GEO LDN Toolbox Training

LAND DEGRADATION NEUTRALITY

Ingrid Teich

WATER

TRADITIONS & HERITAGE

TERRESTRIAL ECOSYSTEMS SERVICES

SOIL & TERRAIN FORMS

LAND

FOOD

PEOPLE

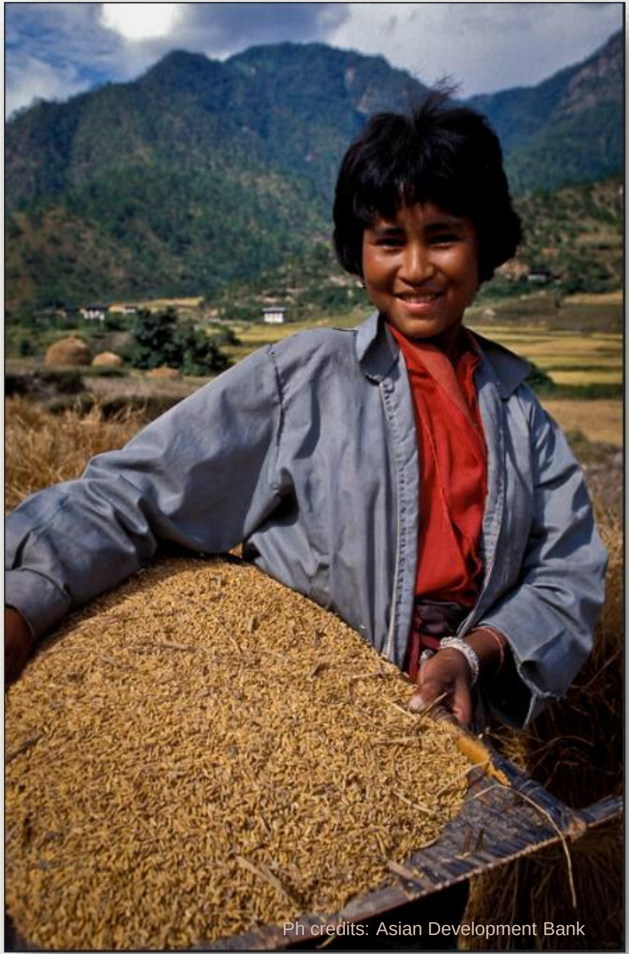
PRODUCTION

PLANTS, ANIMALS, MICROORGANISMS

NATURAL CAPITAL

LAND IS OUR PRIMARY SOURCE OF NATURAL CAPITAL

LAND DEGRADATION is the loss or reduction in land productivity.
When land is degraded, we lose natural capital, and thus all the benefits that land and nature contribute to people.



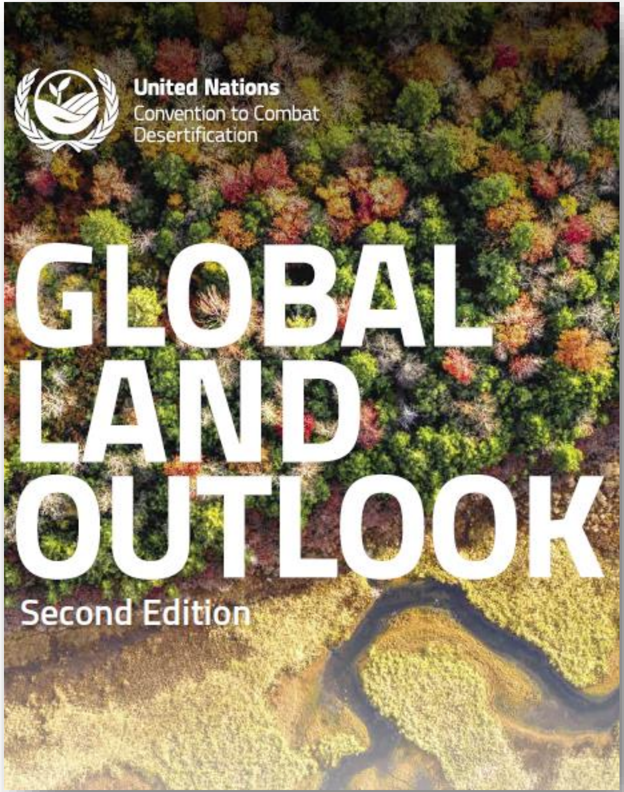
LAND DEGRADATION IS A GLOBAL SEVERE CHALLENGE

Up to 40% of the planet's land is degraded, directly affecting half of humanity

The rate at which fertile soil is being lost per year is alarming

In drought-prone areas, land degradation problems are particularly severe, especially affecting the most vulnerable rural communities and smallholder farmers, who are highly dependent on agriculture for their livelihoods and food security and nutrition.

If business as usual continues, by 2050 the GLO2 report projects additional degradation of an area almost the size of South America.



https://www.unccd.int/resources/global-land-outlook/glo2)

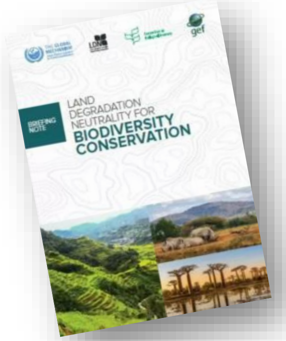
LD is a driver of biodiversity loss through land use change, habitat loss and fragmentation

LD is a driver of climate change through emissions of GHGs and reduced uptake of carbon

Biodiversity loss

Land degradation

Climate change



BD loss intensifies land degradation processes by decreasing land productivity and soil health

Climate change exacerbates land degradation: + soil erosion, vegetation loss, wildfires, + water scarcity

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.

TARGET 15.1 — CONSERVE AND RESTORE TERRESTRIAL AND FRESHWATER ECOSYSTEMS

By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements.

TARGET 15.2 — END DEFORESTATION AND RESTORE DEGRADED FORESTS

By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally.

TARGET 15.3 — END DESERTIFICATION AND RESTORE DEGRADED LAND

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.

TARGET 15.4 — ENSURE CONSERVATION OF MOUNTAIN ECOSYSTEMS

By 2030, ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development.

TARGET 15.5 — PROTECT BIODIVERSITY AND NATURAL HABITATS

Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species.

TARGET 15.6 — PROMOTE ACCESS TO GENETIC RESOURCES AND FAIR SHARING OF THE BENEFITS

Promote fair and equitable sharing of the benefits arising from the utilization of genetic resources and promote appropriate access to such resources, as internationally agreed.

TARGET 15.7 — ELIMINATE POACHING AND TRAFFICKING OF PROTECTED SPECIES

Take urgent action to end poaching and trafficking of protected species of flora and fauna and address both demand and supply of illegal wildlife products.

TARGET 15.8 — PREVENT INVASIVE ALIEN SPECIES ON LAND AND IN WATER ECOSYSTEMS

By 2020, introduce measures to prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems and control or eradicate the priority species.

TARGET 15.9 — INTEGRATE ECOSYSTEM AND BIODIVERSITY IN GOVERNMENTAL PLANNING

By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts.

TARGET 15.A — INCREASE FINANCIAL RESOURCES TO CONSERVE AND SUSTAINABLY USE ECOSYSTEM AND BIODIVERSITY

Mobilize and significantly increase financial resources from all sources to conserve and sustainably use biodiversity and ecosystems.

TARGET 15.B — FINANCE AND INCENTIVIZE SUSTAINABLE FOREST MANAGEMENT

Mobilize significant resources from all sources and at all levels to finance sustainable forest management and provide adequate incentives to developing countries to advance such management, including for conservation and reforestation.

TARGET 15.C — COMBAT GLOBAL POACHING AND TRAFFICKING

Enhance global support for efforts to combat poaching and trafficking of protected species, including by increasing the capacity of local communities to pursue sustainable livelihood opportunities.

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.

TARGET 15.3

END DESERTIFICATION AND RESTORE DEGRADED LAND

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.

Indicators
15.3.1 Proportion of land that is degraded over total land area

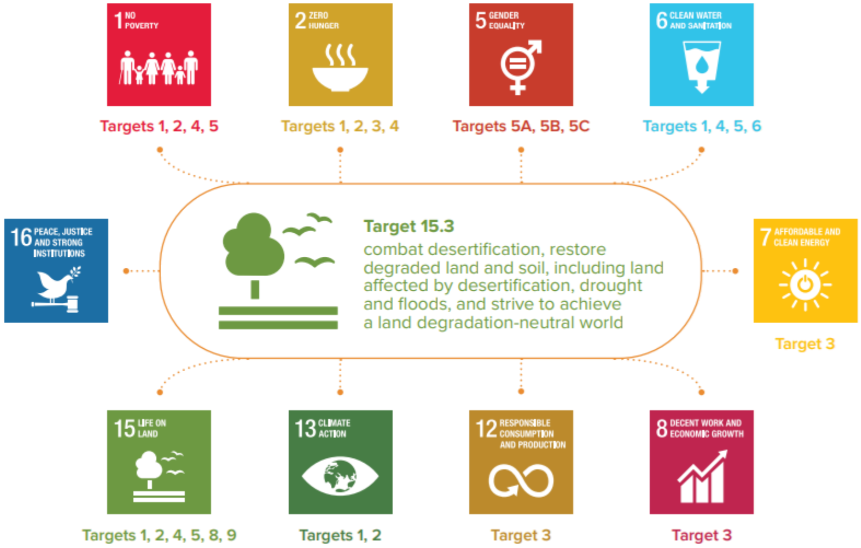
United Nations
Convention to Combat Desertification

CUSTODIAN AGENCY

Responsible for compiling and verifying country data and metadata and for submitting the data, along with regional and global aggregates to the United Nations Statistics Division. Provides Technical guidance to countries.

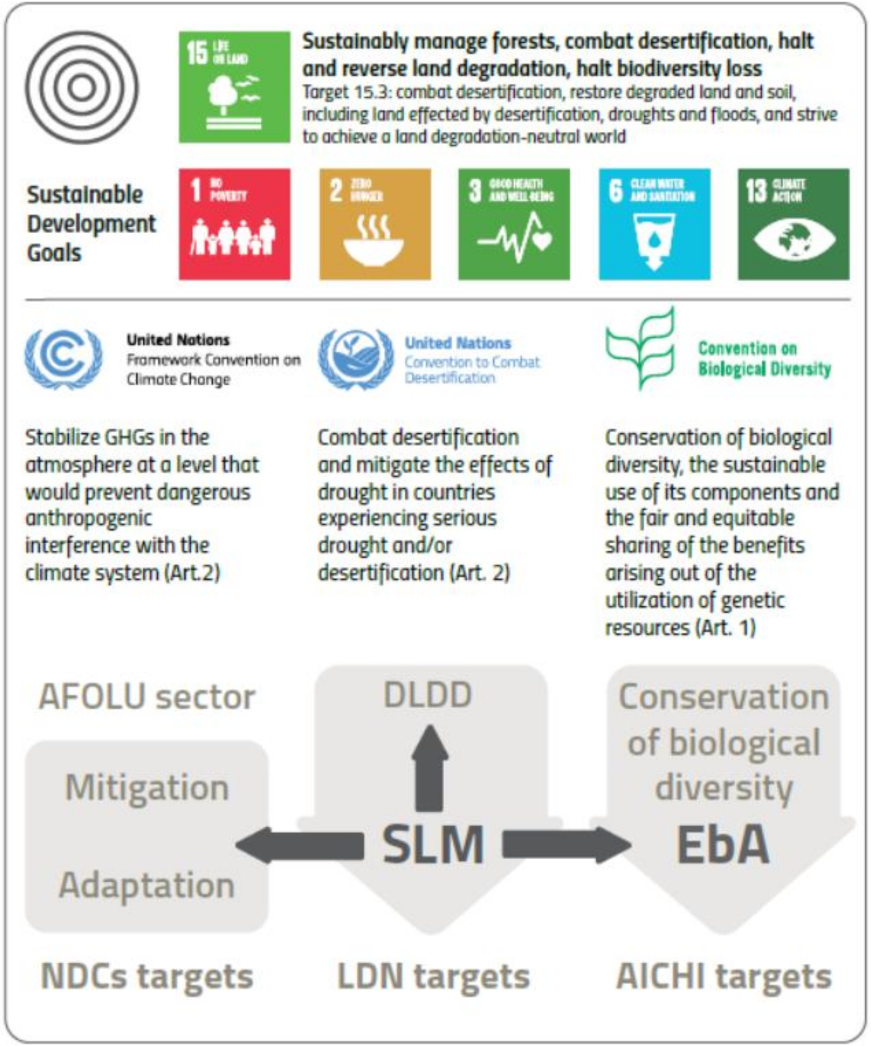
WHAT IS LDN?

"A state whereby the amount and quality of land resources, necessary to support ecosystem functions and services and enhance food security, remain stable or increase within specified temporal and spatial scales and ecosystems".



Source: Global Mechanism-UNCCD, 2019

- ✓ Land based solutions address biodiversity loss and climate change
- ✓ LDN is an accelerator for the attainment of multiple SDGs



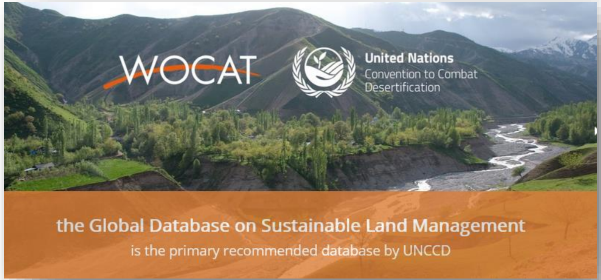
SUSTAINABLE LAND MANAGEMENT

SLM represents a holistic approach to preserving the vital functions and services provided by land in a long-term, sustainable productive capacity, by integrating biophysical, socio-cultural and economic needs and values.

SLM provides appropriate land-based solutions to simultaneously address desertification, land degradation and drought, support climate change adaptation and mitigation, and achieve other co-benefits, such as protecting biodiversity and the quantity and quality of soil and water resources.

SLM can support the objectives of the three Rio Conventions (UNCCD, UNFCCC and CBD), as well as several SDGs.

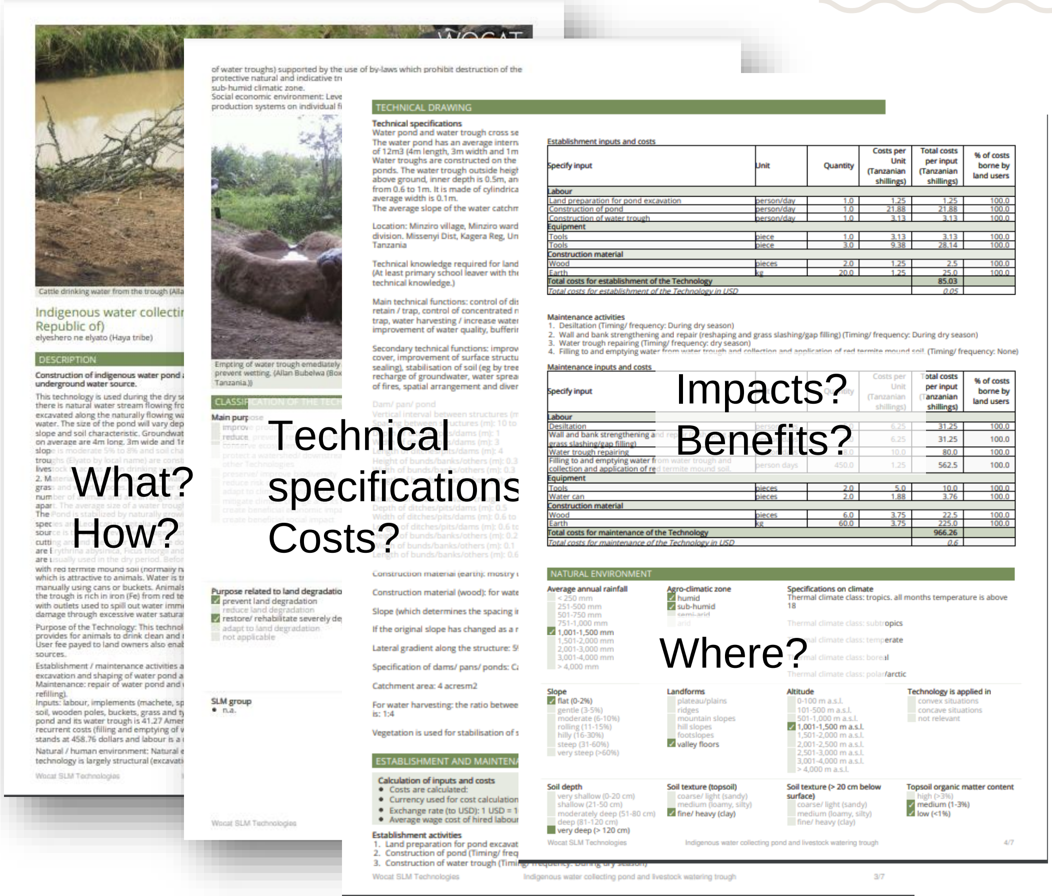
WE HAVE TOOLS & KNOWLEDGE



https://qcat.wocat.net

Key Numbers

- 2146 SLM Practices published from 133 countries by 432 users.
  - 1216 SLM Technologies
  - 481 SLM Approaches
  - 443 UNCCD PRAIS Practices
- 31 new practices drafted in the past 90 days.
- 106985 visits from 198 different countries since launch in August 2016.



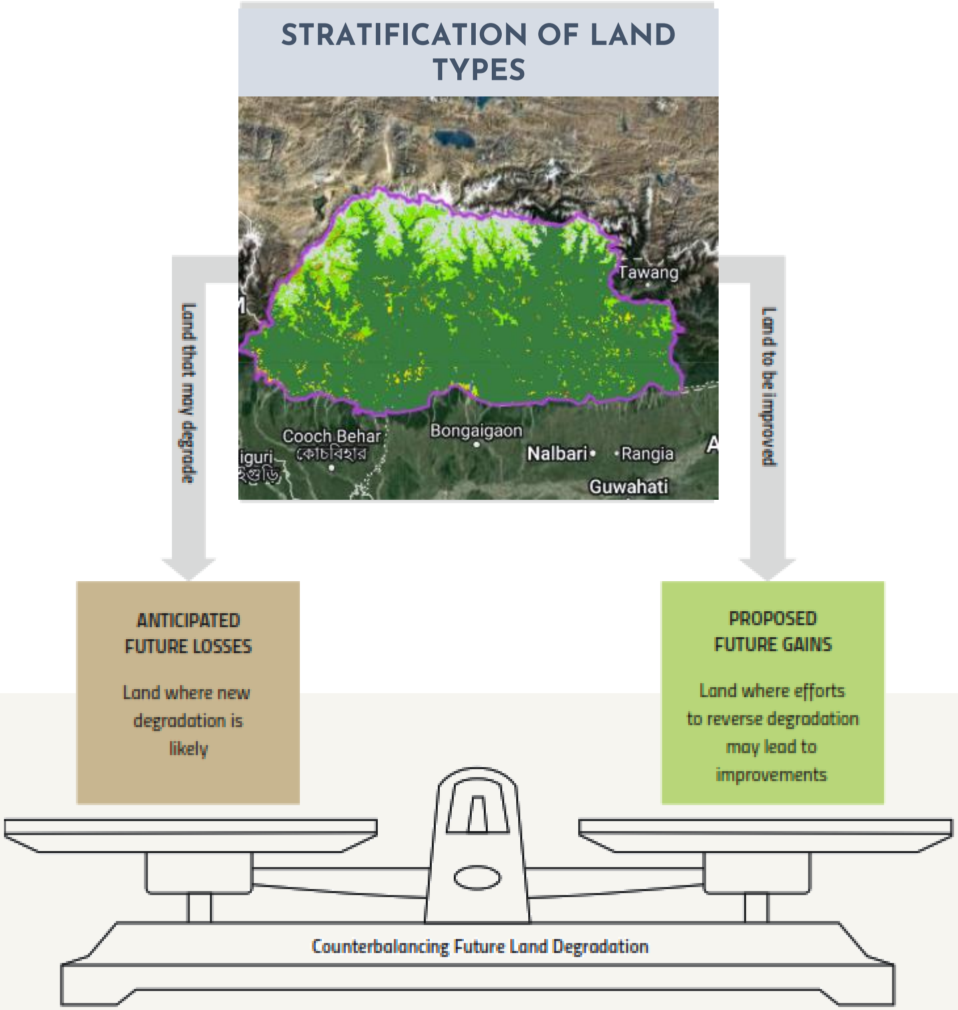
SLM TECHNOLOGIES & APPROACHES

LANDSCAPE DEVELOPMENT

LDN provides a framework for a balanced approach, which considers trade-offs and anticipates new degradation

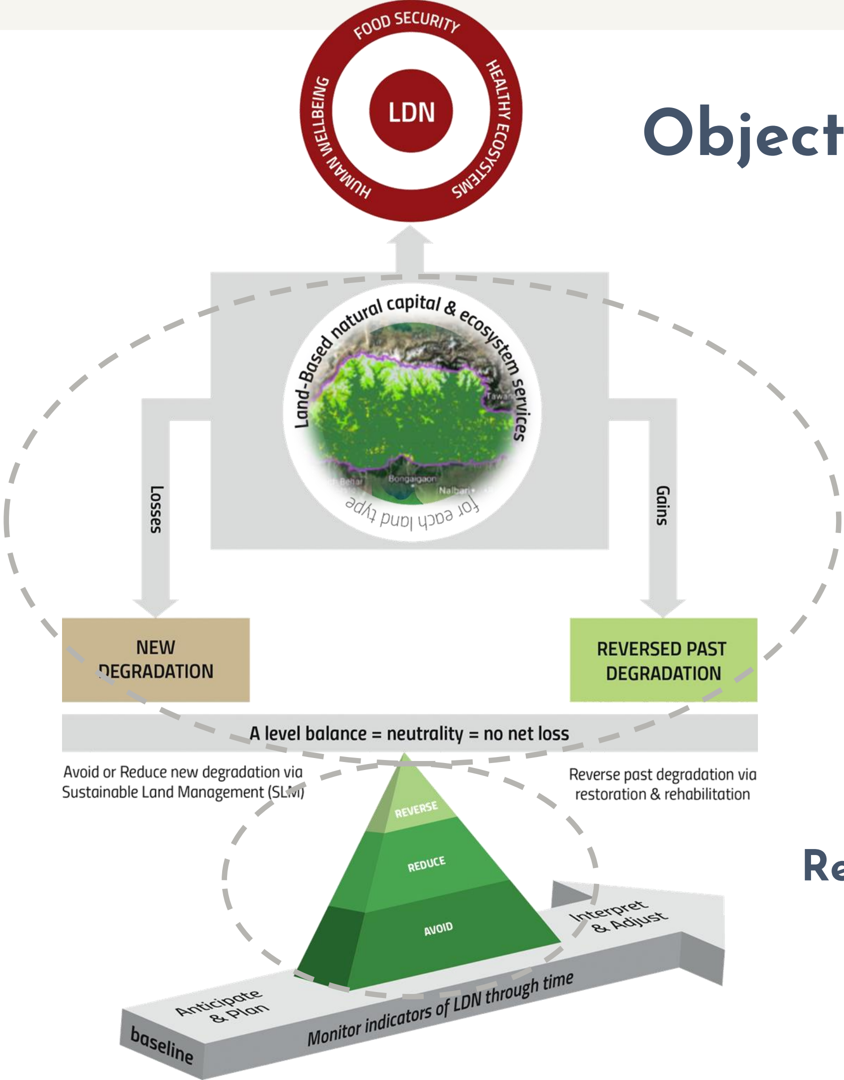
NEUTRALITY MECHANISM

To achieve LDN we need to focus on planning to counterbalance anticipated losses with planned gains, within unique land types



Cowie et al. 2018
https://doi.org/10.1016/j.envsci.2017.10.011

Objective: Achieve LDN



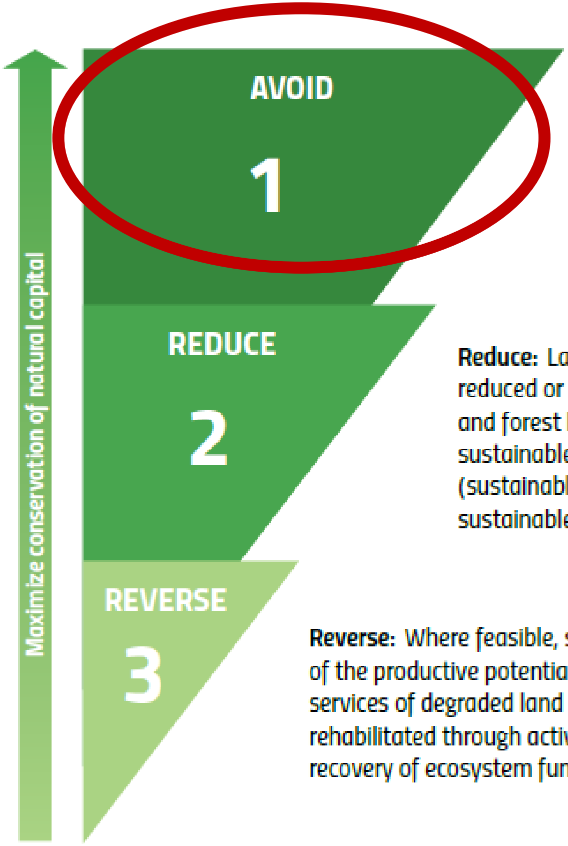
Neutrality Mechanism

Response Hierarchy

LDN RESPONSE HIERARCHY

In the LDN approach the focus is on avoiding land degradation as the most cost-effective way to maximize the conservation of natural capital.

Reversing land degradation is an important part of the solution but will not be enough if we continue degrading land.

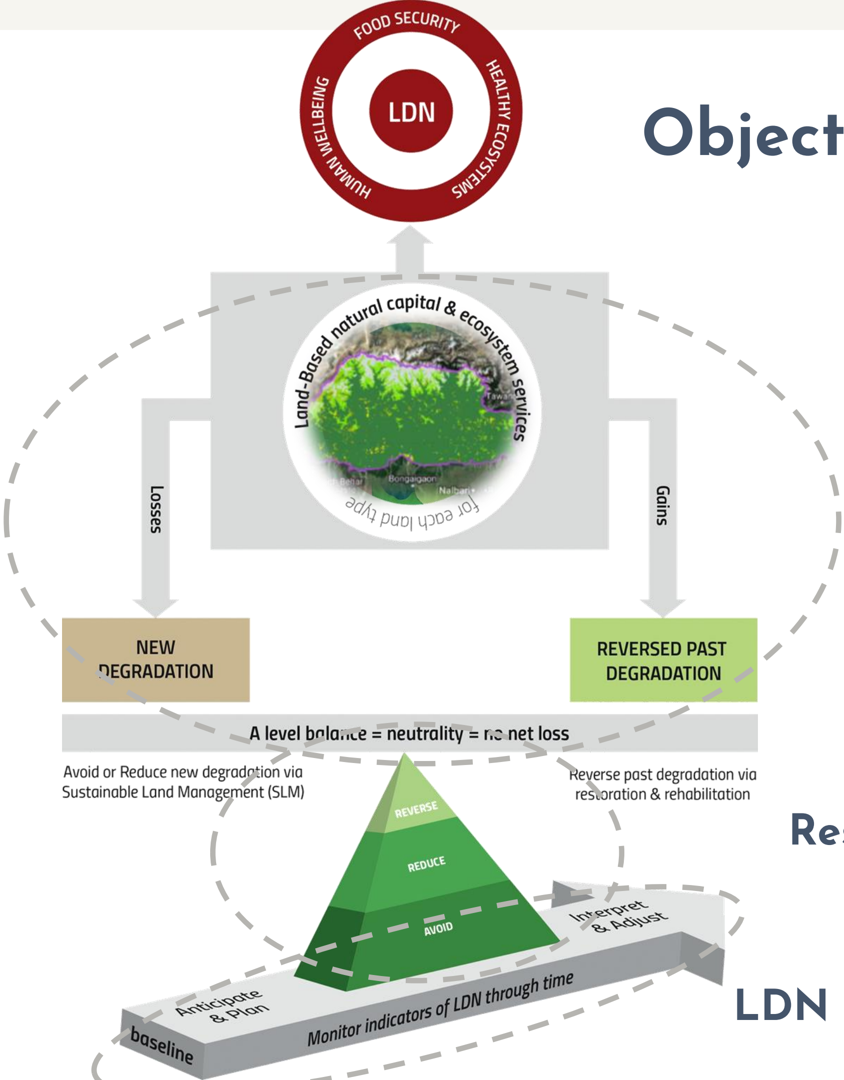


Avoid: Land degradation can be avoided by addressing drivers of degradation and through proactive measures to prevent adverse change in land quality of non-degraded land and confer resilience, via appropriate regulation, planning and management practices.

