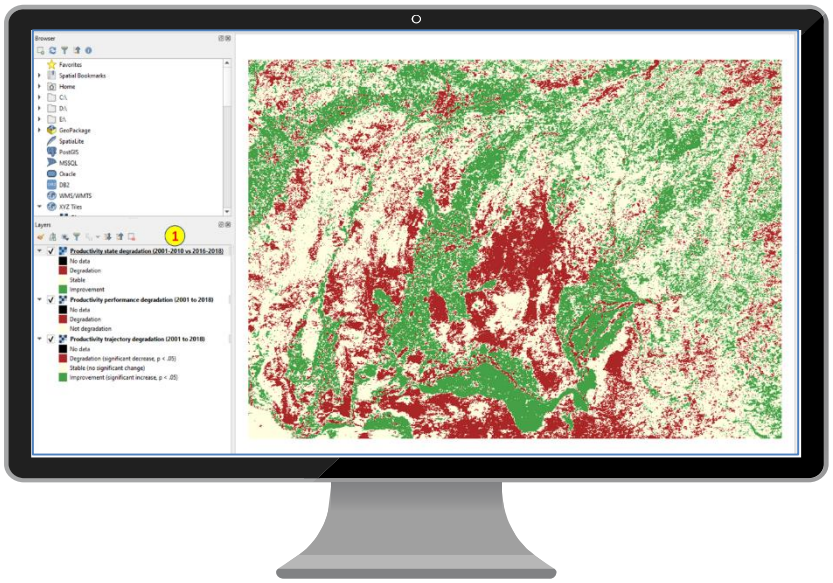
World Overview of Conservation Approaches and Technologies



Tutorial for

Mapping Land Degradation Neutrality Indicators in Central Asia using Trends.Earth

Title: Tutorial for Mapping Land Degradation Indicators in Central Asia using Trends.Earth

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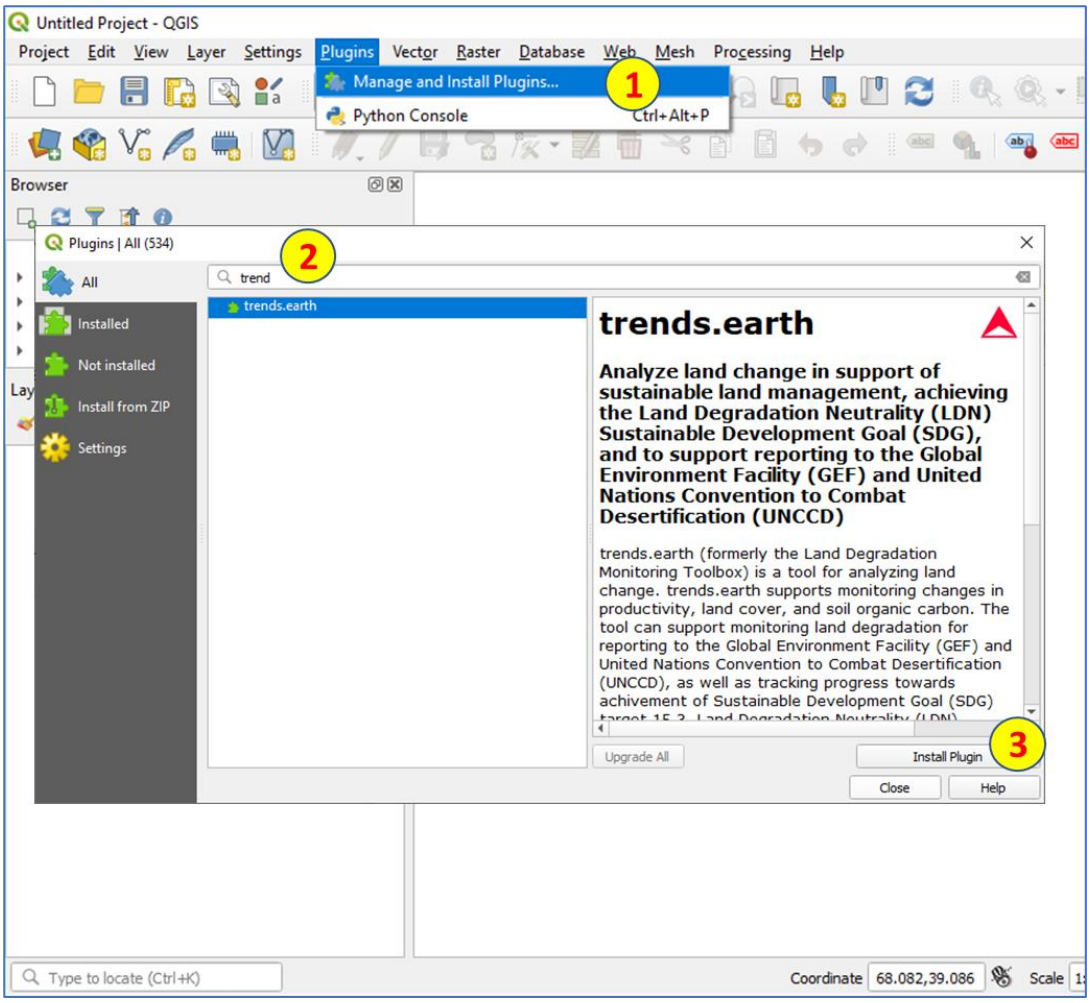
1. Installing Trends.Earth

Trends.Earth is a Plugin Developed by Conservation International and associated partners with the aim of "Enabling the use of global data sources to assess and monitor land degradation at multiple scales". The project was funded by the Global Environment Facility. All the important information and documentation can be found in the official site: http://trends.earth/docs/en/

To install trends.earth please open **Plugins** -> **Manage and Install Plugins… (1).** When the new windows open please filter the plugins list by writing "**trend**" in the search bar **(2)**. Select **trends.earth** from the list and click the Install button **(3).**



1.1 Alternative method – Installing from zip file

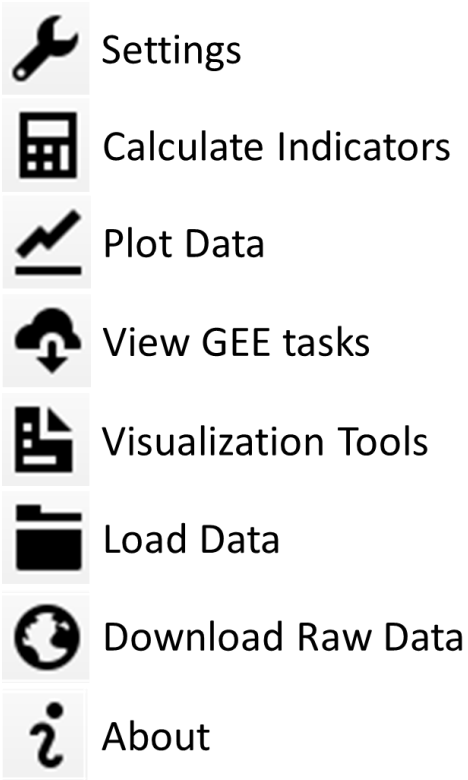
If the previous method does not work, (which may be due to connectivity with the repository) you can download Trends.Earth as a zip file from one of these links:

1.- http://plugins.qgis.org/plugins/LDMP/
2.- https://github.com/ConservationInternational/trends.earth/releases

Once you have the zip file you can use the option **Install from ZIP** from the **Plugin** window.

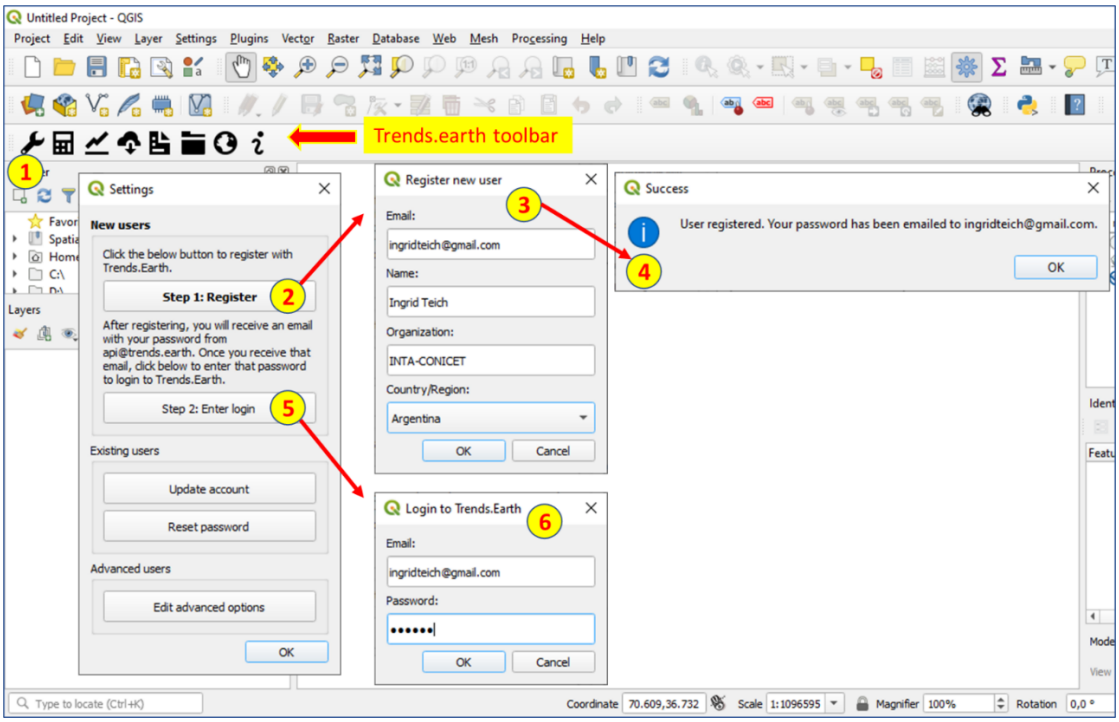
1.2 Trends.Earth Toolbar

Trends.Earth Toolbar will appear in your QGIS after the installation succeeded. We are going to explore all the icons and functionalities during this course and tutorial. We will indicate with the Icon and Name the function that we need to use.



