

CONSERVATION
INTERNATIONAL



TRENDS.EARTH
tracking land change



Remote Sensing for Monitoring Land Degradation and Sustainable Cities SDGs

Speakers: Amber McCullum, Sasha Alexander, Alexander Zvoleff, Monica Noon, Mariano Gonzalez-Roglich

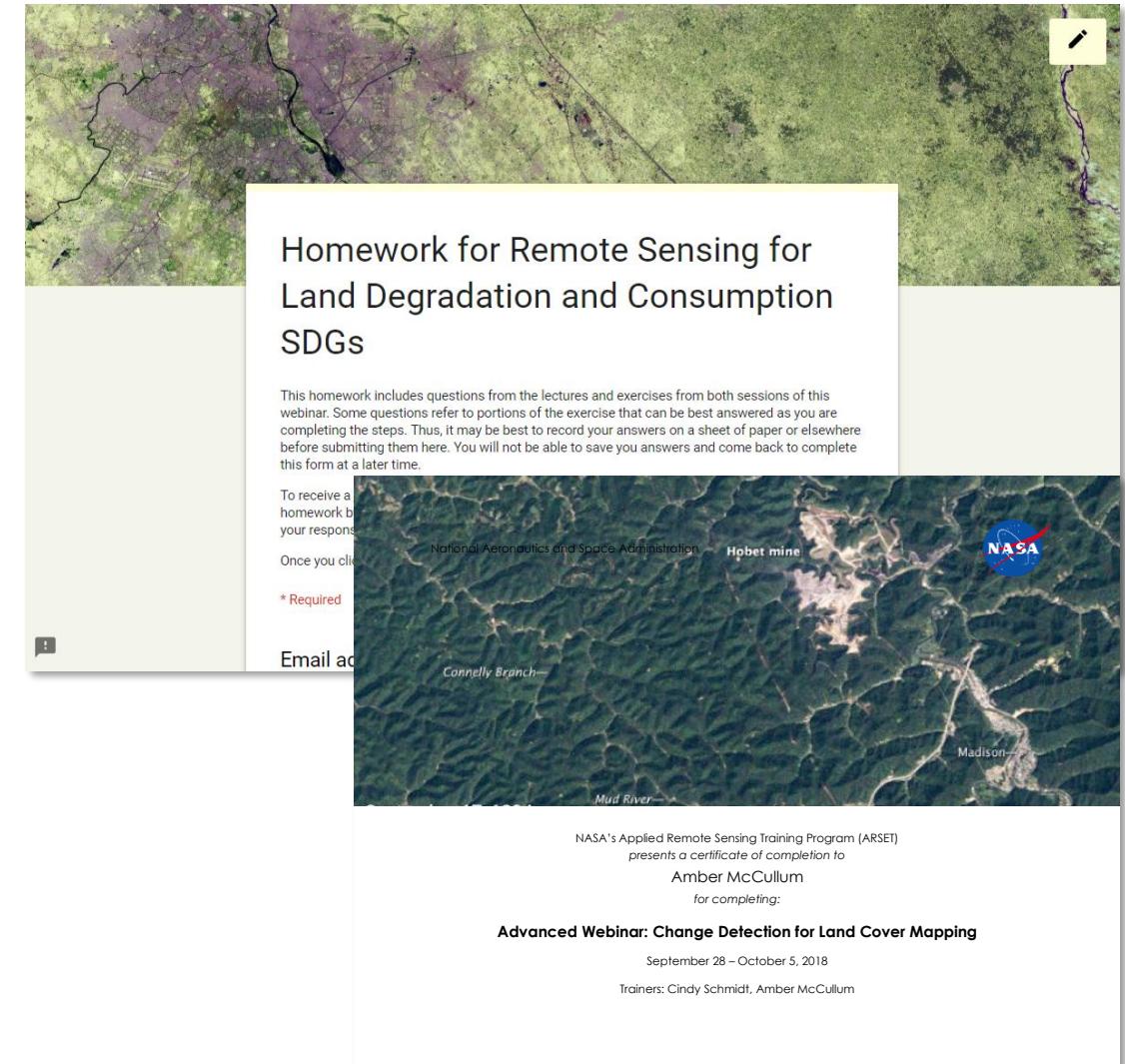
July 9, 2019

Course Structure

- Three, 1.5 hour sessions on July 9, 16, and 23, 2019
- The same content will be presented at two different times each day:
 - Session A: 10:00-11:30 EST (UTC-4)
 - Session B: 18:00-19:30 EST (UTC-4)
 - **Please only sign up for and attend one session per day**
- Webinar recordings, PowerPoint presentations, and the homework assignment can be found after each session at:
 - <https://arset.gsfc.nasa.gov/land/webinars/land-degradation-SDGs19>
- Q&A: Following each lecture and/or by email
 - amberjean.mccullum@nasa.gov
 - Or juan.l.torresperez@nasa.gov

Homework and Certificates

- Homework
 - One homework assignment
 - Answers must be submitted via Google Forms
- Certificate of Completion:
 - Attend both live webinars
 - Complete the homework assignment by the deadline (access from ARSET website)
 - **HW Deadline: Tuesday August 6th**
 - You will receive certificates approximately two months after the completion of the course from:
marines.martins@ssaihq.com



Homework for Remote Sensing for Land Degradation and Consumption SDGs

This homework includes questions from the lectures and exercises from both sessions of this webinar. Some questions refer to portions of the exercise that can be best answered as you are completing the steps. Thus, it may be best to record your answers on a sheet of paper or elsewhere before submitting them here. You will not be able to save your answers and come back to complete this form at a later time.

To receive a certificate of completion, submit your responses.

Once you click the "Submit" button, your responses will be submitted.

* Required

Email address:

National Aeronautics and Space Administration Hobet mine Connelly Branch Madison Mud River

NASA's Applied Remote Sensing Training Program (ARSET) presents a certificate of completion to Amber McCullum for completing:

Advanced Webinar: Change Detection for Land Cover Mapping

September 28 – October 5, 2018

Trainers: Cindy Schmidt, Amber McCullum

10 YEARS OF TRAINING

Prerequisites

- Complete [Sessions 1 & 2A of Fundamentals of Remote Sensing](#), or equivalent experience
- [Download and install QGIS](#). QGIS version 2.18.15
 - Use this exercise for help: [Downloading and Installing QGIS](#)
- Download, install, and register the [Trends.Earth](#) software. This is a QGIS plugin that only currently works with the Version 2 iterations of QGIS (not version 3 or higher).
 - Be sure to read the [Before Installing the toolbox](#) page prior to [Installing the toolbox](#).



Advanced Webinar: Change Detection for Land Cover Mapping



Accessing Course Materials

<https://arset.gsfc.nasa.gov/land/webinars/land-degradation-SDGs19>

The screenshot shows the ARSET website with a header featuring the NASA logo, 'ARSET', and 'Applied Remote Sensing Training'. The top navigation bar includes links for 'Earth Sciences Division', 'Applied Sciences', and 'Capacity Building Program'. A search bar and a Twitter icon are also present. The main content area displays a satellite image of a landscape with green and brown vegetation. Below the image, text specifies the 'Date Range: Mondays, April 15, 2019, April 17, 2019.' and 'Times: 10:00-12:00 and 18:00-20:00 EDT (UTC-4)'. A detailed description follows, mentioning the use of satellite imagery for trend analysis and the focus on MODIS and Landsat data. The 'Learning Objectives' section lists goals such as becoming familiar with time series analysis and integrating point data with satellite imagery. On the right side, a sidebar titled 'Land Management' offers 'Online Trainings' and 'In-Person Trainings'. Under 'Upcoming Training', there are sections for 'Water' (with an introductory webinar on water monitoring) and 'Land' (with an advanced webinar on investigating time series of satellite imagery). A 'View All Events' button is at the bottom of the sidebar.

Prerequisites:

Attendees that do not complete prerequisites may not be adequately prepared for the pace of the course.

- Complete [Sessions 1 & 2A of Fundamentals of Remote Sensing](#), or equivalent experience
- Complete the [Advanced Webinar: Change Detection for Land Cover Mapping](#)
- Install Google Chrome: <https://www.google.com/chrome/>
 - For the Google Earth Engine exercise, Chrome should be used to make sure all features work
- Sign up for the Google Earth Engine Code Editor: <https://signup.earthengine.google.com/>

Audience:

Advanced users of remote sensing data within local, regional, state, federal, and non-governmental organizations involved in land management and conservation efforts. Professional organizations in the public and private sectors engaged in environmental management and monitoring will be given preference over organizations focused primarily on research.

Registration Information:

There is no cost for the webinar, but you must register to attend the sessions. Because we anticipate a high demand for this training, please only sign up for one session. Sessions will only be broadcast in English - Session A will cover the same content as Session B. Professional organizations in the public and private sectors engaged in water resources management and monitoring will be given preference over organizations focused primarily on research.

- [Register for Session A, 10:00-12:00 EDT \(UTC-4\)](#) »
- [Register for Session B, 18:00-20:00 EDT \(UTC-4\)](#) »

Course Agenda:

[Agenda_41.pdf](#)

April 15, 2019

This session will include a review of MODIS and Landsat, a review of change detection, an overview of time series analysis methods, and an AppEEARS hands-on exercise.

Application Area: Land

Available Languages: English

Instruments/Missions: Terra, Landsat, MODIS, Aqua

Keywords: Ecosystems, Land-Cover and Land-Use Change (LCLU), Satellite Imagery, Tools



Course Outline

Session 1: SDG 15

- ARSET and the SDGs
- SDG 15 Overview
- Trends/Earth for 15.3.1
- Exercise (default data)



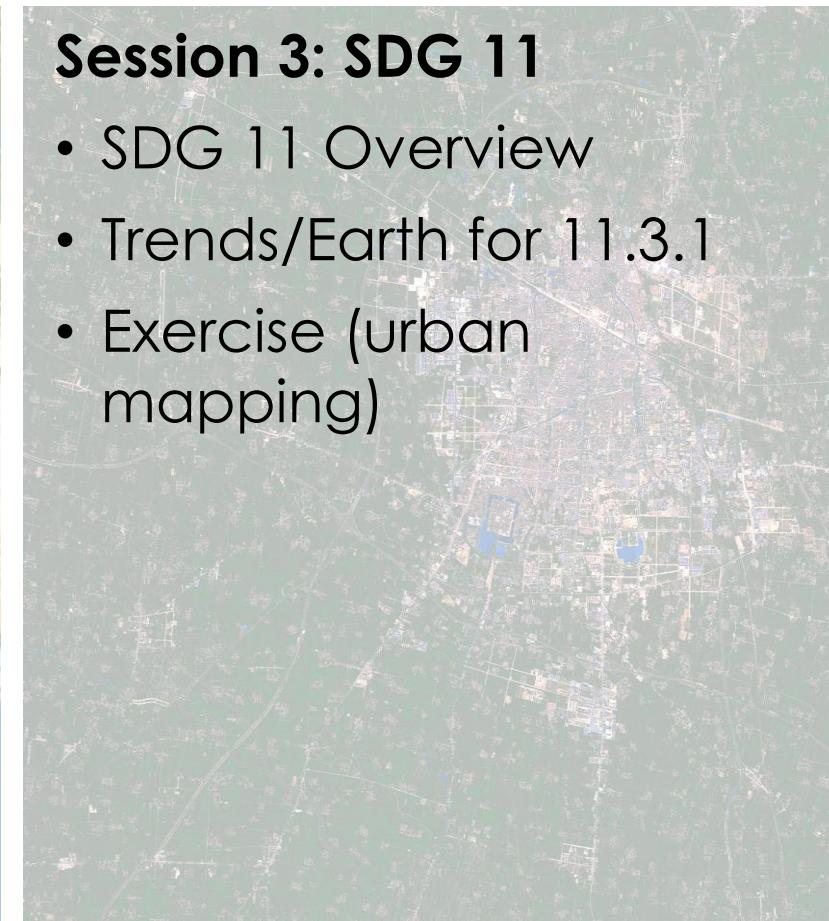
Session 2: SDG 15

- Global Datasets
- Country/local data example
- Exercise (local data)



Session 3: SDG 11

- SDG 11 Overview
- Trends/Earth for 11.3.1
- Exercise (urban mapping)





Session 1 Agenda

- NASA - Brief overview of ARSET and the SDGs in general
- NASA - SDG 15.3.1 and the data needs
- UNCCD – SDG 15.3.1 reporting
- CI - Presentation on the Trends.Earth tool for SDG 15.3.1
- CI - Exercise using default data Trends.Earth