Reduce: Land degradation can be reduced or mitigated on agricultural and forest land through application of sustainable management practices (sustainable land management, sustainable forest management).

Reverse: Where feasible, some (but rarely all) of the productive potential and ecological services of degraded land can be restored or rehabilitated through actively assisting the recovery of ecosystem functions.

Objective: Achieve LDN

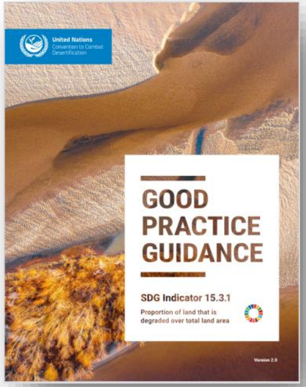


Neutrality Mechanism

Response Hierarchy

LDN Monitoring

SDG 15.3.1
PROPORTION OF LAND THAT IS DEGRADED



TRENDS IN LAND COVER

TRENDS IN LAND PRODUCTIVITY

TRENDS IN CARBON STOCKS

"While it is difficult for a single indicator to fully capture the state or condition of the land, the sub-indicators are ***proxies*** *to monitor the essential variables that reflect the capacity of the land to deliver ecosystem services"* Sims et al. 2021

Monitoring Framework for LDN

Process/response indicators at national and sub-national level

- Enabling policies
- Monitoring systems
- Enhanced capacities

Stress reduction/change in pressure indicators at the landscape scale

- Area of SLM adoption
- Area of restoration
- Alternative livelihood options

National LD indicators

- Soil erosion
- Soil pollution
- NRM-based incomes
- Gender equality

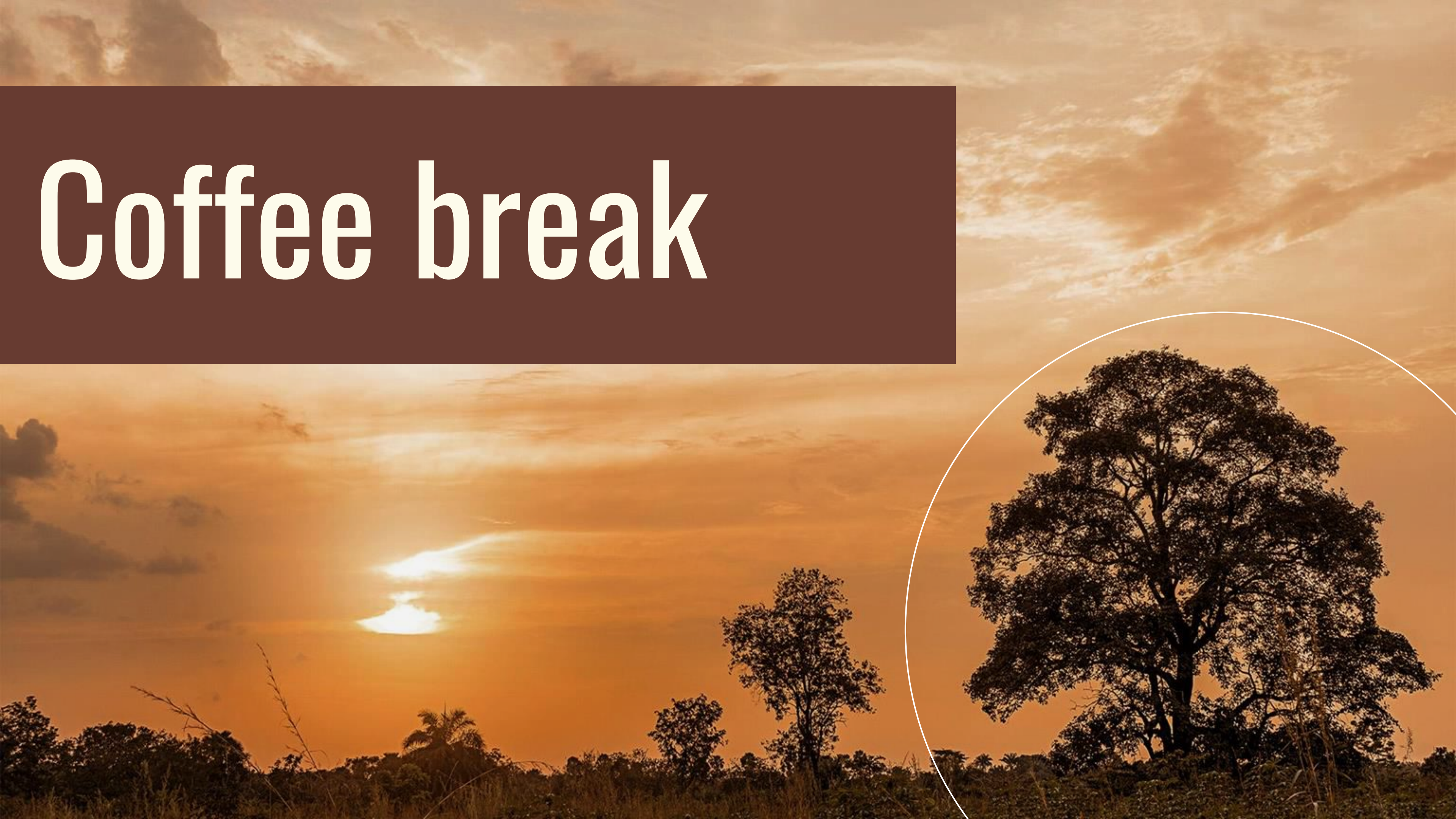
Change of state/impact indicators: global LDN indicators

- Land Cover change
- Trends in Land Productivity
- Trends in Carbon Stock

LDN reporting to the UNCCD

SDG 15.3.1
Proportion of land degraded
Gains and losses of productive land

Coffee break



NATIONAL PROCESSES FOR LDN IMPLEMENTATION

NATIONAL COMMITMENTS

In 2015, UNCCD Parties were invited to formulate **voluntary targets to achieve Land Degradation Neutrality** (LDN) in accordance with their specific national circumstances and development priorities. Countries also have their **National Action Plans (NAP)** to implement the UNCCD.

LDN PROJECTS

Countries use existing financing opportunities and partnerships (GEF, Adaptation Fund, MDB funding, etc) to implement the UNCCD and achieve national commitments such as the LDN targets

NATIONAL REPORTING

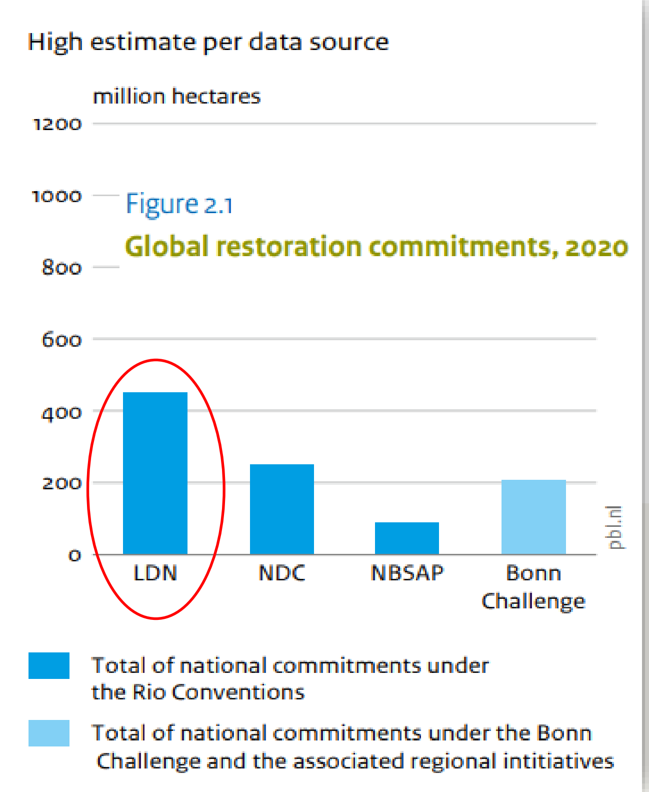
Parties are required to communicate reports, on measures undertaken to implement the Convention through the UNCCD Performance Review and Implementation System (PRAIS) every 4 years. Since 2018, the UNCCD reporting process has also contributed to follow up SDG 15.3

1 LDN TARGET SETTING

Land Degradation Neutrality Target Setting Programme

The Global Mechanism and the secretariat of the UNCCD established the Land Degradation Neutrality Target Setting Programme (LDN TSP) to assist countries to achieve LDN by 2030. Globally, this work has resulted in voluntary commitments to restore ***over 450 million hectares of degraded land***

- ***102 countries published their national LDN reports in the UNCCD website (https://www.unccd.int/our-work/country-profiles);***
- ***72 countries with high-level government adoption.***



source: https://www.pbl.nl/en/publications/goals-and-commitments-for-the-restoration-decade

2 LDN PROJECTS

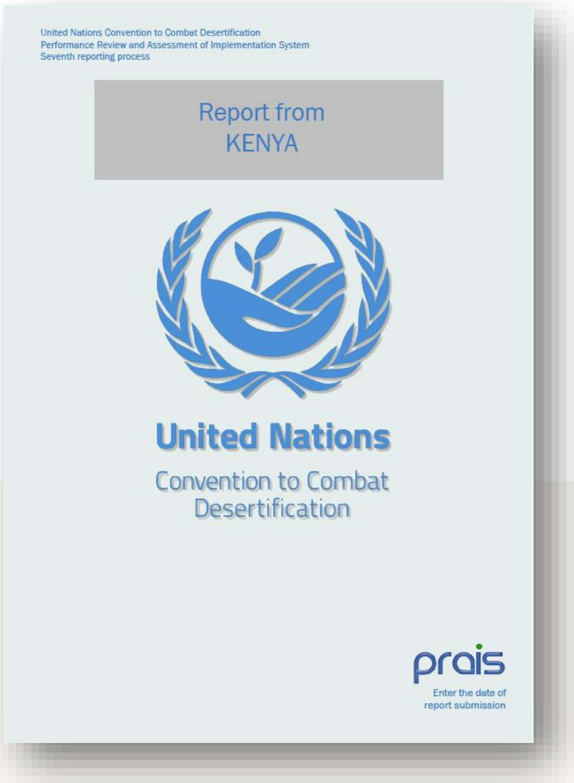
Many countries have on going projects related to LDN. Uncoordinated efforts usually represent a barrier for the optimization of investments. Many projects develop knowledge products and capacities for monitoring LDN. It is always important to make an effort to reach out and build on existing knowledge and create synergies.

CONTRIBUTING TO LAND DEGRADATION NEUTRALITY PROJECT UPPER SAKARYA BASIN

gef

For example: Within the GEF funded Turkiye LDN project a LDN decision support system was developed, which was upscaled to more than 30 countries. The results allowed an enhaced national reporting process.

3 NATIONAL REPORTING



- 1. Strategic objective 1: To improve the condition of affected ecosystems, combat desertification/ land degradation, promote sustainable land management and contribute to land degradation neutrality
  - 1.1. SO 1-1 – Trends in land cover
  - 1.2. SO 1-2 – Trends in land productivity
  - 1.3. SO 1-3 – Trends in carbon stocks above and below ground
  - 1.4. SO 1-4 – Proportion of land that is degraded over total land area (Sustainable Development Goal indicator 15.3.1)
- 2. Strategic objective 2: To improve the living conditions of affected populations
  - 2.1. SO 2-1 – Trends in population living below the relative poverty line and/or income inequality in affected areas
  - 2.2. SO 2-2 – Trends in access to safe drinking water in affected areas
  - 2.3. SO 2-3 – Trends in Population Exposure to Land Degradation Disaggregated by Sex
- 3. Strategic objective 3: To mitigate, adapt to, and manage the effects of drought in order to enhance resilience of vulnerable populations and ecosystems
  - 3.1. SO 3-1 – Trends in the proportion of land under drought over the total land area
  - 3.2. SO 3-2 – Trends in the proportion of the total population exposed to drought
  - 3.3. SO 3-3 – Trends in the degree of drought vulnerability
- 4. Strategic objective 4: To generate global environmental benefits through effective implementation of the United Nations Convention to Combat Desertification
  - 4.1. SO 4-1 – Trends in carbon stocks above and below ground
  - 4.2. SO 4-2 – Trends in abundance and distribution of selected species
  - 4.3. SO 4-3 Trends in protected area coverage of important biodiversity areas
- 5. Strategic objective 5: To mobilize substantial and additional financial and non-financial resources to support the implementation of the Convention by building effective partnerships at global and national level

https://prais4-reporting-manual.readthedocs.io/en/latest/index.html

… goes on

PRAIS 3 REPORT: 2000-2015 (Baseline)


United Nations Convention to Combat Desertification
Performance Review and Assessment of Implementation System
Seventh reporting process

Report from BHUTAN

United Nations
Convention to Combat Desertification

prais
Enter the date of report submission

Strategic objectives

Strategic objective 1: To improve the condition of affected ecosystems, combat desertification/land degradation, promote sustainable land management and contribute to land degradation neutrality

SO1 Proportion of land that is degraded over total land area (Sustainable Development Goal indicator 15.3.1)

Proportion of land that is degraded

Indicate the total area of land that is degraded (in km²), and the proportion of degraded land relative to the total land area (defined as the total surface area of a country less the area covered by inland waters, like major rivers and lakes), and the year.

Total area of degraded land (Km²)	Proportion of degraded land	Year
3.723	9,9	2000-2015

Method

Did you use the 3 sub-indicators (i.e. land cover, land productivity dynamics and soil organic carbon stock) to compute the proportion of land that is degraded?

- [x] yes
- [ ] only 2
- [ ] only 1
- [ ] no

Did you apply the One Out, All Out principle to compute the proportion of land that is degraded?

- [x] yes
- [ ] no

If no, indicate the method used to assess the proportion of land that is degraded

The source of data is Global Data and the area of degraded land is as calculated by the data provider. We

Level of confidence

Indicate your country's level of confidence in the assessment of the proportion of land that is degraded:

- [ ] High (Based on comprehensive evidence)
- [x] Medium (Based on partial evidence)
- [ ] Low (Based on limited evidence)

Describe why the assessment has been given the level of confidence selected above:

PRAIS 4 REPORT: 2000-2015 (Baseline) and 2015-2019 (Reporting Period)

United Nations Convention to Combat Desertification
Performance review and assessment of implementation system
Seventh reporting process

Report from Bhutan

United Nations
Convention to Combat Desertification

prais 4

This report has been submitted by the government of Bhutan to the United Nations Convention to Combat Desertification (UNCCD).
The designations employed and the presentation of material in this report do not imply the expression of any opinion whatsoever on the part of the UNCCD concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

prais 4

4 March 2023

SO1-4.T1: National estimates of the total area of degraded land (in km²), and the proportion of degraded land relative to the total land area

	Total area of degraded land (km²)	Proportion of degraded land over the total land area (%)
Baseline Period	4 607 .57	11 .9
Reporting Period	5 227 .4	13 .5
Change in degraded extent	619.83	

WORKING SESSION 1:

Exploring a country UNCCD profile

01 **GO TO UNCCD website** and SEARCH FOR A COUNTRY

02 **DOES IT HAVE LDN TARGETS? Briefly look at the TSP report, what does it contain?**

03 **Does it have a National Action Plan? What information is in it?**

04 **Did the country report to UNCCD in 2022/3 (PRAIS4)? What is the proportion of land degraded in the baseline and reporting periods?**

Lunch

WE NEED RELIABLE MAPS OF LAND DEGRADATION

MAPPING LAND DEGRADATION

Prioritize areas for interventions

Decide what to do where
(informed decision making)

Support Land Use Planning processes

Establish and refine national targets and commitments

Optimize investments by finding synergies among UN conventions and SDGs

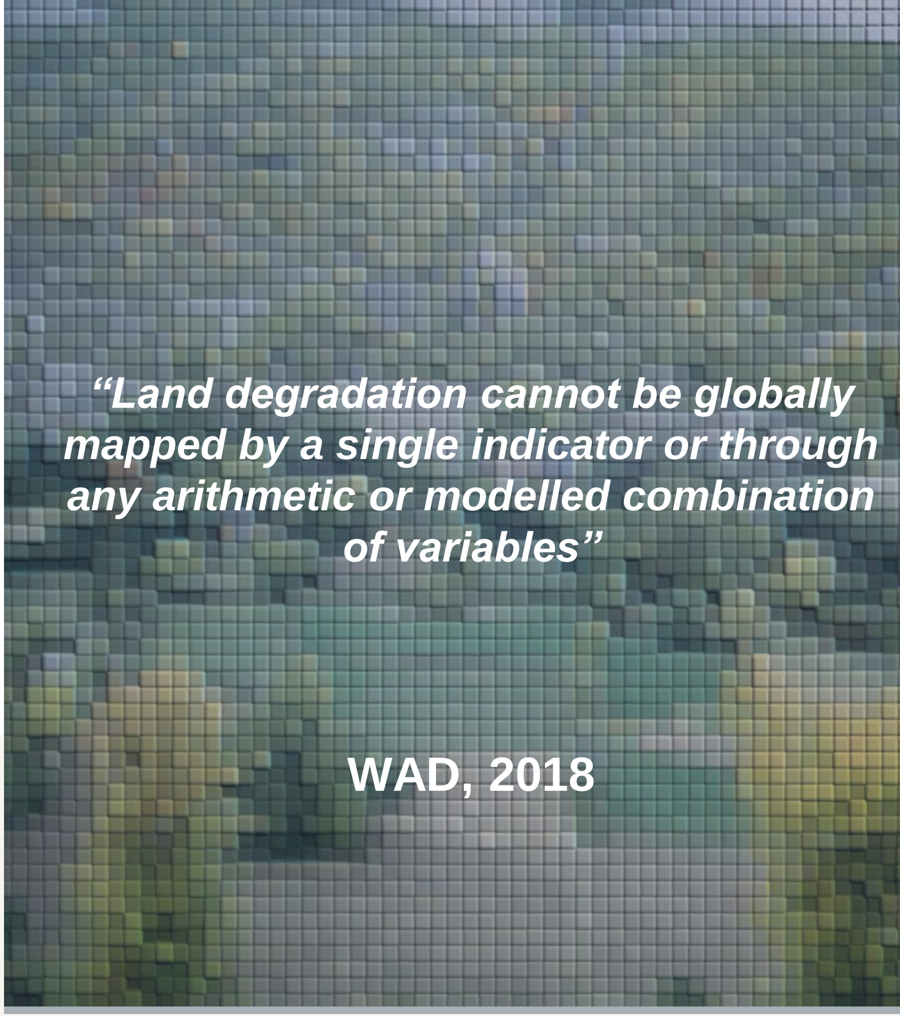
Monitor progress towards LAND DEGRADATION NEUTRALITY (LDN)

Report to UNCCD

MAPPING LAND DEGRADATION IS NOT EASY

Causes, processes and impacts of LD change over space and time

Estimations need to make sense across scales




I don’t think so
Clearly YES
Well, it depends..

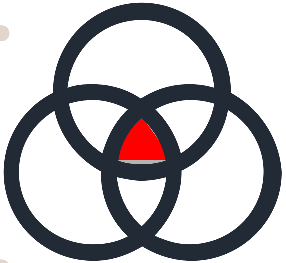
CONVERGENCE OF EVIDENCE

Accumulated evidence that certain core issues related to land degradation currently co-exist at a given location

Convergence of evidence:
Relevant for many SDGs

FIRES, IRRIGATION, LIVESTOCK DENSITY

Underlying pressures that increase degradation vulnerability



SOILS

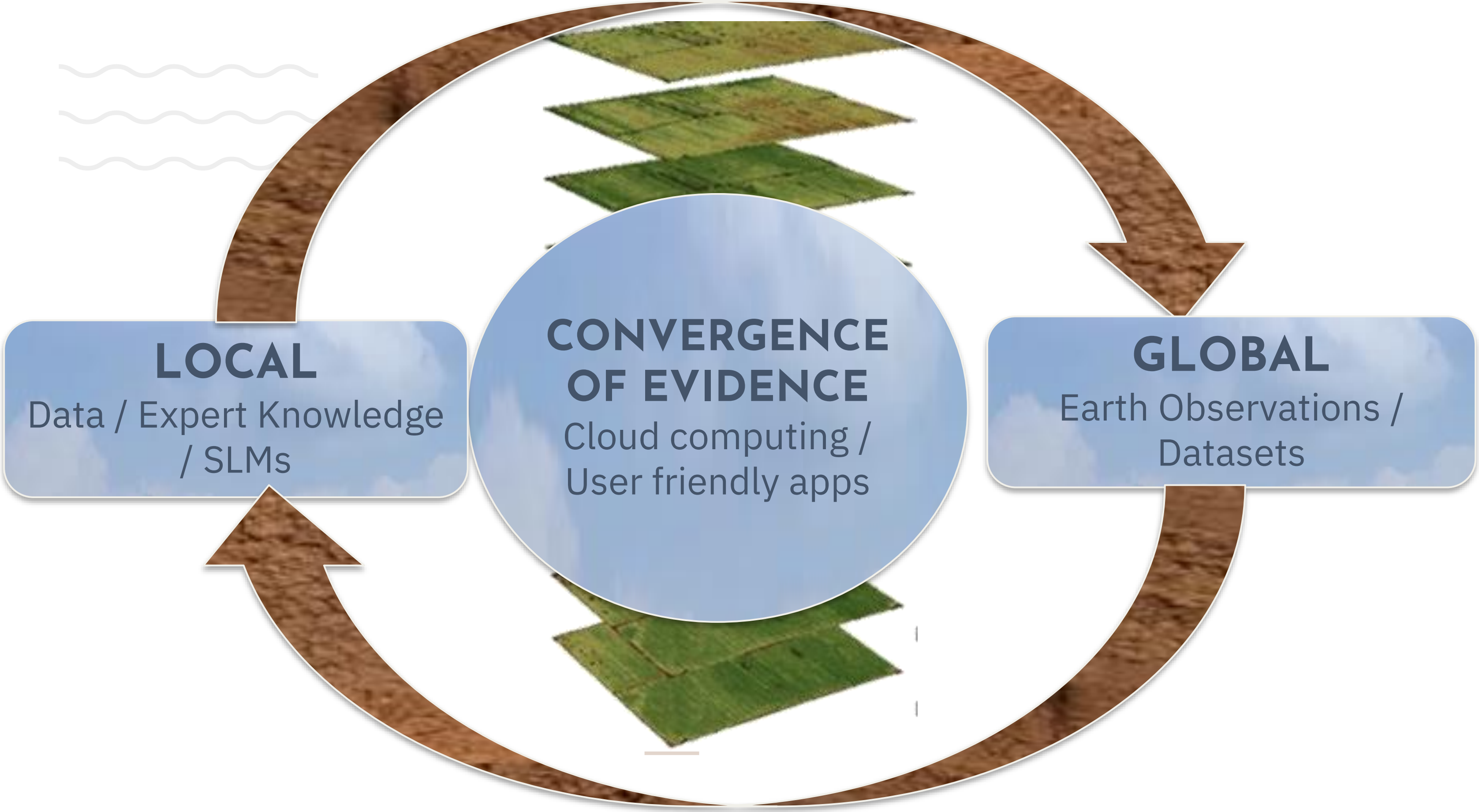
Soil texture, topography, erosion rate, risk, etc

TRENDS IN RAINFALL, ARIDITY, SPI

Climate induced changes

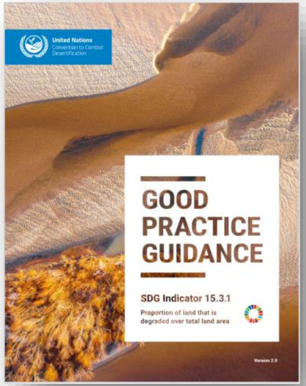
KEY BIODIVERSITY AREAS & PROTECTED AREAS

Biodiversity loss, Kunming-Montreal Global biodiversity framework targets



The most likely explanation (hypothesis, inference, explanation, conclusion or best guess) about the status of LD at a given location that can be updated / improved with additional local information

SDG 15.3.1
PROPORTION OF LAND THAT IS DEGRADED



TRENDS IN LAND COVER

TRENDS IN LAND PRODUCTIVITY

TRENDS IN CARBON STOCKS

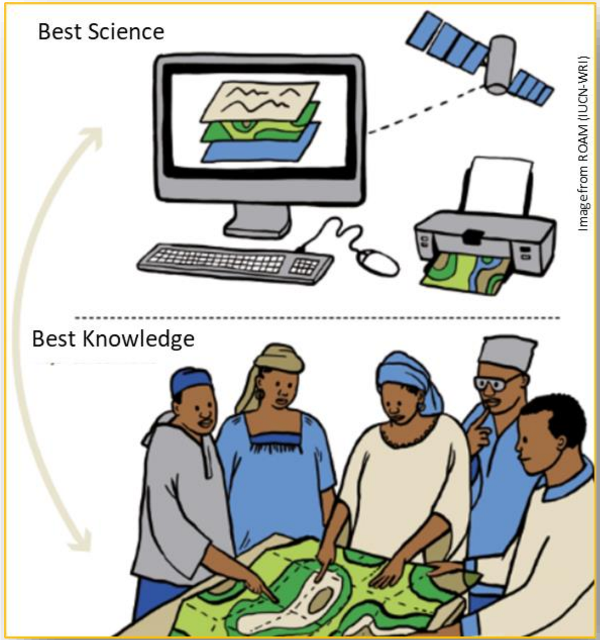
*“While it is difficult for a single indicator to fully capture the state or condition of the land, the sub-indicators are **proxies** to monitor the essential variables that reflect the capacity of the land to deliver ecosystem services”* Sims et al. 2021

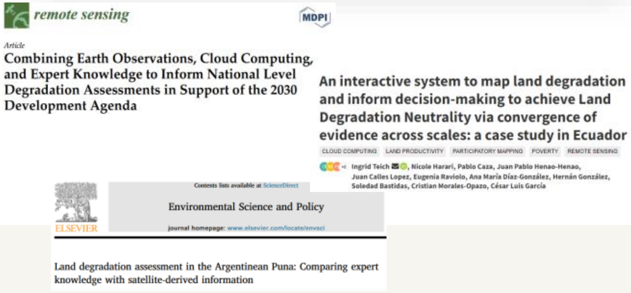
PARTICIPATORY PROCESSES FOR INFORMED DECISION MAKING

Relevant and reliable **maps of land degradation** are a basic input for prioritizing areas of intervention, optimizing resources, reporting to UNCCD and ILUP processes.

Mapping LD is not easy and countries are struggling to develop maps that make sense across scales and monitor LDN. Moreover, their use in decision making process is very limited.

PARTICIPATORY PROCESSES TO MAP LD




remote sensing
MDPI
Article
Combining Earth Observations, Cloud Computing, and Expert Knowledge to Inform National Level Degradation Assessments in Support of the 2030 Development Agenda

An interactive system to map land degradation and inform decision-making to achieve Land Degradation Neutrality via convergence of evidence across scales: a case study in Ecuador
CLOUD COMPUTING | LAND PRODUCTIVITY | PARTICIPATORY MAPPING | POVERTY | REMOTE SENSING
Ingrid Teich, Nicole Harari, Pablo Caza, Juan Pablo Henao-Henao, Juan Calles Lopez, Eugenia Raviolo, Ana María Díaz-González, Hernán González, Soledad Bastidas, Cristian Morales-Opazo, César Luis García

Contents lists available at ScienceDirect
ELSEVIER
Environmental Science and Policy
journal homepage: www.elsevier.com/locate/envsci
Land degradation assessment in the Argentinean Puna: Comparing expert knowledge with satellite-derived information

a) allow for an inclusive, participatory, inter-institutional, multi-stakeholder process versus an individual/consultant-based reporting process;

b) develop long-term capacities for LDN within the Ministries, using the reporting process as an opportunity and momentum; and

c) develop a country-owned system useful beyond the reporting process to guide decisions in land management and restoration overall, also in relation to the climate and biodiversity targets.

