

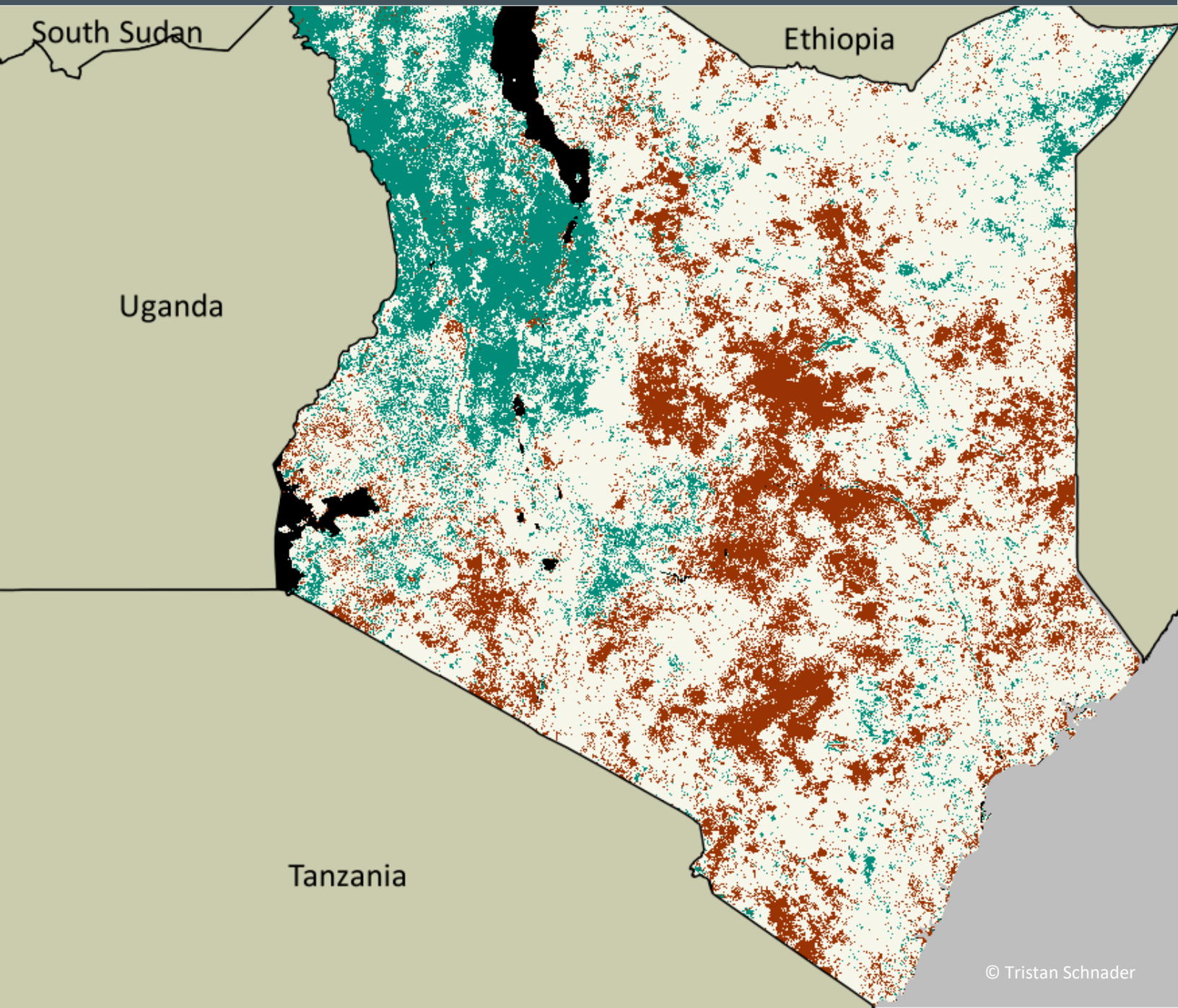
VITAL SIGNS



TRENDS.EARTH  
tracking land change



# GEF-LAND DEGRADATION MONITORING CAPACITY BUILDING WORKSHOP JANUARY 16 – 18, | NAIROBI, KENYA



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## LIST OF ABBREVIATIONS

CI – Conservation International

ESA – European Space Agency

GEF – Global Environment Facility

GIS – Geographic Information System

LDMP – Land Degradation Monitoring Project

NASA – National Aeronautics and Space  
Administration

NDVI – Normalized Difference Vegetation Index

QGIS – Quantum Geographic Information System

RCMRD – Regional Centre for Mapping Resources for  
Development

SLM – Sustainable Land Management

STAP – Science and Technology Advisory Panel of  
the Global Environment Facility