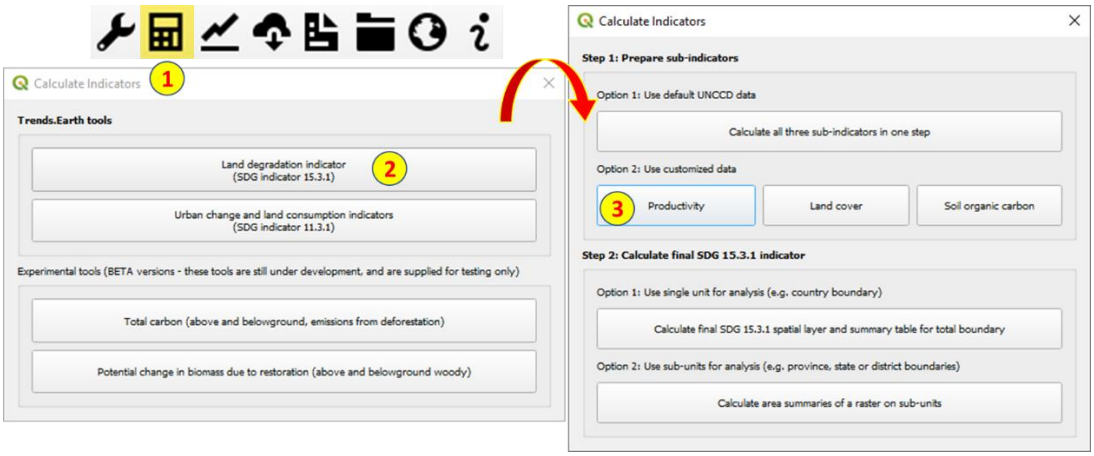
2. Register and Login

Once installed, Trends.Earth toolbar will appear. You can click on the wrench **(1)**, the first icon **(Settings),** to start the registration process. Click on "**Step 1: Register" (2)** and when the new windows appears, please enter your information **(3)**. After you press **OK** you will get a message indicating that the password was sent by email.
Open your email and check your mail (also check spam if you do not find it) and return to settings for "**Step 2: Enter login" (5)** now a new window will appear for you to enter your credentials. Press **OK** and you should receive a message indicating that all went good!



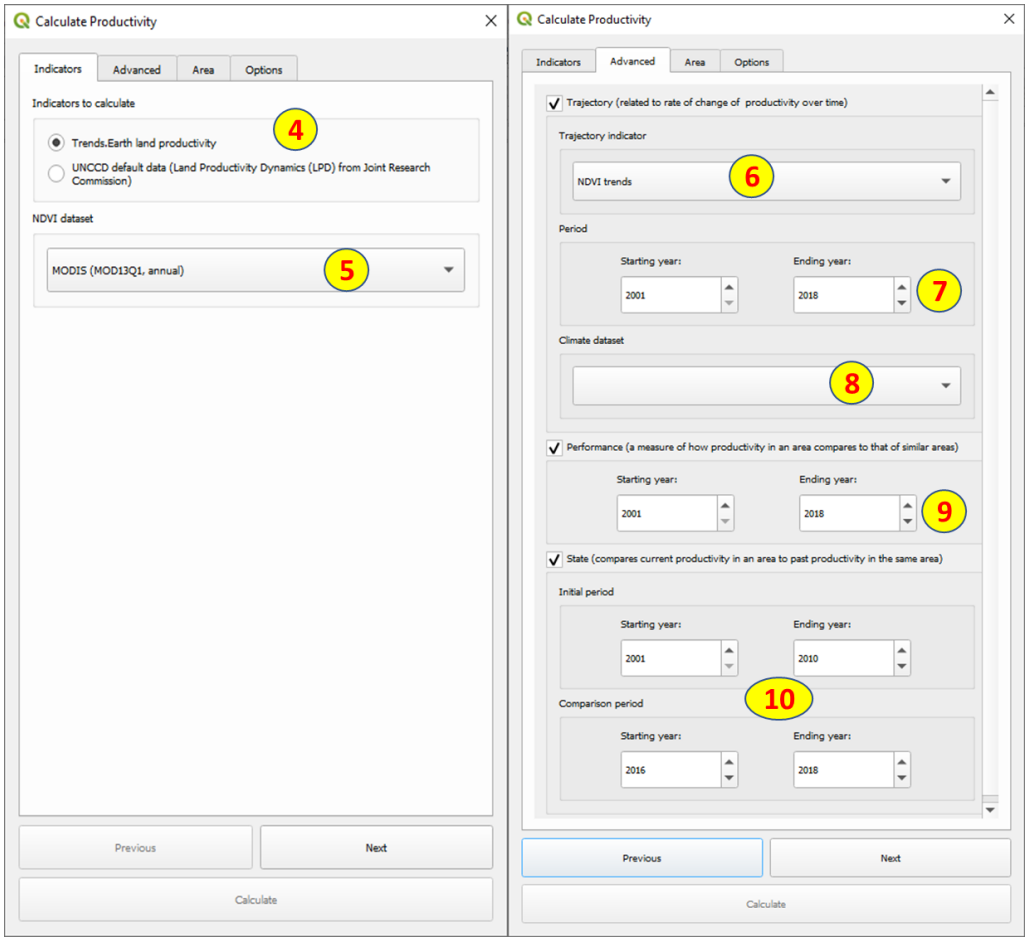
3. Calculate Productivity indicators

The first indicators we are going to work with are the productivity indicators. Please open the **Calculate Indicators (1)** menu and in the window choose **"Land degradation indicator (SDG Indicator 15.3.1)" (2).** This option has all the necessary tools to compute the SDG 15.3.1 using the UNCCD Default data, many alternative data and methods or even your own datasets. All 3 main sub-indicators can be calculated in a Single step, but we recommend you to do it one by one in order to be able to personalize and access all the choices that the tool is offering. Let's start with **Productivity** by just clicking on it **(3):**



A new window will open where you can choose a lot of different options for the calculation of the Productivity indicator. This indicator is made of 3 different Sub-indicators called: Trajectory, Performance and State.

The first choice you have to make is if you prefer to calculate the indicator using **Trends.Earth** land productivity algorithms or with the UNCCD Default data. We recommend the first one **(4)**. Trends.Earth can compute a personalized version with up to date images, instead of the Default UNCCD version, which comes from the World Atlas of Desertification and that is a closed product calculated till 2013.

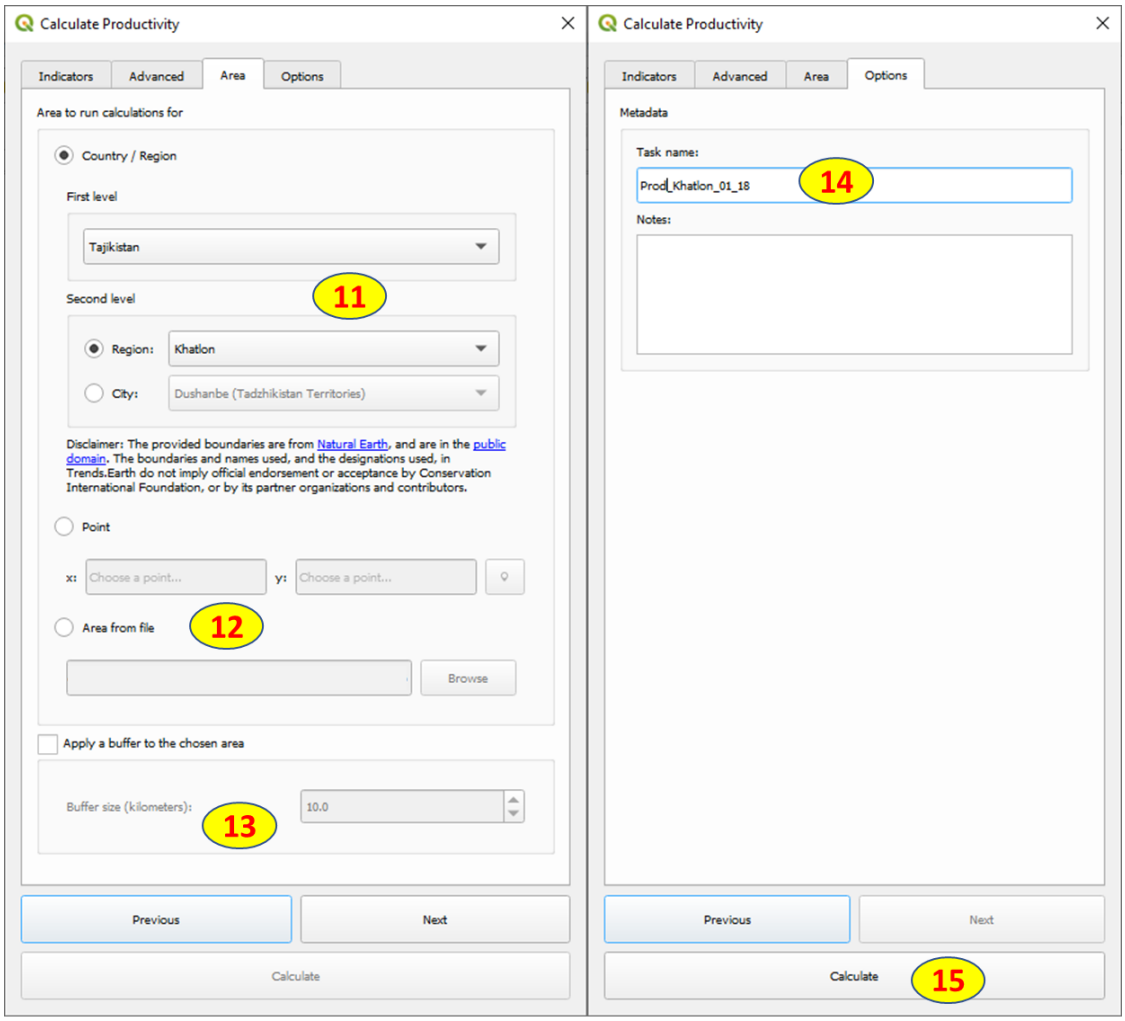


Choose the Dataset for NDVI **(5)**, in this case we will use **MODIS**, which is updated and has a 250m spatial resolution. Click **Next** and you will move to the **Advance** Tab for more personalization on each of the sub-indicators.