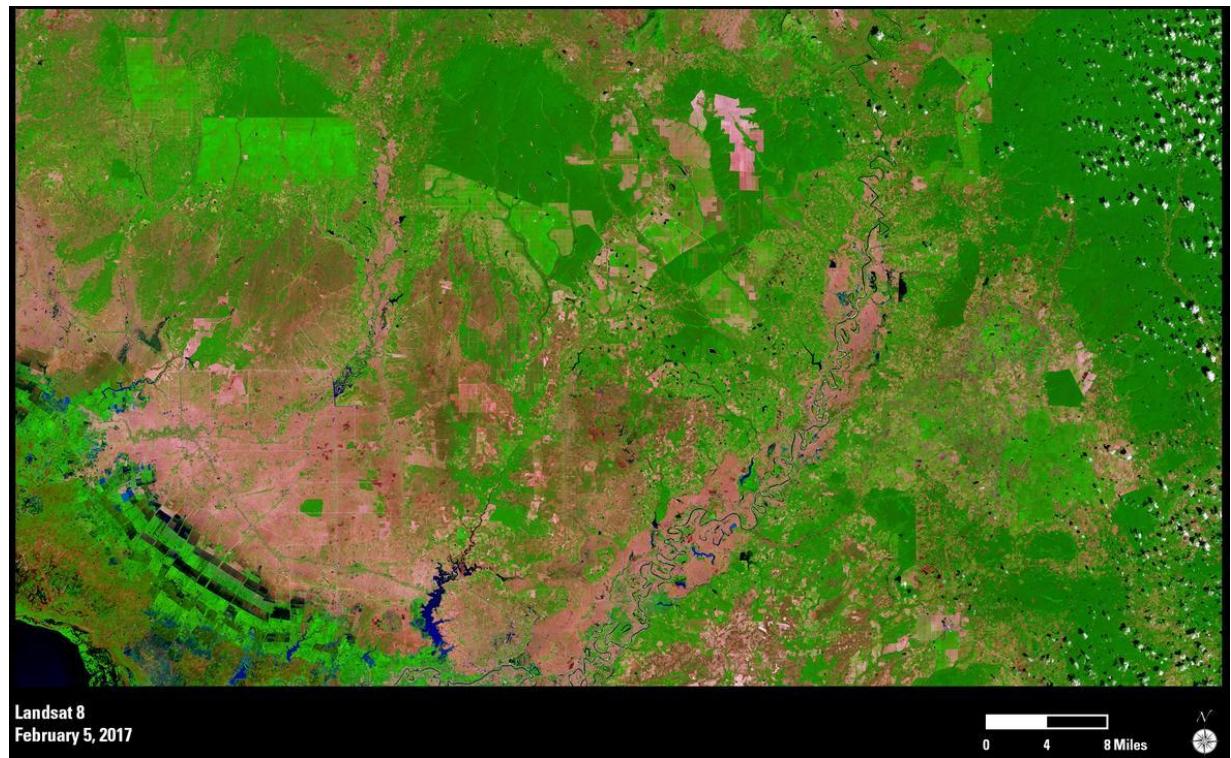
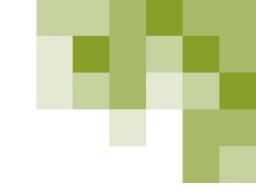


Image Credit: Landsat Image of Cambodia. Image Credit: USGS

NASA Applied Sciences



- Promotes efforts to discover and demonstrate innovative and practical applications of Earth Observations
- Three primary lines of business:
 - Applications
 - Capacity Building
 - Mission Planning
- Across 4 application areas:



Air Quality &
Health



Disasters



Eco



Water
Resources

NASA's Applied Remote Sensing Training Program (ARSET)



<http://arset.gsfc.nasa.gov/>

- Empowering the global community through remote sensing training
- Part of the Applied Science Capacity Building Program
- Seeks to increase the use of Earth science in decision-making through training for:
 - policy makers
 - environmental managers
 - other professionals in the public and private sector
- Training topics focus on:
 - air quality
 - land
 - disasters
 - water

Helping Professionals Solve
Problems Including...



ARSET Trainings



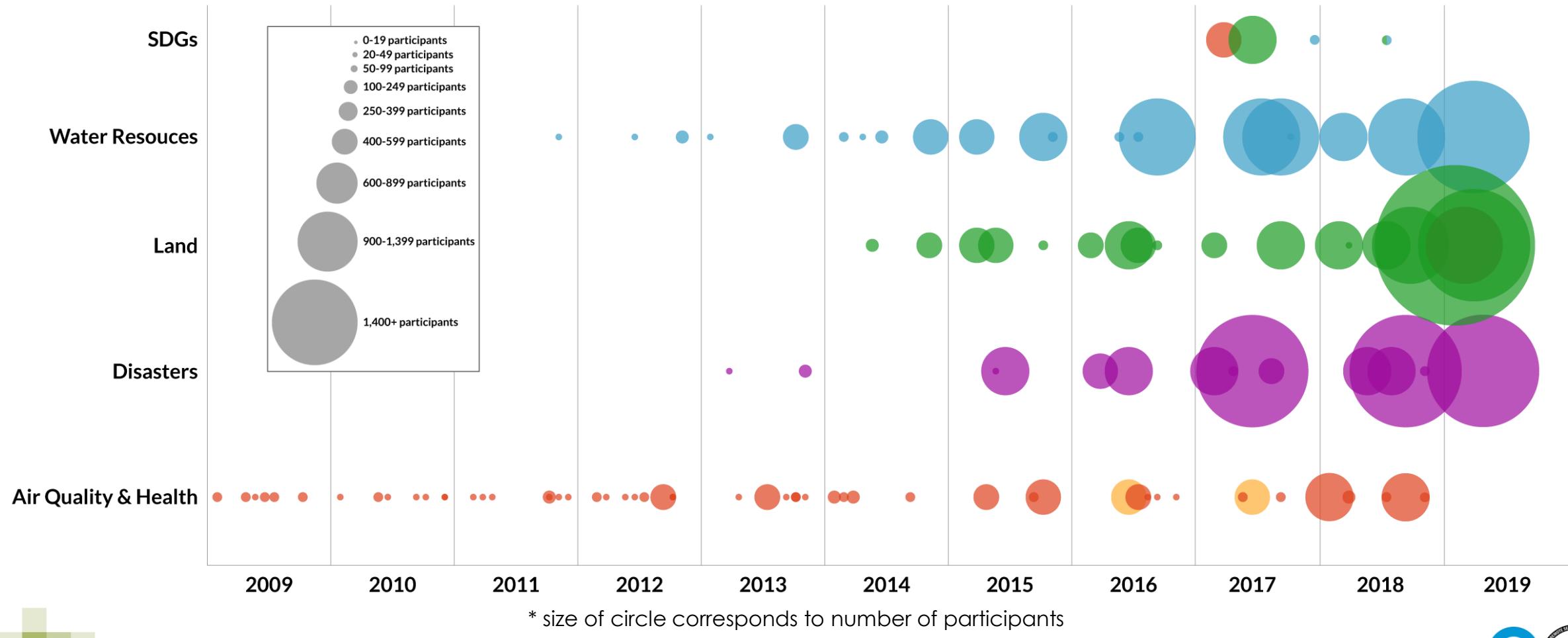
110+ trainings  19,400+ participants



160+ countries



5,000+ organizations



ARSET SDG Trainings

<https://arset.gsfc.nasa.gov/sdgs>



ARSET Trainings for Monitoring & Meeting the UN Sustainable Development Goals

In 2015, global leaders adopted the 17 Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development. These goals aim to end all forms of poverty, and recognize that ending poverty goes hand-in-hand with strategies that build economic growth and address a range of social needs, including education, health, social protection, and job opportunities, while tackling climate change and environmental protection. ([UN Sustainable Development Agenda](#))

Earth observations can support the implementation and monitoring of SDG targets and indicators. ARSET training helps people understand how to access and apply those observations. If a goal below is grayed out, it does not mean that remote sensing can't be applied - just that ARSET has yet to offer a training related to that goal.

Click on a goal below to see relevant ARSET trainings:



ARSET

[Online Trainings](#)

[In-Person Trainings](#)

[Remote Sensing for the UN SDGs](#)

[Sign up for ARSET Emails](#)

[Tools Covered](#)

[Suggest a Training](#)

[List of Upcoming Trainings](#)

Upcoming Training

Water

[Advanced Webinar: Integrating Remote Sensing into a Water Quality Monitoring Program](#)

Jun 05, 2019, Jun 12, 2019, Jun 19, 2019

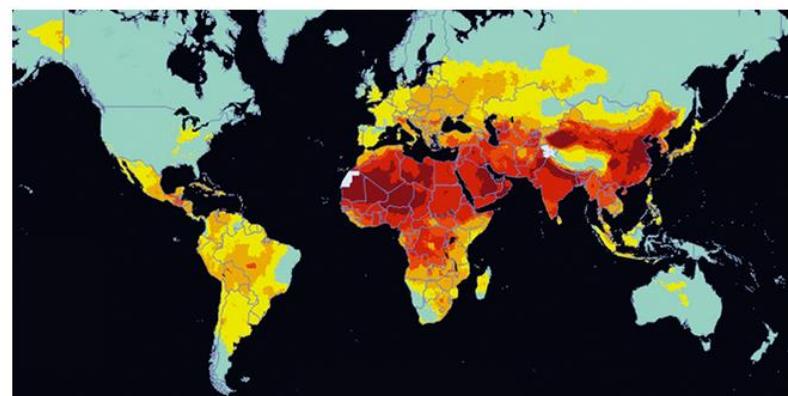
Land

[Advanced Webinar: Remote Sensing for Monitoring](#)

Remote Sensing of Land Indicators for Sustainable Development Goal 15



Satellite Derived Annual PM2.5 Datasets in Support of United Nations Sustainable Development Goals



UN Sustainable Development Goals (SDGs)

Transforming Our World: The 2030 Agenda for Sustainable Development

- A plan of action for people, planet and prosperity
- All countries and all stakeholders, acting in collaborative partnership, will implement this plan
- 17 SDGs and 169 targets under this agenda
- Balance the three dimensions of sustainable development:
 - economic, social, and environmental
- In this webinar series, our focus will be Goal 15: Life on Land

SUSTAINABLE DEVELOPMENT GOALS



Image Credit: Text adapted from "[Transforming our world: the 2030 Agenda for Sustainable Development](#)"

Agency Coordination



Food and Agriculture Organization
of the United Nations

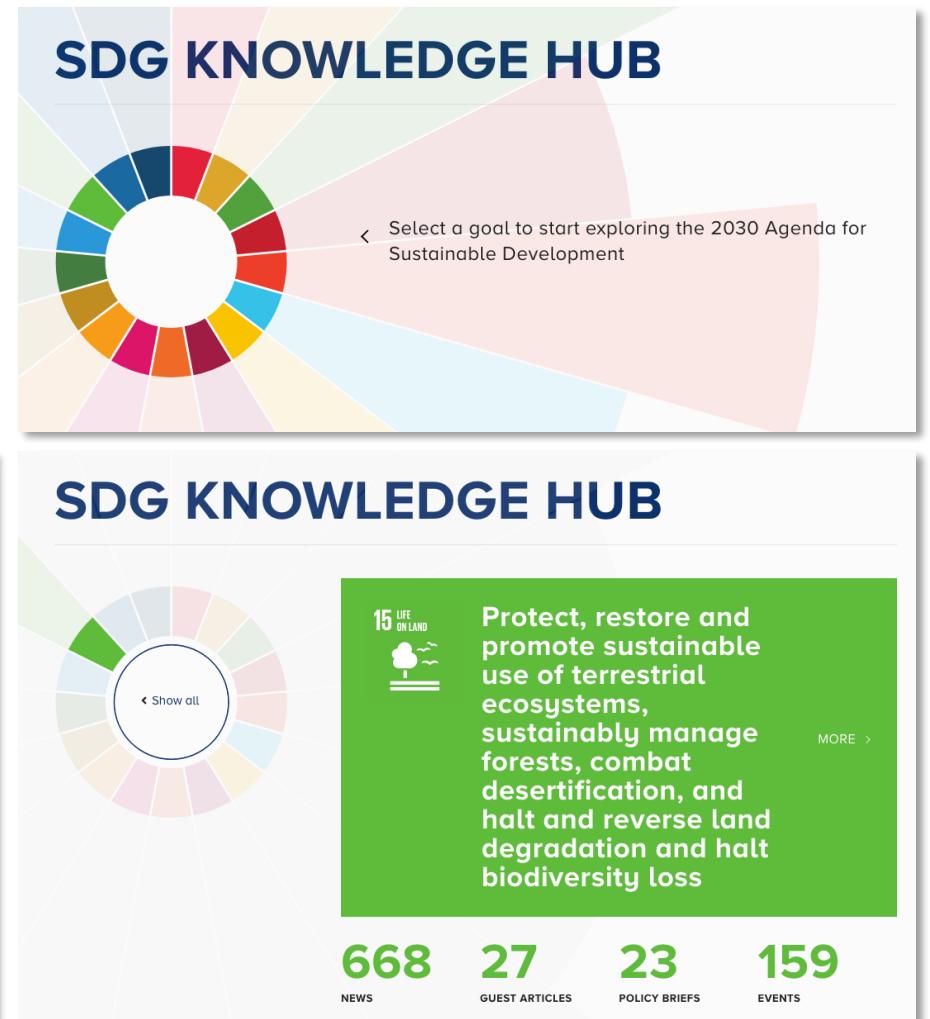


GEO GROUP ON
EARTH OBSERVATIONS

IISD Knowledge Hub

<http://sdg.iisd.org/>

- Provides tools and resources about the SDGs
- Collects news, events, policy briefs for specific goals
- Also provides information on events, actors, and regions