UN – United Nations

UNCCD – United Nations Convention to Combat  
Desertification

## VS – Vital Signs

# INTRODUCTION

The global population is increasing rapidly and is projected to reach 9.6 billion people by 2050, resulting in a need for an estimated 70% increase in food production. Such a dramatic rise in food production will result in a heightened demand in major agricultural regions, including many parts of Africa. It is imperative that decision-makers, from farmers to policy makers, understand how to feed the world without destroying natural capital. Decreasing and reversing land degradation are key components of such an impending developmental challenge.

The idea for the Land Degradation Monitoring Project (LDMP) came out of a 2014 workshop conducted by the Scientific and Technical Advisory Panel (STAP) of the GEF. The STAP approached Vital Signs, NASA, and the ESA to develop a proposal and has been involved throughout the implementation process. The aim of the project is to create a set of global products and tools that will allow national governments to assess and monitor land degradation at multiple scales, starting with four pilot countries (Kenya, Senegal, Tanzania, and Uganda) and then building the capacity to expand.

The Land Degradation Monitoring Project has three major objectives, which include:

- Establishing methods for assessing the status and trends in land degradation within each pilot country;

- Demonstrating methods and creating platforms that will enable widespread adoption of these methods;

- Enhancing gender appropriate capacity to use the toolbox and recommended approaches for assessing the status and trends of land degradation using remote sensing.

The workshop that this report details was a major part of the project's capacity building efforts. The workshop took place in Nairobi, Kenya from January 16-18, 2018, and included key local representatives and stakeholders. The workshop provided background on land degradation, in-depth discussion of our recommended methods for assessing degradation on at multiple scales, and training on the project's open source global toolbox, recently branded TRENDS.EARTH. Feedback was provided by the participating stakeholders and was used to make appropriate adjustments to the project's toolbox. Eight out of 28 participants in the workshop were women.

## VENUE

Regional Centre for Mapping Resources for Development (RCMRD)  
Near Kasarani Police Station  
Kasarani – Mwiki Road, Nairobi, Kenya  
rcmrd@rcmrd.org  
Phone: +254 20 2680748

## DATES

Tuesday, January 16 – Thursday, January 18, 2018

## OBJECTIVES

- To test the effectiveness of the LDMP Toolbox (now called TRENDS.EARTH) in identifying areas of land degradation
- To provide training on the findings and outputs of the Land Degradation Monitoring Project and Toolbox
- To increase capacity and understanding of land degradation processes in different regions and at different scales
- To receive feedback and input from key stakeholders of all four pilot countries on the toolbox
- To encourage stakeholders to disseminate knowledge to other key stakeholders in respective countries

## PARTICIPANTS

### KENYA

Inganga S. Francis  
Michael Oyugah  
Benson Mburu Kinyagia  
Anne Itubo  
Kennedy Ondimu  
Gerrit Gerdes  
Margaret Wanjiru Mugure  
Elizabeth A. Okwuosa  
Walter E.A. Nganyi  
Anne Seda  
Lucy Njino  
Muhammad N. Ahmad  
Celestine Ingutia  
Esther Mwangi  
Guyo Roba  
Jeff Worden  
Lobik Lemiruni

Isaiah Wandabwa  
Owen Wawira  
Shem Kifugo  
Kenneth Mubea  
Robinson Mugo  
Joseph Murage  
Edward Ouko  
Stephen Sande  
Peter Alele  
Tabby Njunge

### PROJECT TEAM

Yengoh Genesis  
Mariano Gonzalez-Roglich  
Monica Noon  
Tristan Schnader  
Alex Zvoleff