Trajectory indicator: please choose **NDVI Trends** **(6)** and set the period to **2001/2018** **(7)**. There is data for 2019 complete year, but since we will make all the indicators and land cover is only available until 2018 we will run the analysis using 2018 as end year for all processes. The option for **Climate dataset (8)** only will be available if you choose another type of analysis in point **(6).**

Performance: Just choose the whole study period **2001/2018** to run this analysis **(9).**

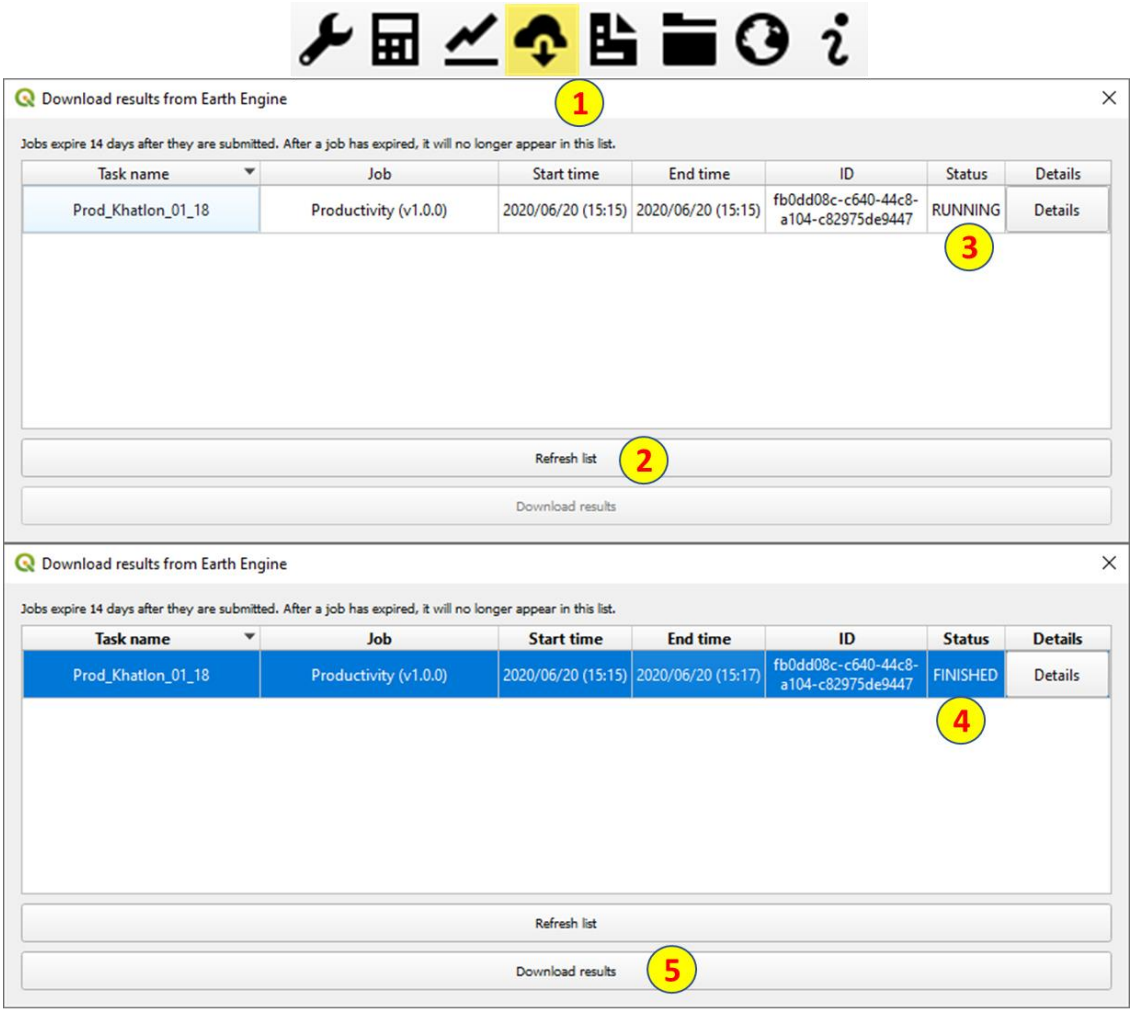
State: For this indicator you need to set the baseline period and comparison period you can try with using the first 10 years as baseline **(2001-2010)** and compare it with the last 3 years **(2016-2018)** **(10).** Please complete it like the figure above and **click next** to move to the **Area** Tab.



In the **Country / Region** menu from the **Area** Tab you will find Pre-Loaded options to quickly choose either a whole country computation or a province (Second Administrative Level). These boundaries are not official and come from Natural Earth Dataset and are simplifications to the scale of 1:10 millions. We are going to choose the same province we used in the past tutorials (**Khatlon in Tajikistan**) as demonstration **(11)**, but feel free to try it in yours. For more accurate or national official boundaries or to use a project area, you can upload your own area **(12)**. You can also set a buffer around the edge of the area in Km **(13)**. **Click next** to move to the final **Option** Tab.
In the **Option** Tab you should choose a name of the Task you are submitting to the server **(14)**. This should be something not too long but clear to understand. I chose to name it as **Prod_Khatlon_01_18**, in order to remember that this is the productivity indicators for the Khatlon province calculated using 2001 and 2018 as start/end year. Final step is to press **Calculate** **(15).**

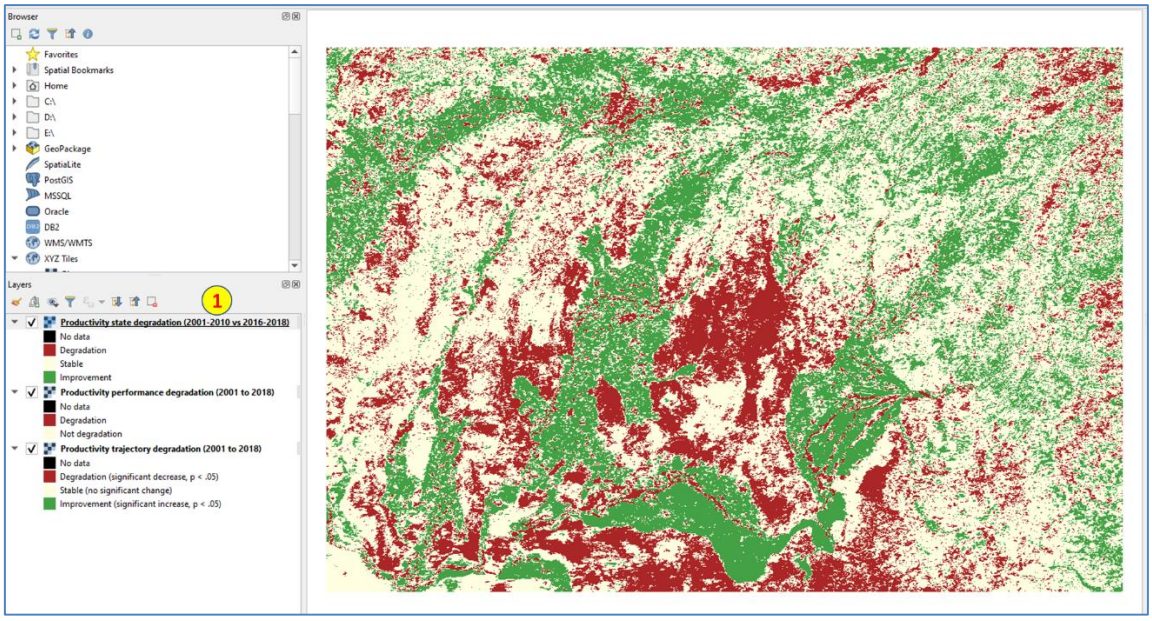
4. Tasks: Status and Downloading

After you press calculate, the task is sent Google Earth Engine servers to process it, and results will be downloaded and stored in Conservation International server for 14 days. During that time, you can download it as many times as you want and after it gets deleted you can simply do it again if needed.
Let's check it out:



Click on the **View GEE Task** Icon **(1)** and the window will open. It will be surely empty if this is the first time or more than 14days past since last time you used it, so press **Refresh List** **(2)** to update the content. In my case, I can see the task I just sent in the previous point. Please notice that under status says **RUNNING (3)**.
Good time for a Tea ☺…There is nothing to do but wait. Anyway, if your area is not too big analysis run fast in the servers! – You will receive an Email notification when it is ready.