United Nations: Statistics for SDGs

<https://unstats.un.org/sdgs/indicators/database/>

- Access SDG data for specific countries
- Obtain metadata and methodology for calculating indicators
- Groups information based on regions

The screenshot shows the homepage of the United Nations SDG Indicators Global Database. At the top, there's a navigation bar with links to United Nations, Department of Economic and Social Affairs, Statistics Division, HOME, NEWS, HLG-PCCB, IAEG-SDGs, EVENTS, SDG INDICATORS (with a dropdown arrow), and REPORTS (with a dropdown arrow). Below the navigation is the UN Sustainable Development Goals logo. The main content area is titled "SDG Indicators Global Database". A welcome message states: "Welcome to the dissemination platform of the Global SDG Indicators Database. This platform provides access to data compiled through the UN System in preparation for the Secretary-General's annual report on "Progress towards the Sustainable Development Goals". The data series identified by the symbol SD correspond to the global indicator framework that was agreed, as a starting point, by the Statistical Commission at its forty-seventh session in March 2016. Additional series are identified by the symbol +." Below this, a section titled "Indicator : 15.1.1 - Forest area as a proportion of total land area" shows a table of available series. The table has columns for Series Description, Country or Area, Frequency, Unit, Location, Age Group, and Sex. The first few rows of the table are:

Series Description	Country or Area	Frequency	Unit	Location	Age Group	Sex
SD Forest area as a proportion of total land area Channel Islands		Annual	Percent (Units)	Total		
SD Forest area as a proportion of total land area Aruba		Annual	Percent (Units)	Total		
SD Forest area as a proportion of total land area Afghanistan		Annual	Percent (Units)	Total		
SD Forest area as a proportion of total land area Angola		Annual	Percent (Units)	Total		
SD Forest area as a proportion of total land area Anguilla		Annual	Percent (Units)	Total		
SD Forest area as a proportion of total land area Albania		Annual	Percent (Units)	Total		
SD Forest area as a proportion of total land area Andorra		Annual	Percent (Units)	Total		
SD Forest area as a proportion of total land area United Arab Emirates		Annual	Percent (Units)	Total		
SD Forest area as a proportion of total land area Argentina		Annual	Percent (Units)	Total		
SD Forest area as a proportion of total land area Armenia		Annual	Percent (Units)	Total		
SD Forest area as a proportion of total land area American Samoa		Annual	Percent (Units)	Total		
SD Forest area as a proportion of total land area Antigua and Barbuda		Annual	Percent (Units)	Total		
SD Forest area as a proportion of total land area Australia		Annual	Percent (Units)	Total		
SD Forest area as a proportion of total land area Austria		Annual	Percent (Units)	Total		

Group on Earth Observations (GEO)

http://www.earthobservations.org/geo_sdgs.php

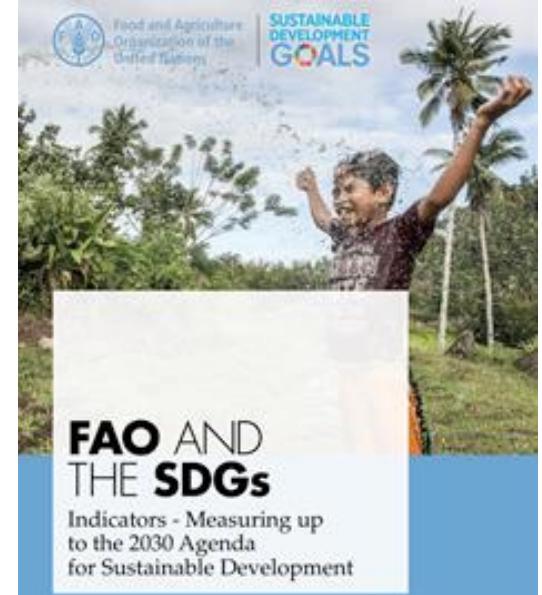
Initiative to support efforts to integrate Earth observations and geospatial information into national development and monitoring frameworks for the SDGs



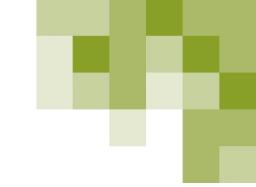
Food and Agriculture Organization (FAO)

<http://www.fao.org/sustainable-development-goals/en/>

- FAO's priorities for the SDGs are:
 - End poverty, hunger and malnutrition
 - Enable sustainable development in agriculture, fisheries and forestry
 - Combat and adapt to climate change



SDG 15: Life on Land



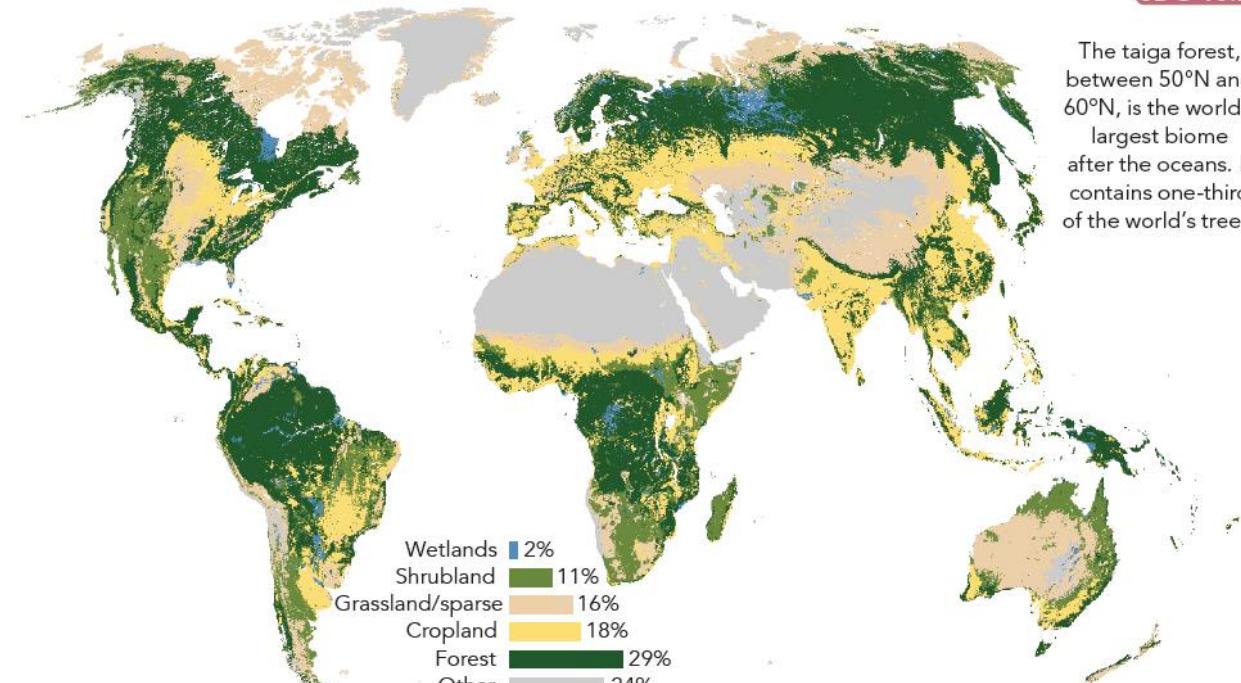
- Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

Most land is covered in vegetation. Forests dominate many regions.

Land cover, vegetation types, based on satellite imagery, 2015

SDG 15.1
SDG 15.2

The taiga forest, between 50°N and 60°N, is the world's largest biome after the oceans. It contains one-third of the world's trees.

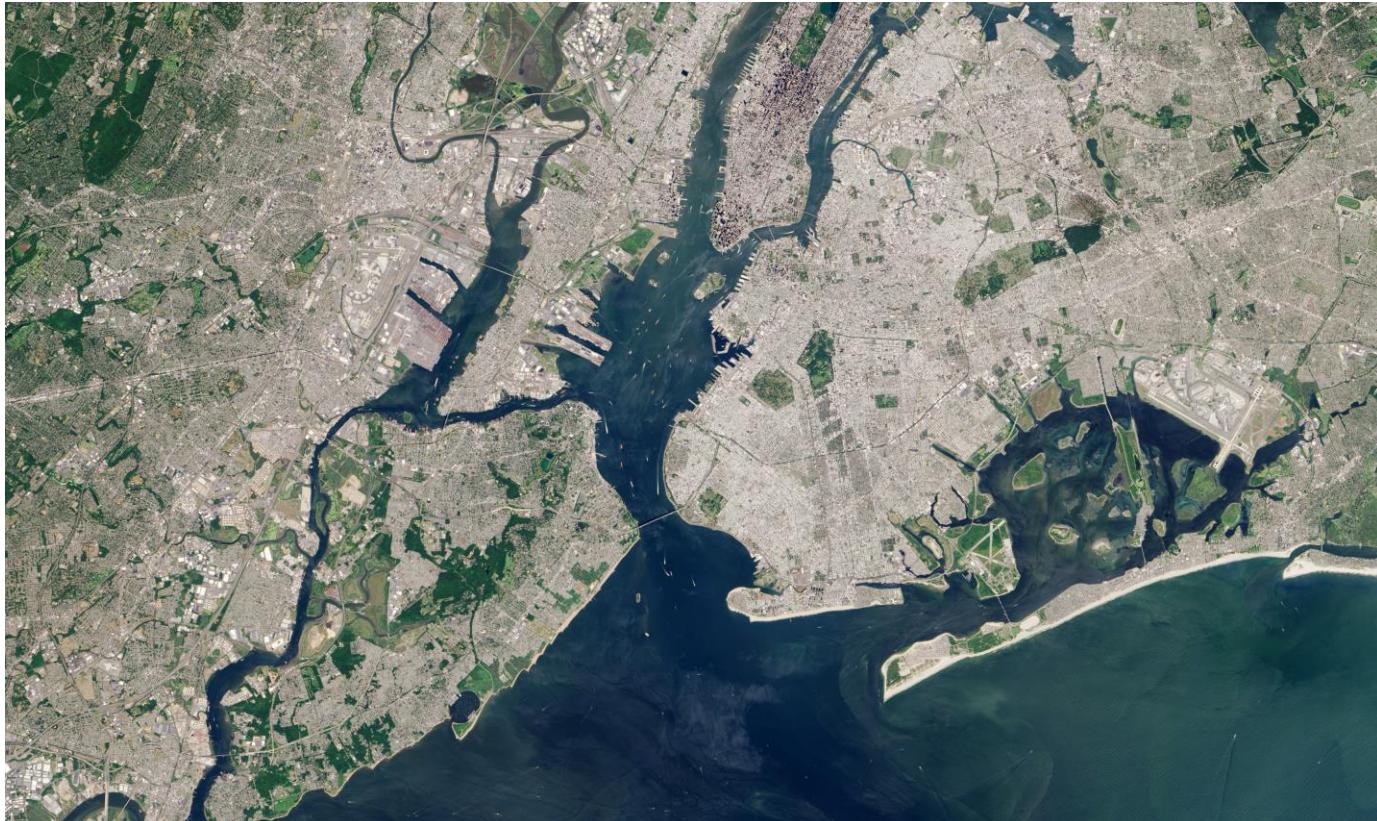


Source: European Space Agency. <https://www.esa-landcover-cci.org/?q=node/175>



SDG 11: Sustainable Cities and Communities

- Make cities and human settlements inclusive, safe, resilient and sustainable



New York City from Landsat. Image Credit: Earth Observatory



SDG Indicators

- Used to monitor progress towards SDGs at local, regional, and global levels
- Turns SDGs and targets into a management tool:
 - develop implementation strategies
 - measure progress (report card)
- 100 Global Monitoring Indicators
 - includes suggestions for complementary national indicators (CNIs)
- Each country chooses the number and range of CNIs to collect and analyze data

Image Credit: <http://unsdsn.org/resources/publications/indicators/>



SDG: Target 15.3

Land Degradation Neutrality (LDN)

- By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world
- Achieving LDN will require **avoiding** or **reducing** new degradation, and **restoring** and **rehabilitating** lands that were degraded in the past

Land degradation threatens the natural capital on which livelihoods depend, including those of over 1.3 billion farmers.