PARTICIPATORY PROCESSES TO MAP LD

The maps resulting from the participatory process and SDG 15.3.1 estimations obtained reflected the estimations that the national and local experts considered appropriate.

Estimations of LD were always higher than the ones estimated by global and default datasets.

These results contributed to more accurate estimations at global level but also resulted in relevant maps of LD that the countries then use to develop national SLM/LDN strategies and prioritize intervention sites.

GENERAL APPROACH

Each country was a different process, but in all cases the process consisted of participatory workshops with diverse stakeholders that were NOT necessarily GIS experts and GEE apps were used to support the discussions

Panama

Colombia

Turkiye

Bhutan

Ecuador

Bosnia and Herzegovina

PARTICIPATORY WORKSHOPS

One day per sub-indicator

- *presentation of the theoretical background*
- *discussion in groups using the pre-processed data and tools*
- *comparison and reflection on results*

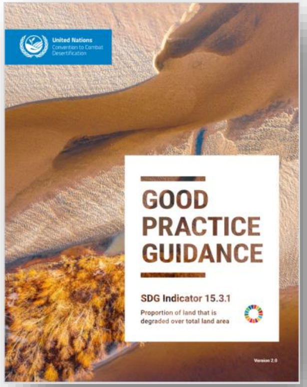
Stakeholders from different institutions and backgrounds

- ***representatives of different regions***
- ***work groups per region/sector***
- ***gender balanced and as representative as possible***
- ***Knowledge of the field and degradation processes (not GIS experts)***

Focussed on discussions and decision making

- ***Tools were not the point of the discussions***
- ***A process for enhancing the enabling environment: capacity development, cooperation and coordination, raising awareness***

SDG 15.3.1
PROPORTION OF LAND THAT IS DEGRADED



TRENDS IN LAND COVER

TRENDS IN LAND PRODUCTIVITY

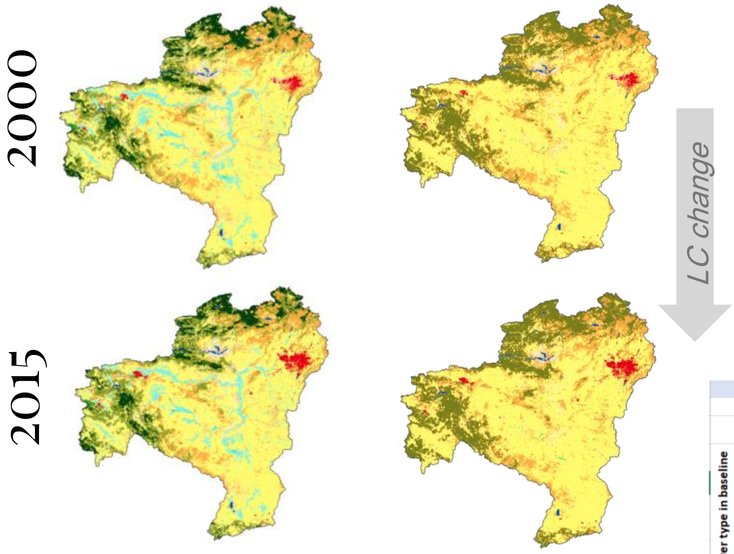
TRENDS IN CARBON STOCKS

"While it is difficult for a single indicator to fully capture the state or condition of the land, the sub-indicators are ***proxies*** *to monitor the essential variables that reflect the capacity of the land to deliver ecosystem services"* Sims et al. 2021

TRENDS IN LAND COVER

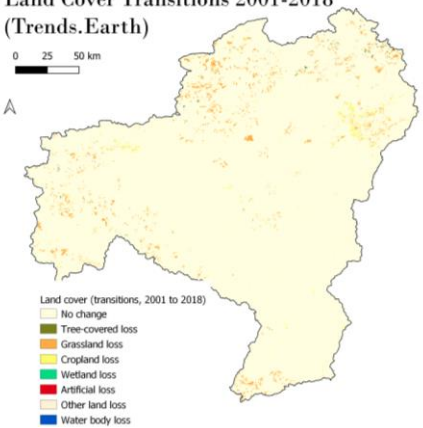
LC data → Transitional Analysis → LC degradation map

37 ESA categories — *Regrouping* → 7 UNCCD cat



Default data set: The **European Space Agency** (ESA) Climate Change Initiative Land Cover (ESA CCI-LC) **300m dataset**

Land Cover Transitions 2001-2018 (Trends.Earth)



Land area by type of land cover transition (sq. km)

Land cover type in baseline year (2001)	Land cover type in target year (2018): Tree-cover	Grasslands	Croplands	Wetlands	Artificial	Other lands	Water bodies	*Total:*
Tree-cover	8,697	48	4	0	4	1	1	*8,755*
Grasslands	806	9,097	58	0	102	6	11	*10,081*
Croplands	50	40	28,595	0	203	12	5	*28,905*
Wetlands	0	0	0	28	0	0	0	*28*
Artificial	0	0	0	0	362	0	0	*362*
Other lands	11	1	56	0	98	780	1	*947*
Water bodies	0	0	0	0	0	0	204	*205*
Total:	*9,565*	*9,186*	*28,713*	*28*	*769*	*799*	*222*	***49,282***

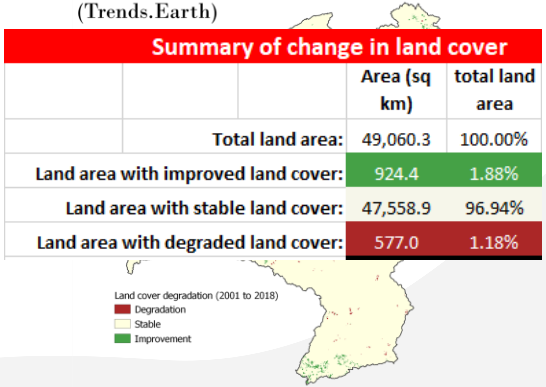
Land cover in target year

Land cover in baseline year	Forest	Grassland*	Cropland	Wetland	Artificial area	Bare land	Water body
Forest	0	-	-	-	-	-	0
Grassland*	+	0	+	-	-	-	0
Cropland	+	-	0	-	-	-	0
Wetland	-	-	-	0	-	-	0
Artificial area	+	+	+	+	0	+	0
Bare land	+	+	+	+	-	0	0
Water body	0	0	0	0	0	0	0

Legend: Degradation (-) · Stable (0) · Improvement (+)

Land Cover Degradation 2001-2018 (Trends.Earth)

Summary of change in land cover	Area (sq km)	total land area
Total land area:	49,060.3	100.00%
Land area with improved land cover:	924.4	1.88%
Land area with stable land cover:	47,558.9	96.94%
Land area with degraded land cover:	577.0	1.18%



TRENDS IN LAND COVER

01 **CHOOSE BEST AVAILABLE DATA**
National, ESA, CORINE, etc

02 **SELECT A LEGEND**
That allows monitoring of key degradation processes

03 **TRANSITION MATRIX**
Changes lead to degradation, improvement or are neutral

04 **VALIDATE**
Field validation, error adjusted area estimates

01

Best available Land cover data

DEFAULT DATA

Default data derived from the ESA CCI-LC dataset v. 2.0.7, 2017.

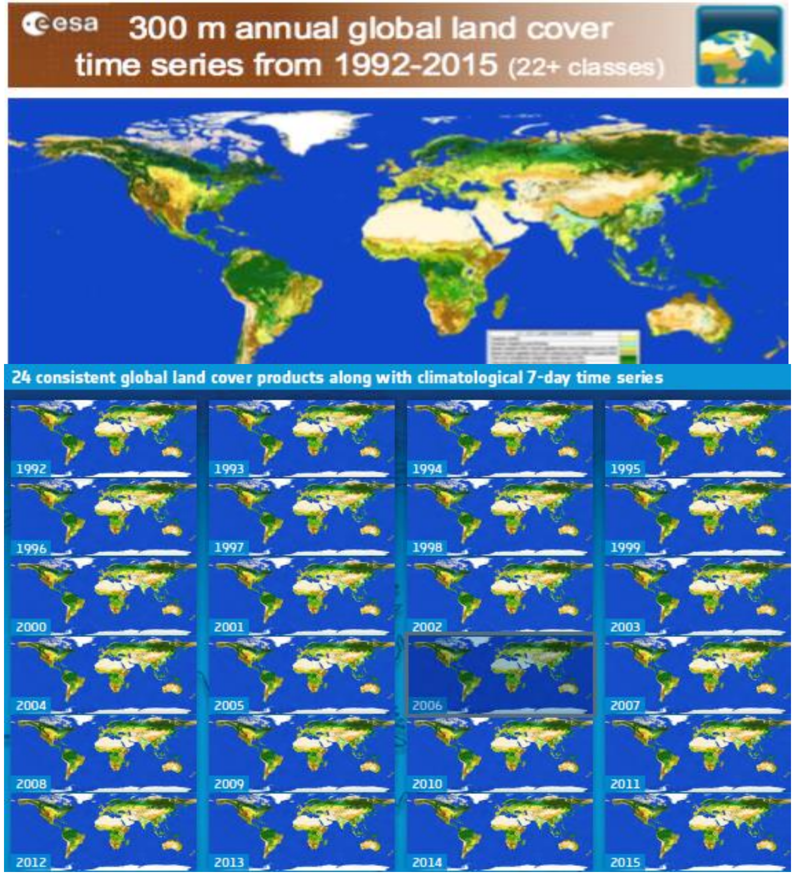
(http://www.esa-landcover-cci.org/):

- Global Coverage - harmonized
- Spatial resolution: 300m
- Based on moderate resolution satellite data
  (ENVISAT MERIS, MODIS, SPOT VGT and PROBA-V)

Maps updated to 2019 for PRAIS4

Access:

http://maps.elie.ucl.ac.be/CCI/viewer/index.php



United Nations Convention to Combat Desertification

prais4

The default UNCCD land cover legend for SDG indicator 15.3.1 is a modified version of the Intergovernmental Panel on Climate Change (IPCC) six land use categories, wherein this modified version, 'water bodies' are separated from 'wetlands' and grouped in a seventh class

SDG Indicator 15.3.1	European Space Agency Climate Change Initiative Land Cover
Tree-covered areas	Tree cover, broadleaved, evergreen, closed to open (>15%)
	Tree cover, broadleaved, deciduous, closed to open (>15%)
	Tree cover, broadleaved, deciduous, closed (>40%)
	Tree cover, broadleaved, deciduous, open (15–40%)
	Tree cover, needle leaved, evergreen, closed to open (>15%)
	Tree cover, needle leaved, evergreen, closed (>40%)
	Tree cover, needle leaved, evergreen, open (15–40%)
	Tree cover, needle leaved, deciduous, closed to open (>15%)
	Tree cover, needle leaved, deciduous, closed (> 40%)
	Tree cover, needle leaved, deciduous, open (15–40%)
	Tree cover, mixed leaf type (broadleaved and needle leaved)
	Mosaic tree and shrub (>50%)/herbaceous cover (< 50%)
Wetland	Tree cover, aquatic or regularly flooded in fresh or brackish water
	Tree cover, aquatic, regularly flooded in salt or brackish water, mangroves
	Shrub or herbaceous cover, flooded, fresh/brackish water
Grassland	Mosaic herbaceous cover (>50%)/tree and shrub (<50%)
	Grassland
	Shrubland
	Shrubland evergreen
	Shrubland deciduous
	Lichen and mosses
	Sparse trees (<15%)
	Sparse shrub (<15%)
	Sparse herbaceous cover (<15%)
Cropland	Cropland, rainfed
	Herbaceous cover
	Tree or shrub cover
	Cropland, irrigated or post-flooding
	Mosaic cropland (>50%)/natural vegetation (tree, shrub, herbaceous cover) (<50%)
	Mosaic natural vegetation (tree, shrub, herbaceous cover) (>50%)/cropland (< 50%)
Artificial surfaces	Urban areas
Other land	Bare areas
	Consolidated bare areas
	Unconsolidated bare areas
	Permanent snow and ice
Water bodies	Water bodies

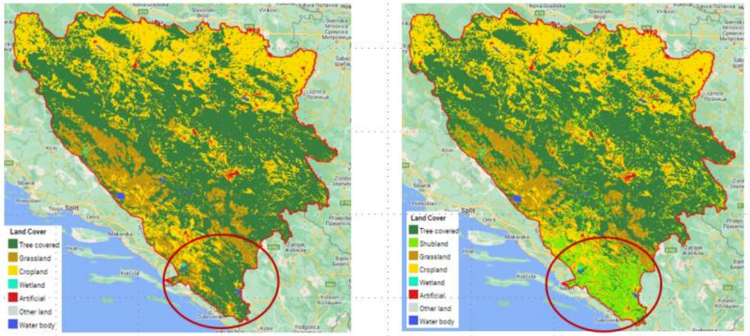
01

Best available Land cover data

	Data
Panama	National data – 2000, 2012, 2020
Colombia	National data -2001, 2012, 2019
Ecuador	National data - 2000, 2014, 2018
Bosnia and Herzegovina	Default (ESA CCI) reclassified
Turkey	Regional data (CORINE) – 2000, 2012, 2018
Bhutan	Default (ESA CCI) reclassified

Use of default data can be improved by a more in depth analysis and reclassification. BiH, for example, identified shrublands as a separate category. This is an important and particular Mediterranean ecosystem that is also a hotspot of degradation.

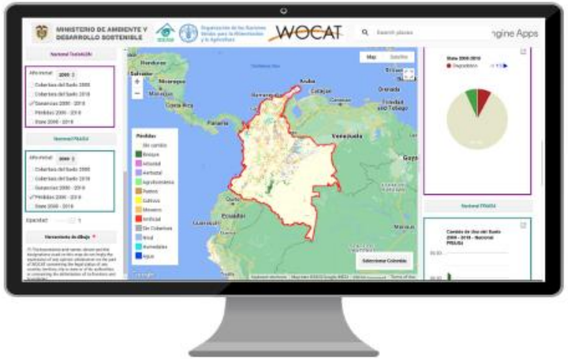
Bosnia and Herzegovina
Default data, with shrublands



01 Best available Land cover data

Land Cover Transition Analysis Apps

These apps allow users to compare alternative land cover datasets and re-categorizations as well as alternative land cover transition matrixes. With just a few clicks the transitions for different periods can be explored, as well as the final degradation due to land cover change maps (SO1-1). Statistics at different spatial scales, and for different periods, as well as resulting maps are easily obtained. For example, Bhutan experts used the app to compare alternative re-classifications of ESA CCI Land cover National, and alternative global land cover maps. Colombia compared alternative reclassifications of their national land cover maps.



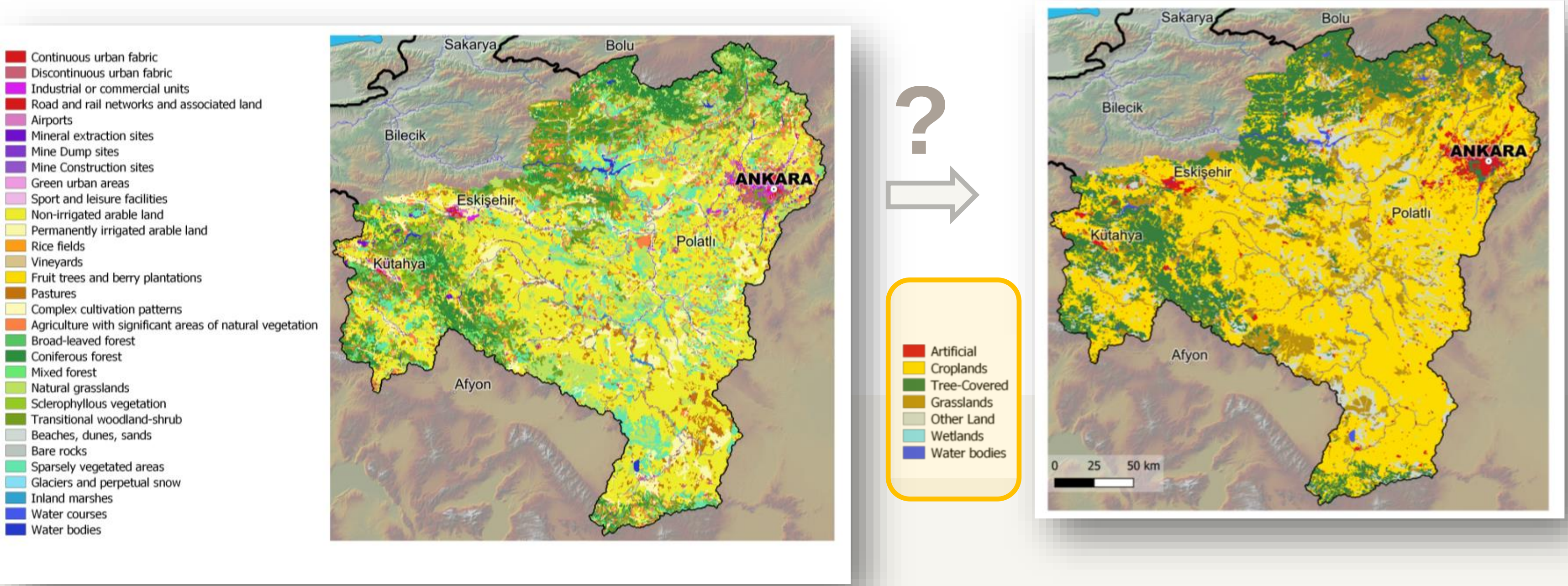
Colombia Land Cover Transitions Tool - Co-developed with IDEAM and the Ministry of Environment for PRAIS4 National Report. Languages: Spanish and English.

Bhutan Land Cover Transitions Tool - Co-developed with the National Soil Services Centre during PRAIS4 National Reporting. Languages: English

Panama tool to compare Degrdation due to Land Cover transitions using national data and expert knowledge. Languages: Spanish and English.

https://www.wocat.net/en/ldn/wocatapps/

In Turkiye re-classification of CORINE data was not easy



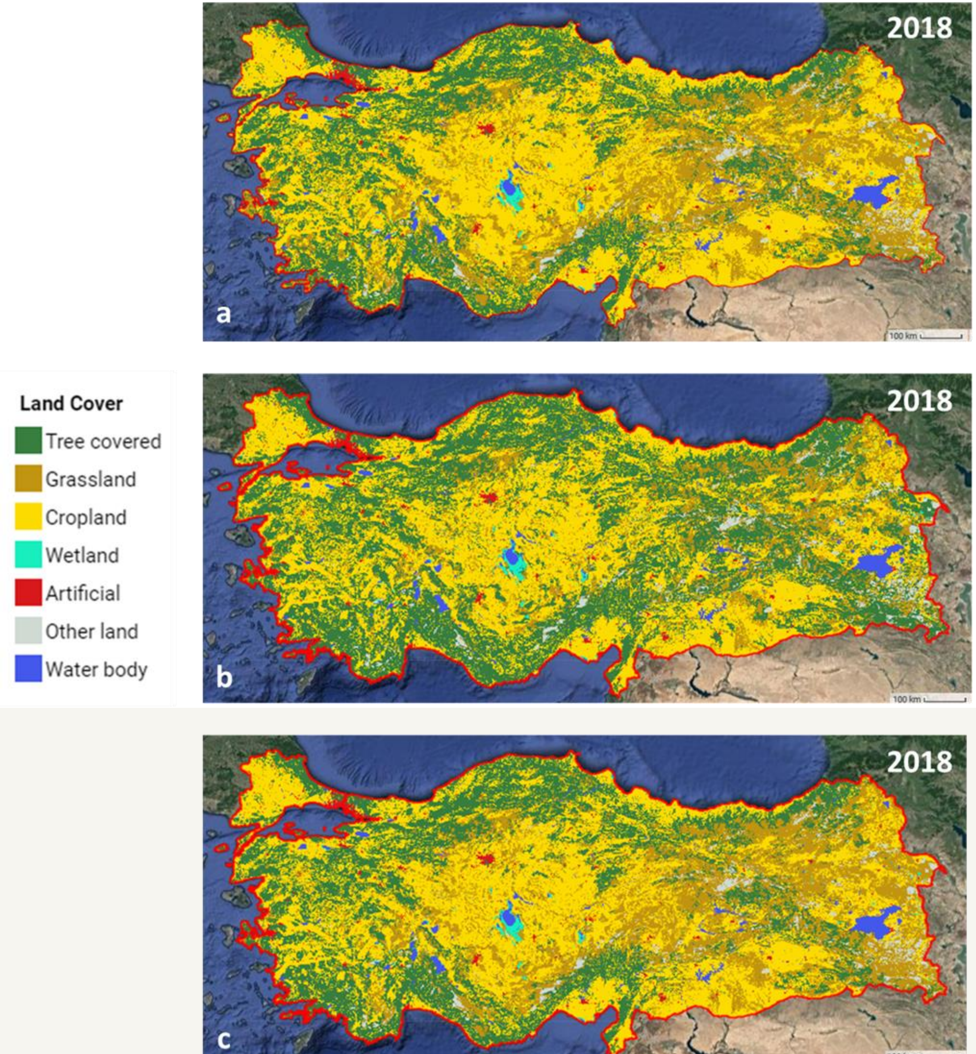
Re-classification of CORINE data was not easy

- *CORINE classes 3.2.3 (Sclerophyllous vegetation) and 3.2.4 (transitional woodland/shrubs) could be reclassified either as grasslands or as tree covered areas.*

- *A detailed analysis of **alternative re-classifications** of CORINE land cover classes was undertaken, including the use of specific **GEE App for land cover transitions**.*

- *The **official national estimates** of forest area and agricultural land were considered in the analysis to contribute to the alignment of the results with national statistics.*

- *A **field trip** to validate the land cover transition maps in the Türkiye LDN Decision Support System contributed to identify the best reclassification of the CORINE land cover classes into the 7 UNCCD classes. In the field trip, 30 sites were visited in the Central Anatolia Region*



SAME data
DIFFERENT Re-classifications

Different re-classifications of CORINE Land cover 2018 were compared in Türkiye during the LDN project:

(a) default re-classification,
(b) Türkiye re-classification;
(c) Türkiye adjusted re-classification, the one that was finally used.

02

LD processes and legend

Which are the main processes of Land Degradation in your country that originate from a change in land cover?

Degradation Process	Starting Land Cover	Ending Land Cover
+ Add Record		

Are the seven UNCCD land cover classes sufficient to monitor the key degradation processes in your country?

- (●) Yes
- ( ) No

02 LD processes and legend

Discussion of LD processes due to LC changes in BiH

Land cover legend and transition matrix

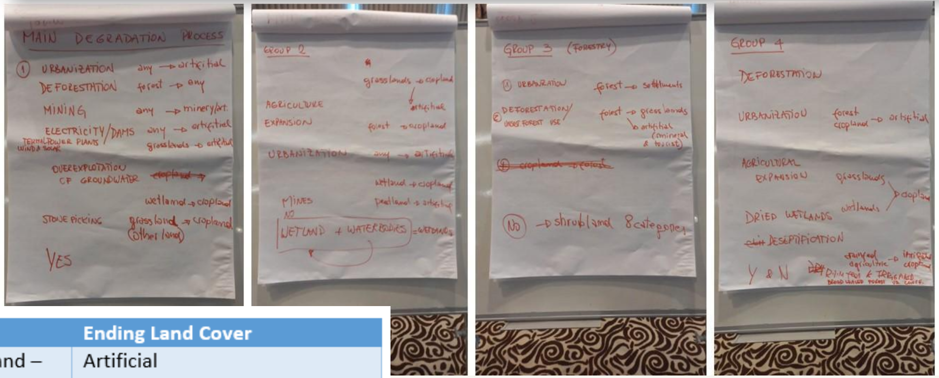
State the key degradation processes relevant in your country, define a land cover legend that allows for their monitoring, and generate a transition matrix that specifies land cover changes as being either degradation, improvement or neutral transitions.

SO1-1.T2: Key Degradation Processes

State the key degradation processes relevant in your country and the corresponding land cover transitions.

Degradation Process	Starting Land Cover	Ending Land Cover

Are the seven UNCCD land cover classes sufficient to monitor the key degradation processes in your country?