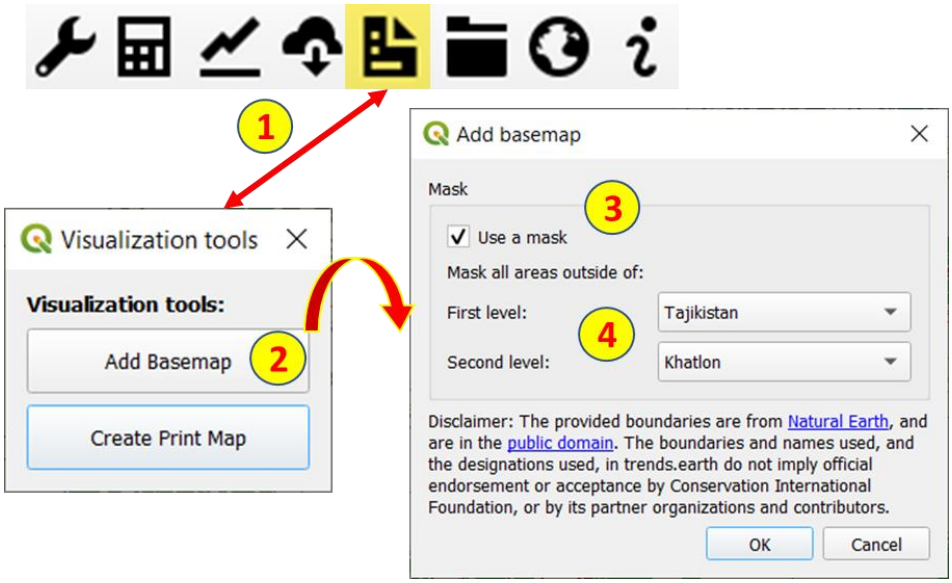
Just click on **Refresh List (2)** and see if the status changes to **FINISHED (4).** In my case for Khatlon province it took only 2 minutes. Now that the task is finished, select the **Download result** Button should be available now **(5)**. Click Download and select a place in your computer to save the File and a Name (I usually use the same as the Task so I can relate). A Map should appear as in the next figure:



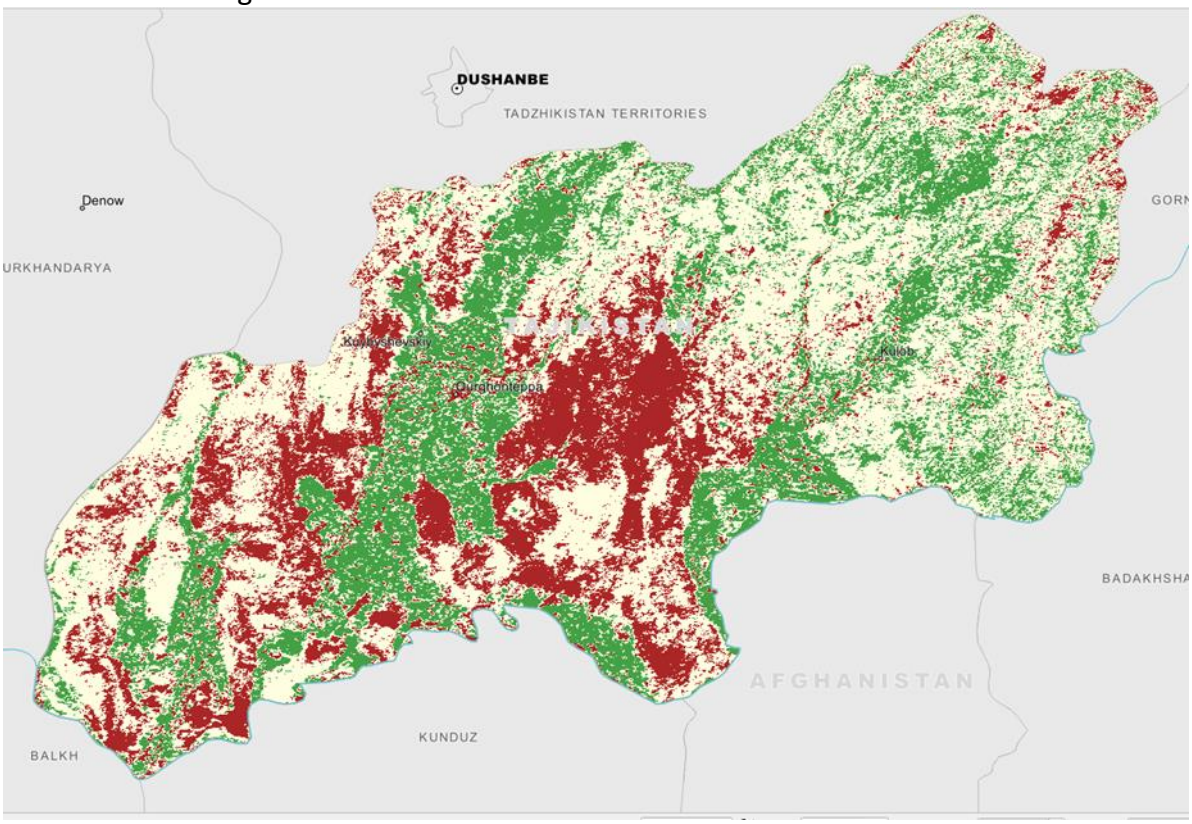
As you will see the map extent occupies a whole area, i.e A rectangle defined by the minimum and maximum Lat/long of your study area. Also 3 layers can be seen loaded **(1)**, but some others are calculated, we will explore these things in the following points.

5. Visualization Tool

You can use the **Visualization tool (1)** to choose the **Add Basemap (2)** Option of Trends.Earth. This will open a new window where you can choose to **Use a Mask (3)** and the area you want to keep unmasked, in our case **Tajikistan** for first level and **Khatlon** for second level **(4).** This will trigger the downloading of information from the internet of a Global map that you will be able to use in any other project. If you want to mask another place later, the tool will perform the masking but no extra downloading will be needed.

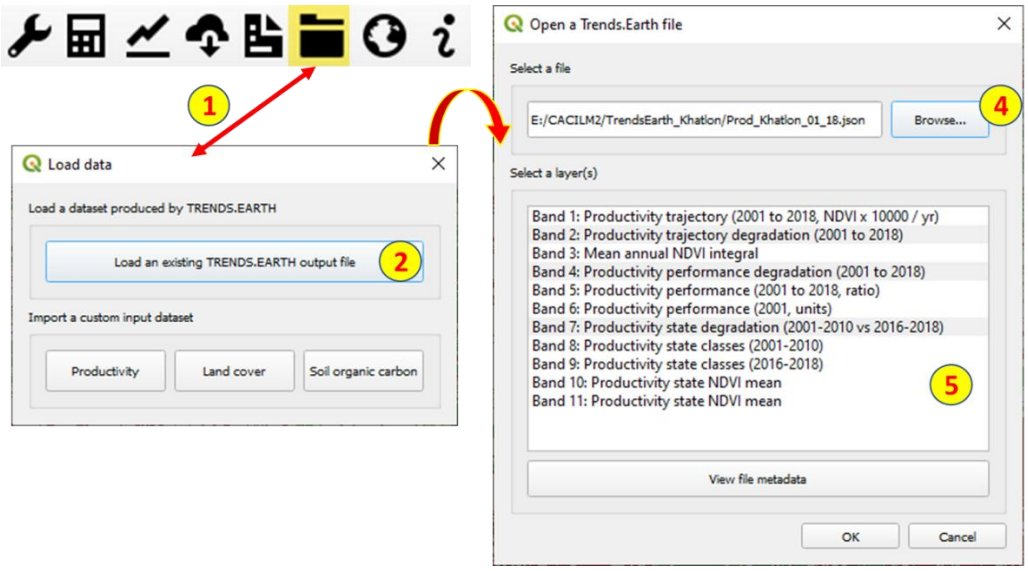


After downloading is done, you should see the same maps as before but with some boundaries and legends:



6. Loading Data and Exploring the results

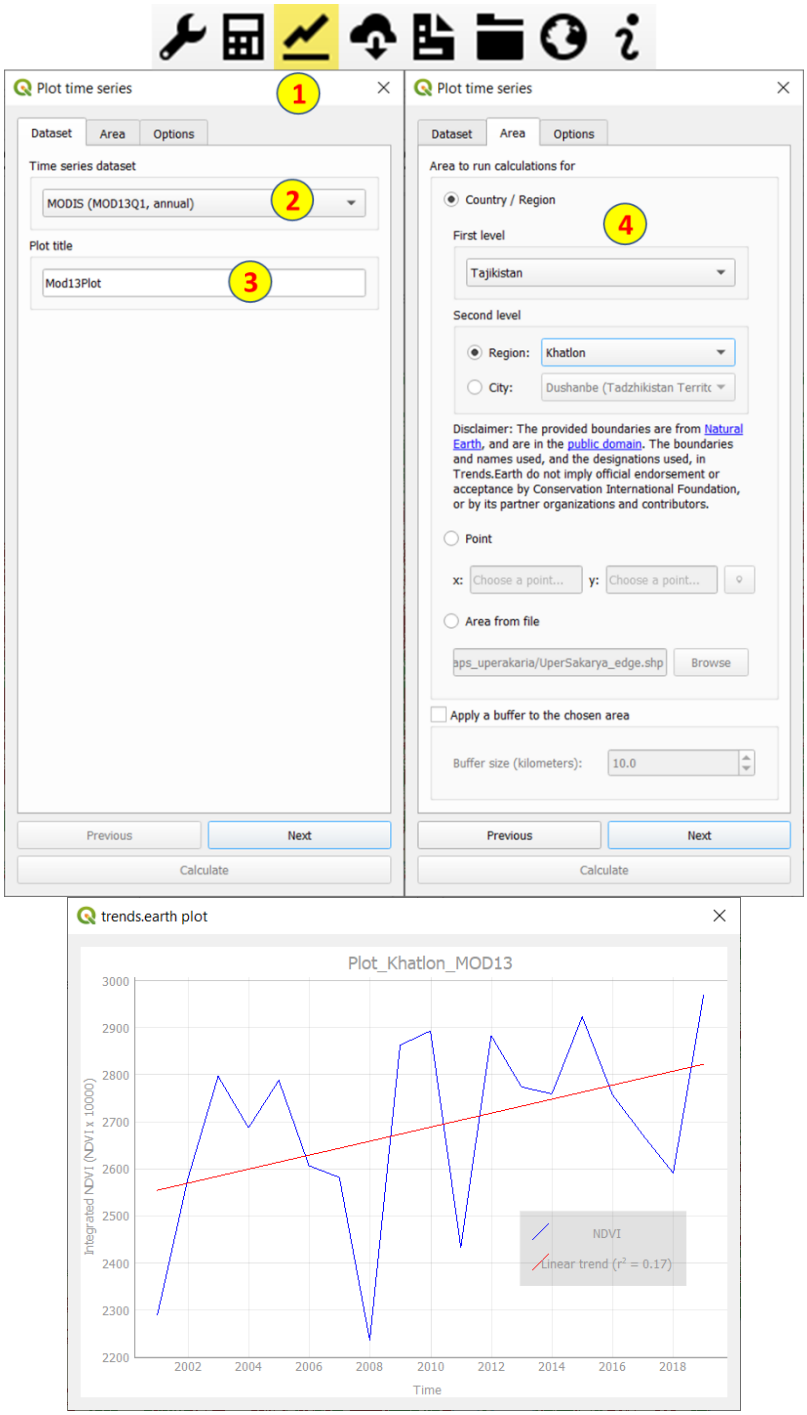
To see all the information available at your *.JSON layer, you need to use **the Load Data (1)** tool and select the option **"Load an existing TRENDS.EARTH output file" (2)**. Browse the layer you downloaded earlier **(4)** and you will access to the different layers produced during the calculation **(5)**:



As you can see there are 11 products, Bands 1 and 2 correspond to productivity trajectory, Band 3 corresponds to the mean annual NDVi for the whole period, Bands 4 to 6 to performance and bands 7 to 11 correspond to state. You can select the ones you are interested in visualized and they will appear in the Layer Panel. Please select them all and explore them.