SDG: Target 15.3

Land Degradation Neutrality (LDN)

- Objectives
 - maintain or improve the sustainable delivery of ecosystem services;
 - maintain or improve productivity, in order to enhance food security;
 - increase resilience of the land and populations dependent on the land;
 - seek synergies with other social, economic and environmental objectives; and
 - reinforce responsible and inclusive governance of land.

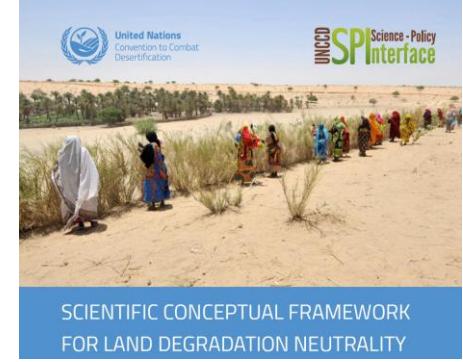


Image Credit: Alex Zvoleff

Indicator 15.3.1

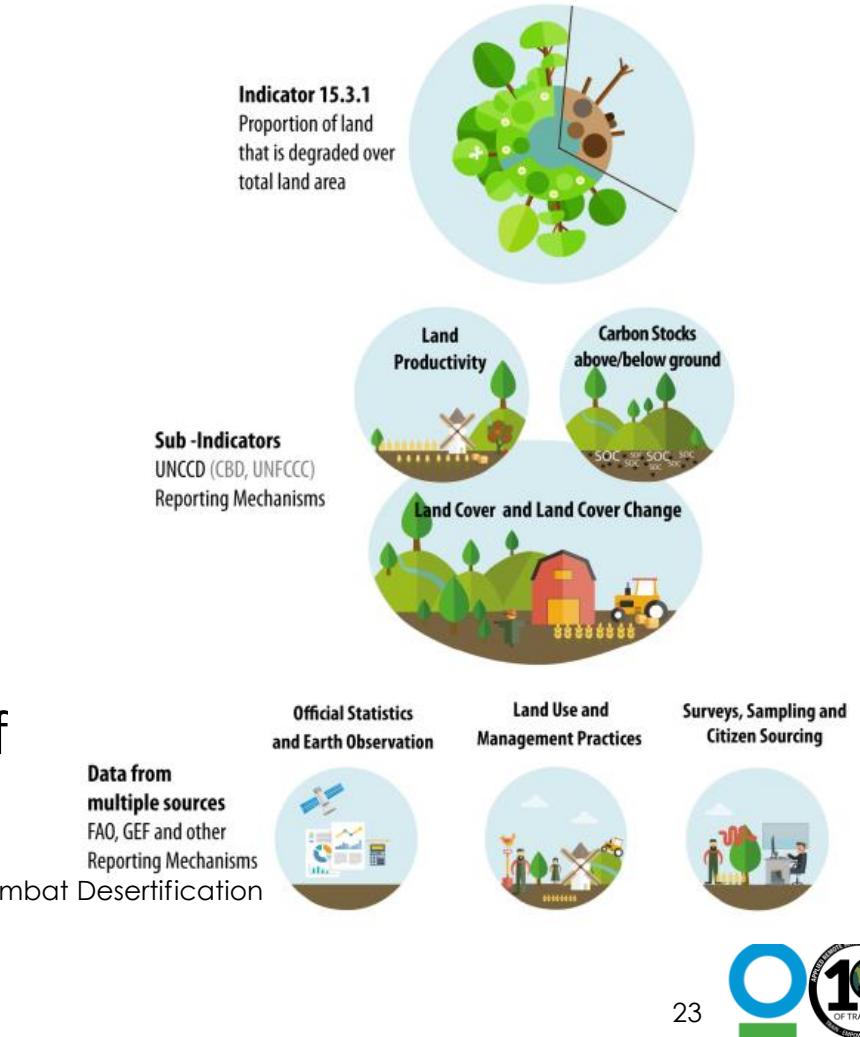
Proportion of land that is degraded over total land area

Sub-indicators

- 1) Land cover and land cover change
 - 2) Land productivity
 - 3) Carbon stocks above and below ground
- A combination of satellite Earth observations and site-based data will be needed to
 - set baselines to determine the initial status of the sub-indicators
 - detect change in each of the sub-indicators
 - derive the indicator by determining what areas of change are considered land degradation

Image Credit: Framework and Guiding Principles for a Land Degradation Indicator, United Nations Convention to Combat Desertification

Framework for Monitoring and Reporting on SDG Target 15.3



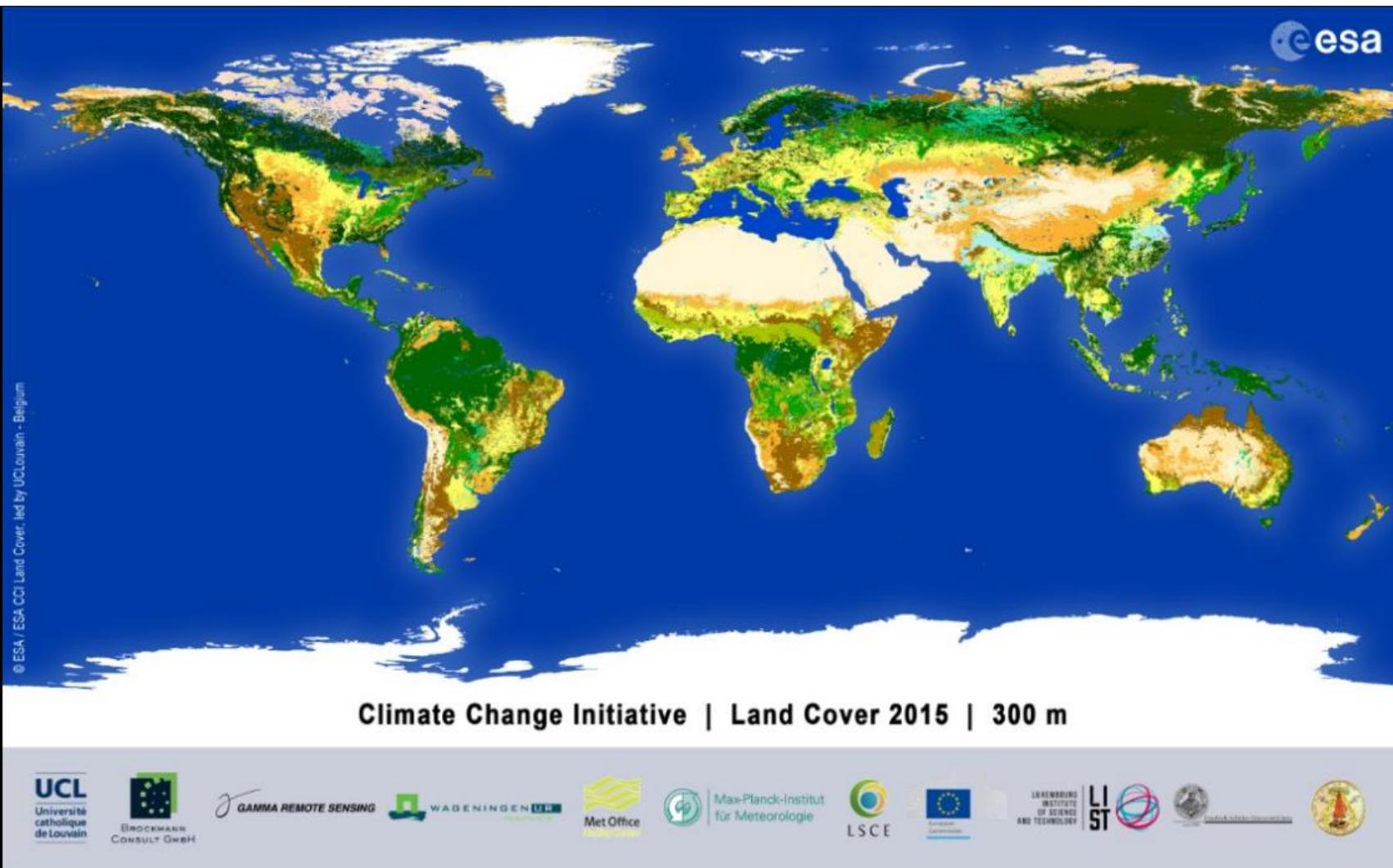


SDG 15 Data Needs

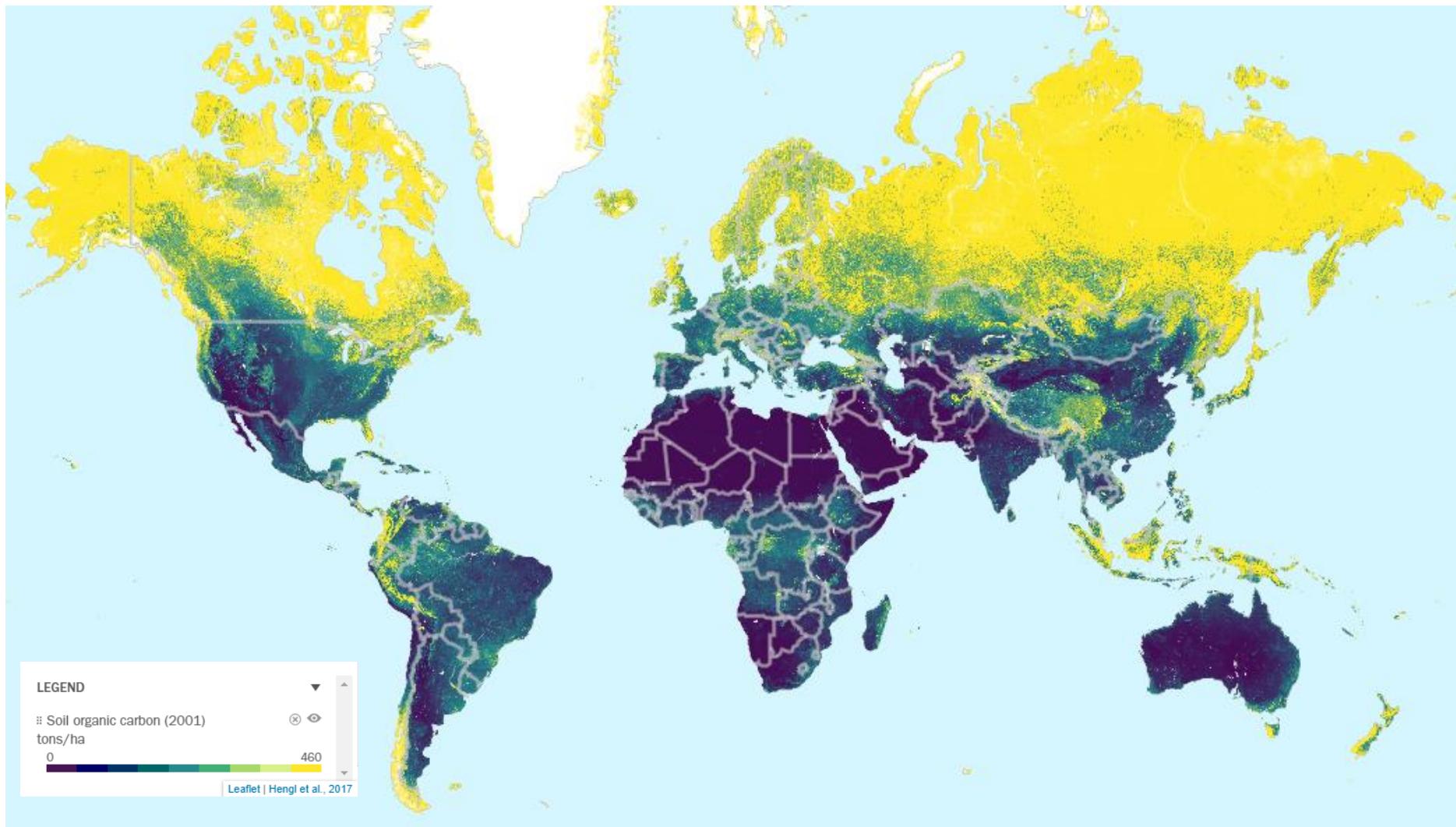
Sub-indicators

- Global datasets for standardized reporting
 - Landcover
 - Forest Area and Forest Change (Landsat)
 - Protected Areas
 - Important sites for Biodiversity
 - Carbon Stocks
 - Land Productivity
 - Etc.
- Good Practice Guidelines
- Country reporting