# WORKSHOP PROGRAM

## TUESDAY, JANUARY 16, 2018

- 8:30 a.m. – 9:00 a.m. ARRIVAL + REGISTRATION  
All workshop participants must sign in upon arrival
- 9:00 a.m. – 9:30 a.m. OPENING AND WELCOMING REMARKS  
RCMRD Representative
- 9:30 a.m. – 10:00 a.m. [INTRODUCTIONS](#)  
Dr. Peter Alele, Conservation International
- 10:00 a.m. – 11:00 a.m. [LAND DEGRADATION – EXTENT & CHALLENGES FOR SUSTAINABLE DEVELOPMENT](#)  
*Group Discussion:* Dr. Yengoh Genesis, Lund University
- 11:00 a.m. – 11:30 a.m. COFFEE + TEA BREAK
- 11:30 a.m. – 12:30 p.m. [POTENTIAL AND LIMITATIONS OF REMOTE SENSING FOR LAND DEGRADATION MONITORING](#)  
*Group Discussion:* Dr. Yengoh Genesis, Lund University
- 12:30 p.m. – 1:30 p.m. BUFFET LUNCH  
Open to all workshop participants
- 1:30 p.m. – 2:30 p.m. [LAND DEGRADATION IN FOCUS](#)  
Dr. Jeff Worden, Osilalei Limited
- 2:30 p.m. – 3:00 p.m. COFFEE + TEA BREAK
- 3:00 p.m. – 5:00 p.m. [TRENDS.EARTH INTRODUCTION](#)  
*Demonstration:* Dr. Mariano Gonzalez-Roglich, Conservation International



## WEDNESDAY, JANUARY 17, 2018

- 8:30 a.m. – 9:00 a.m. QGIS OVERVIEW  
*Demonstration:* Dr. Alex Zvoleff, Conservation International
- 9:00 a.m. – 10:30 a.m. TRENDS.EARTH TUTORIAL, PART I  
*Demonstration:* Ms. Monica Noon, Conservation International
- 10:30 a.m. – 11:00 a.m. COFFEE + TEA BREAK
- 11:00 a.m. – 12:30 p.m. TRENDS.EARTH TUTORIAL, PART II  
*Demonstration:* Ms. Monica Noon, Conservation International
- 12:30 p.m. – 1:30 p.m. BUFFET LUNCH  
Open to all workshop participants
- 1:30 p.m. – 3:00 p.m. ANALYSIS OF LAND DEGRADATION: DEMONSTRATION  
*Group Practical Session:* Dr. Alex Zvoleff, Conservation International
- 3:00 p.m. – 3:30 p.m. COFFEE + TEA BREAK
- 3:30 p.m. – 5:00 p.m. GENERATING + INTERPRETING VISUALIZATIONS  
*Group Practical Session:* Dr. Mariano Gonzalez Roglich,  
Conservation International

## THURSDAY, JANUARY 18, 2018

- 9:00 a.m. – 11:00 a.m.                      REPORTING ON NATIONAL LEVEL ANALYSIS, PART I  
*Group Discussion:* Dr. Alex Zvoleff, Conservation  
International
- 11:00 a.m. – 11:30 a.m.                      COFFEE + TEA BREAK
- 11:30 a.m. – 12:30 p.m.                      REPORTING ON NATIONAL LEVEL ANALYSIS, PART II  
*Group Discussion:* Dr. Mariano Gonzalez Roglich,  
Conservation International
- 12:30 p.m. – 1:30 p.m.                      BUFFET LUNCH  
Open to all workshop participants
- 1:30 p.m. – 3:30 p.m.                      REFLECTIONS ON POTENTIAL + CHALLENGES OF LAND  
DEGRADATION BASED ANALYSIS  
*Group Discussion:* Dr. Yengoh Genesis, Lund University
- 3:30 p.m. – 4:00 p.m.                      COFFEE + TEA BREAK
- 4:00 p.m. – 5:00 p.m.                      FINAL REMARKS + CONCLUSION  
*Group Discussion:* Dr. Alex Zvoleff, Conservation  
International
- 6:00 p.m. – 9:00 p.m.                      BUFFET DINNER + SOCIAL EVENING  
Open to all workshop participants  
*ICIPE Guest House (walking distance from RCMRD)*

# OVERVIEW

## OPENING REMARKS

Dr. Robinson Mugo, RCMRD Project Manager – Chief of Party, gave introductory comments. He opened the session by welcoming all the participants and asked every participant to introduce themselves. Lastly, he thanked the participants for their feedback and expressed enthusiasm for the days ahead.