7. Plotting time series of annual means of NDVI for your area

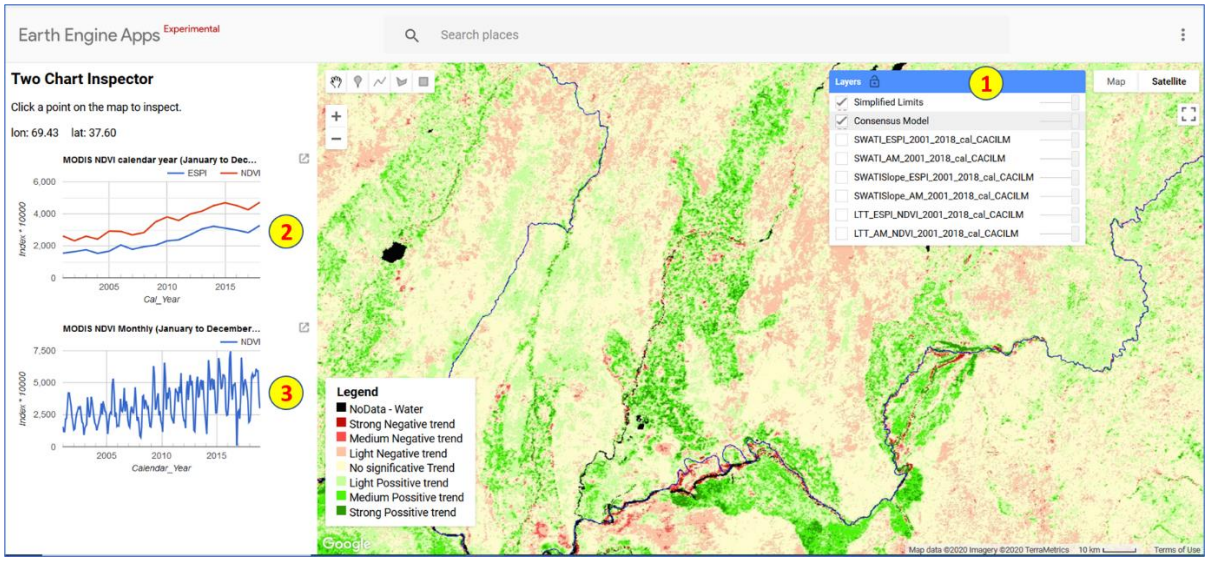
Using the **Plot Times Series (1)** tool is simple. Choose the NDVI dataset **(2)** and export spatial mean behavior for your whole area **(4)**:



8. Alternative Land productivity Trend Maps using Google Earth Engine

In Google Earth Engine you can use multiple datasets including the same MODIS data (MOD13Q1) used in Trends.Earth and perform different analysis. This cloud computing system can give you the advantage to explore multiple environmental issues with great flexibility and power. Also, after finishing your processes you can create Apps for sharing and interact with other users.
As an example, you can explore the App we developed for CACILM 2 project, shown in the presentation, which contains 6 different models and a consensus model for the whole world. This can be done from any web browser using this link:
https://cesarnon.users.earthengine.app/view/cacilmlti

You can manage the visibility of the layers **(1)** to see different models and by clicking on any image you will be able to see the times series for: NDVI Annual mean and ESPI **(2)** and the monthly NDVI for that pixel **(3)**. This is an easy way to explore the data and models results:

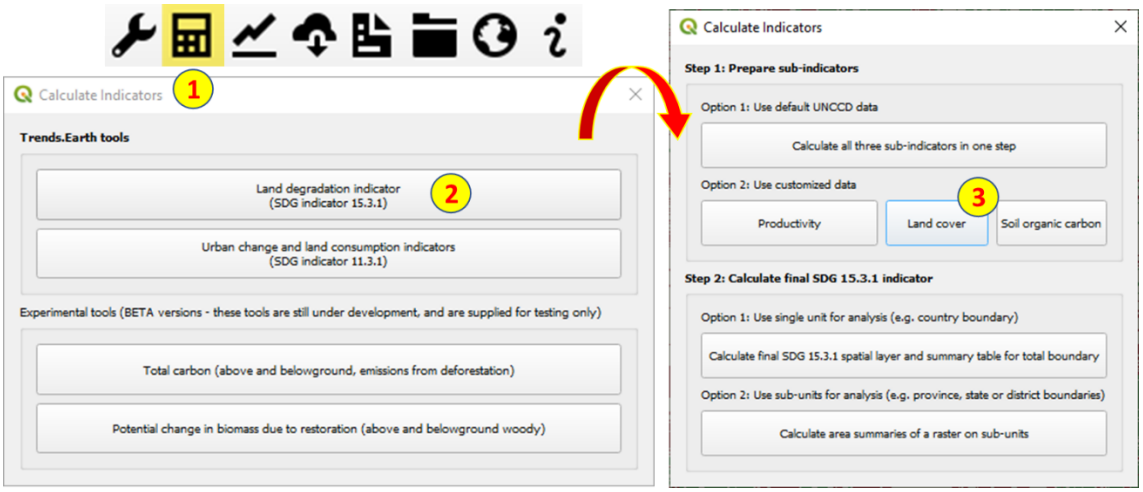


You can also download these layers to explore in QGIS or take them to the field in your mobile using the QField App. In the Webinar Share Folder, you can find a folder for each CACILM country with the Layers and a QGIS project file *.QGZ ready for opening.

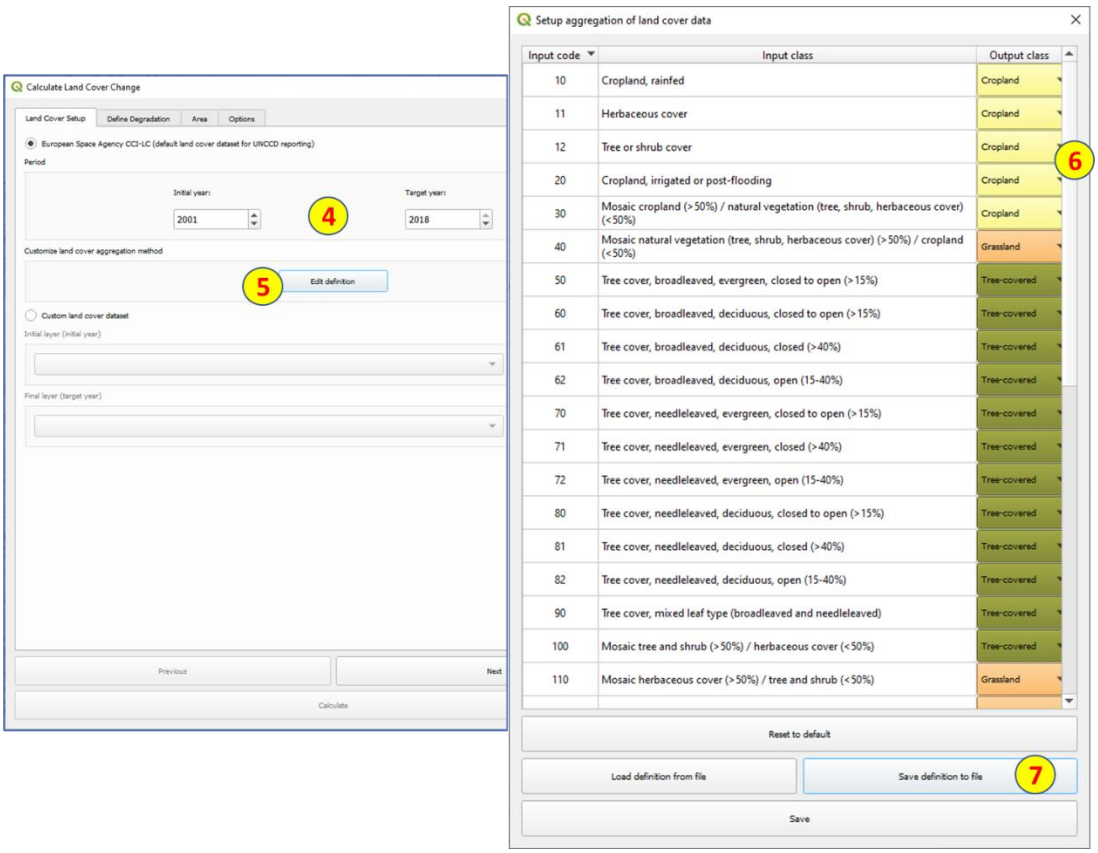
More information about this alternative models and the Script to produce them in Google Earth Engine are publicly available at: https://doi.org/10.3390/rs11242918

9. Calculate Land cover indicators

The second indicator we are going to calculate is the Land cover indicator. Please open the **Calculate Indicators (1)** menu and in the window choose **"Land degradation indicator (SDG Indicator 15.3.1)" (2).** Select this time **Land cover** by just clicking on it **(3):**



A new window will open where you can set the **Initial/Target** year **(4)** and choose to review the ESA land cover reclassification **(5)**. If you find it suitable you can change it easily by clicking the colored **"Output class" (6)** and choosing one of the options, if you modify it is very advisable to save it for later use **(7)**.