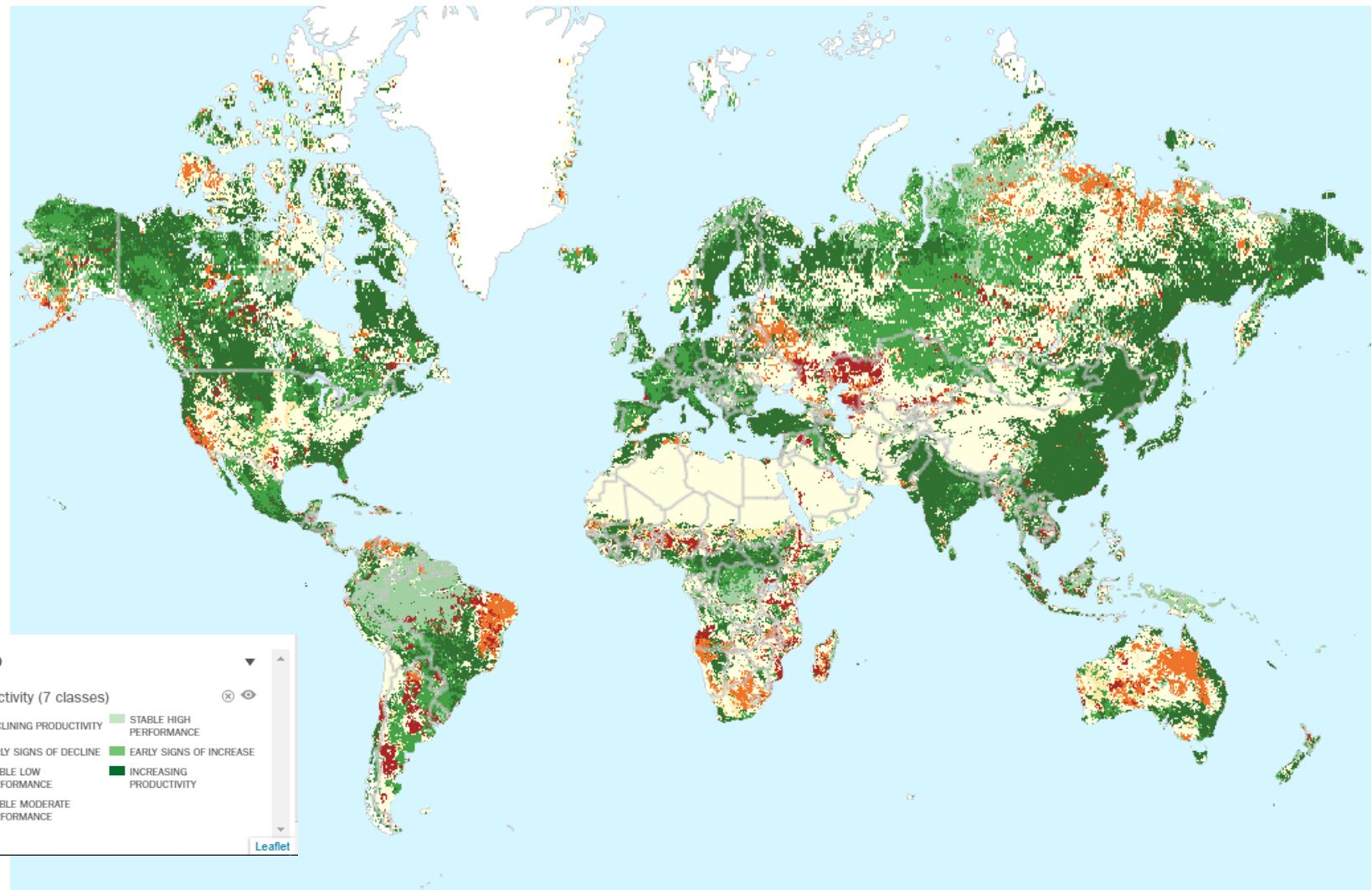
Land Cover



Carbon Stocks



Land Productivity





United Nations Convention to Combat Desertification

<http://www2.unccd.int/>

- Focus on Target 15.3 in effort for land degradation neutrality
 - <http://www2.unccd.int/land-degradation-neutrality>
- Links environment and development to sustainable land management
- Specifically addresses arid, semi-arid, and dryland ecosystems
- Works to:
 - improve living conditions in drylands
 - maintain and restore land & soil productivity
 - mitigate drought
 - combat desertification and land degradation

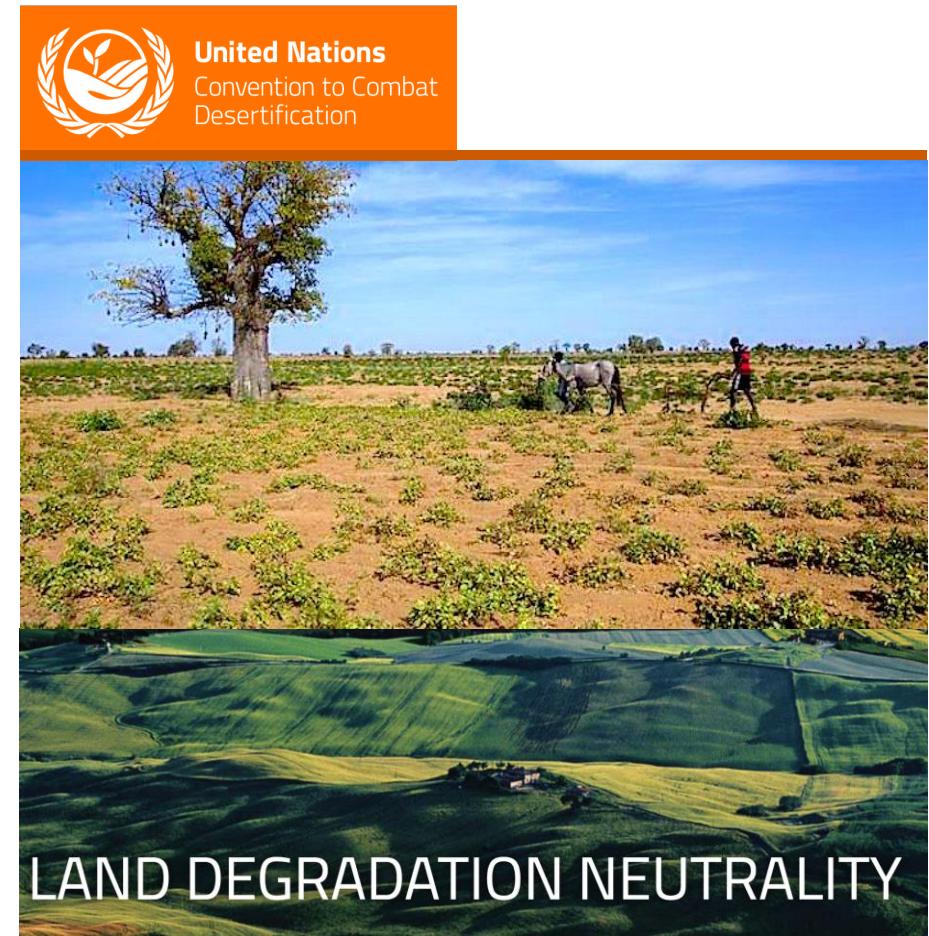
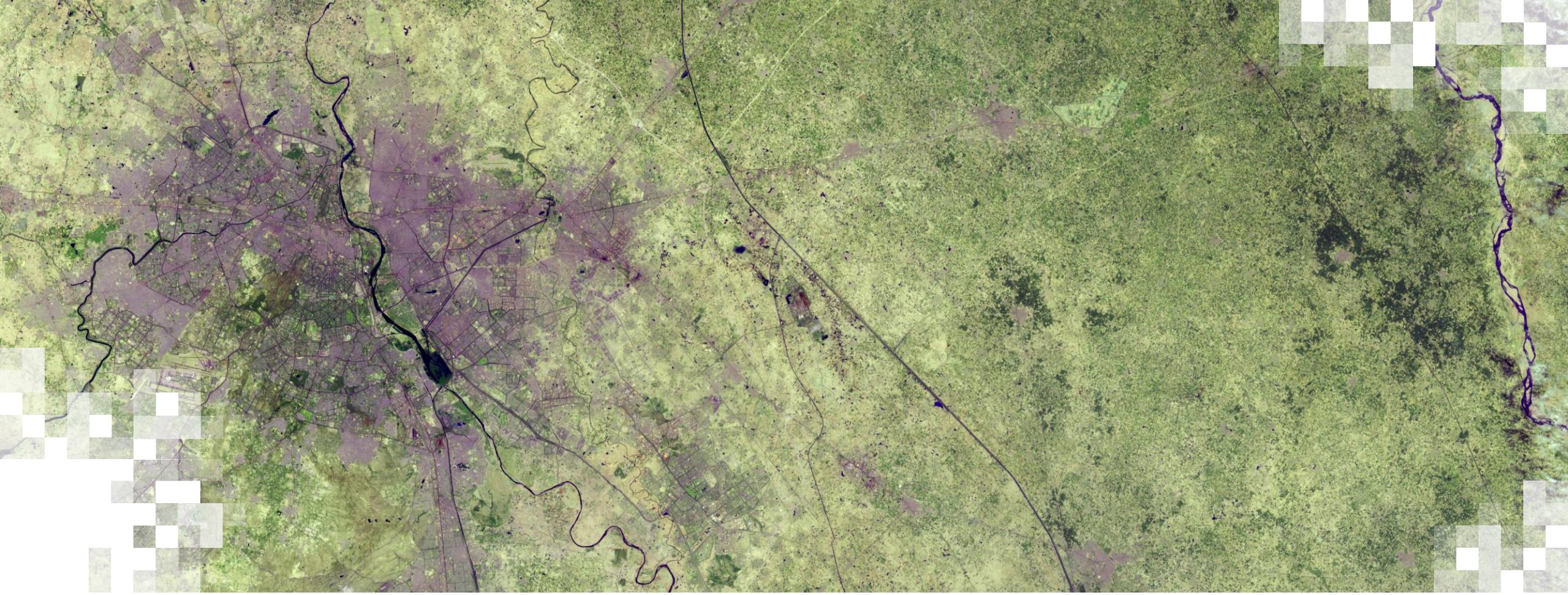


Image Credits: (Top) BBC (Bottom) UN Convention to Combat Desertification



Guest Speakers:

Sasha Alexander (UNCCD), Alexander Zvoleff (CI), Monica
Noon (CI), Mariano Gonzalez-Roglich (CI)
trends.earth@conservation.org

REMOTE SENSING FOR MONITORING & REPORTING ON LAND DEGRADATION



United Nations
Convention to Combat
Desertification

EXPERIENCE OF THE UNITED NATIONALS CONVENTION TO
COMBAT DESERTIFICATION (UNCCD)

CONSERVATION
INTERNATIONAL



TRENDS.EARTH
tracking land change



UNCCD: THE CUSTODIAN AGENCY FOR SDG INDICATOR 15.3.1



United Nations
Convention to Combat
Desertification

- Setting the Stage
- Building Capacity
- Looking Ahead

ARRIVING AT SDG TARGET 15.3 AND LAND DEGRADATION NEUTRALITY (LDN)



United Nations

Convention to Combat
Desertification

- The first milestone was the adoption of the UNCCD strategic plan 2008-2018 which introduced a new indicator-based monitoring and assessment framework -- ‘performance review and assessment of the implementation system’ (PRAIS) -- to track progress towards its operational and strategic objectives.
- The next was the Convention’s adoption of land-based indicators with global data sets to enhance the assessment of progress made towards its strategic objectives and to monitor, evaluate and communicate progress towards country implementation of the Convention.
- Finally the 2030 Agenda for Sustainable Development and SDG target 15.3 which promoted the full development of a unique LDN approach for translating and implementing global targets on land degradation at the national level, including the adoption of SDG indicator 15.3.1.