Results by groups in Turkiye LC transitions workshop

Degradation Process	Starting Land Cover	Ending Land Cover
URBANIZATION	Cropland – Forest – Wetland – Grassland - Other Land	Artificial
AGRICULTURAL EXPANSION	Wetland, Grassland, Forest	Cropland
DEFORESTATION	Forest	Cropland, Artificial, Grassland, wetland, other land
MINING	Cropland – Forest – Wetland – Grassland - Other Land	Artificial

02

LD processes and legend

	Legends
Panama	9 categories - manglar and rastrojo
Colombia	12 categories - mosaics, agroforestry, snow and glaciars
Ecuador	7 categories
Bosnia and Herzegovina	8 categories with shrublands
Turkey	7 categories
Bhutan	7 categories with Shrublands and no wetlands

Bhutan alternative re classification of default data

ID Original	Original	Color		Default Category		BTN Category
0	No Data		0			
10	Cropland, rainfed		3	Cropland	4	Cropland
11	Herbaceous cover		3	Cropland	4	Cropland
12	Tree or shrub cover		3	Cropland	2	Shrubland
20	Cropland, irrigated or post-flooding		3	Cropland	4	Cropland
30	Mosaic cropland (>50%) / natural vegetation (tree, shrub, herbaceous cover) (<50%)		3	Cropland	4	Cropland
40	Mosaic natural vegetation (tree, shrub, herbaceous cover) (>50%) / cropland (<50%)		3	Cropland	2	Shrubland
50	Tree cover, broadleaved, evergreen, closed to open (>15%)		1	Forest	1	Forest
60	Tree cover, broadleaved, deciduous, closed to open (>15%)		1	Forest	1	Forest
61	Tree cover, broadleaved, deciduous, closed (>40%)		1	Forest	1	Forest
62	Tree cover, broadleaved, deciduous, open (15-40%)		1	Forest	1	Forest
70	Tree cover, needleleaved, evergreen, closed to open (>15%)		1	Forest	1	Forest
71	Tree cover, needleleaved, evergreen, closed (>40%)		1	Forest	1	Forest
72	Tree cover, needleleaved, evergreen, open (15-40%)		1	Forest	1	Forest
80	Tree cover, needleleaved, deciduous, closed to open (>15%)		1	Forest	1	Forest
81	Tree cover, needleleaved, deciduous, closed (>40%)		1	Forest	1	Forest
82	Tree cover, needleleaved, deciduous, open (15-40%)		1	Forest	1	Forest
90	Tree cover, mixed leaf type (broadleaved and needleleaved)		1	Forest	1	Forest
100	Mosaic tree and shrub (>50%) / herbaceous cover (<50%)		1	Forest	2	Shrubland
110	Mosaic herbaceous cover (>50%) / tree and shrub (<50%)		2	Grassland	3	Grassland
120	Shrubland		2	Grassland	2	Shrubland
121	Evergreen shrubland		2	Grassland	2	Shrubland
122	Deciduous shrubland		2	Grassland	2	Shrubland
130	Grassland		2	Grassland	3	Grassland
140	Lichens and mosses		2	Grassland	3	Grassland
150	Sparse vegetation (tree, shrub, herbaceous cover) (<15%)		2	Grassland	3	Grassland
152	Sparse shrub (<15%)		2	Grassland	3	Grassland
153	Sparse herbaceous cover (<15%)		2	Grassland	3	Grassland
160	Tree cover, flooded, fresh or brakish water		4	Wetland	5	Wetland
170	Tree cover, flooded, saline water		4	Wetland	5	Wetland
180	Shrub or herbaceous cover, flooded, fresh/saline/brakish water		4	Wetland	5	Wetland
190	Urban areas		5	Artificial	6	Artificial
200	Bare areas		6	BareLand	7	BareLand
201	Consolidated bare areas		6	BareLand	7	BareLand
202	Unconsolidated bare areas		6	BareLand	7	BareLand
210	Water bodies		7	WaterBody	8	WaterBody
220	Permanent snow and ice		6	BareLand	7	BareLand

03 Transition matrix

"National decisions about which land cover transitions are linked to a degradation process should be made in a participatory, transparent and deliberate way through a multi-stakeholder consultation process"

Final Class (columns) / **Original Class** (rows)

IPCC Class	Forest Land	Grassland	Cropland	Wetlands	Settlements	Other Land
Forest Land	Stable	Vegetation loss	Deforestation	Inundation	Deforestation	Vegetation loss
Grassland	Afforestation	Stable	Agricultural expansion	Inundation	Urban expansion	Vegetation loss
Cropland	Afforestation	Withdrawal of Agriculture	Stable	Inundation	Urban expansion	Vegetation loss
Wetlands	Woody Encroachment	Wetland drainage	Wetland drainage	Stable	Wetland drainage	Wetland drainage
Settlements	Afforestation	Vegetation establishment	Agricultural expansion	Wetland establishment	Stable	Withdrawal of Settlements
Other Land	Afforestation	Vegetation establishment	Agricultural expansion	Wetland establishment	Urban expansion	Stable

Original class (rows)

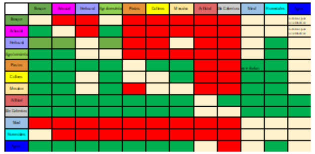
			Native forest	Exotic forest	Native grassland	Improved pasture	Managed parkland	Plantation	Cereals	Horticulture	Wetland – permanent	Wetland – ephemeral	Coastal wetland	Settlements	Other Land
			Forest		Grassland			Cropland			Wetlands				
Original class	Forest	Native forest	S	D	D	D	D	D	D	D	D	D	D	D	D
		Exotic forest	I	S	NC	D	NC	NC	NC	NC	I	I	I	D	D
	Grassland	Native grassland	I	NC	S	D	D	D	D	D	I	D	D	D	D
		Improved pasture	I	I	I	S	NC	I	NC	NC	I	NC	I	D	D
		Managed parkland	I	NC	I	NC	S	NC	NC	NC	I	I	I	D	D
	Cropland	Plantation	I	NC	I	D	NC	S	NC	NC	I	NC	I	D	D
		Cereals	I	NC	I	NC	NC	NC	S	NC	I	I	I	D	D
		Horticulture	I	NC	I	NC	NC	NC	NC	S	I	NC	I	D	D
	Wetlands	Wetland – permanent	I	D	D	D	D	D	D	D	S	D	NC	D	D
		Wetland – ephemeral	I	D	I	NC	D	NC	D	NC	I	S	NC	D	D
		Coastal wetland	I	D	I	D	D	D	D	D	NC	NC	S	D	D
		Settlements	I	I	I	I	I	I	I	I	I	I	I	S	I
		Other Land	I	I	I	I	I	I	I	I	I	I	I	D	S

Alternative legend and transition matrix validated through `participatory processes

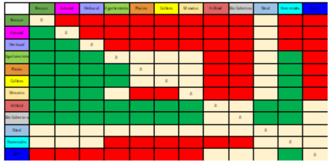
03

Transition matrix

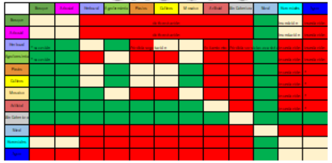
GROUP 1



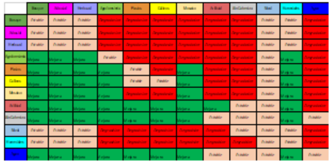
GROUP 2



GROUP 3



GROUP 4



	Forests	Shrublands	Grasslands	Agroforestry	Pastures	Cropland	Productive Mosaics	Artificial	Bareland	Snow and glaciers	Wetlands	Water
Forests	4n	2-2n	2n2-	3-1n	4-	4-	4-	4-	4-	3n1+	3n1-	3-1n
Shrublands	1+3n	4n	2-2n	3-1+	4-	4-	4-	4-	4-	3n1+	3n1-	3-1n
Grasslands	2+2n	2n2+	4n	1+3-	4-	3-1n	2n2-	4-	4-	3n1+	2-1n1+	3-1n
Agroforestry	4+	4+	2+1n1-	4n	3-1n	3-1n	2n2-	4-	4-	4n	3+1-	3-1n
Pastures	4+	4+	3+1n	4+	4n	1+1-2n	3+1n	4-	4-	4n	3+1-	3-1n
Cropland	4+	4+	2+2n	4+	4n	4n	3+1n	4-	4-	4n	3+1-	3-1n
Productive Mosaics	4+	4+	3+1n	2+2n	4-	3-1n	4n	4-	4-	4n	3+1-	3-1n
Artificial	4+	4+	4+	4+	4+	4+	4+	4n	2n1-1+	4n	3+1-	3-1n
Bareland	4+	4+	4+	4+	4+	4+	4+	3n1+	4n	4n	4+	2-2n
Snow and glaciers	2n2-	2n2-	2n2-	3-1n	3-1n	3-1n	3-1n	3-1n	3-1n	4n	3n1-	2-2n
Wetlands	4+	3n1-	2n2-	4-	4-	4-	4-	4-	4-	4n	4n	4n
Water	4+	2-2+	2-2+	2-2+	2-2+	2-2+	2-2+	3n1-	3n1-	4n	3+1-	4n

n NEUTRAL | + POSITIVE | - NEGATIVE

Results in Colombia

03

Transition matrix

Turkiye Example of analysis of group results of transitions from croplands where the transition from crop to tree covered areas was considered positive for some and negative for other groups:

Initial LC	Final LC	Group 1	Group 2 semiarid	Group 2 arid	Group 3	Group 4	Conclusion	Confidence
Cropland	Tree covered land	Negative	Neutral/Positive	Positive	Positive	Negative	Neutral	1
Cropland	Grassland	Negative	Positive	Positive	Positive	Negative	Positive	3
Cropland	Cropland	Neutral	Neutral	Neutral	Neutral	Neutral	No change	
Cropland	Wetlands	Neutral	Neutral	Negative	Positive	Negative	Neutral	2
Cropland	Artificial land	Negative	Negative	Negative	Negative	Negative	Negative	5
Cropland	Other lands	Negative	Negative	Negative	Negative	Negative	Negative	5
Cropland	Water Bodies	Neutral				Negative	Neutral	
Cropland	Transitional vegetation				Positive			
Cropland	Shrubland					Negative		

During the workshop, the experts worked in groups according to their expertise (e.g. forestry, agriculture, etc.). This led to some **contrasting land cover transition matrices**.

03

Transition matrix

Turkiye LC transition matrix:

	Tree covered land	Grassland	Cropland	Wetlands	Artificial land	Other lands	Water Bodies
Tree covered land	No change	Negative	Negative	Neutral	Negative	Negative	Neutral
Grassland	Neutral	No change	Negative	Neutral	Negative	Negative	Neutral
Cropland	Neutral	Positive	No change	Neutral	Negative	Negative	Neutral
Wetlands	Neutral	Negative	Negative	No change	Negative	Negative	Negative
Artificial land	Positive	Positive	Positive	Positive	No change	Neutral	Positive
Other lands	Positive	Positive	Positive	Positive	Neutral	No change	Neutral
Water Bodies	Negative	Negative	Negative	Negative	Negative	Negative	No change

Different from the default:

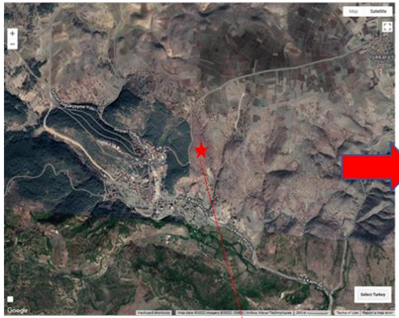
Land cover in target year

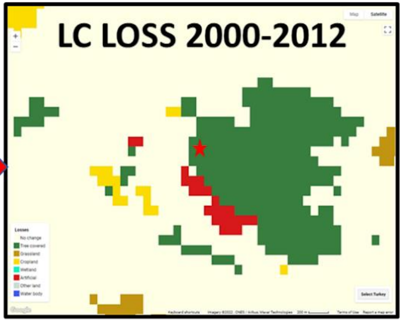
Land cover in initial year

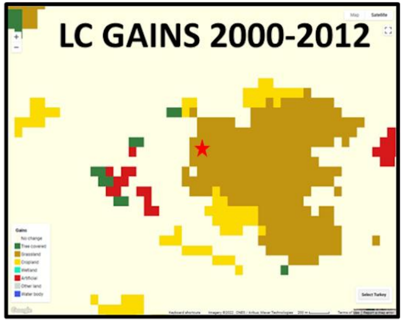
	Tree-covered	Grassland	Cropland	Wetland	Artificial	Other land	Water body
Tree-covered	0	-	-	-	-	-	0
Grassland	+	0	+	-	-	-	0
Cropland	+	-	0	-	-	-	0
Wetland	-	-	-	0	-	-	0
Artificial	+	+	+	+	0	+	0
Other land	+	+	+	+	-	0	0
Water body	0	0	0	0	0	0	0

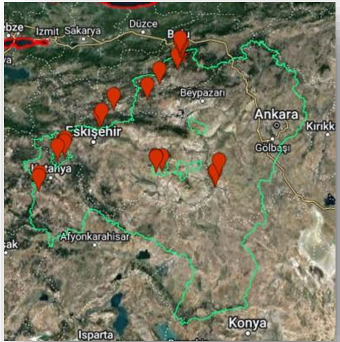
04 Validation

In Turkey a field trip was done to validate the transitions map and the different possibilities of reclassification of CORINE data
The LDN DSS was used during the field trip
More time is needed for this









Example: A site where a land cover transitions from forest to grasslands was detected in the baseline period (2000-2012) with the default re-classification but when validated in the field in 2022, such change had not occurred and the area had been a stable tree covered area.

FINAL RESULTS

Land cover degradation

This section is pre-filled with default land cover degradation estimates for the baseline and reporting periods. Keep the default data or replace it with national datasets.

SO1-1.T8: National estimates of land cover degradation (km²) in the baseline period

Quantitative summary of land that is degraded or non-degraded due to land cover change in the baseline period, reported as the total area of degraded land cover in km² and the area of degraded land cover as a proportion (%) of the total country area.

	Area (km²)	Percent of total land area (%)
Land area with degraded land cover ⓘ	6879	0.9
Land area with non-degraded land cover ⓘ	773209	99.1
Land area with no land cover data ⓘ	0	0.0

Default

	Area (km²)	Percent of total land area (%)
Land area with degraded land cover	58 138 .8117	7 .5
Land area with non-degraded land cover	721 894 .8143	92 .5
Land area with no land cover data	0	0 .0

Reported

2 PERIODS TO REPORT

Baseline 2000-2015
Reporting period 2016-2019

3 COMPARABLE MAPS
2000, 2015, 2019

RESULTS in Bhutan

- The best available data set is ESA CCI
- Wetlands should be better mapped in the future and will be merged with water bodies
- The 7 UNCCD categories are not enough to map one of the country's main degradation process, woody encroachment, so shrublands will be added as a category
- Between 2000 and 2019 there are 74,598 ha are detected with land cover change

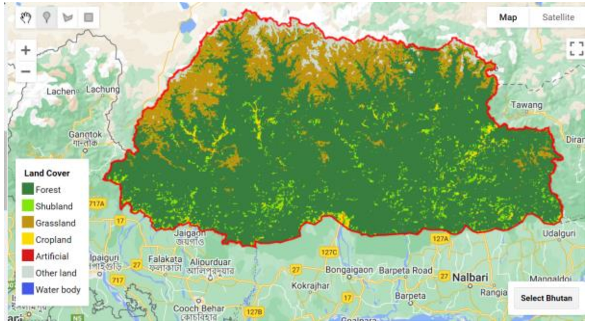
Are the seven UNCCD land cover classes sufficient to monitor the key degradation processes in your country?

- ○ Yes
- ◉ No

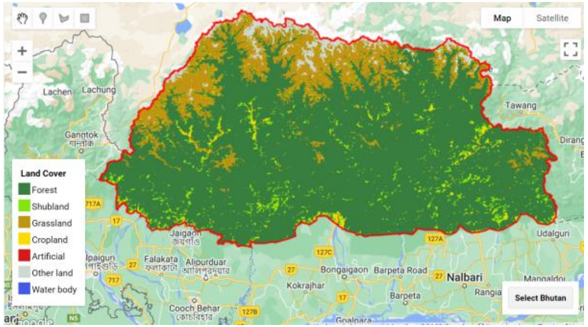
Land Cover
- Forest
- Shubland
- Grassland
- Cropland
- Artificial
- Other land
- Water body

⟹ The selected legend

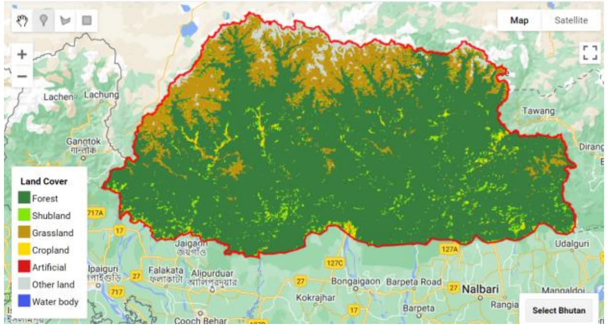
2000



2015

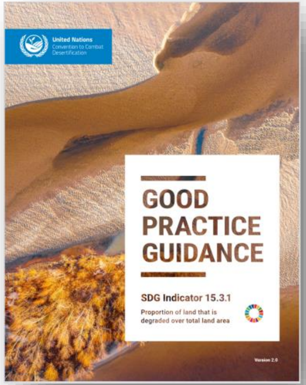


2019



SDG 15.3.1
PROPORTION OF LAND THAT IS DEGRADED

United Nations
Convention to Combat Desertification



TRENDS IN LAND COVER

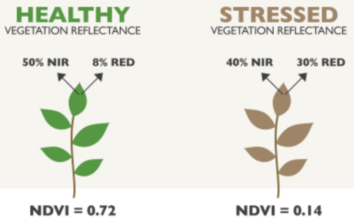
TRENDS IN LAND PRODUCTIVITY

TRENDS IN CARBON STOCKS

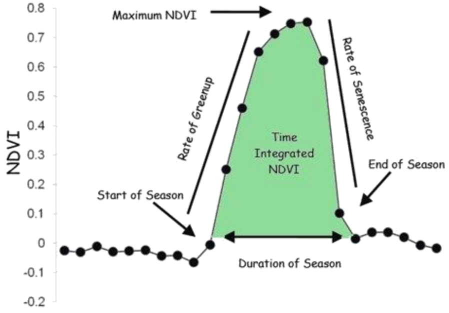
*"While it is difficult for a single indicator to fully capture the state or condition of the land, the sub-indicators are **proxies** to monitor the essential variables that reflect the capacity of the land to deliver ecosystem services"* Sims et al. 2021

TRENDS IN LAND PRODUCTIVITY

Time series of NDVI data



- Every 16 days (the algorithm chooses the best available pixel value: low clouds, low view angle, and the highest NDVI value)
- 250 m spatial resolution
- 23 composites per year
- Global scale



https://modis.gsfc.nasa.gov/data/dataprod/mod13.php

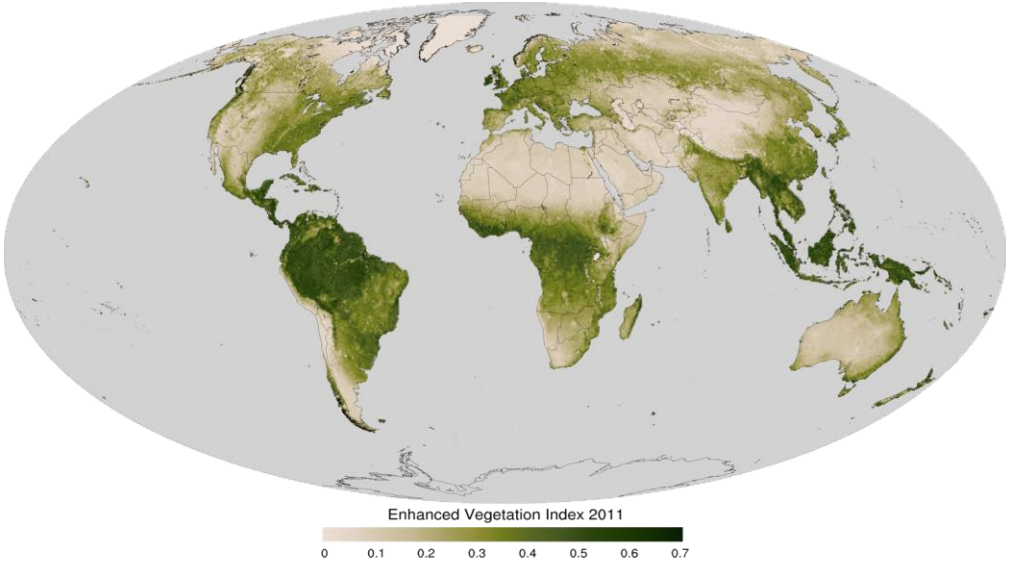
Other vegetation indexes

EVI: Enhanced vegetation Index

(corrects for atmospheric conditions and canopy background noise, more sensitive in areas with dense vegetation)

SAVI: Soil Adjusted Vegetation Index

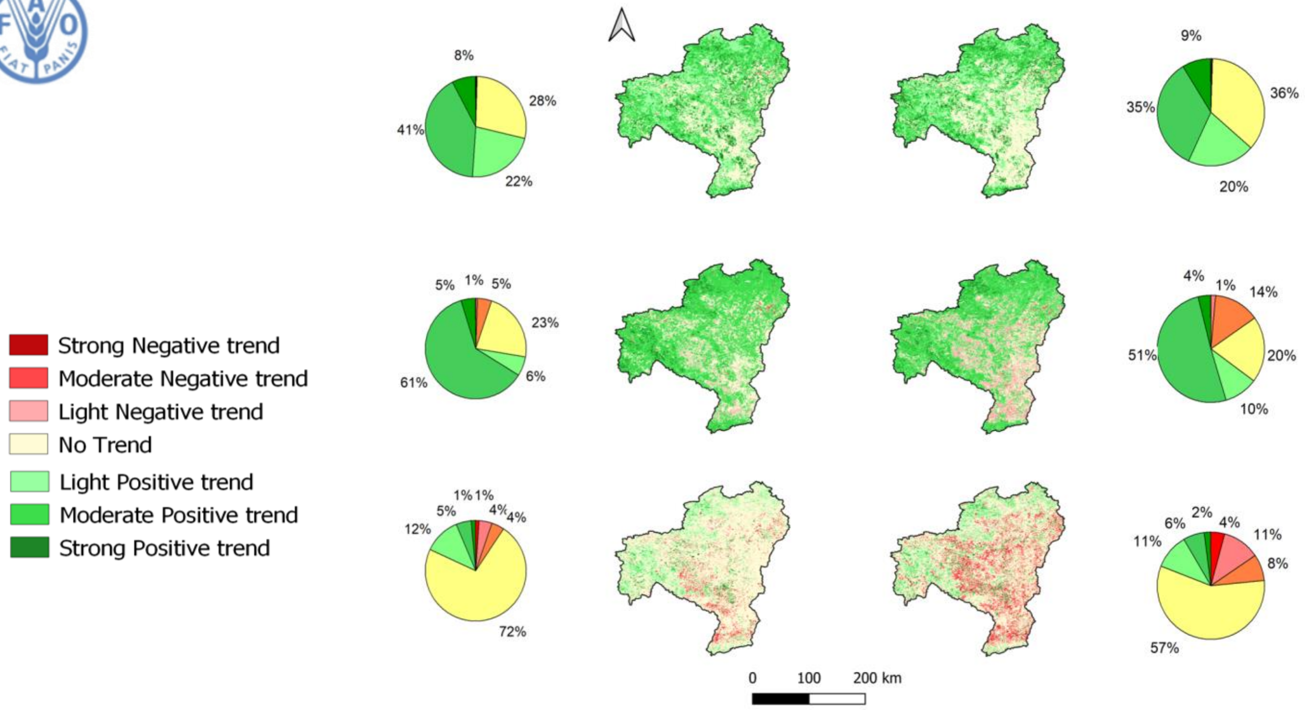
(corrects the influence of soil brightness when vegetative cover is low



Upper Sakarya Basin, Turkey

Land Productivity Trends

Same data + different analytical approaches = very different results



Integration of Expert Knowledge

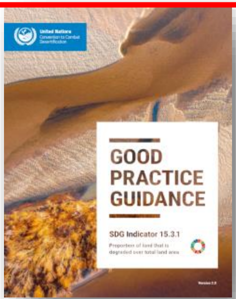
Teich et al. 2019

DIFFERENT ANALYSIS / ALGORITHMS

1- Trends.Earth

Trends.Earth

TRENDS.EARTH
tracking land change
from Conservation International



2- JRC (Default)

ELSEVIER

Ecological Indicators
Volume 133, December 2021, 108386

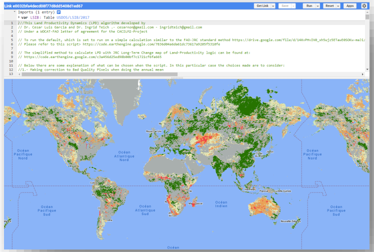
LPDynR: A new tool to calculate the land productivity dynamics indicator

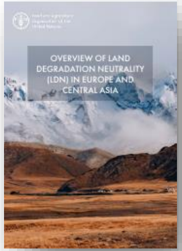
Xavier Rotllan-Puig [a], Eva Ivits [b], Michael Cherlet [c]

Joint Research Centre
JRC

3 FAO WOCAT

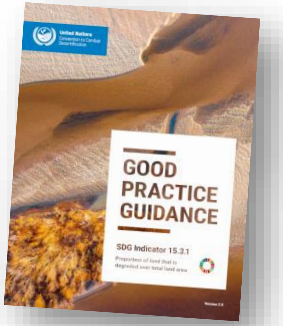
WOCAT





Three measures of change derived from NDVI time series data

Trends.Earth
TRENDS.EARTH
tracking land change
from Conservation International



TRAJECTORY

Measures the rate of change in primary productivity over time.

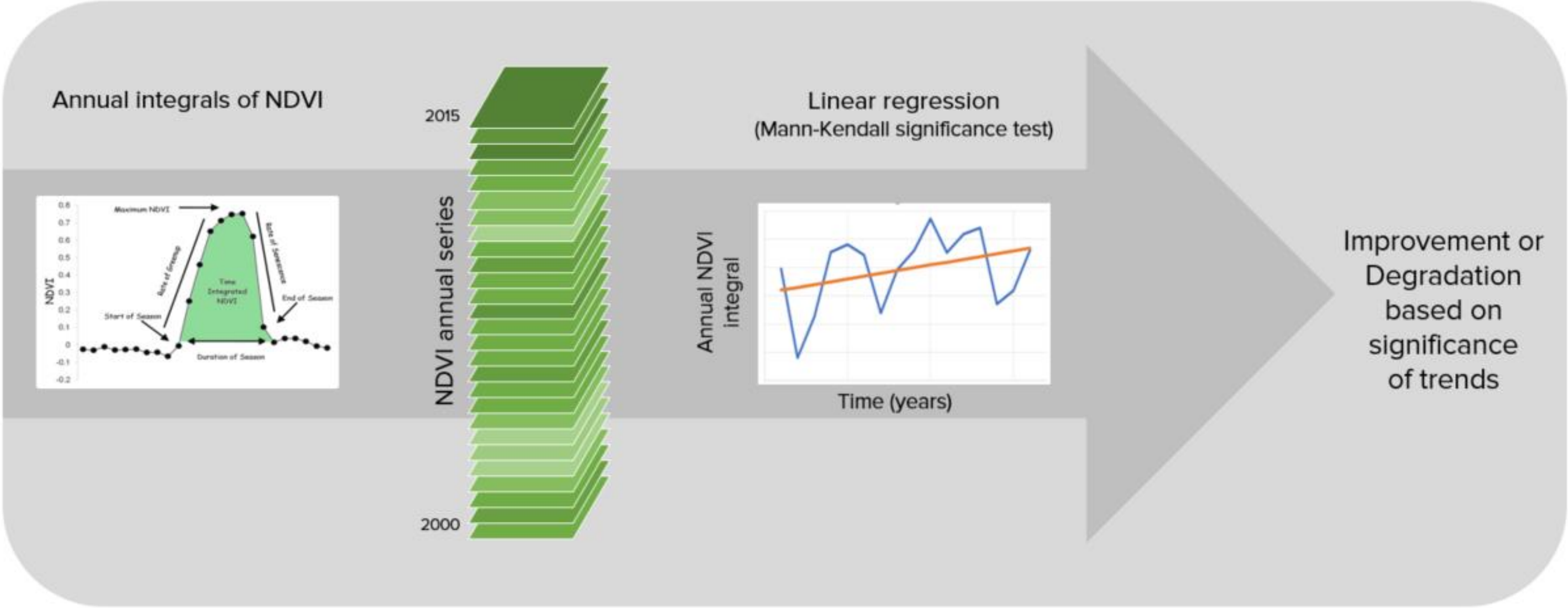
STATE

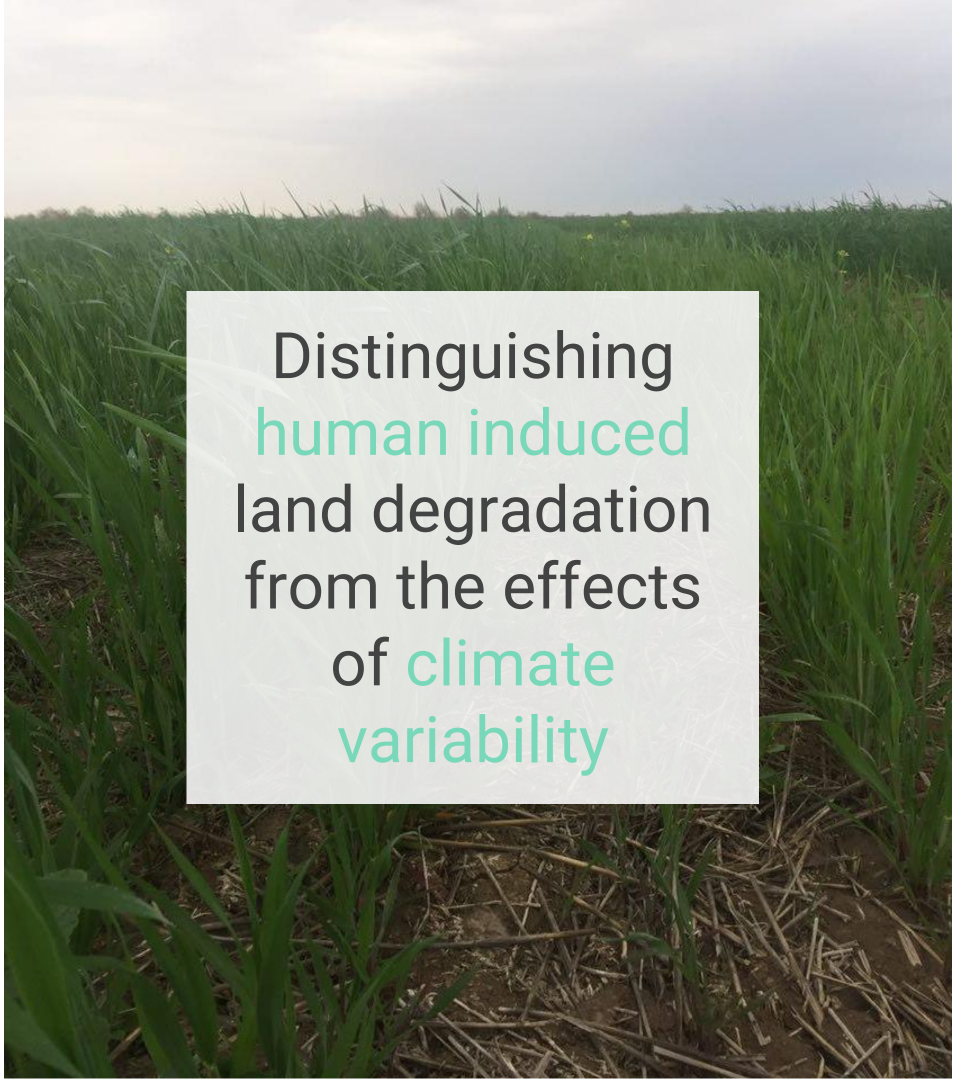
Compares the current productivity level in a given area to historical observations of productivity in that same area.