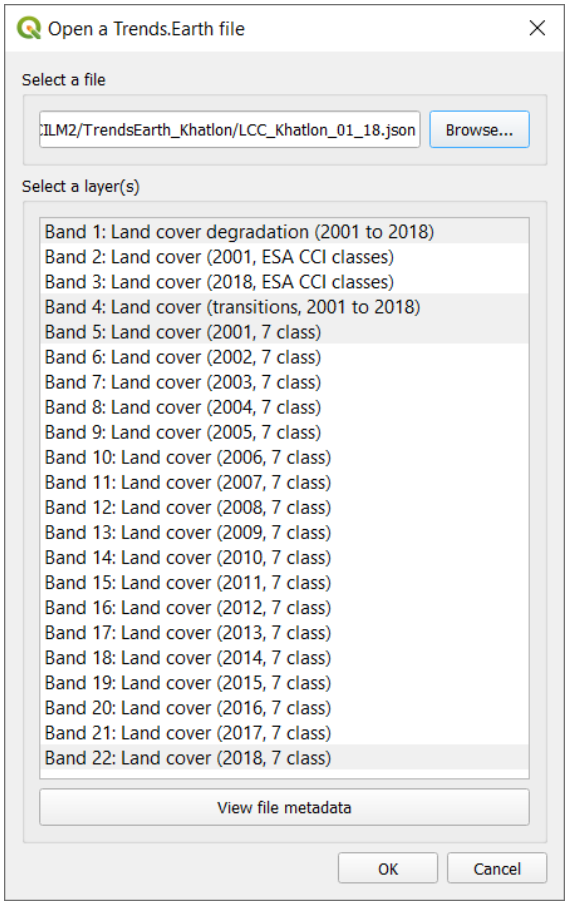
The next Tab is "**Define Degradation**" **(8)** and here is where you can specify which of the land cover changes should be considered as Neutral (0), Improvement (+) or Degradation (-). You can also edit and change this by clicking in any cell **(9)** and writing what you think is more appropriate (+, 0, -). Please be aware that initial land cover is in the rows, whereas columns represent the target year Land cover. After you are done editing please save the table (10) and click next.

	Tree-covered	Grassland	Cropland	Wetland	Artificial	Bare land	Water body
Tree-covered	0	-	-	-	-	-	0
Grassland	+	0	+	-	-	-	0
Cropland	+	-	0	-	-	-	0
Wetland	-	-	-	0	-	-	0
Artificial	+	+	+	+	0	+	0
Bare land	+	+	+	+	-	0	0
Water body	0	0	0	0	0	0	0

You can try a different one like this one below:

	Tree-covered	Grassland	Cropland	Wetland	Artificial	Bare land	Water body
Tree-covered	0	-	-	-	-	-	0
Grassland	+	0	-	-	-	-	0
Cropland	+	+	0	-	-	-	0
Wetland	-	-	-	0	-	-	0
Artificial	+	+	+	+	0	-	0
Bare land	+	+	+	+	0	0	0
Water body	0	0	0	0	0	0	0

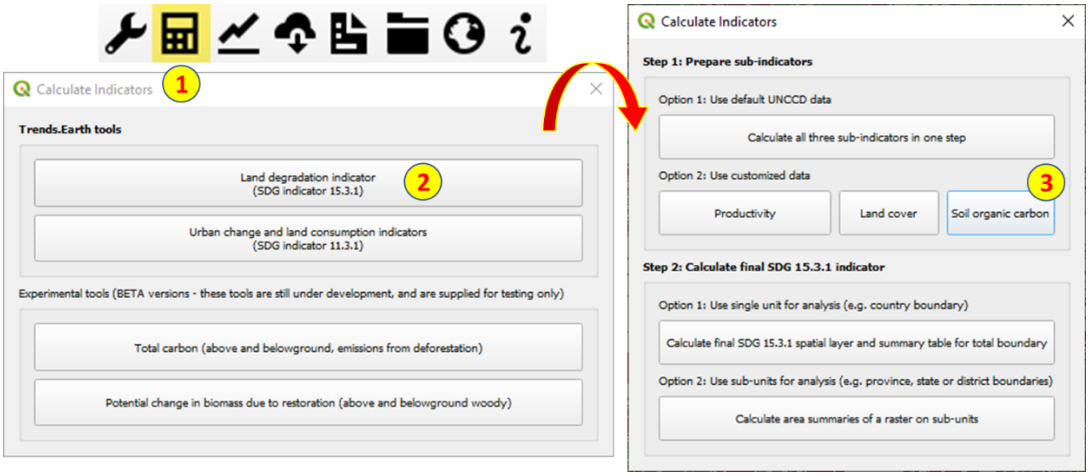
Next **Tabs** are **Area** and **Options** which by now you can complete by yourself! :D
After the process is finished you can now download it and explore the default layers that appear and also the ones that are inside the file you just saved:



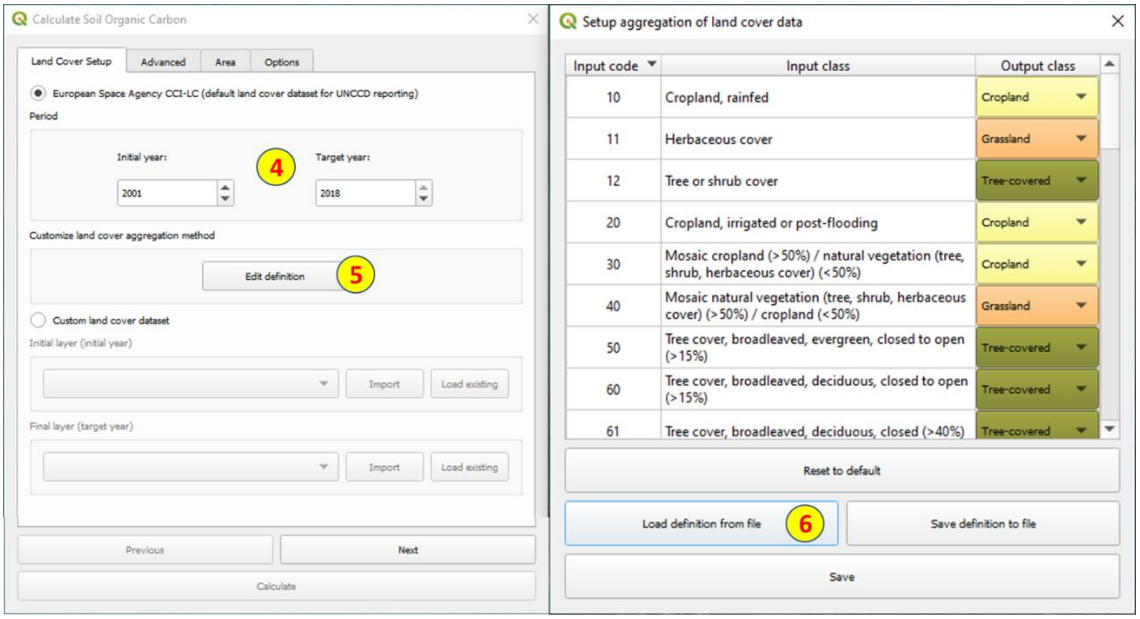
In this case a total of 22 bands are produced, one for each year with the 7-class reclassification, the transition layer, the degradation indicator and the initial/target year original ESA CCI with all the different categories. These last ones are really handy to see if you should reclassify something different.

10. Calculate Soil Organic Carbon (SOC) indicators

For the last indicator please open the **Calculate Indicators (1)** menu and in the window choose **"Land degradation indicator (SDG Indicator 15.3.1)"** **(2)** and select **Soil Organic Carbon (3).**

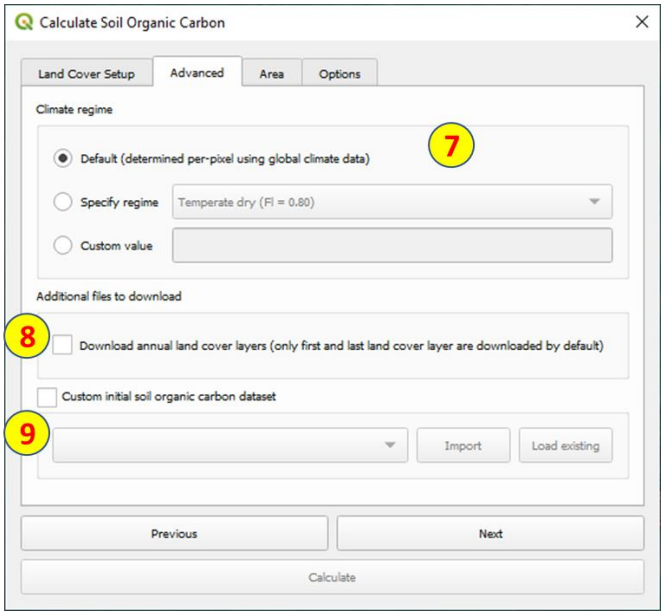


The first Tab is then very similar to the Land cover one and you can set the **Initial/Target** year **(4)** and choose to review the ESA land cover reclassification **(5)**. If you changed this one for the Land Cover, you can use the **Load** button **(6)**.