LAYING THE FOUNDATION: LDN FRAMEWORK AND GUIDANCE

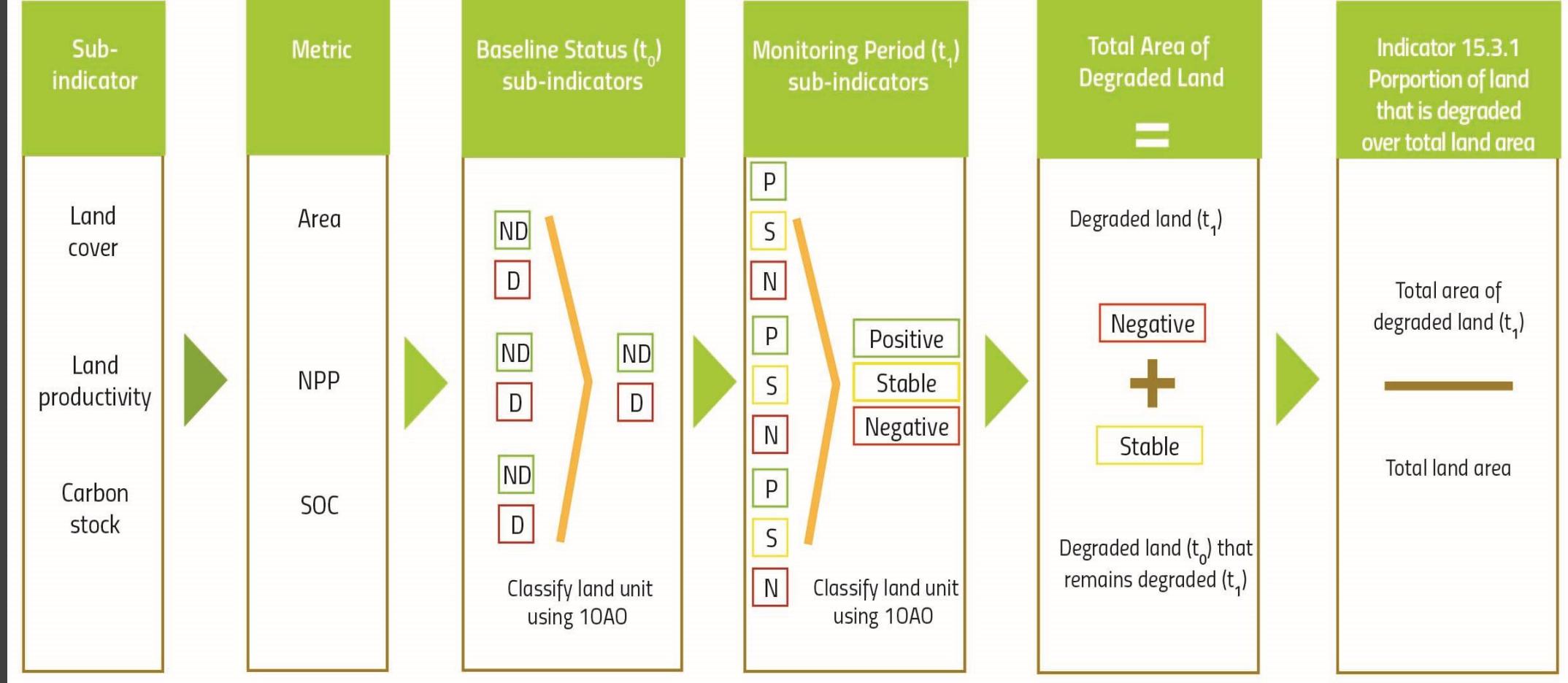


- The Scientific Conceptual Framework for Land Degradation Neutrality (LDN) provides a scientific foundation for understanding, implementing and monitoring LDN -- designed to create a bridge between the vision and the practical implementation of LDN
- The Good Practice Guidance (GPG) for SDG indicator 15.3.1 provides detailed information for countries to implement the methodology for deriving the land degradation indicator and its sub-indicators. It helps countries identify and select the most appropriate spatial datasets and determine the most suitable process for estimating the indicator
- The GPG provides an overview of remotely-sensed global, regional and national data and provides detailed instruction for countries to produce their own national-scale data. This encourages a sense of national ownership over the monitoring process.

ESTIMATING SDG INDICATOR 15.3.1



United Nations
Convention to Combat
Desertification



DATA PRODUCTS, PRACTICAL TOOLS, AND CAPACITY BUILDING



- Conservation International, in partnership with Lund University, NASA, and with the support of the Global Environment Facility (GEF), produced a decision support tool for SDG 15.3.1 reporting called Trends.Earth – operates as a free plugin to the open source QGIS 2.18.x.
- Trends.Earth can be used to plot time series of key spatially explicit indicators of land change (including degradation and improvement) and to produce maps and other graphics that can support monitoring and project implementation to address land degradation. The tool can also potentially be used to overlay other relevant and spatially-explicit indicators.
- Regional capacity building workshops provided hands-on training on default data, the methods, Trends.Earth tool and the use of national data – it was also an opportunity to identify the end-user challenges for building national capacities to utilize big EO data sets.

GEO LDN INITIATIVE AND THE 2021-2022 REPORTING CYCLE



United Nations
Convention to Combat
Desertification

There is still much work to be done!

The Group on Earth Observations (GEO) recently established a LDN Initiative to address some of the remaining gaps in the use of EO data for land degradation. These include:

- The need for continuous access of high resolution images and capacity building and products to transform this data into actionable information
- The development of minimum data quality standards and decision trees to help stakeholders select the most appropriate data sets
- The inter-operability of these data sets with other indicators to better target interventions at local scales using platforms such as Trends.Earth or data cubes

MORE INFORMATION



United Nations

Convention to Combat
Desertification

- <https://prais.unccd.int/>
- <https://www.earthobservations.org/activity.php?id=149>
- Sasha Alexander
Policy Officer
salexander@unccd.int



TRENDS.EARTH

LAND DEGRADATION



TRENDS.EARTH - MONITORING LAND CONDITION



- Identification of degraded lands
- Can set baselines, and track progress
- Best global datasets
- Allows use of best-available local information



Supports all three components of SDG Indicator 15.3.1



Land Productivity



Land Cover



Carbon Stocks



TRENDS.EARTH - SDG 15.3.1

Proportion of land that is degraded over a total area



1. Land Productivity

Net Primary Productivity



2. Land Cover

Land Cover Change

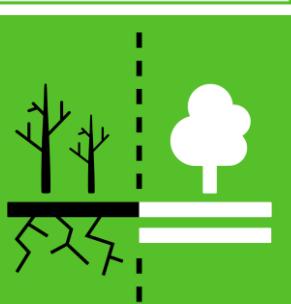


3. Above and Below Ground C

Soil Organic Carbon

TARGET

15·3



END DESERTIFICATION
AND RESTORE
DEGRADED LAND

TRENDS.EARTH - PRODUCTIVITY



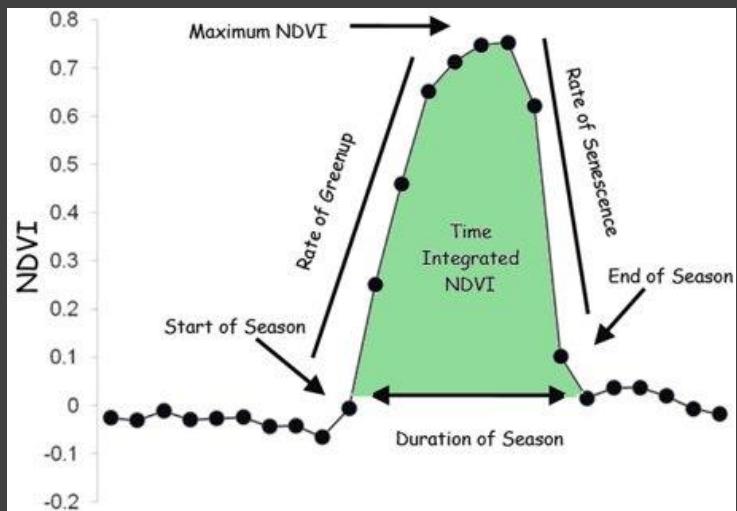
- **Land productivity** is the biological productive capacity of the land, the source of all the food, fiber and fuel that sustains humans (United Nations Statistical Commission 2016).



TRENDS.EARTH - PRODUCTIVITY → PRIMARY PRODUCTIVITY

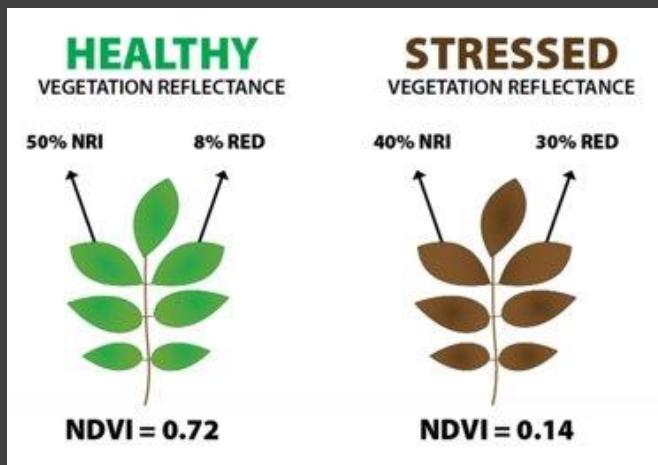


- Net primary productivity (NPP) is the net amount of carbon assimilated after photosynthesis and autotrophic respiration over a given period of time (Clark et al. 2001) and is typically represented in units such as kg/ha/yr.



$$\text{NDVI} = \frac{\text{NIR} - \text{RED}}{\text{NIR} + \text{RED}}$$

$$\text{NDVI} = 0.72$$





TRENDS.EARTH - PRODUCTIVITY INDICATORS



Trajectory: • Measures the rate of change in primary productivity over time.

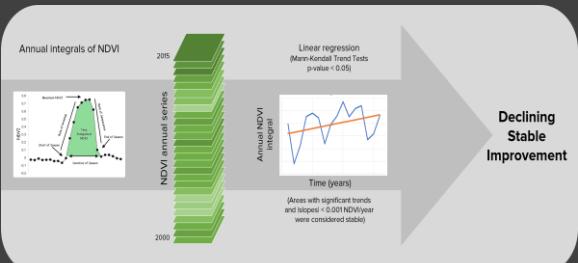
State: • Compares the current productivity level in a given area to historical observations of productivity in that same area.

Performance: • Measures local productivity relative to other similar vegetation types in similar land cover types or bioclimatic regions throughout the study area.