Dr. Peter Alele, Vital Signs Africa Field Director, also thanked the audience and provided context on Conservation International's and Vital Signs' involvement in Kenya and, more broadly, Africa. He encouraged active participation in the workshop and then gave the floor to Dr. Alex Zvoleff, who provided a broad overview of the GEF-Land Degradation Monitoring Project and the purpose of its recently developed tool, TRENDS.EARTH.

## LAND DEGRADATION IN CONTEXT

Dr. Yengoh Genesis gave a lecture on land degradation and the processes that drive degradation around the world. Land degradation, deforestation, and desertification are all prevalent global environmental threats. Dr. Genesis elaborated on examples of the complex relationships and combinations of drivers that lead to degradation around the world, and noted the most common causes behind deforestation, desertification, erosion by water and wind, soil fertility decline, and salinization. He concluded the lecture with a discussion on land improvement and Sustainable Land Management (SLM) techniques, including agronomic practices, tree planting, structural measures, and sustainable grazing management.

To provide more context and background, Dr. Genesis presented on the extent and challenges of sustainable development through the lens of land degradation. First, he presented land degradation as a land use challenge, where a balance must be struck between social reality and ecosystem health. Dr. Genesis then noted that land

degradation itself cannot be directly measured; however, proxies that indicate land degradation *are* measurable, biophysically justifiable, and scalable through remote sensing techniques. Although, he noted that ancillary data is necessary for validation purposes.

Dr. Genesis then provided background information on remote sensing and the Normalized Difference Vegetation Index (NDVI), describing Planck's Law, reflectance at various wavelengths, how absorbed photosynthetically active radiation can be easily measured using different satellite datasets. In his presentation, he also included a variety of useful tips and ideas to keep in mind when using NDVI to measure indicators of land degradation.

Dr. Jeff Worden of Osilalei, Ltd. presented an overview of land degradation through a Kenyan lens, first moving from the global context of degradation, reviewing environmental, agricultural, social, and economic impacts on land. He then focused on the challenges and opportunities Kenya faces in relation to land degradation and ended the presentation with ideas on how to reduce degradation and restore ecosystems within country.

## THE LAND DEGRADATION MONITORING PROJECT TOOLBOX

Dr. Mariano Gonzalez-Roglich provided an conceptual overview of the TRENDS.EARTH. The toolbox is an open source platform that is freely available as a global public good. The methods on assessing land degradation were previously established by the LDMP ([see Report 1](#)) and are implemented in the toolbox through a QGIS, an open source Geographic Information System (GIS) platform. The toolbox is designed to measure three main indicators (or proxies) of land degradation – land productivity, land cover, and soil carbon – that are consistent with the UNCCD [SDG 15.3](#).

The toolbox:

1. Facilitates downloading and visualizing datasets projects by the project;
2. Includes routines for mapping and calculating vegetation indices and studying trends in vegetation productivity;
3. Supports comparing analytical outputs derived from coarse – and medium-resolution – datasets with those derived from high-resolution data;

4. Allows users to integrate ground datasets with earth observation data to derive insights on the possible drivers of land degradation; and
5. Supports reporting to the UNCCD and GEF, including production of summary tables and maps.

Dr. Gonzalez-Roglich explained the relationship between specific indicators and land degradation, reviewing the three different component indicators of land productivity (trajectory, performance, and state) and demonstrated how to combine the indicators to arrive at a final assessment of area degraded.

Ms. Monica Noon led the group in practical sessions, where stakeholders followed along using personal laptops. Together, the group used TRENDS.EARTH to create a full-country assessment of Kenya. Ms. Noon walked the group through downloading the toolbox and how to properly enter data and subsequently produce outputs for the various indicators. She then showed the group how to generate visualization layers and maps and how to interpret them.

## REPORTING ON NATIONAL ANALYSIS

Participants worked in groups to run analyses and report at the regional level using TRENDS.EARTH. Moderators were available for questions, but groups successfully ran the toolbox independently. Each group presented on what they found for their selected region.

Dr. Zvoleff used this exercise to review the reporting components within the tool and demonstrated the flexibility the tool provides users by allowing them to change land cover class transitions from the default settings.

## OTHER

Since the workshop, RCMRD has posted a short overview of the workshop, which you can find [here](#). For pictures from the first day of the workshop, please visit [here](#).