PERFORMANCE

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

Trajectory


Annual integrals of NDVI
Maximum NDVI
Rate of Greening
Rate of Senescence
Time Integrated NDVI
Start of Season
End of Season
Duration of Season
NDVI
2015
NDVI annual series
2000
Linear regression
(Mann-Kendall significance test)
Annual NDVI integral
Time (years)
Improvement or Degradation based on significance of trends



Distinguishing human induced land degradation from the effects of climate variability

WATER, LIGHT, TEMPERATURE

Different factors affect primary productivty

INTERPRETING VARIABILITY

Historical precipitation information as a context

CLIMATE CORRECTION METHODS

Residual Trend Analysis (RESTREND), Rain & Water Use Efficiency (RUE & WUE)

RESIDUAL TREND ANALYSIS

Trends in vegetation production independent of rainfall

Contents lists available at SciVerse ScienceDirect

Remote Sensing of Environment

journal homepage: www.elsevier.com/locate/rse

Limits to detectability of land degradation by trend analysis of vegetation index data

K.J. Wessels [a,b,*], F. van den Bergh [a], R.J. Scholes [c]

[a] Remote Sensing Research Unit, CSIR-Meraka Institute, Pretoria, South Africa
[b] Centre for Geoinformation Science, Department of Geography, Geoinformatics and Meteorology, University of Pretoria, South Africa
[c] Ecosystems, Processes and Dynamics, CSIR-Natural Resources and Environment, Pretoria, South Africa

ARTICLE INFO

Article history:
Received 7 February 2011
Received in revised form 22 June 2012
Accepted 23 June 2012
Available online 26 July 2012

Keywords:
Desertification
Land degradation
AVHRR
NDVI
Trend analysis
Change detection

ABSTRACT

This paper demonstrates a simulation approach for testing the sensitivity of linear and non-parametric trend analysis methods applied to remotely sensed vegetation index data for the detection of land degradation. The intensity, rate and timing of reductions in seasonally-summed NDVI are systematically varied on sample data to simulate land degradation, after which the trend analysis was applied and its sensitivity evaluated. The study was based on a widely-used, 1 km^2 AVHRR data set for a test area in southern Africa. The trends were the most negative and significant when the degradation was introduced rapidly (over a period of 2–5 years) and in the middle of a 16-year time series. The seasonally-summed NDVI needs to be reduced by 30–40% before a significant negative linear slope or Kendall's correlation coefficient was apparent, given an underlying positive trend caused by rainfall. The seasonally-summed data were reordered to remove this underlying positive trend, before simulating degradation again. With no underlying positive trend present, degradation of 20% resulted in significant negative trends. Since areas widely agreed to be degraded show only 10–20% reductions compared to non-degraded areas, this raises doubts over the ability of trend analyses to detect degradation in a timely way in the presence of underling environmental trends. Residual Trends Analysis (RESTREND) was applied in an attempt to correct for variability and trends in rainfall. However, a simulated degradation intensity ≥20% caused the otherwise strong relationship between NDVI and rainfall to break down, making the RESTREND an unreliable indicator of land degradation. The results of such analyses will vary between different environments and need to be tested for sample areas across regions. Although the paper does not claim to solve the challenge of detecting land degradation amidst rainfall variability, it introduces a method of assessing the sensitivity of land degradation monitoring using remote sensing data.

1. Introduction

Desertification or land degradation in dry areas materially affects the wellbeing of over 250 million people (Adger et al., 2000), making it among the most pressing of contemporary environmental issues (MEA, 2005; Reynolds et al., 2007). Desertification can be defined as a persistent loss of ecosystem services (MEA ; Safriel & Adeel, 2005), building on earlier definitions based on reduced biological productivity due to soil erosion, loss of soil fertility, loss of vegetation cover, change in plant species and other processes (UNCCD, 1994). Although 194 countries have ratified the United Nations Convention on Combating Desertification (UNCCD), little progress has been made in solving the problem. One of the constraining issues is a lack of scientifically robust methods for monitoring and assessing land degradation (Veron et al., 2006).

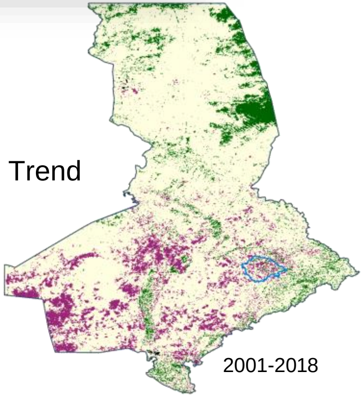
Serious desertification ultimately results in long-lasting and observable loss of vegetation cover and biomass productivity over time and in space. Thus the temporal change in vegetation productivity is a key indicator of desertification (Hellden & Tottrup, 2008). Vegetation indices based on reflectance in the visible and near-infrared spectra (e.g. the widely-used Normalised Difference Vegetation Index, NDVI) have been shown to correlate with plant biomass, leaf area and primary production (Myneni et al., 1995; Prince, 1991a; Tucker et al., 2005). Many studies have used vegetation indices calculated from multi-year, coarse resolution (≥1 km) satellite data, notably Advanced Very High Resolution Radiometer (AVHRR), to monitor trends in primary productivity, for the purposes of assessing land degradation (Bastin et al., 1995; Diouf & Lambin, 2001; Holm et al., 2003; Nicholson et al., 1998; Prince & Justice, 1991; Prince et al., 1998; Tucker et al., 1991a, 1991b; Wessels et al., 2007a).

Monitoring and detecting desertification with AVHRR NDVI time series has, however, become a controversial topic. The methods for reliably identifying desertification from satellite and rainfall data are fiercely debated in the scientific literature (Bai et al., 2008; Hein & de Ridder, 2006; Prince et al., 2007; Veron et al., 2006; Wessels, 2009). In addition, global and regional studies of "browning" or "greening" trends based on NDVI

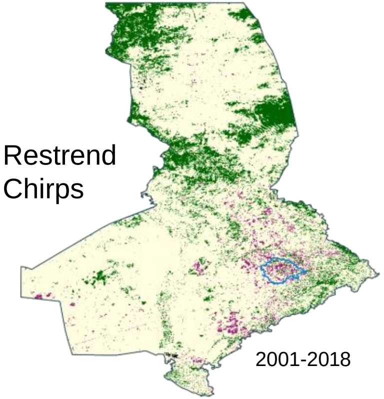
Turkistan Oblast, Kazakhstan

TRENDS.EARTH

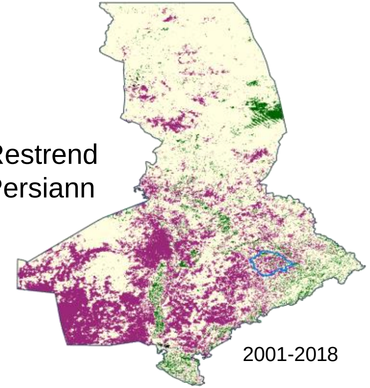
Trend



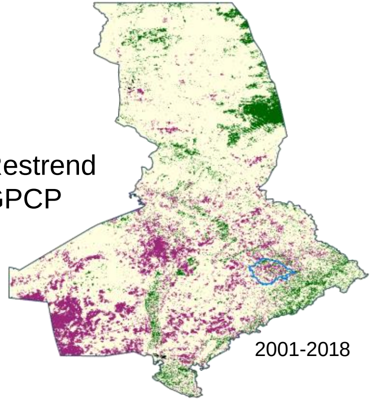
Restrend Chirps



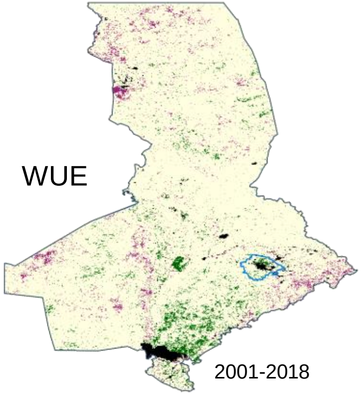
Restrend Persiann



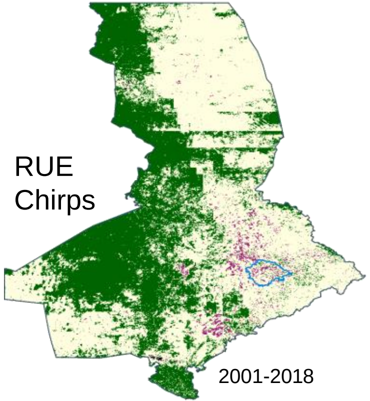
Restrend GPCP



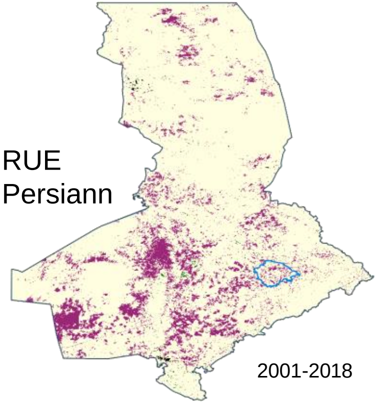
WUE



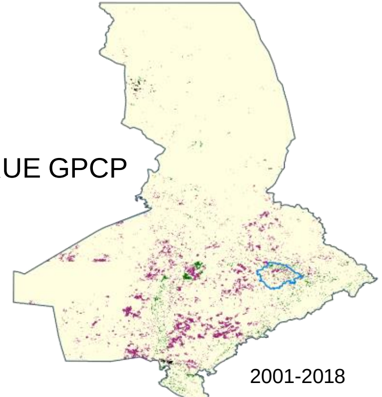
RUE Chirps



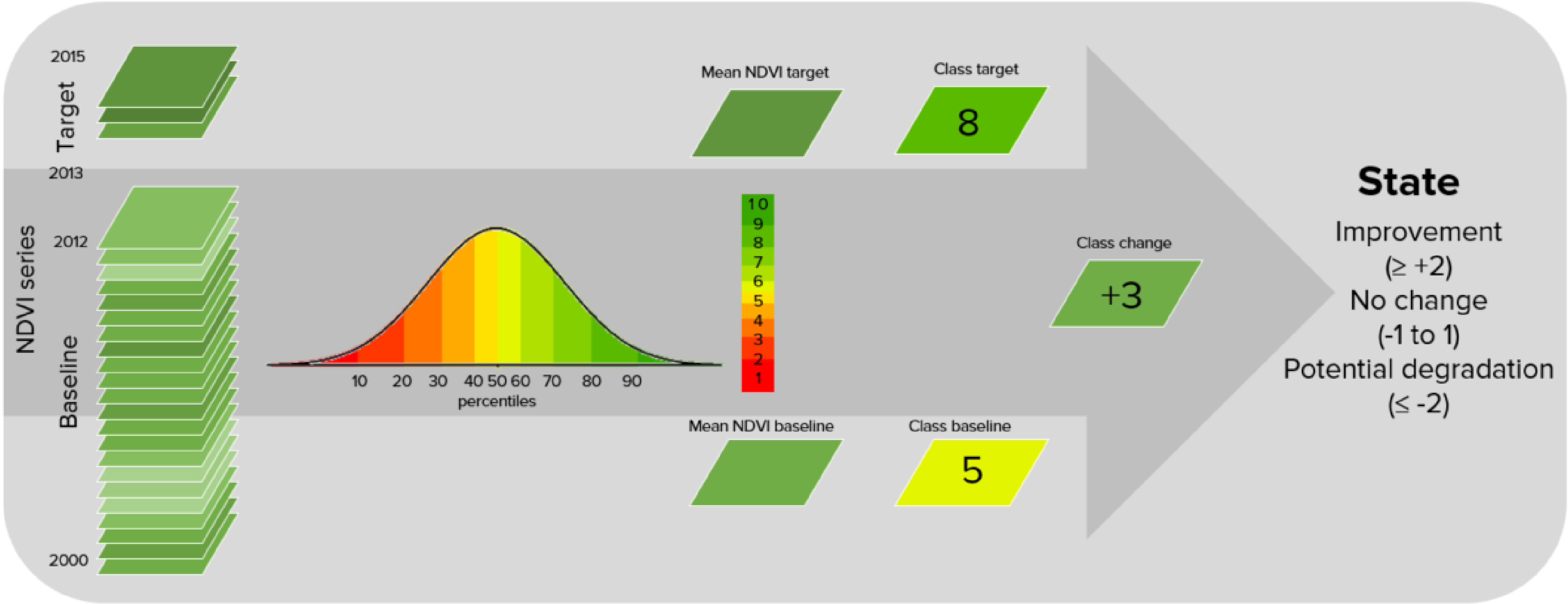
RUE Persiann



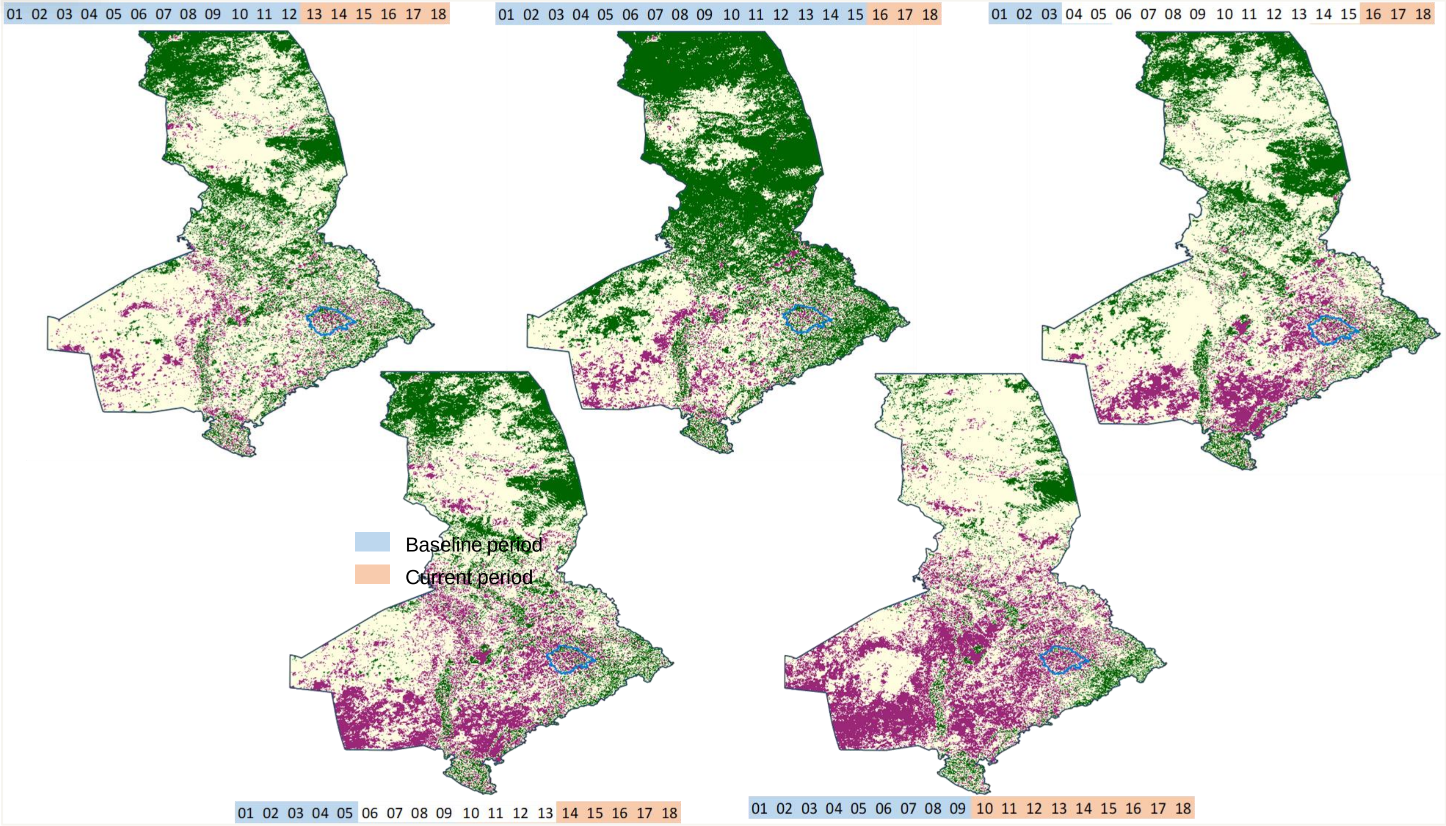
RUE GPCP



State (temporal comparison)

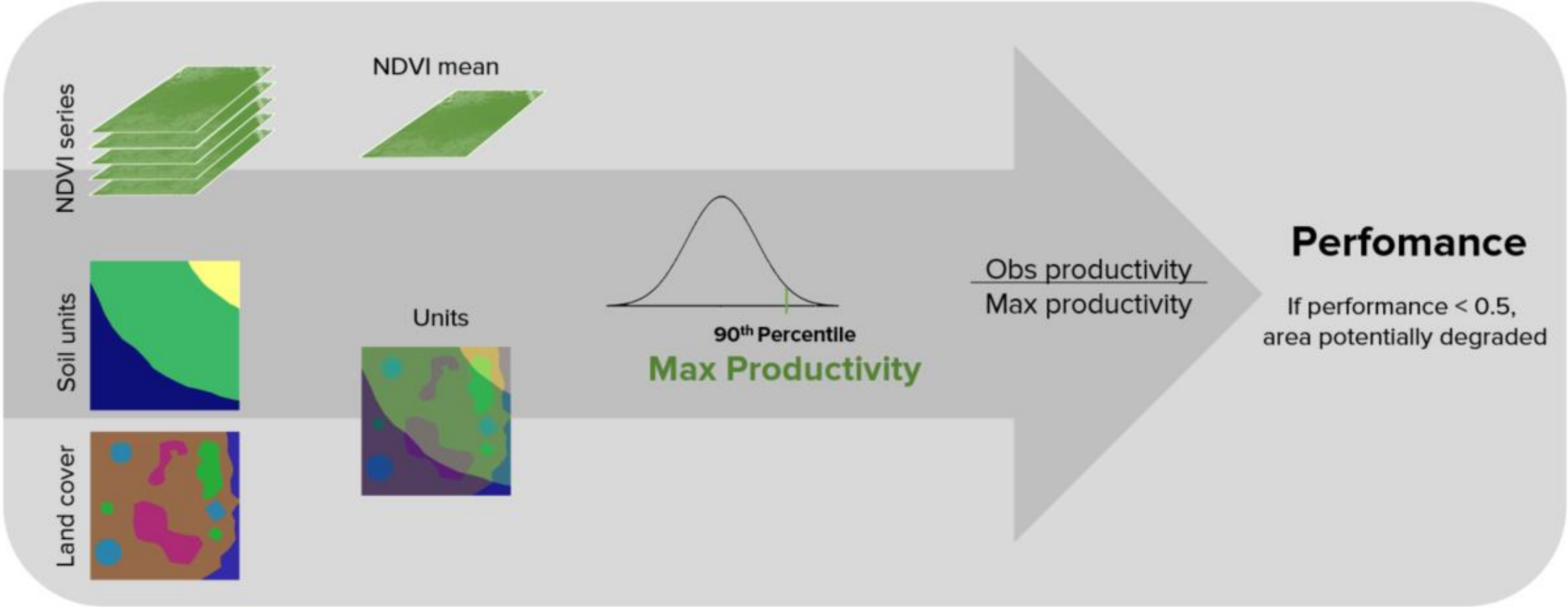


Turkistan Oblast, Kazakhstan



Performance (spatial comparison)

Trends.Earth
TRENDS.EARTH
tracking land change
from Conservation International



Aggregating the productivity sub-indicators

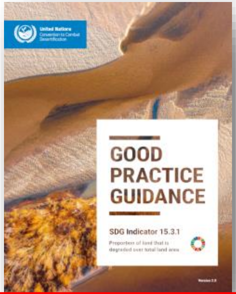
Trajectory	State	Performance	3 Classes	5 Classes
Improvement	Improvement	Stable	Improvement	Improving
Improvement	Improvement	Degradation	Improvement	Improving
Improvement	Stable	Stable	Improvement	Improving
Improvement	Stable	Degradation	Improvement	Improving
Improvement	Degradation	Stable	Improvement	Improving
Improvement	Degradation	Degradation	Degradation	Stable
Stable	Improvement	Stable	Stable	Stable
Stable	Improvement	Degradation	Stable	Stable
Stable	Stable	Stable	Stable	Stable
Stable	Stable	Degradation	Degradation	Stable but stressed
Stable	Degradation	Stable	Degradation	Early signs of decline
Stable	Degradation	Degradation	Degradation	Declining
Degradation	Improvement	Stable	Degradation	Declining
Degradation	Improvement	Degradation	Degradation	Declining
Degradation	Stable	Stable	Degradation	Declining
Degradation	Stable	Degradation	Degradation	Declining
Degradation	Degradation	Stable	Degradation	Declining
Degradation	Degradation	Degradation	Degradation	Declining

DIFFERENT ANALYSIS / ALGORITHMS

1- Trends.Earth

Trends.Earth

TRENDS.EARTH
tracking land change
from Conservation International



2- JRC (Default)

ELSEVIER

Ecological Indicators
Volume 133, December 2021, 108386

LPDynR: A new tool to calculate the land productivity dynamics indicator

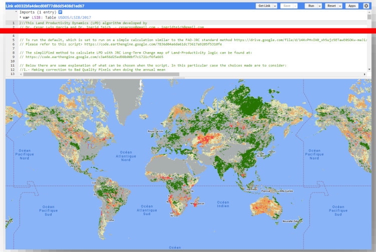
Xavier Rotllan-Puig [a], Eva Ivits [b], Michael Cherlet [c]

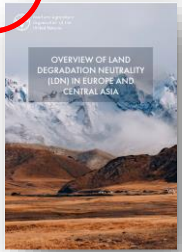
Joint Research Centre
JRC

3 FAO WOCAT

FAO FIAT PANIS

WOCAT

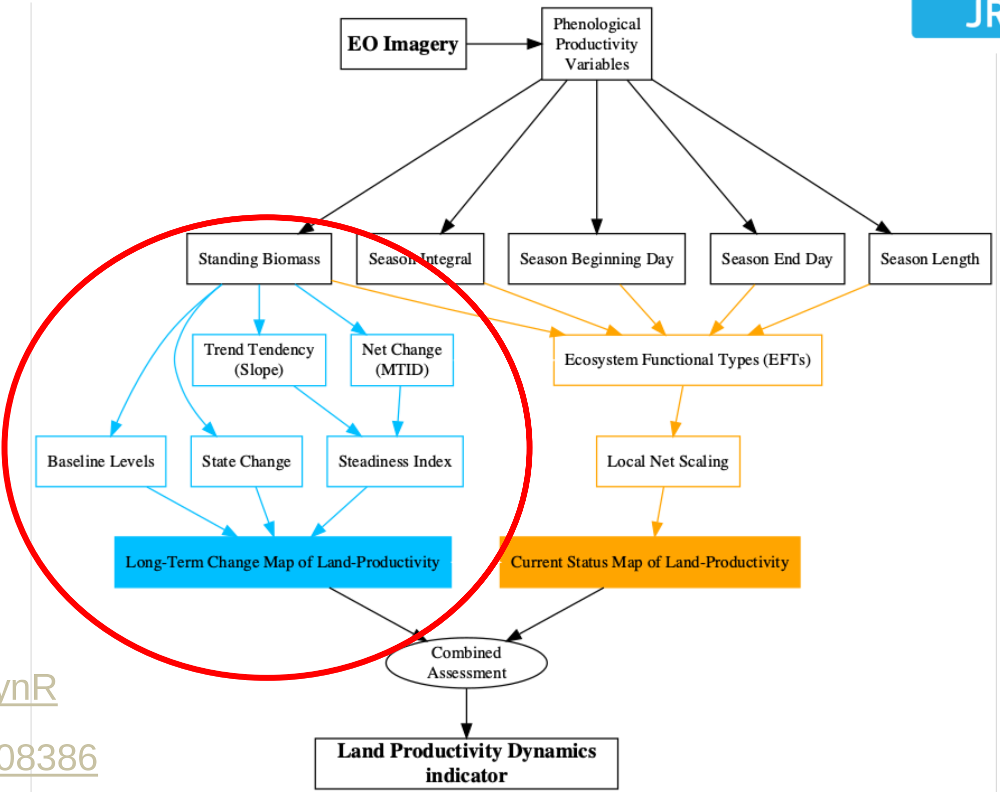




JRC – Default in PRAIS4

Data source: Copernicus Global Land long term NDVI, based on SPOT/VEGETATION, PROBA-V

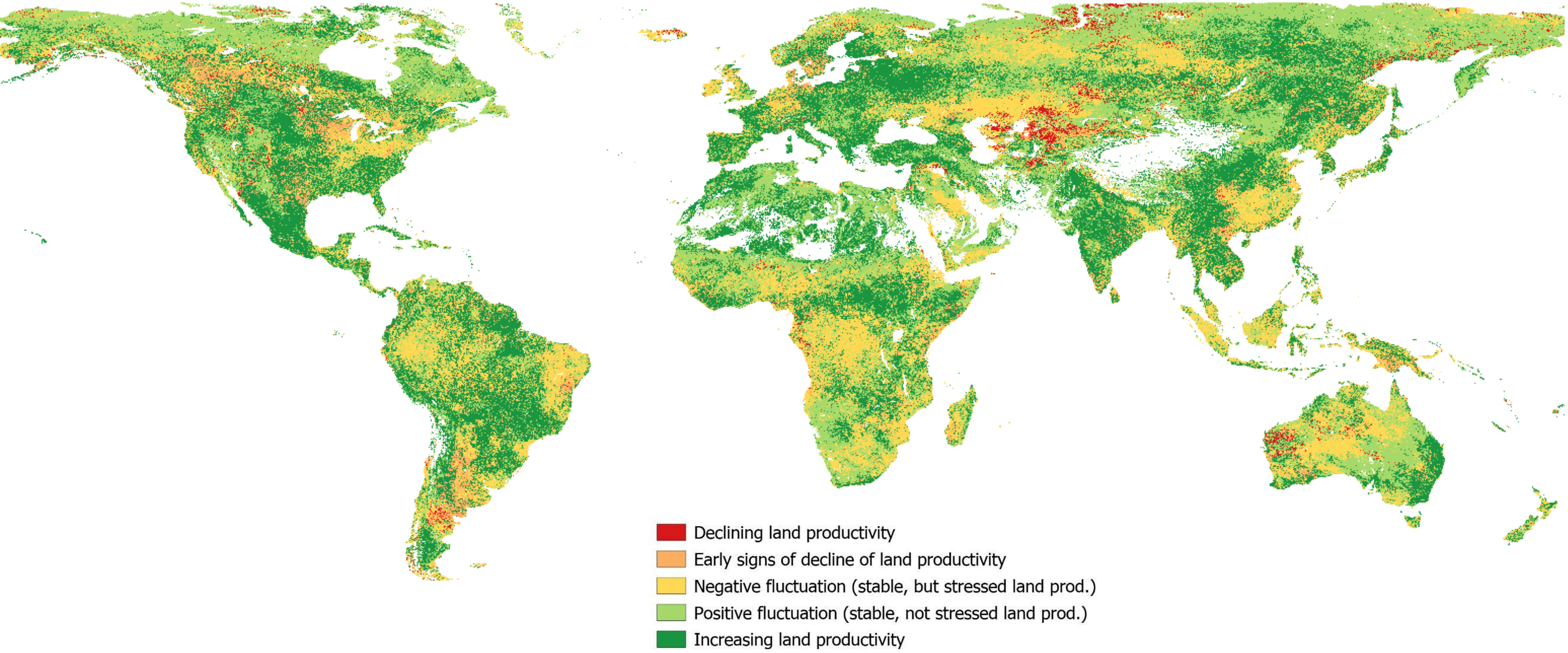
1 km²



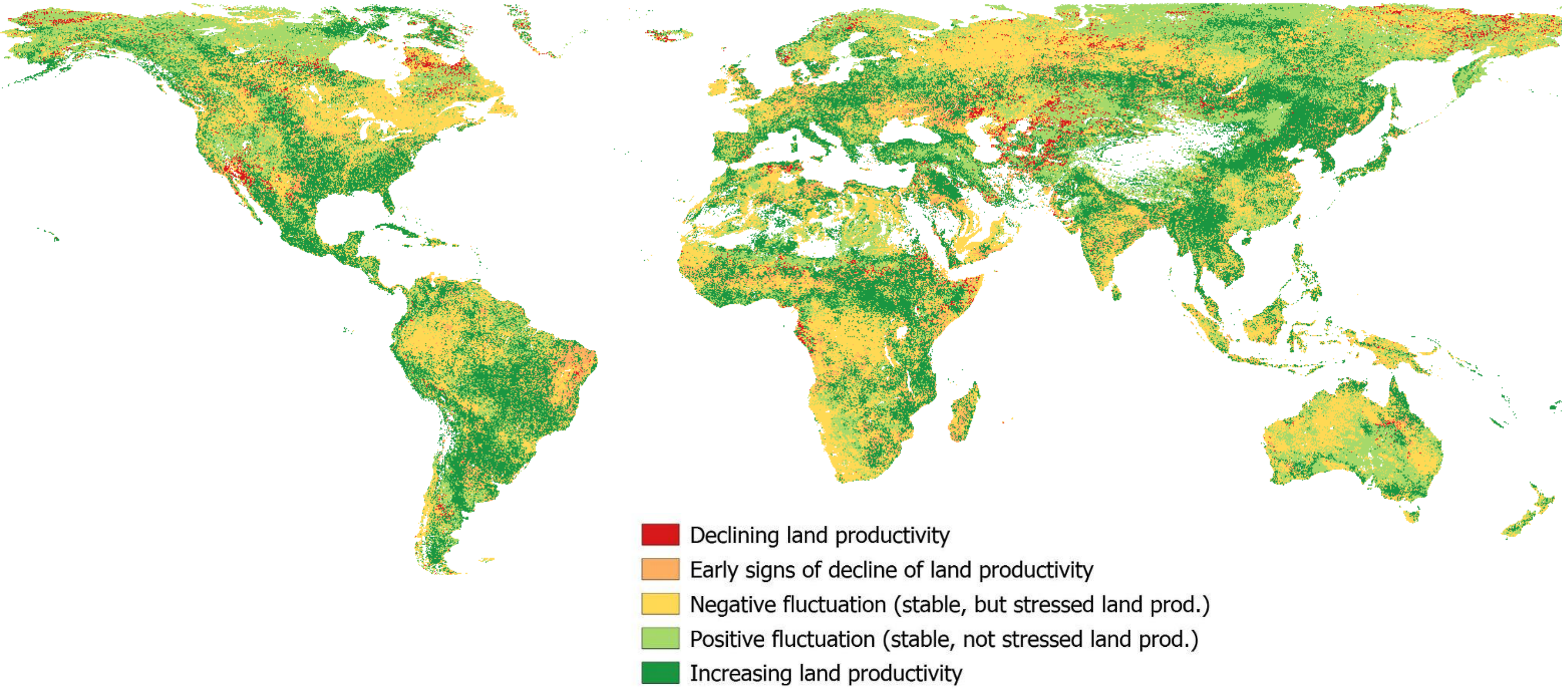
https://github.com/xavi-rp/LPDynR

https://doi.org/10.1016/j.ecolind.2021.108386

Baseline (2000-2015)