TRENDS.EARTH - PRODUCTIVITY INDICATORS



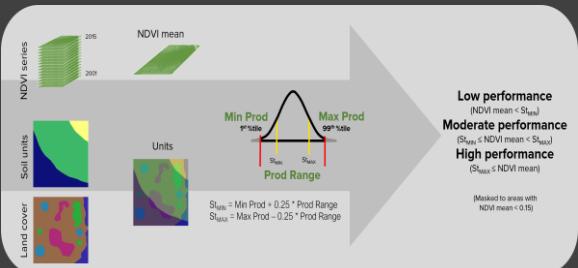
Trajectory:



State:



Performance:



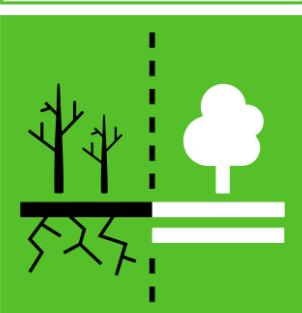
For details, check:

<http://trends.earth/docs/en/index.html>



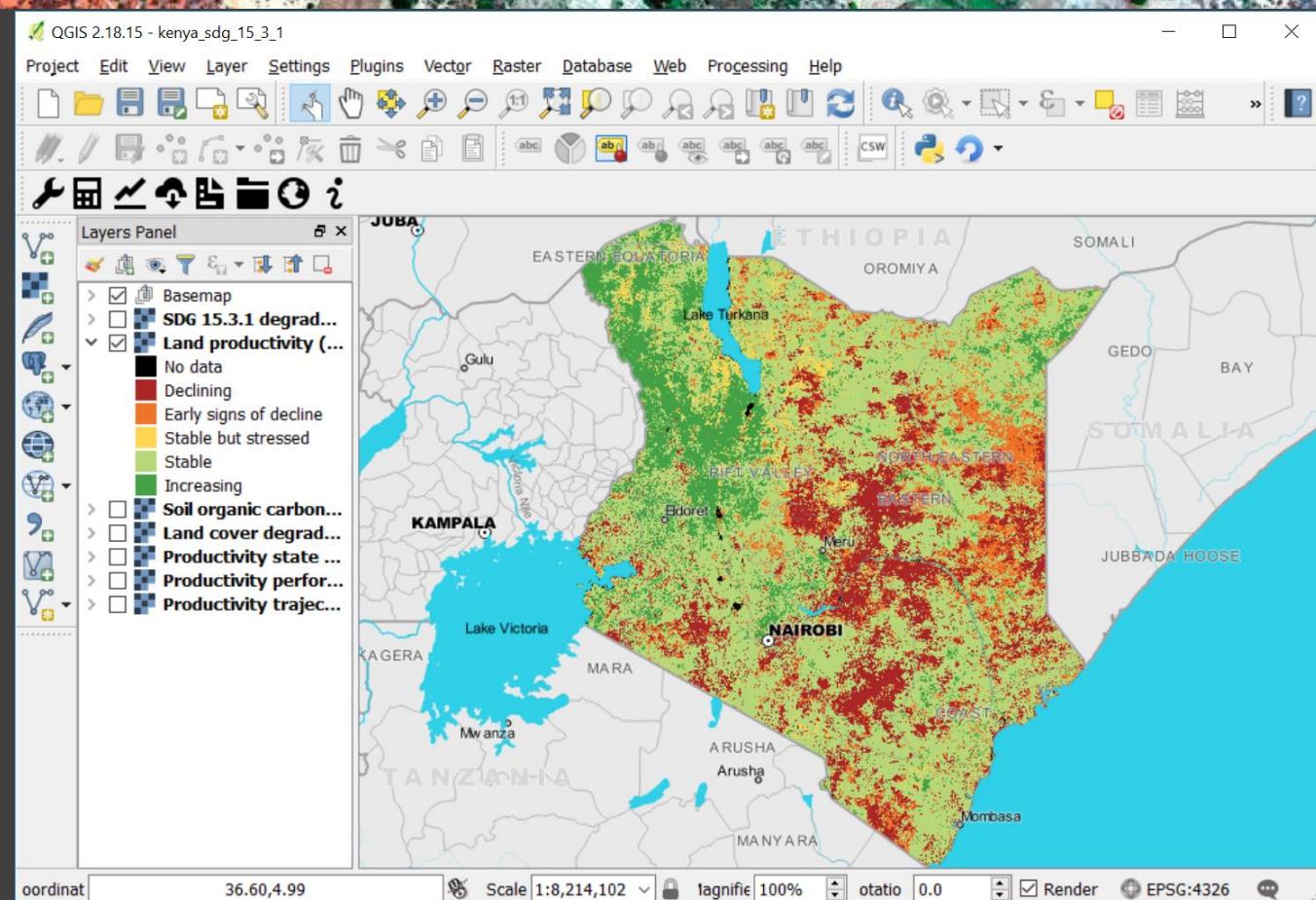
TARGET

15·3



END DESERTIFICATION
AND RESTORE
DEGRADED LAND

TRENDS.EARTH - LAND PRODUCTIVITY



TRENDS.EARTH - SDG 15.3.1

Proportion of land that is degraded over a total area



1. Land Productivity

Net Primary Productivity



2. **Land Cover**

Land Cover Change



3. Above and Below Ground C

Soil Organic Carbon



TRENDS.EARTH - LAND COVER CHANGE



- ...describes changes in the observed biophysical character of the earth's surface to help identify areas that may be subject to change. A transition from one land cover type to another may be considered an improvement, a neutral change or degradation, depending on the perspective of the country in question.

TRENDS.EARTH - LAND COVER CHANGE



Land cover for baseline and target years

2015

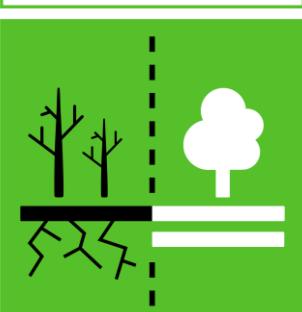
2001

Transition map

Transition criteria

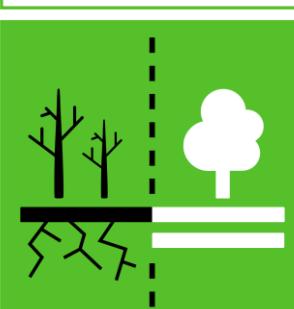
+

Potential land degradation



END DESERTIFICATION
AND RESTORE
DEGRADED LAND





END DESERTIFICATION
AND RESTORE
DEGRADED LAND

TRENDS.EARTH - LAND COVER CHANGE



		Land cover in target year						
		Tree-covered	Grassland	Cropland	Wetland	Artificial	Bare land	Water body
Land cover in initial year	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

Legend

Degradation	Stable	Improvement
-	0	+

*The "Grassland" class consists of grassland, shrub, and sparsely vegetated areas (if the default aggregation is used).

TRENDS.EARTH - SDG 15.3.1



Proportion of land that is degraded over a total area



1. Land Productivity

Net Primary Productivity



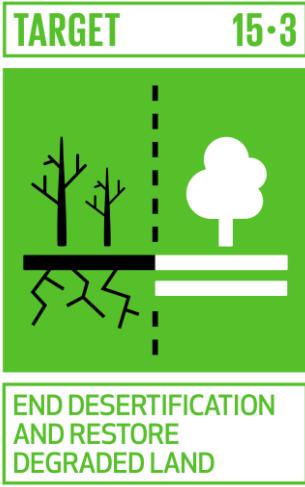
2. Land Cover

Land Cover Change



3. Above and Below Ground C

Soil Organic Carbon

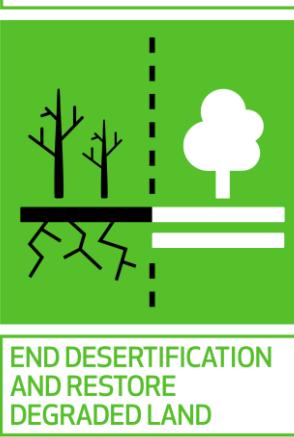
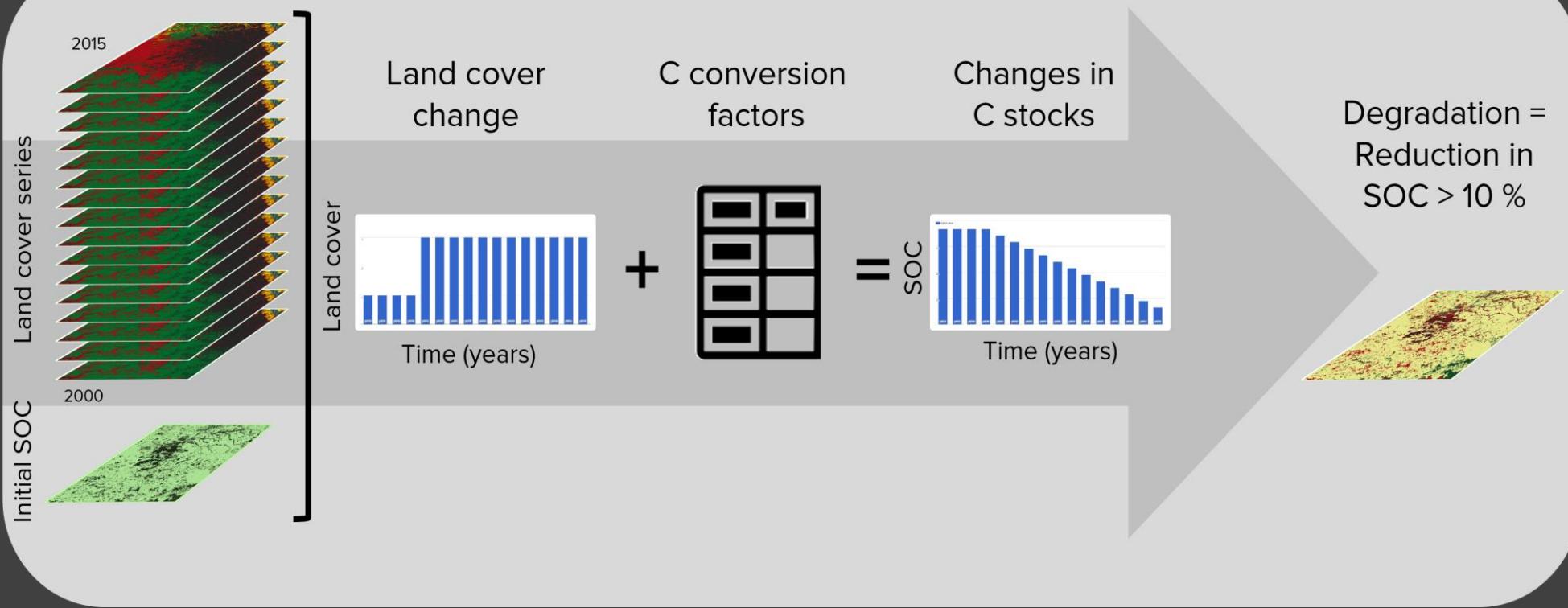


TRENDS.EARTH - SOIL ORGANIC CARBON



- Carbon stocks reflect the integration of multiple processes affecting plant growth and the gains and losses from terrestrial organic matter pools. The metric used to assess carbon stocks adopted for Indicator 15.3.1 is soil organic carbon (SOC).

TRENDS.EARTH - SOIL ORGANIC CARBON





TRENDS.EARTH - SOIL ORGANIC CARBON



$$SOC_{final} = SOC_{ref} \times FLU \times FMG \times FI$$

- **FLU:** land-use factor that reflects carbon stock changes associated with type of land use,
- **FMG:** management factor representing the main management practice specific to the land-use sector (e.g., different tillage practices in croplands)
- **FI:** input factor representing different levels of carbon input to soil.

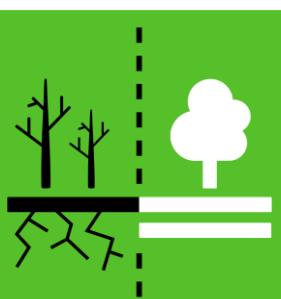


TRENDS.EARTH - SOIL ORGANIC CARBON



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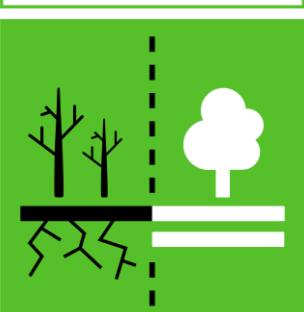
END DESERTIFICATION
AND RESTORE
DEGRADED LAND

TRENDS.EARTH - SOIL ORGANIC CARBON



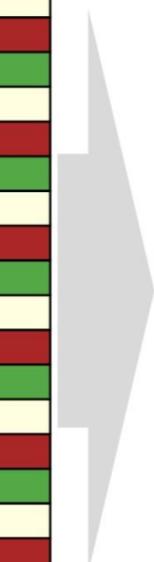
Land use factors		Final land cover						
		Forest	Grassland	Croplands	Wetlands	Artificial	Bare lands	Water
Initial land cover	Forest	1	1	f	1	0.1	0.1	1
	Grassland	1	1	f	1	0.1	0.1	1
	Croplands	1/f	1/f	1	1/0.71	0.1	0.1	1
	Wetlands	1	1	0.71	1	0.1	0.1	1
	Artificial	2	2	2	2	1	1	1
	Bare lands	2	2	2	2	1	1	1
	Water	1	1	1	1	1	1	1

- Tropical Montane ($f = 0.64$)
- Tropical Moist ($f = 0.48$)
- Tropical Dry ($f = 0.58$)
- Temperate Moist ($f = 0.69$)
- Temperate Dry ($f = 0.80$)