## REFLECTIONS, FEEDBACK, + CHALLENGES

The feedback received from the workshop and on the LDMP Toolbox was mostly positive. The group was engaged throughout the week and had many questions and suggestions. The major discussion items are addressed below:

### WHY DO I SEE AREAS IMPROVING (IN GREEN) OR DEGRADING (IN RED) AFTER THE FINAL ANALYSIS WHEN I KNOW THAT THOSE AREAS ARE NOT DEGRADED OR IMPROVING?

The final output is a measurement of land degradation based on changes in productivity, land cover and soil organic carbon. These are compared to the baseline period. If the area was already degraded and is improving due to increases in precipitation, for example, the baseline period in the year of 2001 may be impacting the observed changes in future years.

### CAN YOU PROVIDE MORE TIME FOR WORKING WITH THE TOOLBOX DURING THE WORKSHOP TO MASTER ITS FUNCTIONALITY?

Many stakeholders were concerned that they did not have enough time to use the toolbox and suggested reducing the concept portion of the workshop. In addition to spending more time during the workshop, the participants requested that materials are covered more slowly as they will users at different levels.

### CLARIFYING THE UNDERLYING THEORIES OF STATE AND PERFORMANCE.

Participants identified that the information presented to define productivity state and performance were unclear. Technical experts are currently working to better define these indicators, and further guidance will be provided on how to estimate and interpret performance and state.

### HOW WERE THE LAYERS COMBINED TO DEFINE THE FINAL DEGRADATION OUTPUT?

Performance, state, and trajectory (the three indicators of change in productivity\_ are combined following the good practice guidance developed by the UNCCD. This document will be shared with participants. Productivity, soil carbon, and land cover change (the three sub-indicators of SDG 15.3.1) are combined using a "one out, all out"

principle. In other words: if there is a decline in any of the three indicators at a particular pixel, then that pixel is mapped as being “degraded”.

## WHEN WILL THERE BE AN OFFLINE VERSION OF THE TOOLBOX?

The final toolbox will be available as both as an offline and online version. The online version allows users to access current datasets more easily, while also allowing users to leverage Google Earth Engine to provide computing in the cloud. An offline version allows users to access data and perform analyses where internet connectivity may be limited, but it does have the disadvantage of requiring users to have enough local computing capacity to run analyses locally. The technical team intends to build the offline version of the toolbox and provide countries with data relevant for reporting at the national level within the pilot project countries.

## MONITOR THE ACHIEVEMENTS OF THE TRAINING.

Participants suggested the project monitor the achievements of the training and create an online discussion group for those trained in the use of the toolbox to share questions and best practices.

## IT WOULD BE USEFUL TO HAVE AN OPTION TO DOWNLOAD THE ORIGINAL DATA.

The technical team will incorporate this functionality before January 2018.

## WILL THE TOOLBOX SUPPORT HIGHER SPATIAL RESOLUTION DATA?

The toolbox currently supports AVHRR (8km) and MODIS (250m) data for primary productivity analysis, and ESA LCC CCI (300m) for land cover change analysis. Sentinel (20m) and Landsat (30m) will be provided in the form of country mosaics for epochs (2000, 2005, 2010 and 2015 for Landsat, and 2016 and 2017 for Sentinel). Functionalities will be added to support national scale land cover datasets at their native resolution.

## THE PLOT FUNCTION WOULD BE MUCH MORE USEFUL IF THE CLIMATE DATA (E.G. PRECIPITATION) WAS SHOWED ALONG WITH THE NDVI.

This functionality will be added before January 2018.

CURRENTLY, THE LAND COVER AGGREGATION IS DONE FOLLOWING IPCC GUIDELINES, BUT THAT CLASIFICATION DOES NOT TAKE INTO ACCOUNT COUNTRY LEVEL CHARACTERISTICS. COULD IT BE POSSIBLE TO ALLOW THE USER TO DEFINE THE AGGREGATION CRITERIA?

We totally agree with this comment, and the functionality to allow users to define land cover aggregation scheme will be incorporated to the toolbox before January 2018.

## FINAL REMARKS + CONCLUSION

Dr. Zvoleff thanked everyone for their time and for the feedback they provided. He emphasized the importance of continued engagement and dissemination of the knowledge exchanged during the workshop. The team also gave special thanks to RCMRD, who were gracious hosts and have been engaged partners during the project.