Reporting period (2004-2019)



DIFFERENT ANALYSIS / ALGORITHMS

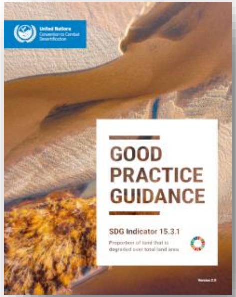
1- Trends.Earth

Trends.Earth

TRENDS.EARTH

tracking land change

from Conservation International



2- JRC (Default)

ELSEVIER

Ecological Indicators

Volume 133, December 2021, 108386

Joint Research Centre

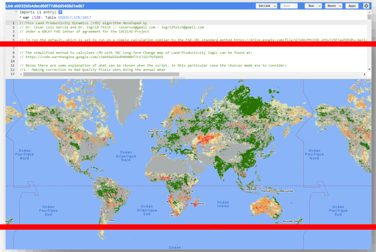
JRC

LPDynR: A new tool to calculate the land productivity dynamics indicator

Xavier Rotllan-Puig [a], Eva Ivits [b], Michael Cherlet [c]

3 FAO WOCAT

WOCAT



STRATEGY

⇩

Build on previous efforts and lessons learnt

Use the "official" legend of 5 categories

Produce a flexible approach were users can easily modify parameters

Open code & FAIR data & easy access

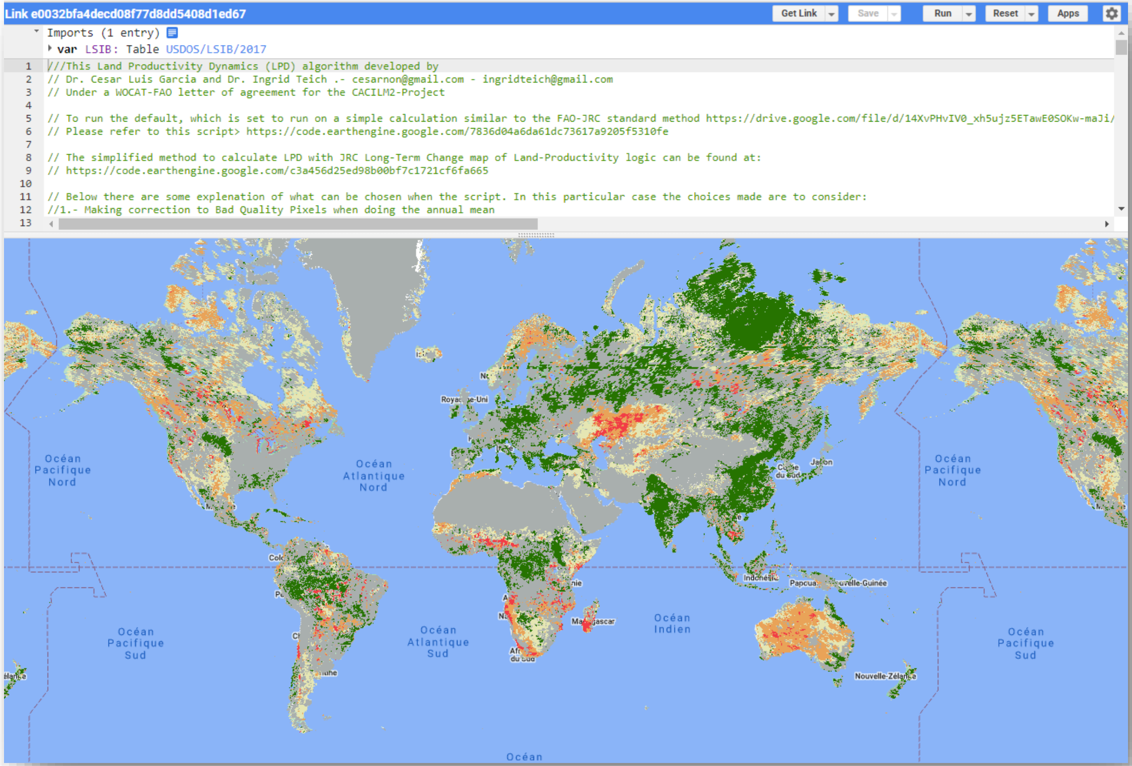
Base the development on the JRC simplified GEE code produced by FAO

Integrate ideas implemented of Trends.Earth approach

Co-development with countries and capacity building

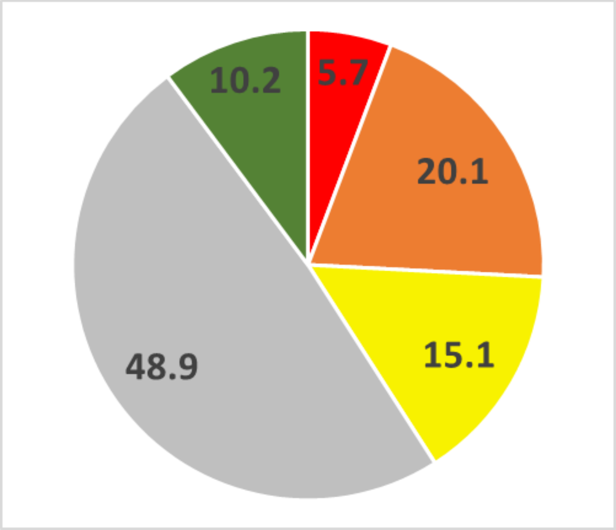
SCRIPT IN GEE

https://code.earthengine.google.com/e0032bfa4decd08f77d8dd5408d1ed67

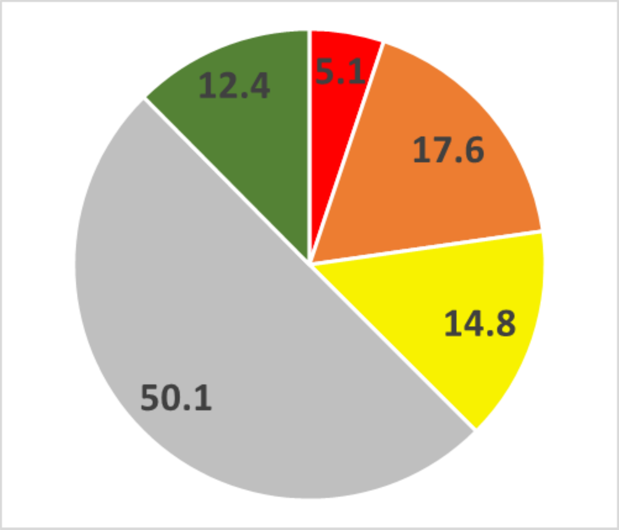


GLOBAL RESULTS
of the previous script for different periods

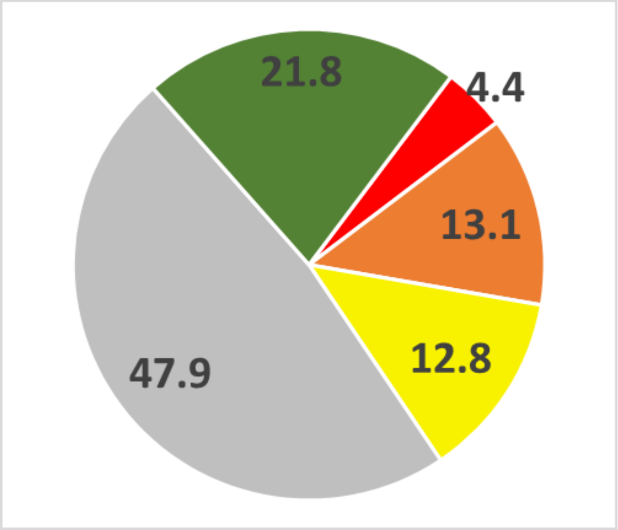
Baseline Period
2001 - 2015



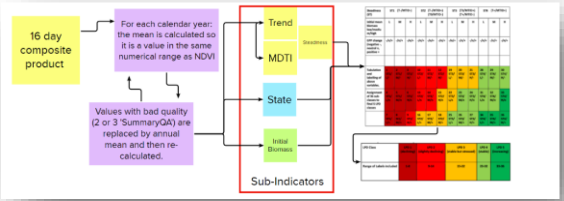
Reporting Period
2005 - 2019



Long-Term
2001 - 2021



HOW IS IT CALCULATED?



01

DATA

NDVI time series from MOD13Q1.006 Terra Vegetation Indices 16-Day Global 250m

02

SUB-INDICATORS

Steadiness (trend + MTID), initial biomass, State

03

CLASSIFICATION

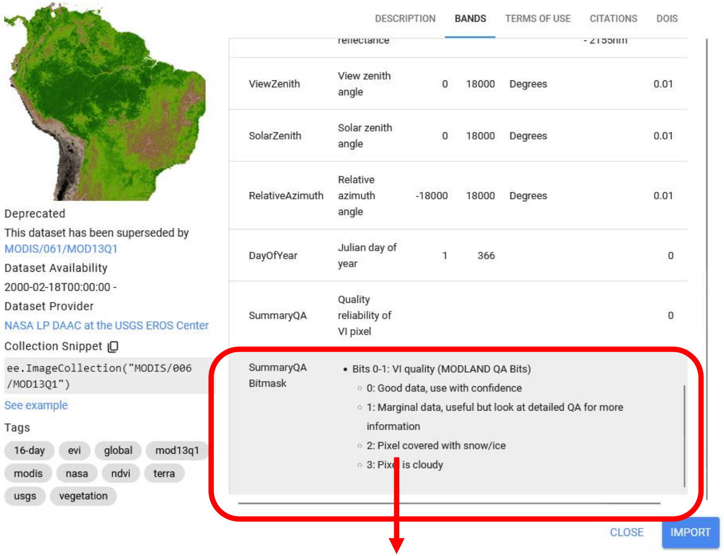
36 categories groups in 5 LPD categories (see table)

04

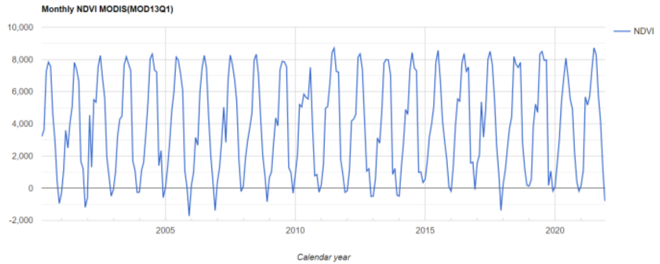
MASKS

Hyperarid areas and water

01 DATA

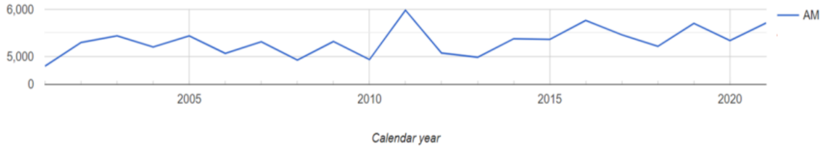


Quality correction QC: Pixels with SummaryQA of 2 and 3 are replaced by the anual mean value



Annual means re calculated after QC

Seasonality is removed by calculating the anual means



02 SUB-INDICATORS: STEADINESS

TREND

The significance is considered Mann Kendall (α=0.05)

⇩

3 categories :
1: Negative trend – Significative
2: No significative Trend
3: Positive trend - Significative

MTID

Multi Temporal Image Differencing

Multi Temporal Image Differencing (MTID) using Last 3 years mean

2 categories :
1: Negative MTID
2: Positive MTID

STEADINESS

Combinations categorized in 4 types of steadiness (MTDI helps when there is no significance)

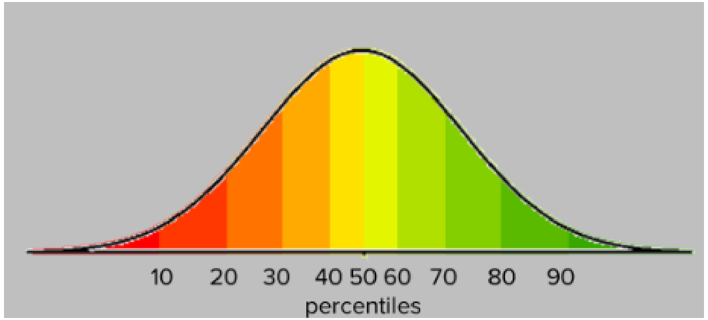
```
////--------------------------------------------------------------------
//// Calculate steadiness
//--------------------------------------------------------------------
// Calculate the 4 value steadiness index  based on the a combination of Mann
//where MTDI helps when there is no significance

var steadiness = ee.Image(0)
  .where(finalTrend.eq(1).and(MTDIcode.eq(1)),1) // T- MTDI-
  .where(finalTrend.eq(1).and(MTDIcode.eq(2)),2) // T- MTDI+
  .where(finalTrend.eq(2).and(MTDIcode.eq(1)),2) // T 0 MTDI-
  .where(finalTrend.eq(2).and(MTDIcode.eq(2)),3) // T 0 MTDI+
  .where(finalTrend.eq(3).and(MTDIcode.eq(1)),3) // T+ MTDI-
  .where(finalTrend.eq(3).and(MTDIcode.eq(2)),4) // T+ MTDI+
  //.where(waterMask.eq(1),0);
```

02 SUB-INDICATORS: STATE (GPP Change)

Baseline: 15 years

1



2

Locate the position of this values

Time 1: Mean of First 4 years

Time 2: Mean of last 4 years

3

Threshold is a percentile jump lager than 2 positions:

Class 1: Negative – Time 2 more than 2p **Lower** than Time 1
Class 2: Neutral – percentile jump less than 2
Class 3: Positive – Time 2 more than 2p **Higher** than Time 1

02 SUB-INDICATORS: INITIAL BIOMASS

NDVI of 3 first years
3 CATEGORIES

Low : < 0.4
Medium: 0.4 – 0.7
High: > 0.7

Higher RESILIENCE in areas with higher levels biomass

Each country can change these parameters using for example their mean and the SD

03 CATEGORIZATION:

Steadiness (ST)	ST1 (T-/MTID-)			ST2 (T-/MTID+) (T0/MTID-)			ST3 (T0/MTID+) (T+/MTID-)			ST4 (T+/MTID+)		
Initial mean biomass low/mediu m/high	L	M	H	L	M	H	L	M	H	L	M	H
GPP change (negative -, neutral n, positive +	-/n/+	-/n/+	-/n/+	-/n/+	-/n/+	-/n/+	-/n/+	-/n/+	-/n/+	-/n/+	-/n/+	-/n/+
Tabulation and labelling of above variables.	1 ST1/ L/-	2 ST1/ M/-	3 ST1/ H/-	10 ST2/ L/-	11 ST2/ M/-	12 ST2/ H/-	19 ST3/ L/-	20 ST3/ M/-	21 ST3/ H/-	28 ST4/ L/-	29 ST4/ M/-	30 ST4/ H/-
Assignment of 36 sub-classes to final 5 LPD classes	4 ST1/ L/n	5 ST1/ M/n	6 ST1/ H/n	13 ST2/ L/n	14 ST2/ M/n	15 ST2/ H/n	22 ST3/ L/n	23 ST3/ M/n	24 ST3/ H/n	31 ST4/ L/n	32 ST4/ M/n	33 ST4/ H/n
	7 ST1/ L/+	8 St1/ M/+	9 ST1/ H/+	16 ST2/ L/+	17 ST2/ M/+	18 ST2/ H/+	25 ST3/ L/+	26 ST3/ M/+	27 ST3/ H/+	34 ST4/ L/+	35 ST4/ M/+	36 ST4/ H/+

```
////------------------------------------------------------------------------
//// Calculate steadiness
//--------------------------------------------------------------------------
// Calculate the 4 value steadiness index  based on the a combination of Mann
//where MTDI helps when there is no significance

var steadiness = ee.Image(0)
  .where(finalTrend.eq(1).and(MTDIcode.eq(1)),1) // T- MTDI-
  .where(finalTrend.eq(1).and(MTDIcode.eq(2)),2) // T- MTDI+
  .where(finalTrend.eq(2).and(MTDIcode.eq(1)),2) // T 0 MTDI-
  .where(finalTrend.eq(2).and(MTDIcode.eq(2)),3) // T 0 MTDI+
  .where(finalTrend.eq(3).and(MTDIcode.eq(1)),3) // T+ MTDI-
  .where(finalTrend.eq(3).and(MTDIcode.eq(2)),4) // T+ MTDI+
  //.where(waterMask.eq(1),0);
```

LPD Class	LPD 1 (declining)	LPD 2 (slightly declining)	LPD 3 (stable but stressed)	LPD 4 (stable)	LPD 5 (increasing)
Range of Labels included	1-8	9-14	15-22	23-32	33-36

04 MASKS: WATER MASK

250m Yearly MOD44W Land/Water time series

⇩

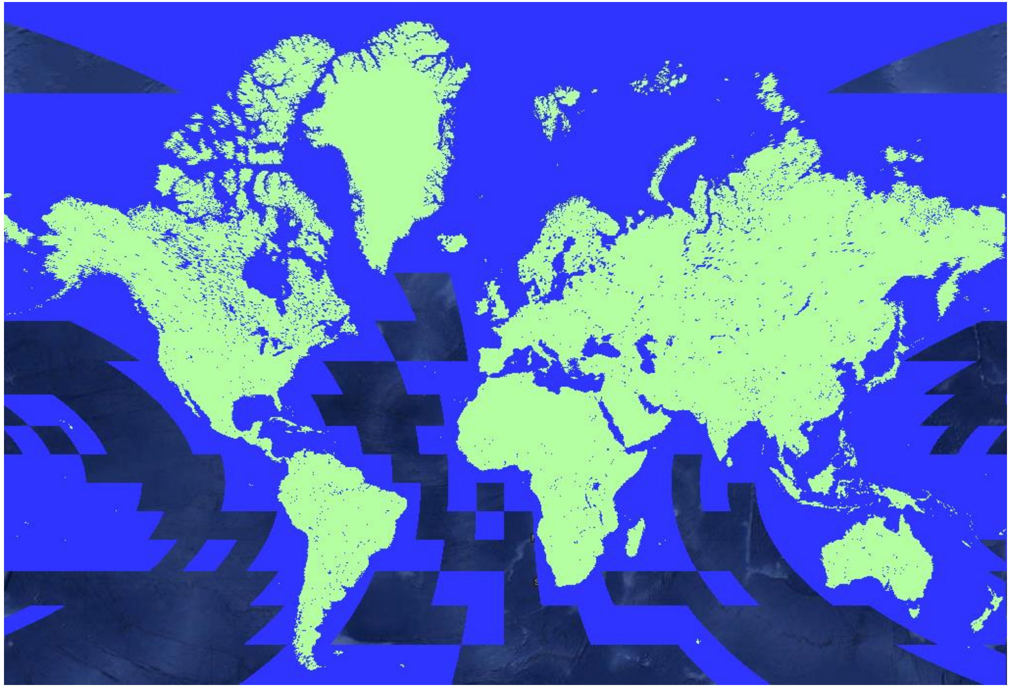
If water is present in a pixel for more than 12 years

⇩

Permanent Water

⇩

NoData



04 MASKS: HYPERARID AREAS

16-days NDVI time series

⇩

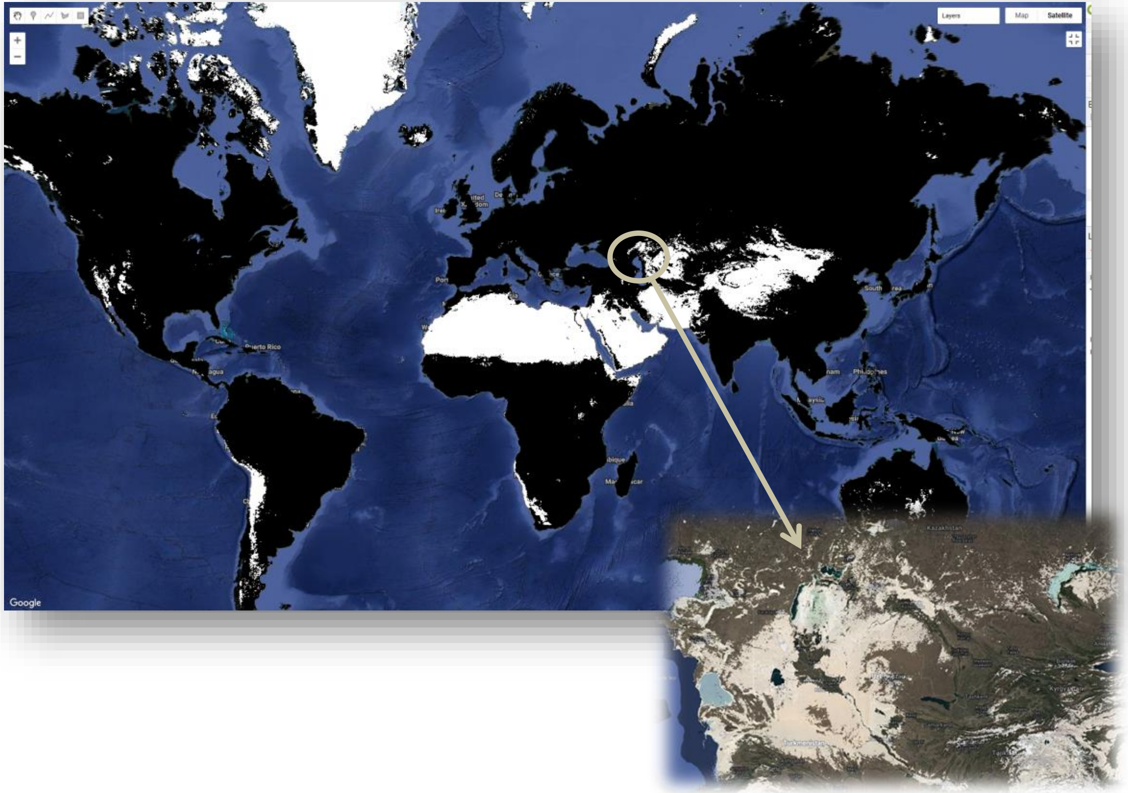
If NDVI is always below 0.25

⇩

Masked as desert

⇩

STABLE



TRENDS IN LAND PRODUCTIVITY

01

CHOOSE BEST AVAILABLE DATA

Trade off between temporal and spatial resolution

02

EXPLORE DIFFERENT ANALYSIS

SAVI, EVI, NDVI, ESPI, algorithms, periods, trends in precipitation, etc

03

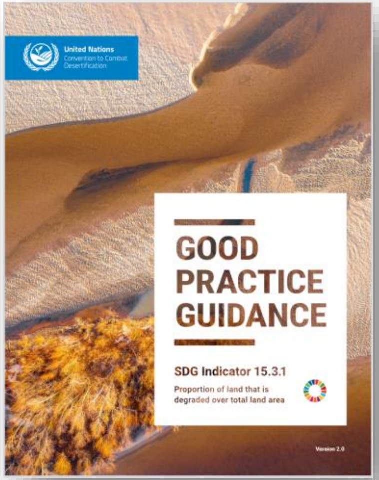
EXPERT KNOWLEDGE

Choose the most representative result via participatory process

04

VALIDATE

Field validation, identification of false positives and negatives



4.1.3 Interpretation and further work

Countries should ultimately strive to report changes in land productivity at the highest level of detail and rigour. However, differences between countries in their capacity to conduct remote sensing analyses, access to and availability of data sets and the range and distribution of productivity conditions will make some methods more suitable in some countries than in others.

4.2.3.2 National datasets

The default datasets are recommended for use only where a more suitable national dataset is not available. Ideally, countries will have, or aim to produce, a land productivity time series dataset that best suits their landscape and land productivity characteristics

B.5 Validating productivity measurements

Teich et al. (2019) developed a software survey tool to harness expert opinion to identify the best representation of productivity Trend in Argentina. While this process can be time consuming, the expert's opinions also yielded additional information on the drivers of productivity change, and established a network which may increase the likelihood of adoption of new methods in future.

Table 7-1
Trend intensity groupings recommended by Teich et al. (2019)

Description	Trend Intensity
Strong Negative Trend	Decrease of at least 50%
Moderate Negative Trend	Decrease between 25% and 50%
Light Negative Trend	Decrease of less than 25%
No Trend	No significant slope
Light Positive Trend	Increase of up to 25%
Moderate Positive Trend	Increase between 25% and 50%
Strong Positive Trend	Increase of at least 50%

The most representative LPD map

1.- Which model is best for your country?

2.- Which processes relate with the "Red areas"?

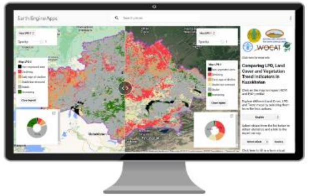
3.- Which processes relate to "Green areas"?

4.- What is the model that provides the worst results?

Land Productivity Dynamics (LPD) Comparison Apps

These apps allow users to interactively compare and validate alternative LPD maps (SO1-2). Statistics at different spatial scales are shown in the app, and experts can use their own knowledge to validate the different LPD maps (for example FAO-WOCAT LPD, JRC, Trends.Earth, etc) by looking at known areas that are hotspots of brightspots. Stakeholders from different sectors can discuss in groups and vote for the most representative LPD map. For example, Panama experts compared 5 different LPD maps using the LPD Comparison Tool and chose an LPD map obtained with Trends.Earth, whereas experts from Bhutan chose WOCAT-FAO LPD map for PRAIS4 report.