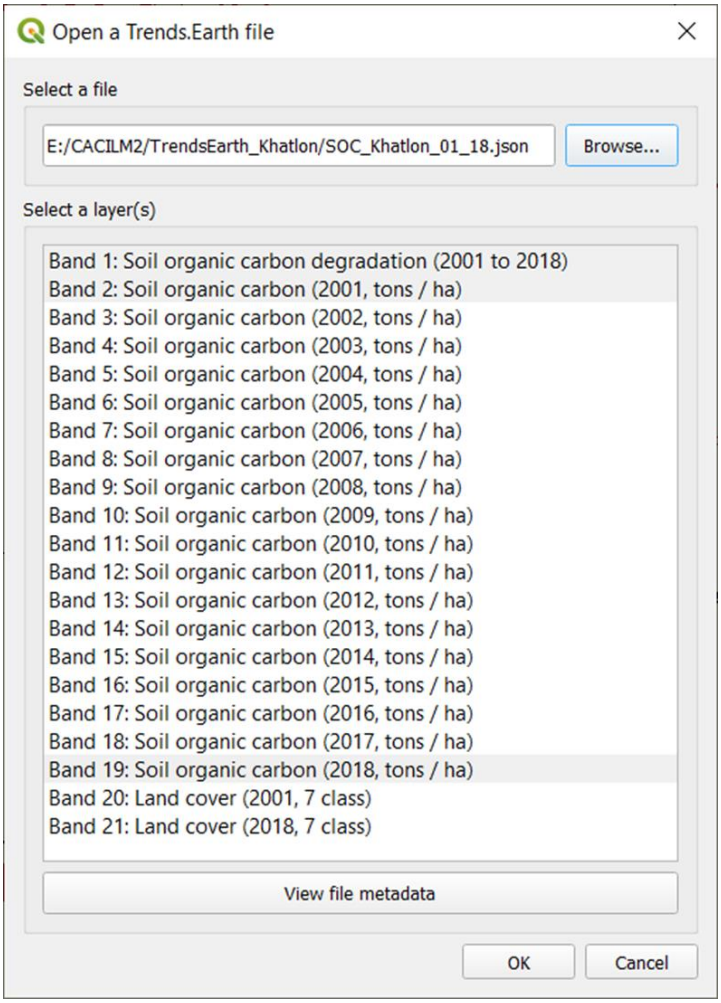


Next Tab is **Advance,** which allows to change the **f** parameter **(7)** that is explained in: http://trends.earth/docs/en/background/understanding_indicators15.html#soil-organic-carbon

You can also ask for downloading the Land cover layers **(8)** but will be that same annual ones that we got from the Land cover indicator. And you can also use another initial SOC map to calculate the proportional stock changes **(9)**.

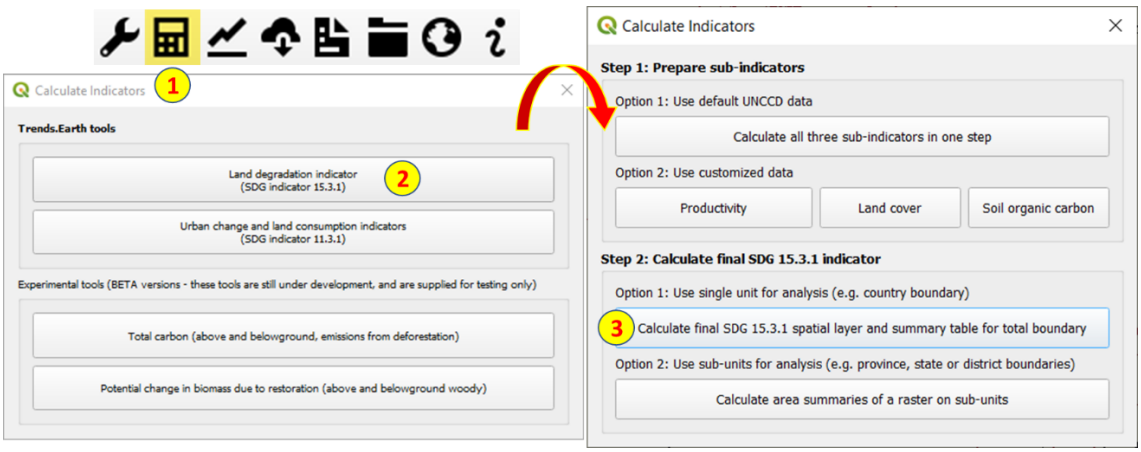


After the whole process is done the results should then have few layers for you to explore…. Have fun:

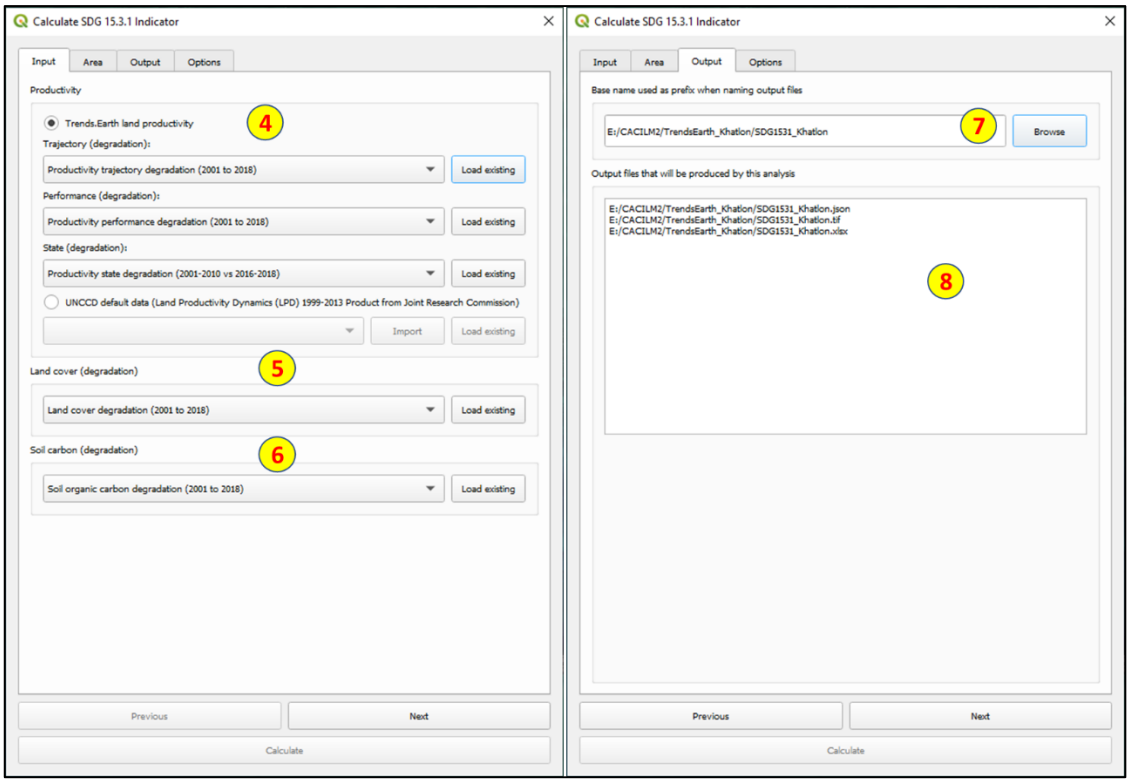


11. Calculate Final SDG 15.3.1 indicator

Once you have calculated and downloaded the 3 previous indicators (Productivity, Land cover and SOC) you can make the calculation of the final SDG 15.3.1 indicator. Open the **Calculate Indicators (1)** menu and in the window choose **"Land degradation indicator (SDG Indicator 15.3.1)" (2)** and select **Calculate Final SDG 15.3.1 (3).**



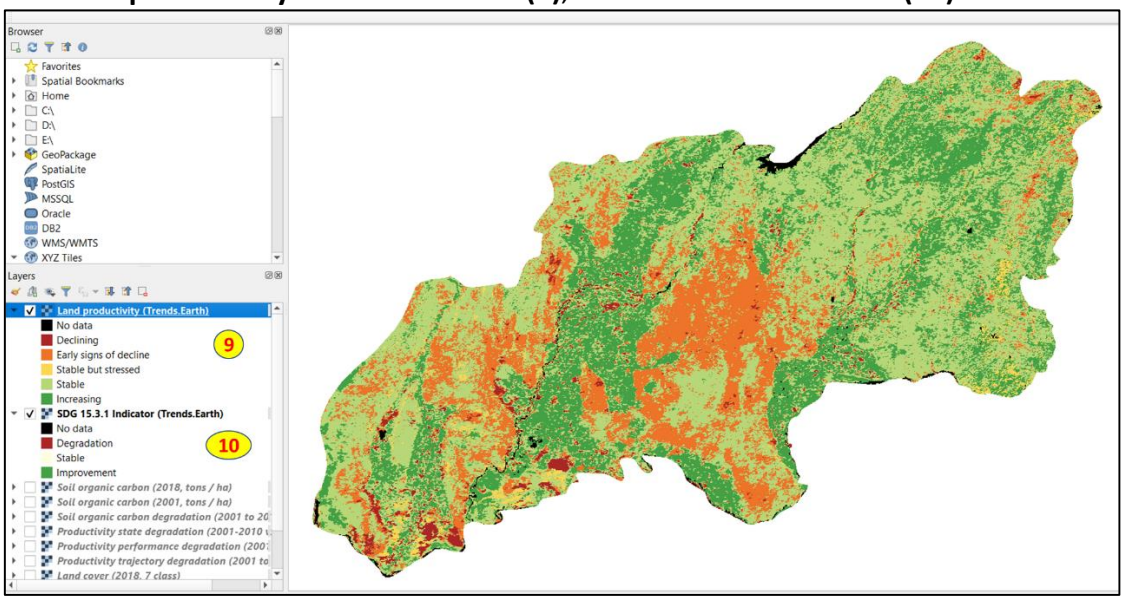
If in your project you have already opened all the previous outputs, the **Input tab** will be automatically completed by trends.earth. If that is not the case or you made different calculations you can choose which one to put use for productivity **(4)**, land cover **(5)** and SOC **(6).**