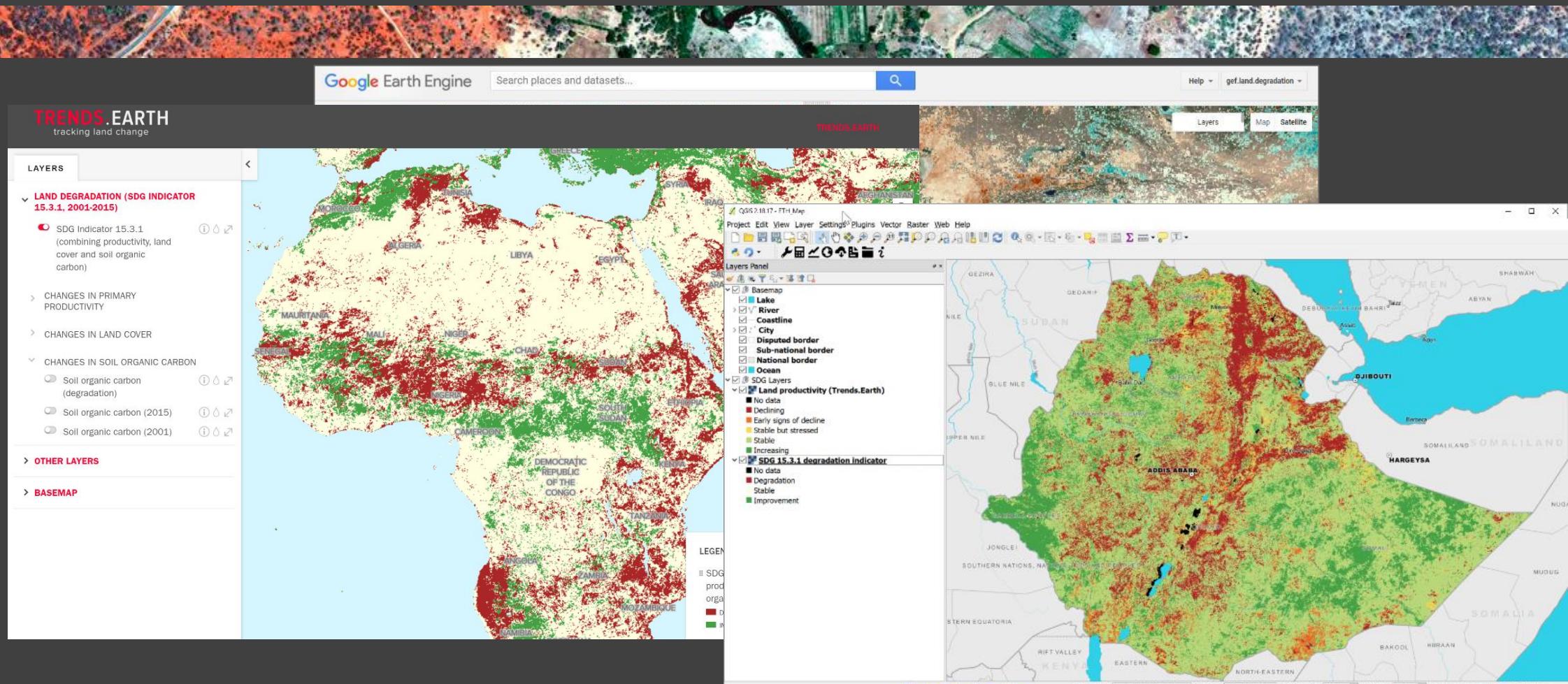
END DESERTIFICATION
AND RESTORE
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TRENDS.EARTH - SDG 15.3.1 one out-all out



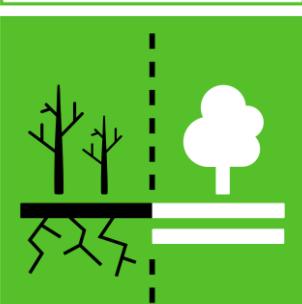
Productivity	Land Cover	SOC	SDG 15.3.1
Improving	Improving	Improving	Improving
Improving	Improving	Stable	Improving
Improving	Improving	Declining	Declining
Improving	Stable	Improving	Improving
Improving	Stable	Stable	Declining
Improving	Stable	Declining	Declining
Improving	Declining	Improving	Declining
Improving	Declining	Stable	Declining
Improving	Declining	Declining	Declining
Stable	Improving	Improving	Improving
Stable	Improving	Stable	Improving
Stable	Improving	Declining	Declining
Stable	Stable	Improving	Improving
Stable	Stable	Stable	Stable
Stable	Stable	Declining	Declining
Stable	Declining	Improving	Declining
Stable	Declining	Stable	Declining
Stable	Declining	Declining	Declining
Declining	Improving	Improving	Declining
Declining	Improving	Stable	Declining
Declining	Improving	Declining	Declining
Declining	Stable	Improving	Declining
Declining	Stable	Stable	Declining
Declining	Stable	Declining	Declining
Declining	Declining	Improving	Declining

TRENDS.EARTH - TRACKING LAND CHANGE



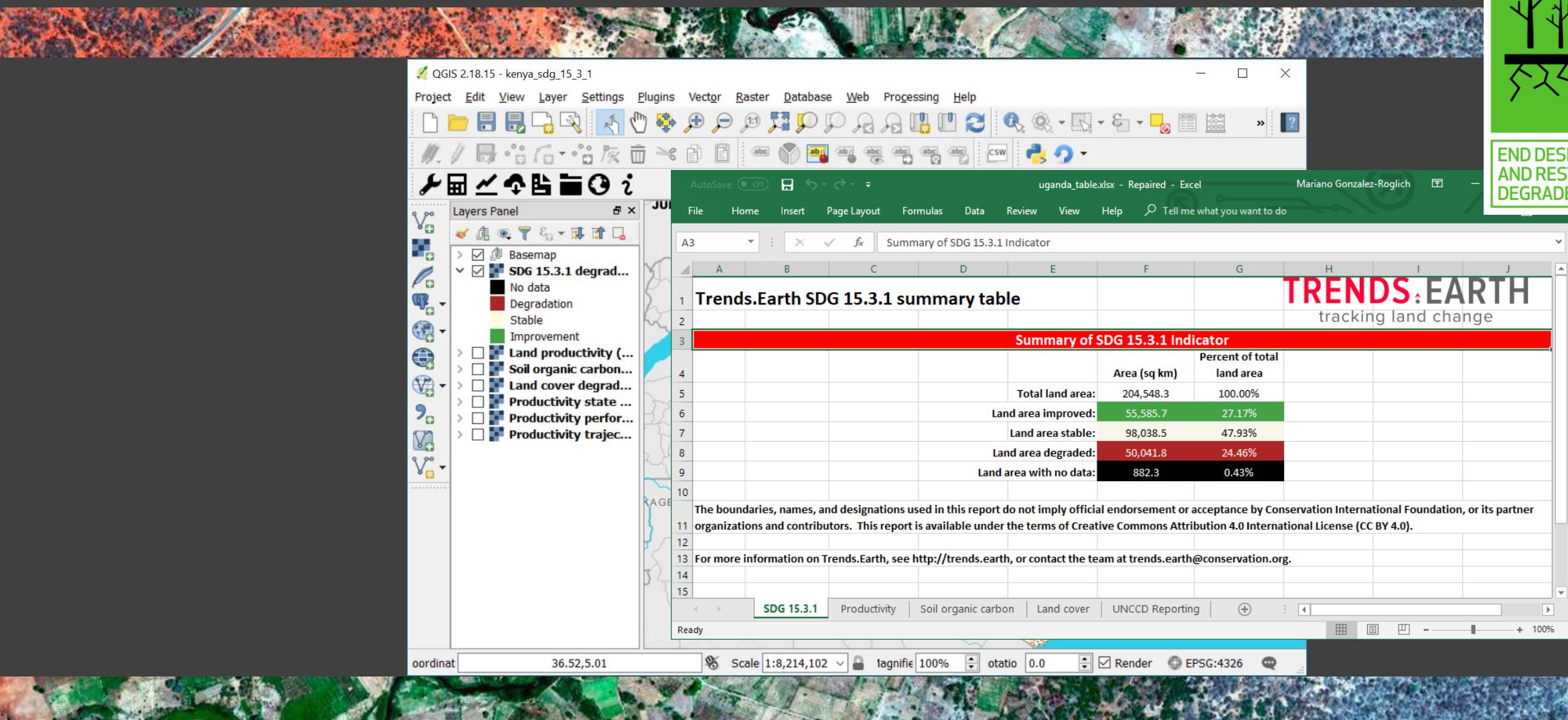
TARGET

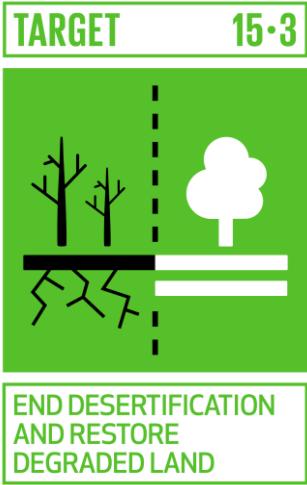
15·3



END DESERTIFICATION
AND RESTORE
DEGRADED LAND

TRENDS.EARTH - SDG 15.3.1





TRENDS.EARTH - EXERCISE

- QGIS Plug-in: Trends.Earth
- Website: <http://trends.earth/>
- Outputs: <http://maps.trends.earth>



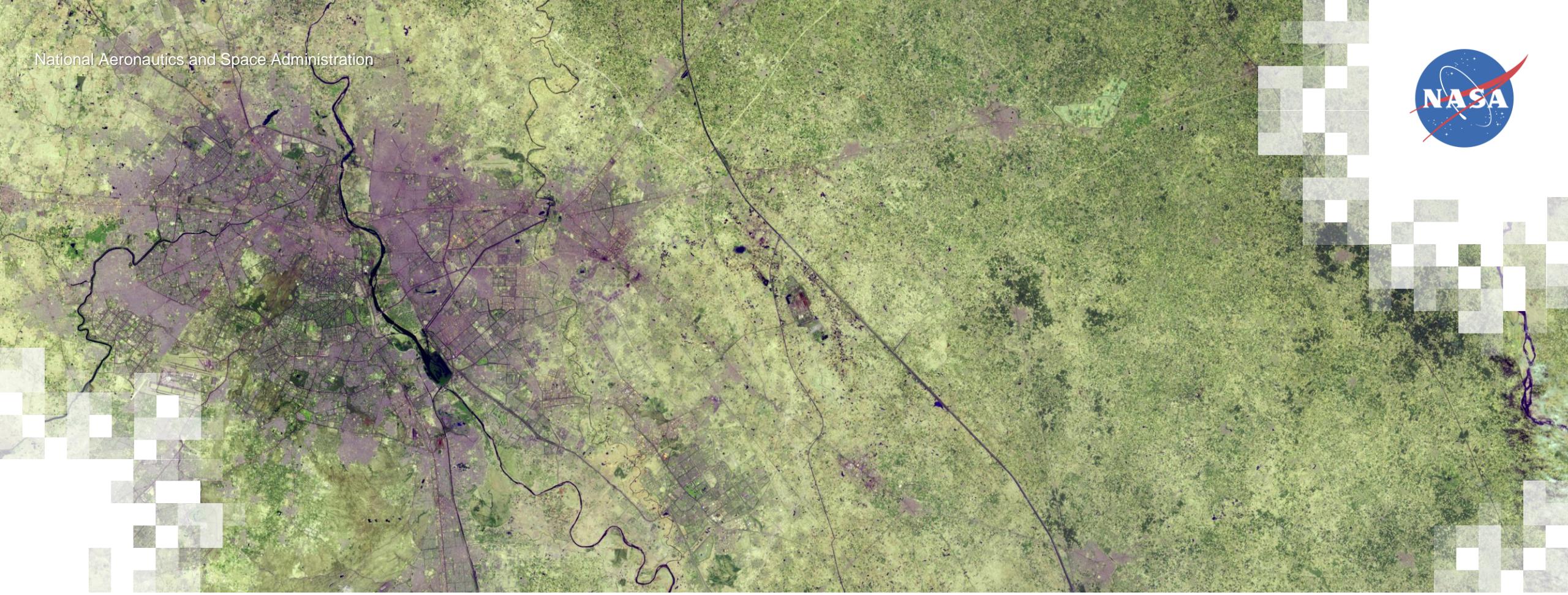
Trends.Earth Exercise



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- ARSET Website:
 - <http://arset.gsfc.nasa.gov>

National Aeronautics and Space Administration



CONSERVATION
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TRENDS.EARTH
tracking land change



Thank You

Next Session: July 16th, 2019

7/9/2019