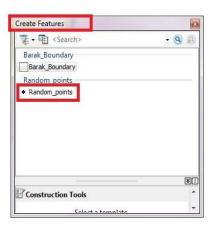
Create New Shapefile	S X	Spatial Reference Properties	2 X
Name: R	andom_points	XY Coordinate System	
Feature Type:	oint 👻	Name: GCS_WGS_1	1984
Spatial Reference		Details:	
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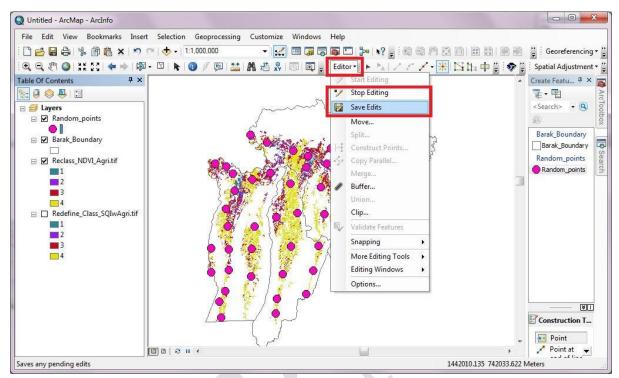
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**Step IV:** Right click on the Randoms\_point and on the Edit Features, select Start Editing to add the point within layer of SQI Agriculture. The create Features window will appear and select the Random\_point on the layer, add at least 50 or more GCP points (depends on the area) which lies within the layer of SQI in agriculturemap. These points are used to check the accuracy of SQI map within agriculturearea.

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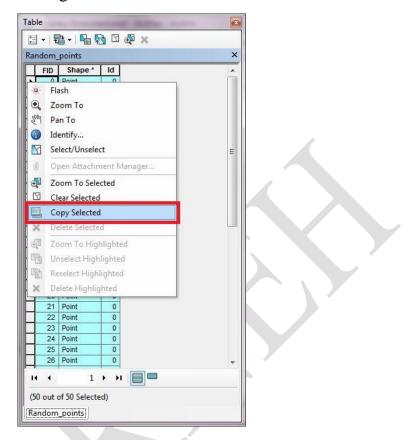
**Step V:** After adding the point. Go to Editor,Click on Save Edits and then Stop Editing as shown in the figure below. The ground control points (GCP layers) will appear



**Step VI:** Right click on the Ramdom\_points layer and select Open attribute table as shown in the figure below

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**Step VII:** Select all the points in the attributes table of Random\_points. Right click on the points which are selected and click on Copy Selected as shown in the figure below.



**Step VIII:** Open Microsoft Excel and paste the Copy Points from the attributes table of Random points.

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**Step IX:** Create two columns, one for NDVI (Reclass\_NDVI\_Agri) and the other for SQI Agriculture map (Redefine\_class\_SQIAgri). From the ArcMap, identify each point in which class does it fall on both the NDVI and SQI Agriculture maps.

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**Step X:** Prepare the Error Matrix Correction to check the Agreement (AA0 and Disagreement (DA) as shown in the figure below.Calculate the Kappa Coefficient (KC). For classes 2 and 4, the values varied from 0.70-0.75 (falls as substantial agreement) while for class 3, it was in perfect agreement class (KC>0.81)

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#### F. References

Choudhury, B.U. and Mandal. S. 2021. Indexing soil properties through constructing minimum datasets for soil quality assessment of surface and profile soils of intermontane valley (Barak, North East India). Ecological Indicators, 123 (2021) 107369. https://doi.org/10.1016/j.ecolind.2021.107369.

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