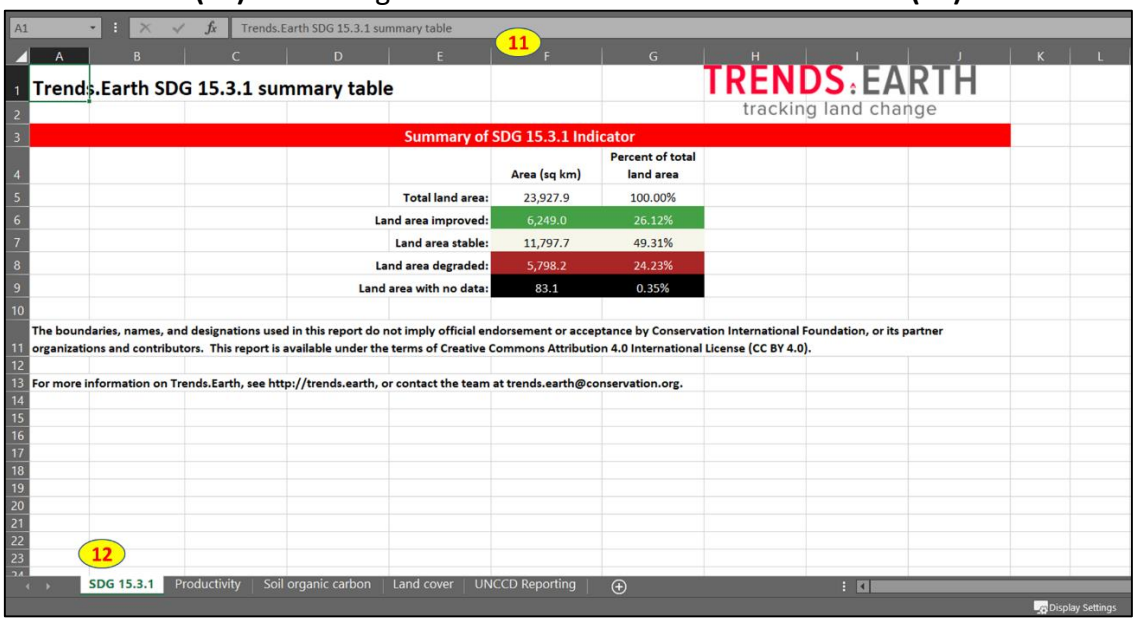
ATTENTION: There is something different here as you can see in the **Output Tab**, this last step is performed by trends.earth in your own computer and not in the cloud computing servers. So, this may take quite a while if you chose a large area and

depends also on the computer's processing power. You have to browse to your preferred location and choose a general file name **(7)** and trend.earth will use that to name the 3 files **(8)** that will be output of this tool:

The **Land productivity** 5 class indicators **(9)**, the **SDG 15.3.1** indicator **(10)** and…



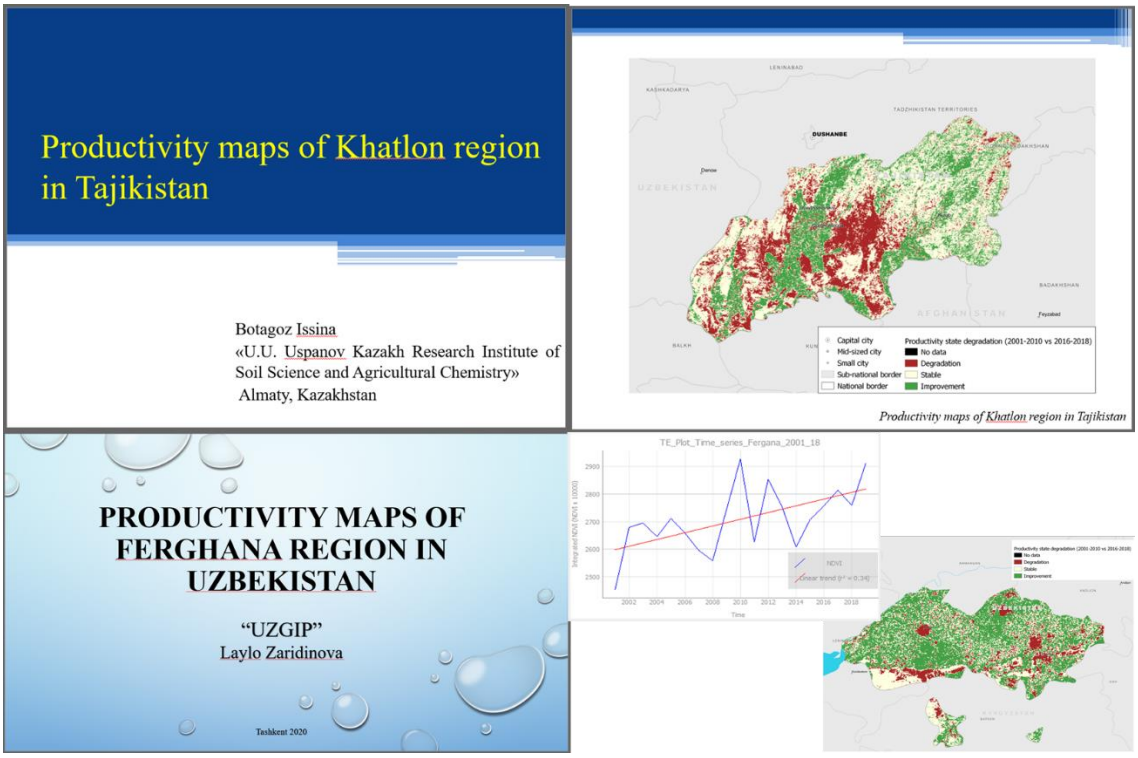
…a excel table **(11)** containing different sheets with detailed statistics **(12)**

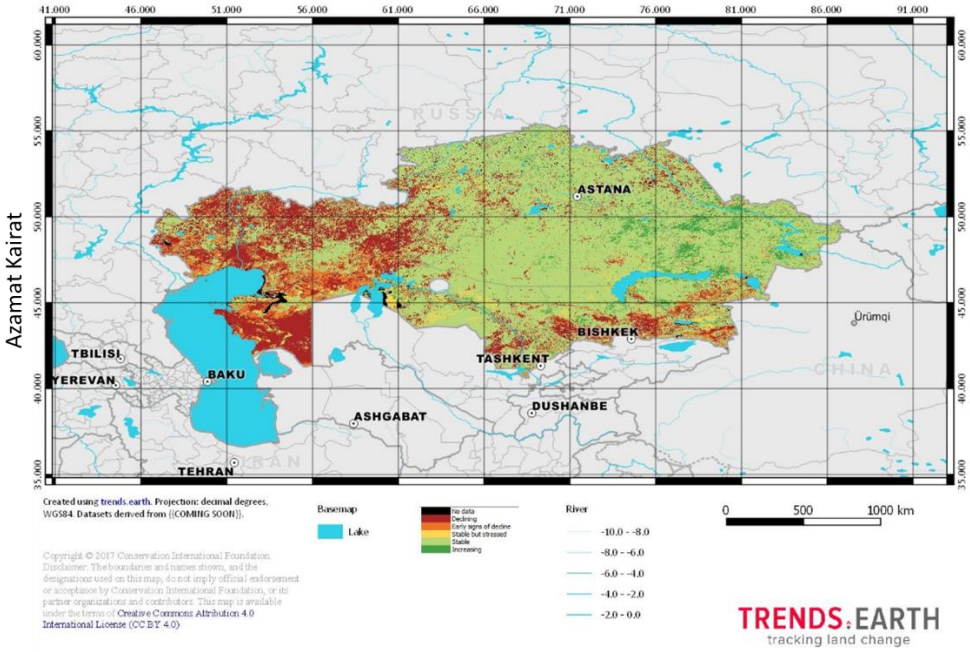


12. Exercise:

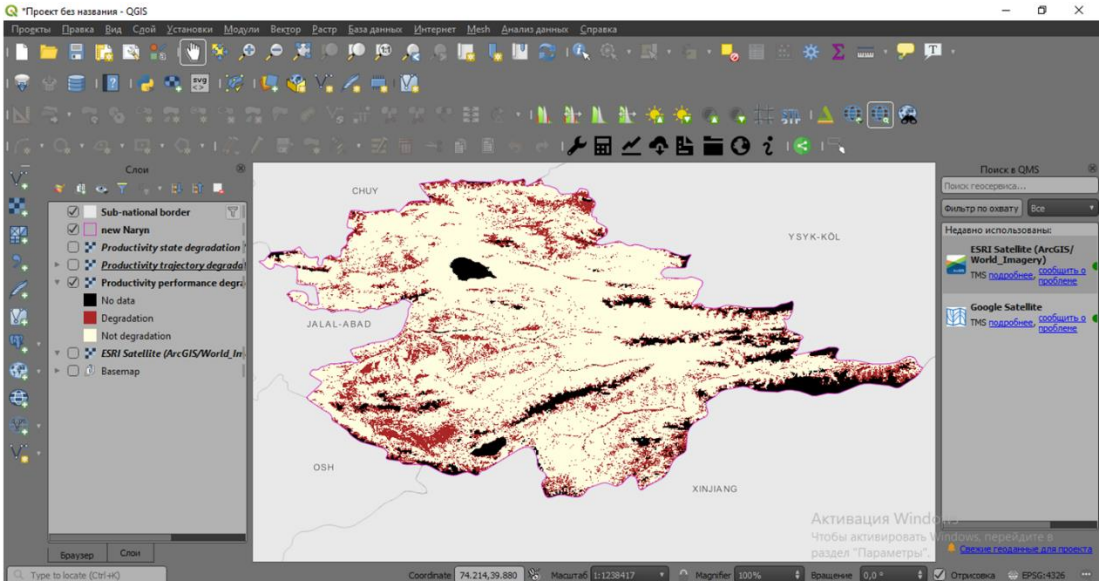
Please make all the indicators and the final SDG 15.3.1 calculation for a province of your choosing. Have critical look at the results and find interesting (Good or Bad) areas

Here some Nice examples from the work done by some of participants during a training:





Aigerim Zhumabekova



Utkir Shermanov