PRAIS4 Comparison App - Co-developed with FAO and Conservation International to support countries in choosing the most appropiate datasets for PRAIS4 reporting



Kazakhstan Expert Knowledge Comparison Tool - Linked to a survey this tool allows experts to compare and choose the most appropiate Land Cover and LPD maps. Languages: Russian and English

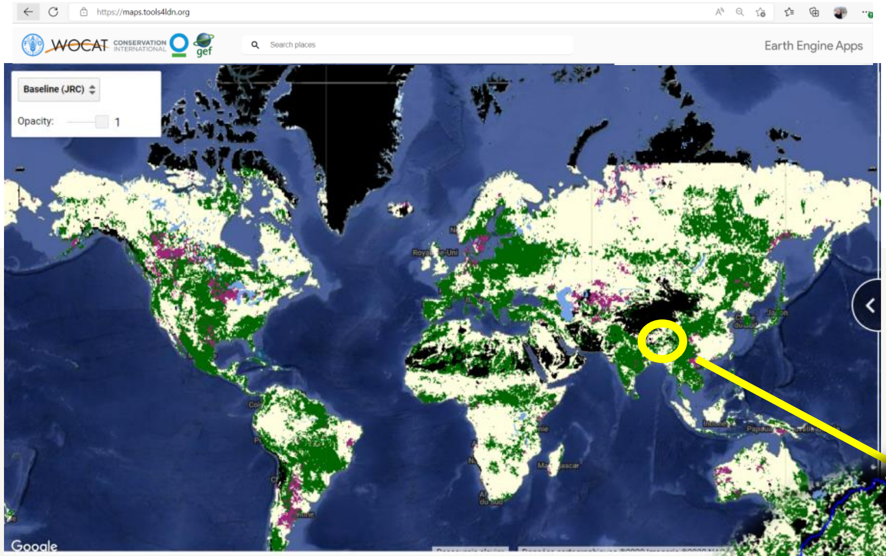
Panama LPD Comparison Tool - Co-developed with the Ministry of Environment for PRAIS4 national reporting process, to support integration of expert knowledge. Languages: Spanish and English

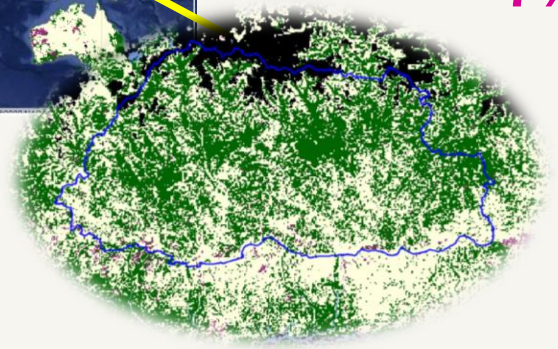
Bhutan Land Productivity Dynamics Comparison Tool - Co-developed with the National Soil Services Centre during PRAIS4 National Reporting

Ecuador LPD comparison tool - Co-developed with CONDESAN and the Ministry of Environment, Water and Ecological transition to integrate expert knowledge during the PRAIS4 national report process. Languages: Spanish and English.

Colombia LPD Comparison Tool -Co-developed with IDEAM and the Ministry of Environment for PRAIS4 National Report. Languages: Spanish and English.

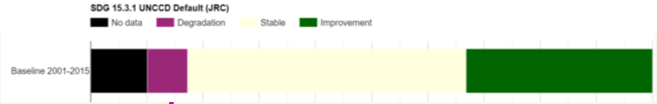
PRAIS 4 – Comparison of SDG 15.3.1



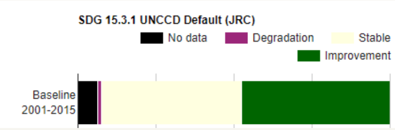


https://maps.tools4ldn.org/

Default data PRAIS4 (JRC LPD)
Baseline 2001-2015

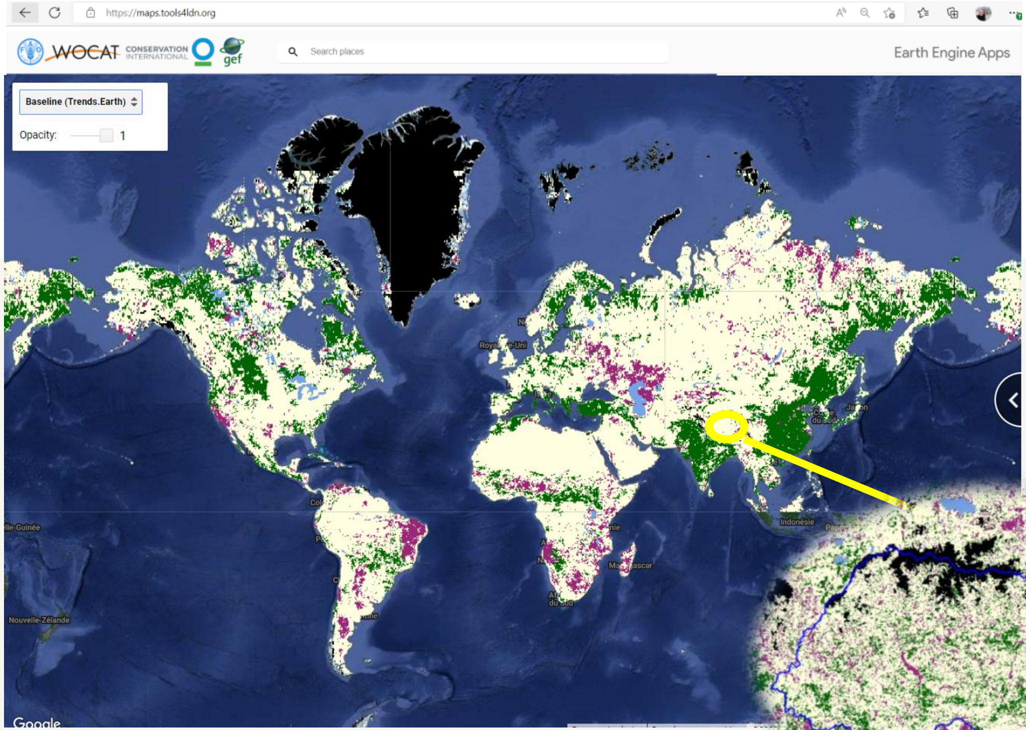


≈7% (global scale)

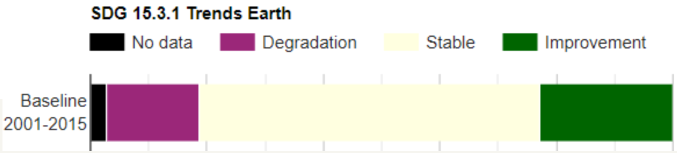


≈1.4% (Bhutan)

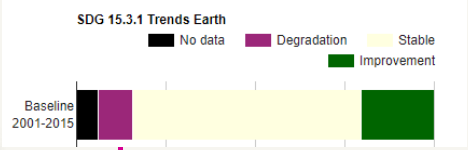
PRAIS 4 – Comparison of SDG 15.3.1



Trends.Earth LPD Baseline 2001-2015



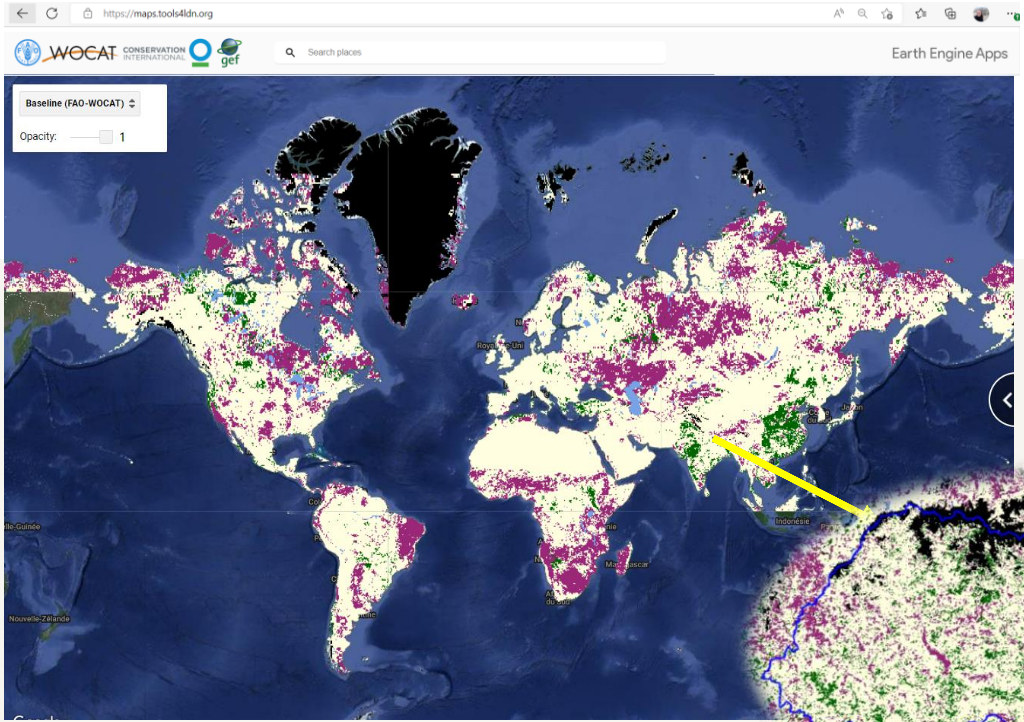
≈16% (global scale)



≈9.6% (Bhutan)

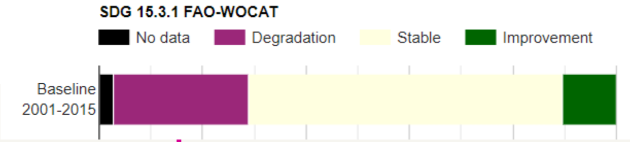
https://maps.tools4ldn.org/

PRAIS 4 – Comparison of SDG 15.3.1

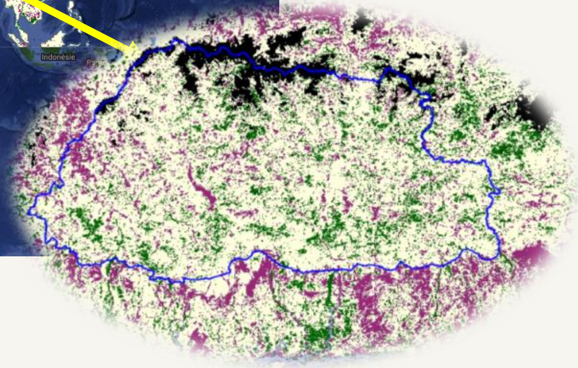


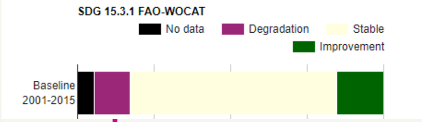
https://maps.tools4ldn.org/

FAO-WOCAT LPD
Baseline 2001-2015



≈26% (global scale)





≈11.5% (Bhutan)

4 DAY PARTICIPATORY WORKSHOP ON NATIONAL REPORTING TO THE UNCCD
January 2023

The workshop was attended by national experts from eight key agencies:

- Department of Livestock
- National Statistical Bureau
- Department of Forests and Park Services
- National Land Commission Secretariat
- National Biodiversity Centre
- Department of Geology and Mines
- National Centre for Hydrology and Meteorology
- National Soil Services Centre.

Working session: The most representative LPD map

Used a Google Earth Engine Application to compare and validate **5 different LPD maps**

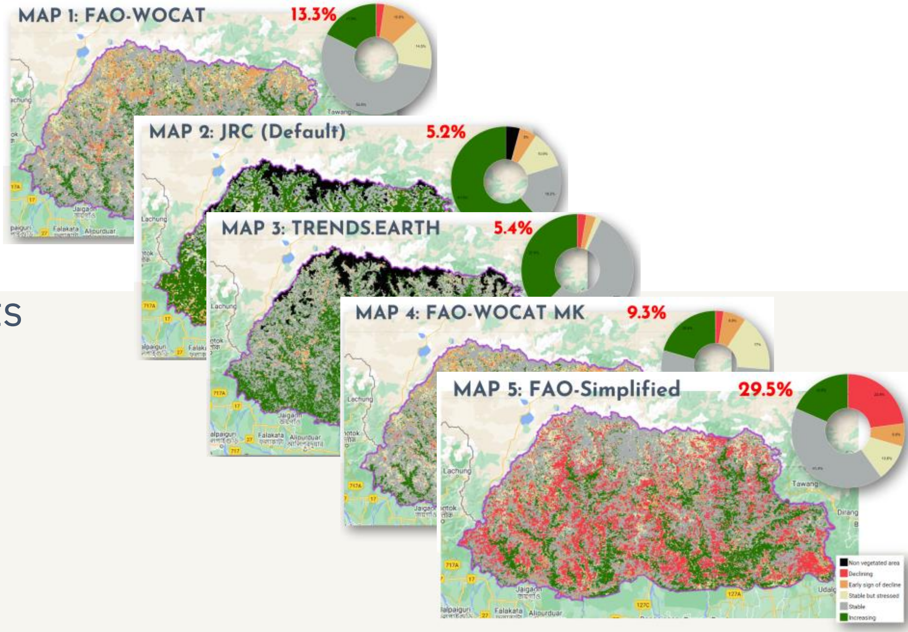
1.- Which model is best for Bhutan?
2.- Which processes relate with the "Red areas"?
3.- Which processes relate to "Green areas"?
4.- What is the model that provides the worst results?

https://wocatapps.users.earthengine.app/view/dss-bhutan-lpd

National Expert Assessment

- 5 LPD Maps were explored and compared
- Experts from different sectors used their knowledge and data to compare results in:

1. Degraded forest areas
2. Mining Areas
3. Overgrazed grasslands
4. Agricultural areas with restoration projects
5. Settlement areas



Types of sites for the comparison of maps

DEPARTMENT OF FORESTS AND PARK SERVICES
MINISTRY OF ENERGY AND NATURAL RESOURCES
ROYAL GOVERNMENT OF BHUTAN

Degraded Forests

1. *Forest fires: forest fire near Thimphu*
2. *Bark beetle infestation in Uruk*
3. *Timber Extraction Area*
4. *Timber extraction area using cable*
5. *Hydroelectric plant*

NATIONAL SOIL SERVICES CENTRE, DEPARTMENT OF AGRICULTURE, MINISTRY OF AGRICULTURE & FORESTS

SLM in Agricultural lands

1- SLM project Wangphu Gewog
2- Borangma, Norbugang rehabilitation site
3- Namlaythang, Tsangkha rehabilitation site
4- Wangphu land management site

Ministry of Energy and Natural Resources
BHUTAN
Believe

Mining sites

1- Marug ri, Nganglam 2015
2- Gumtu, limestone mine
3- Paro, Gebjana Stone Quarry 2010-2019

DOL
Department of Livestock
Ministry of Agriculture & Forests
Royal Government of Bhutan

Overgrazed grasslands

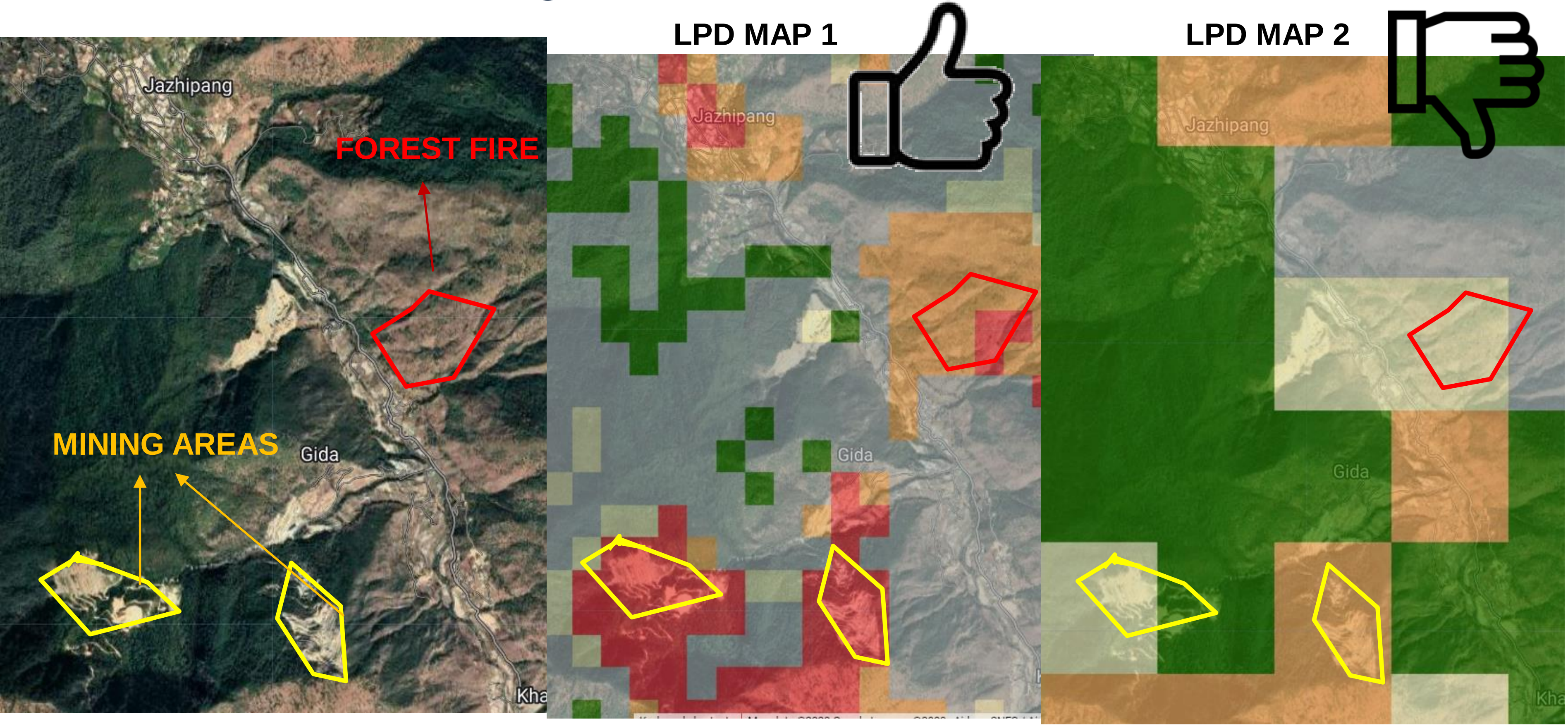
1. *Longzhi Grassland, overgrazing in northern mountainous areas with grazing by yaks*
2. *Grasslands and wetlands with overgrazing, grazed by cattle during summer months and during the winter by yaks, so all year long grazing.*

NATIONAL STATISTICS BUREAU
Towards Supporting Evidence-Based Decision Making

1. *Toorsa developing area*
2. *Thimphu district statistical analysis*

Example: Hotspots of degradation

Forest Fire and mining areas



RESULTS

*LPD 1 and **LPD 4** (FAO-WOCAT) performed better, capturing the different degradation processes*

Urban expansion was identified as declining productivity by all LPD maps

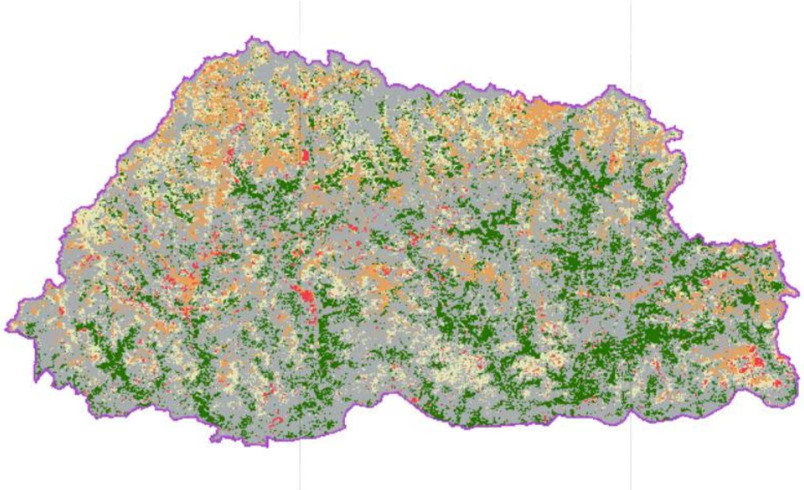
LPD 2 (JRC, default) was the least representative map, in general not capturing the degradation processes (too optimistic)

The investments and activities to rehabilitate degraded lands by the country are not reflected in the green areas, with increasing trends of land productivity, probably due to the need of more time to impact in the LPD indicator.

RESULTS: LPD 4 was selected for PRAIS 4

BASELINE

REPORTING PERIOD



SDG 15.3.1

SO1-4 Proportion of degraded land over the total land area

Proportion of degraded land over the total land area (Sustainable Development Goal Indicator 15.3.1)

This section is pre-filled with national estimates derived from global data sources. Keep the default national estimates or, in the event of data and capacity, replace them with national data.

SO1-4.T1: National estimates of the total area of degraded land (in km²), and the proportion of degraded land relative to the total land area

	Total area of degraded land (km²)	Proportion of degraded land over the total land area (%)
Baseline Period	541	1.4
Reporting Period	2218	5.7
Change in degraded extent	1677	

DEFAULT ESTIMATIONS

Proportion of degraded land over the total land area (Sustainable Development Goal Indicator 15.3.1)

SO1-4.T1: National estimates of the total area of degraded land (in km²), and the proportion of degraded land relative to the total land area

	Total area of degraded land (km²)	Proportion of degraded land over the total land area (%)
Baseline Period	4 607 .57	11 .9
Reporting Period	5 227 .4	13 .5
Change in degraded extent	619.83	

OUR ESTIMATIONS

TRENDS IN LAND PRODUCTIVITY

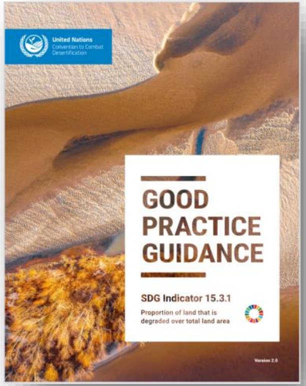
	Data
Panama	Trend.Earth default LPD
Colombia	WOCAT-FAO LPD
Ecuador	Trends.Earth climate correction
Bosnia and Herzegovina	WOCAT-FAO LPD
Turkey	WOCAT-FAO LPD
Bhutan	WOCAT-FAO LPD

The default LPD was always regarded as the worst one, as well as FAO simplified

It is important to include the climate correction in the WOCAT FAO

WOCAT FAO performed better in arid areas

SDG 15.3.1
PROPORTION OF LAND THAT IS DEGRADED



TRENDS IN LAND COVER

TRENDS IN LAND PRODUCTIVITY

TRENDS IN CARBON STOCKS

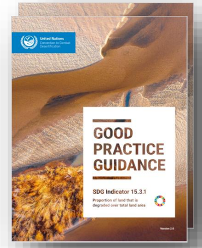
*“While it is difficult for a single indicator to fully capture the state or condition of the land, the sub-indicators are **proxies** to monitor the essential variables that reflect the capacity of the land to deliver ecosystem services”* Sims et al. 2021

Changes in Soil Organic Carbon

Maps of SOC are based on past observations (legacy data for several years) collected by different sampling campaigns, different measurement techniques & at different depths.

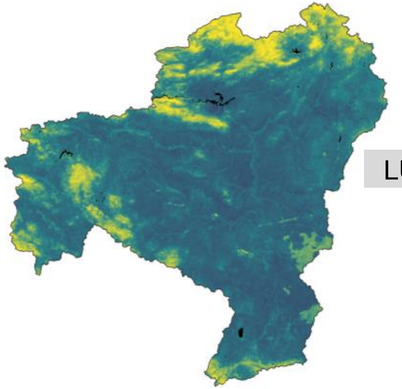
Changes in Soil organic carbon

Default data & approaches (Tier 1)



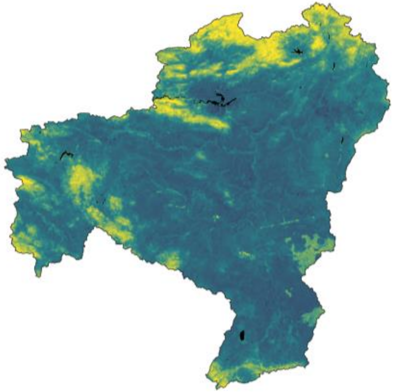
Combined land cover & SOC approach

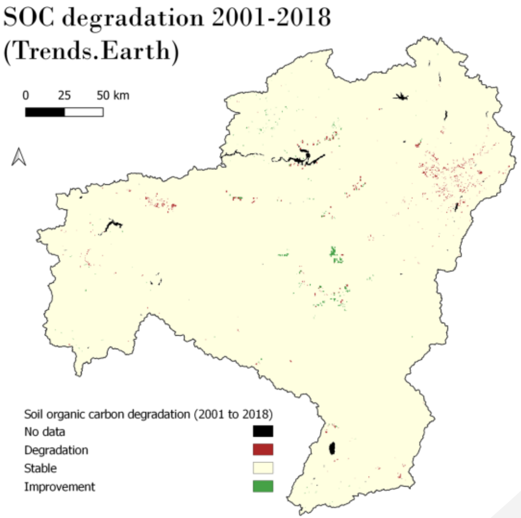
2001



LU change

2015





Default data set: ISRIC **SoilGrids 250m 0-30 cm SOC stock (tonnes/ha)**

A TIERED APPROACH

Default data & approaches (Tier 1)

Table 5-2. Conceptual framework for quantifying changes in SOC stock

Level of detail	SOC stock baseline	SOC stock changes
Tier 1	Apply IPCC Tier 1 methods that relate SOC stock to environmental and management factors, with separate approaches and defaults for mineral and organic soils. As an alternative to IPCC default values, reference stocks can be determined from global digital maps of SOC.	Apply IPCC Tier 1 methods to assess SOC stock change after default 20-year period[1]; methods differ for mineral and organic soils. Option to use global soil map data for reference stocks combined with default stock change factors.
Tier 2	Apply IPCC Tier 2 method i.e., update of SOC reference stocks with country-specific values. A blend of data sources may be used. SOC reference stocks can be determined from national digital soil maps or from measurements (e.g., national soil surveys).	Apply IPCC Tier 2 method using stock change factors with country-specific values. A blend of data sources may be used. Stock change factors can be determined from region/country-specific long-term experiments or other field measurements (e.g. chronosequence studies).
Tier 3	Two general approaches: **a)** Use a national on-ground measurement-based inventory with a monitoring network; **b)** Use calibrated and validated ecosystem (process-based) modelling which links the model and country-specific spatial datasets, such as soil maps, land use, climate, and agricultural activity (i.e. land use/management).	**a)** Apply IPCC Tier 3 national soil monitoring method with large sampling density to minimise uncertainty, and to represent all management systems and associated land-use changes, across all climatic regions and major soil types; **b)** Apply ecosystem modelling for changed land-uses and management systems, calibrated/validated at points using results from new field measurements/monitoring.

GPG v2.0, 2021

If you opted not to use default Tier 1 data, what did you use to calculate the estimates above?

- ○ Modified Tier 1 methods and data
- ○ Tier 2 (additional use of country-specific data)
- ○ Tier 3 (more complex methods involving ground measurements and modelling)

Bhutan – Working Draft – SO1-3

SO1-1 SO1-2 SO1-3 SO1-4 SO1 Voluntary Targets

SO1-3 Trends in carbon stocks above and below ground

Soil organic carbon stocks

This section is pre-filled with default soil organic carbon (SOC) stock data derived from the SoilGrids250m dataset of the International Soil Reference and Information Centre (ISRIC). Keep the default national estimates or, in the event of data and capacity, replace them with national datasets.

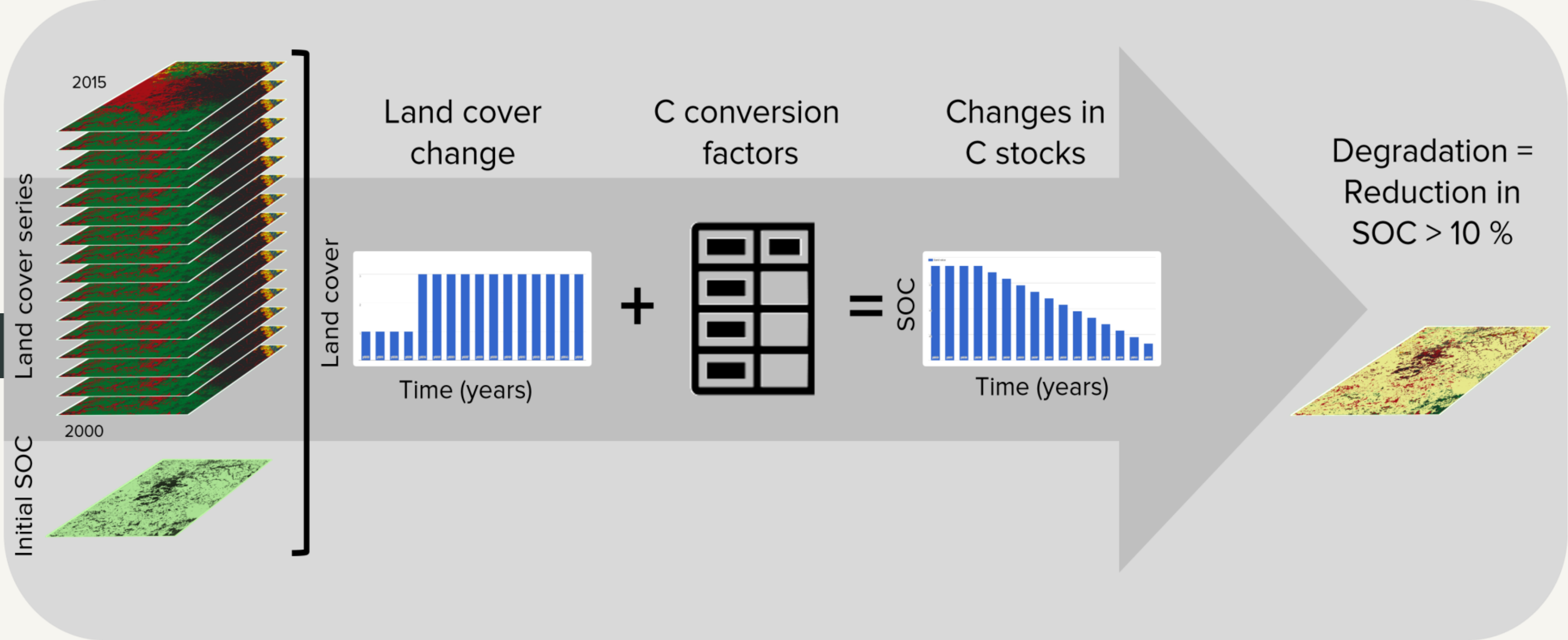
SO1-3.T1: National estimates of the soil organic carbon stock in topsoil (0-30 cm) within each land cover class (in tonnes per hectare).

	Soil organic carbon stock in topsoil (t/ha)						
Year	Tree-covered areas	Grasslands	Croplands	Wetlands	Artificial surfaces	Other Lands	Water bodies
2000	167	122	113	314	409	2	54
2001	167	123	112	314	409	2	54
2002	167	125	112	314	409	2	54
2003	166	126	113	314	409	2	54
2004	166	128	114	314	409	2	54
2005	165	129	114	314	358	2	54
2006	165	129	114	314	358	2	54
2007	165	130	115	314	168	2	54

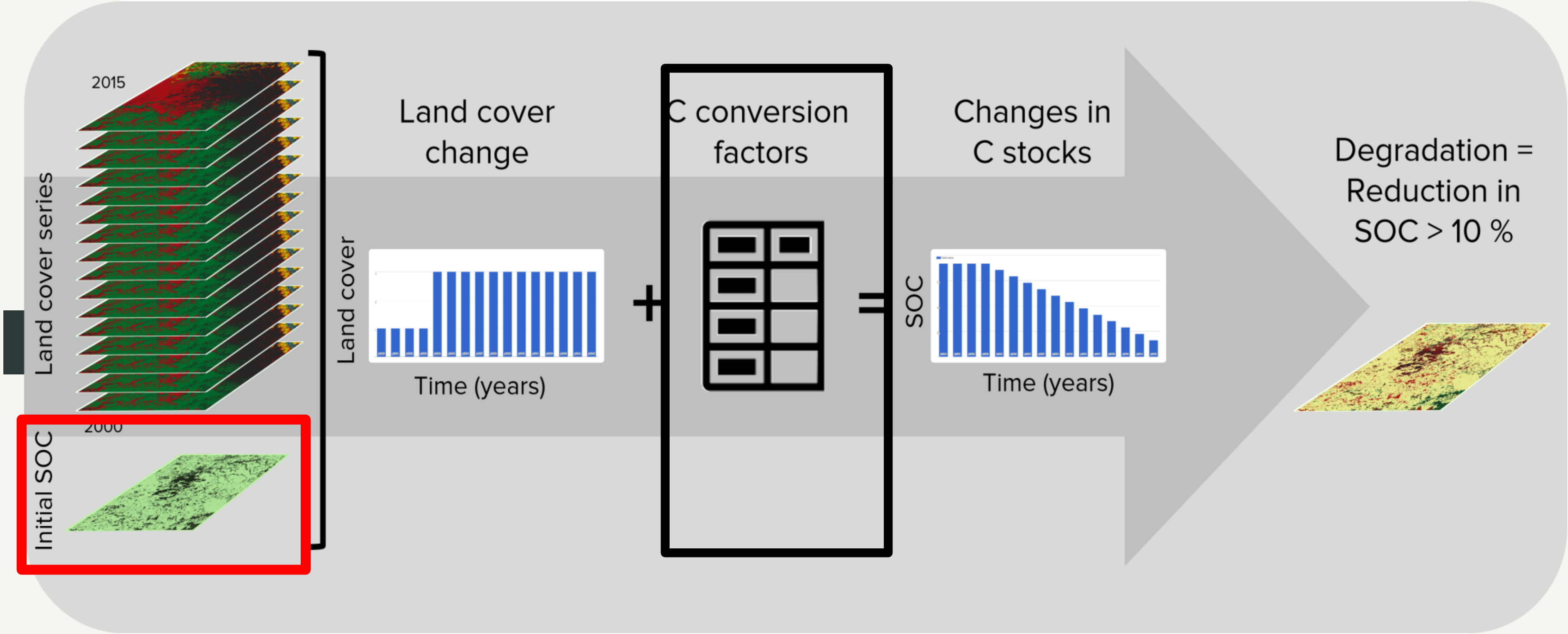
Ideally:
A Soil Monitoring System that allows to keep track of changes in SOC (and other soil properties) over time.

Continues to 2019

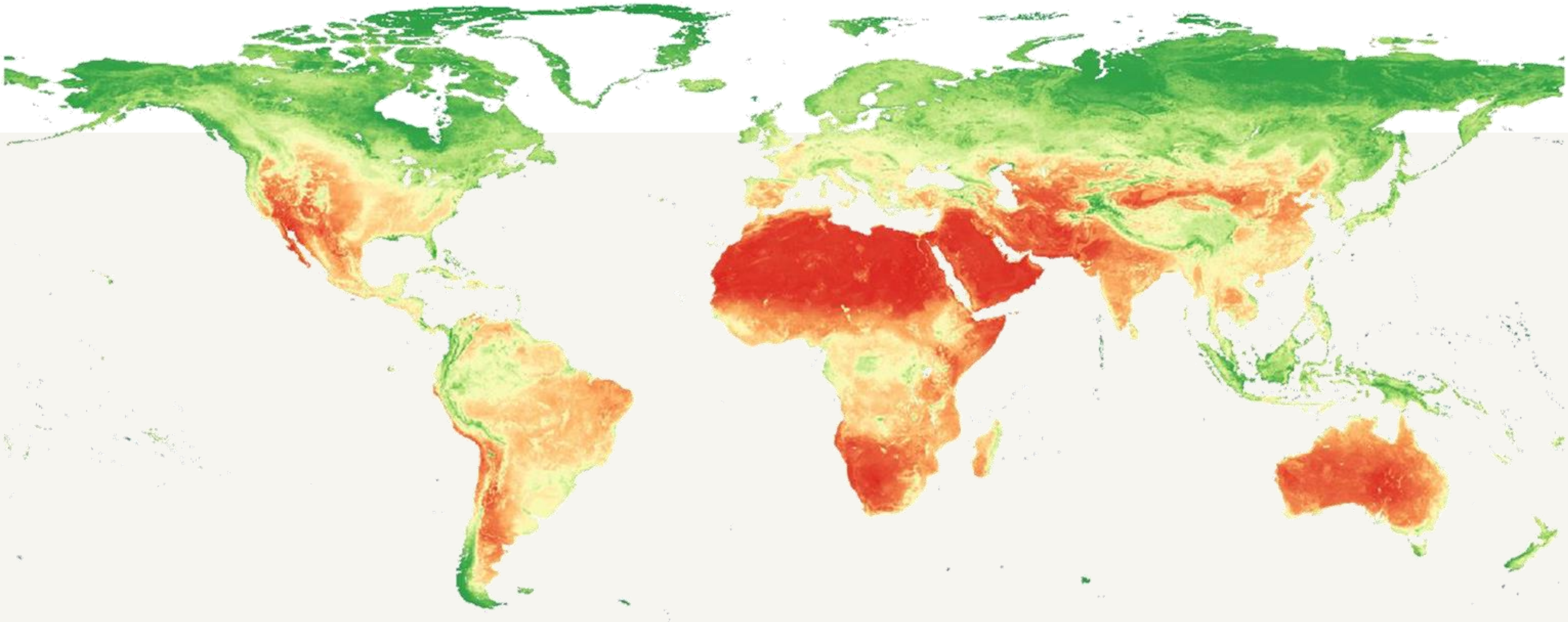
Method combining land cover and conversion factors in TRENDS.EARTH



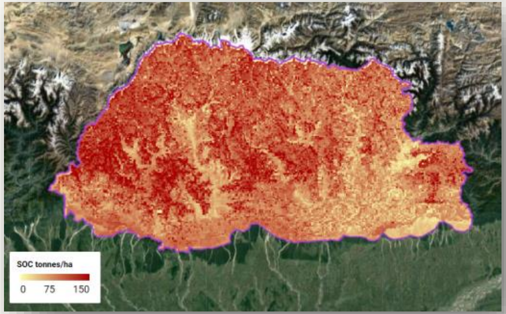
Method combining land cover and conversión factors in TRENDS.EARTH



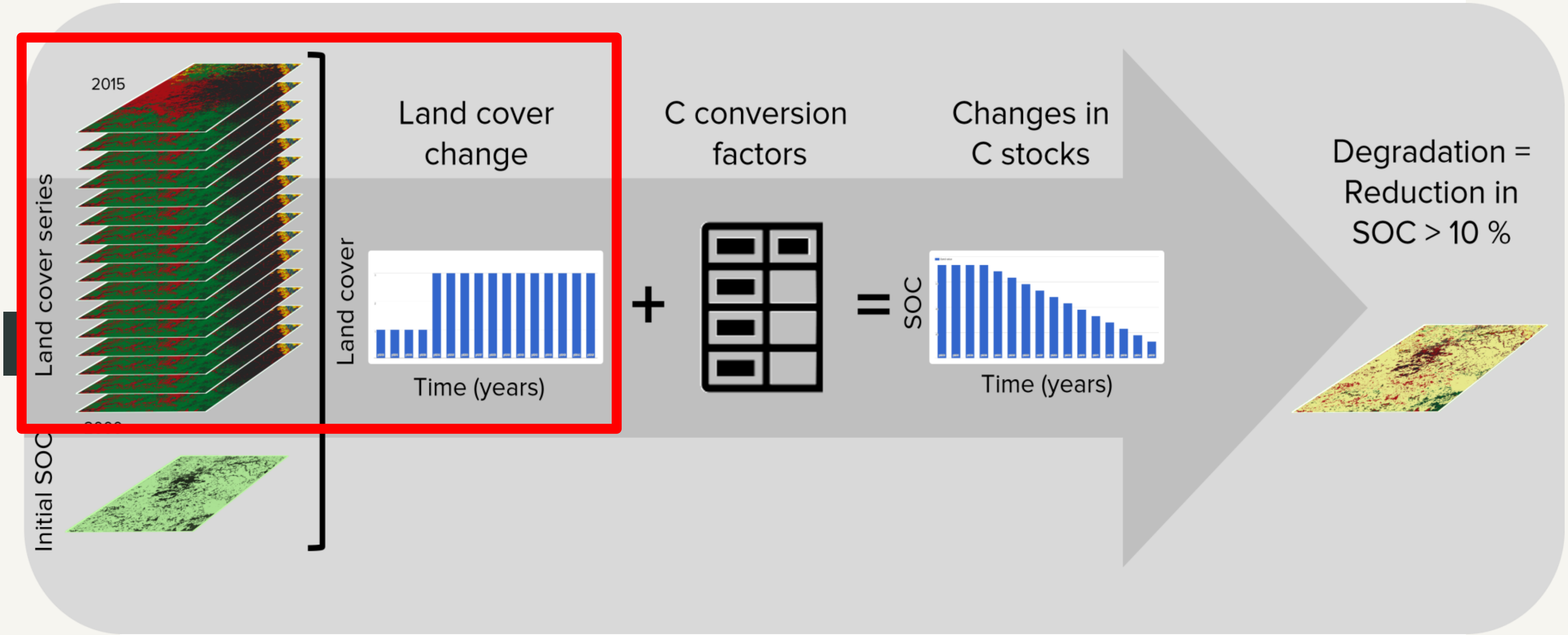
DEFAULT DATA SET: SoilGrids 250m 0-30 cm SOC stock (tonnes/ha)



NATIONAL SOC MAPS

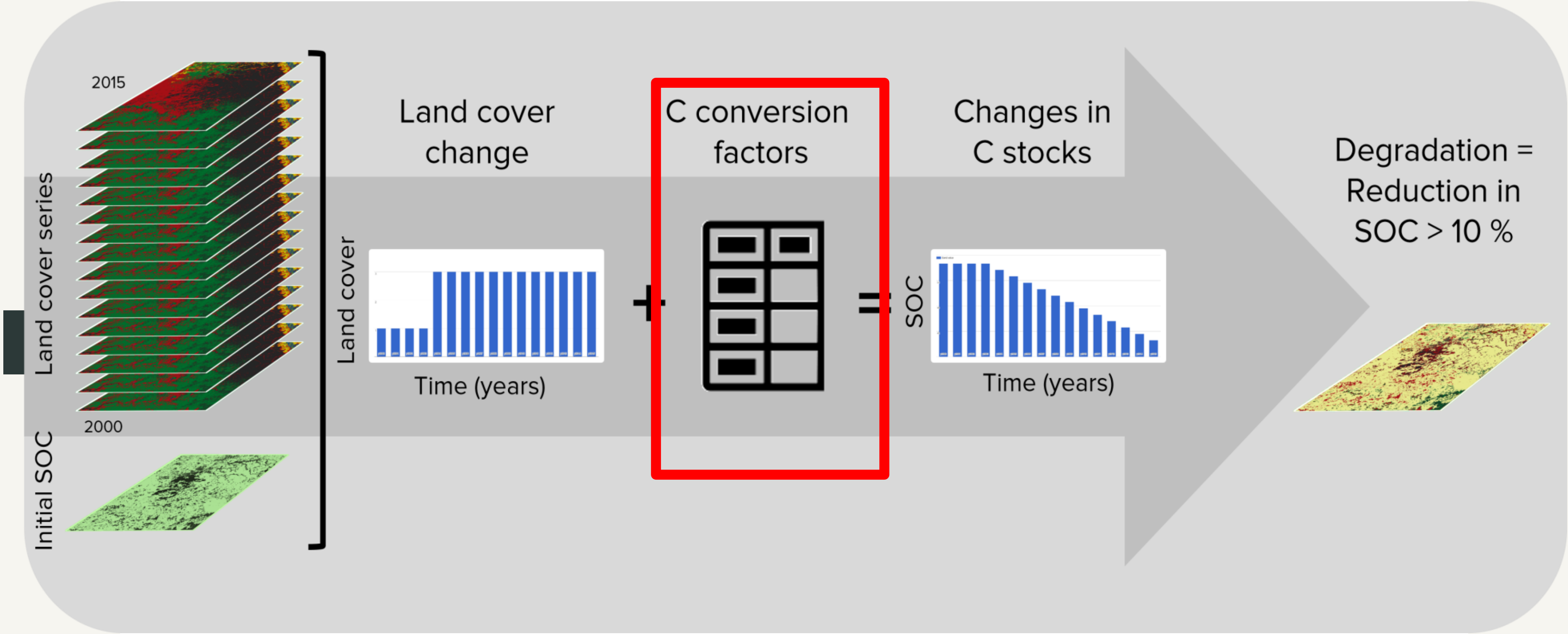


Method combining land cover and conversión factors in TRENDS.EARTH



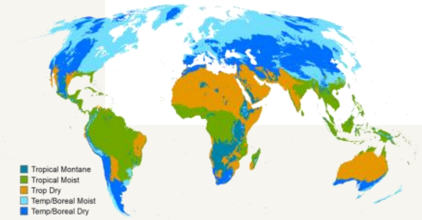
Land-use change based calculations of SOC changes disregard management

Method combining land cover and conversión factors in TRENDS.EARTH



DEFAULT CONVERSION FACTORS

LU coefficients	Forest	Grasslands	Croplands	Wetlands	Artifical areas	Bare lands	Water bodies
Forest	1	1	f	1	0.1	0.1	1
Grasslands	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
Artifical areas	2	2	2	2	1	1	1
Bare lands	2	2	2	2	1	1	1
Water bodies	1	1	1	1	1	1	1

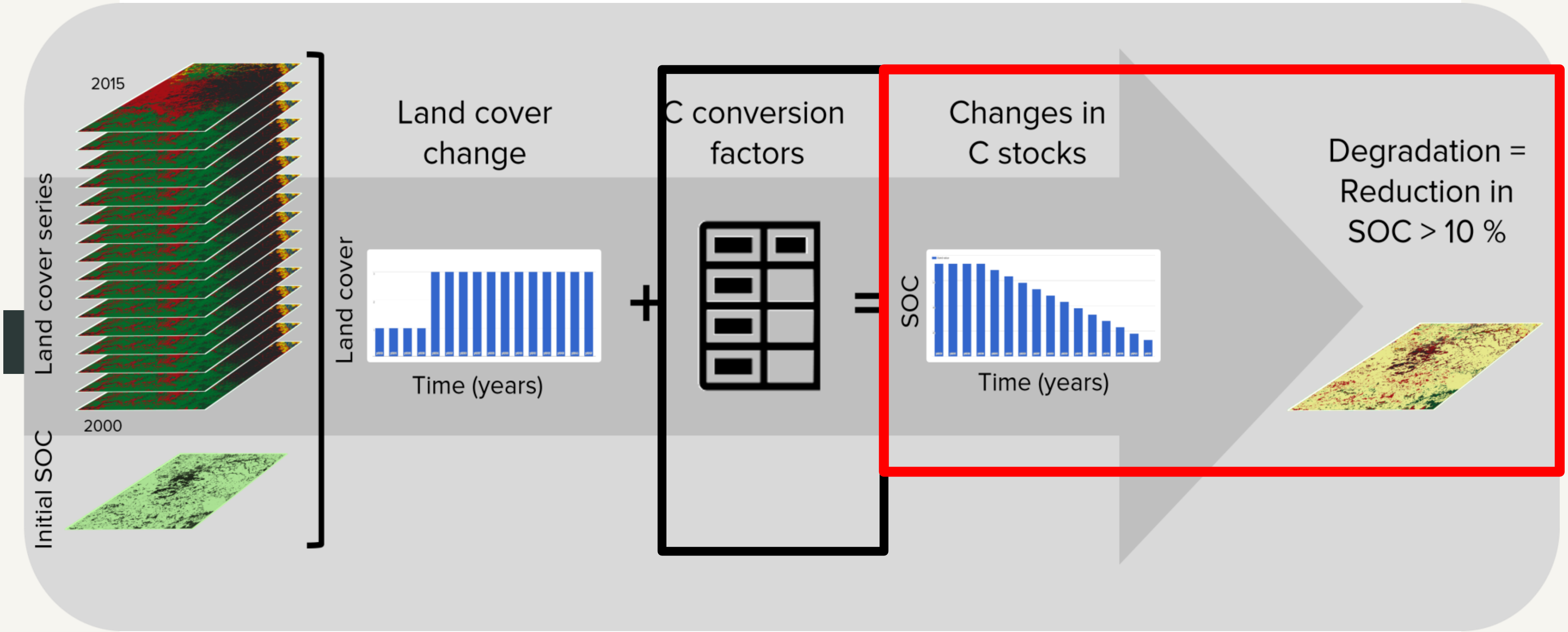


Tropical Montane (f = 0.64)
Tropical Moist (f = 0.48)
Tropical Dry (f = 0.58)
Temperate Moist (f = 0.69)
Temperate Dry (f = 0.80)

20 Years

Blanket calculations: not representative of local realities

Method combining land cover and conversión factors in TRENDS.EARTH



IMPROVING ESTIMATIONS

Default		National
Default data set: ISRIC SoilGrids 250m 0-30 cm SOC stock (ton/ha)	→	National SOC Map - 0-30 cm SOC stock (ton/ha)
Default data set for Land Cover Change: ESA CCI	→	NATIONAL?
IPCC & UNCCD Conversion coefficients for changes in land use	→	Conversion factors from National SOC map

RELATIVELY SIMPLE

COMBINING THE 3 SUB INDICATORS

The one Out All Out Principle (1OAO)

Land is degraded when degradation is shown in any one of the sub-indicators.

1OAO is a conservative way to integrate the sub-indicators that is consistent with the precautionary principle. The 1OAO approach will become increasingly conservative as the number of indicators applied in this manner increases.

SDG 15.3.1

SO1-1 (LCC)
“transformational” variable

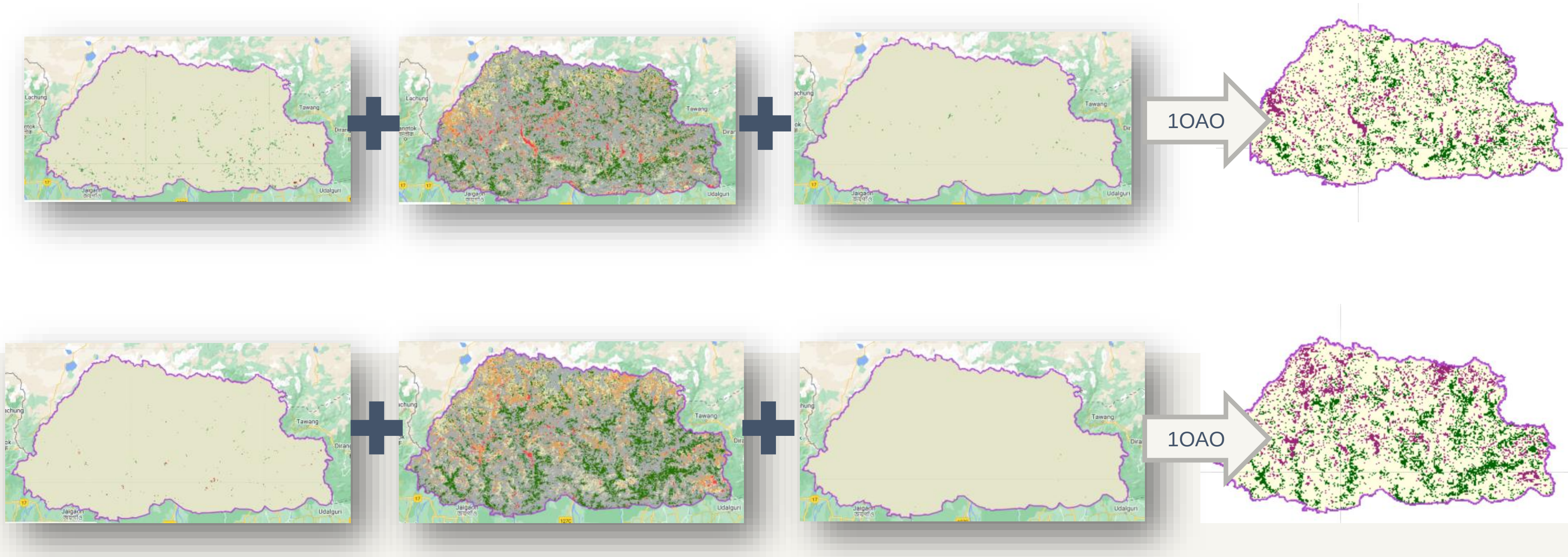
SO1-2 (LPD)
“fast” ecological variable

SO1-3 (SOC)
“slow” ecological variable

SDG 15.3.1

Baseline

Reporting period



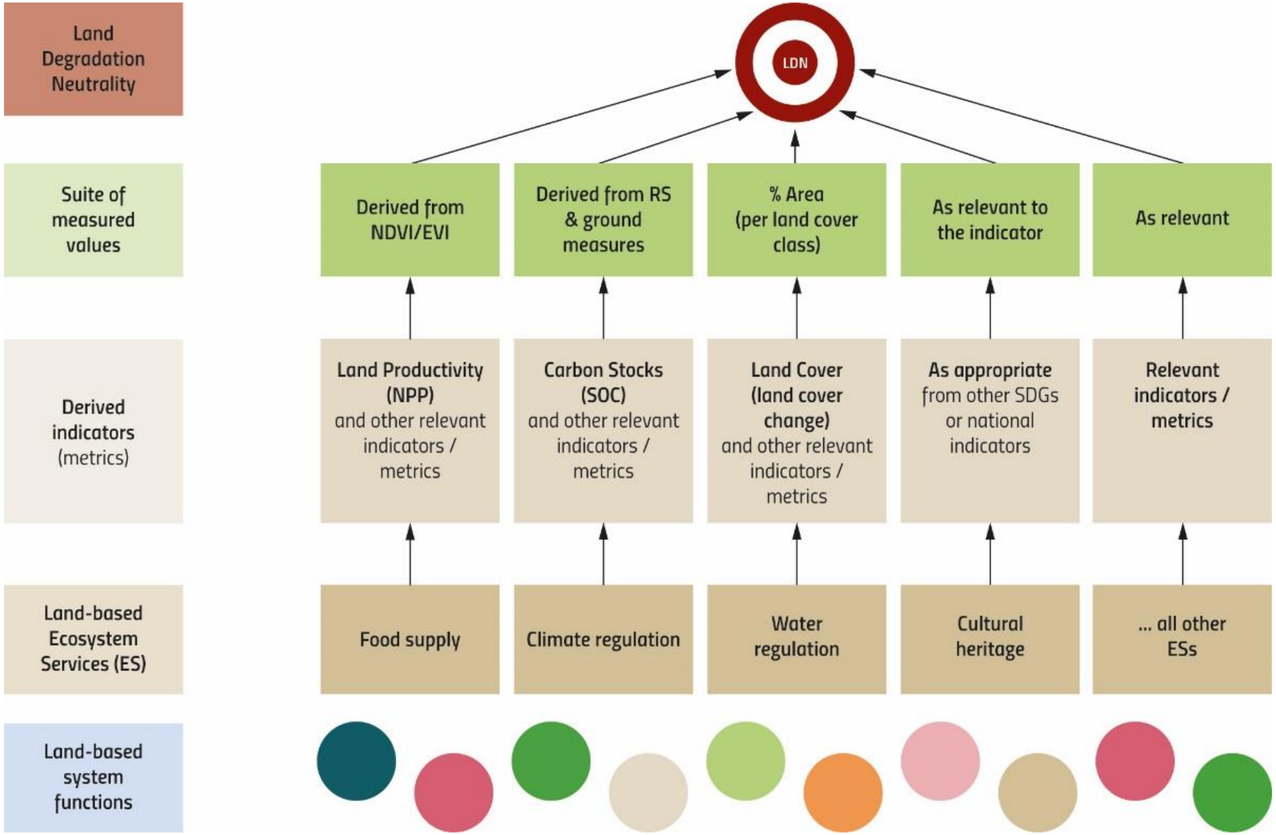
Working session 2

Using the 1OAO principle to combine the three sub-indicators into a single binary indicator, fill in the table indicating for each row whether the land unit (pixel) would be classified as either degraded (Y) or not degraded (N).

Sub-indicator			**Indicator**
Land cover	Productivity	SOC	Degraded
Y	Y	Y	Y
Y	Y	N	?
Y	N	Y	?
Y	N	N	?
N	Y	Y	?
N	Y	N	?
N	N	Y	?
N	N	N	?

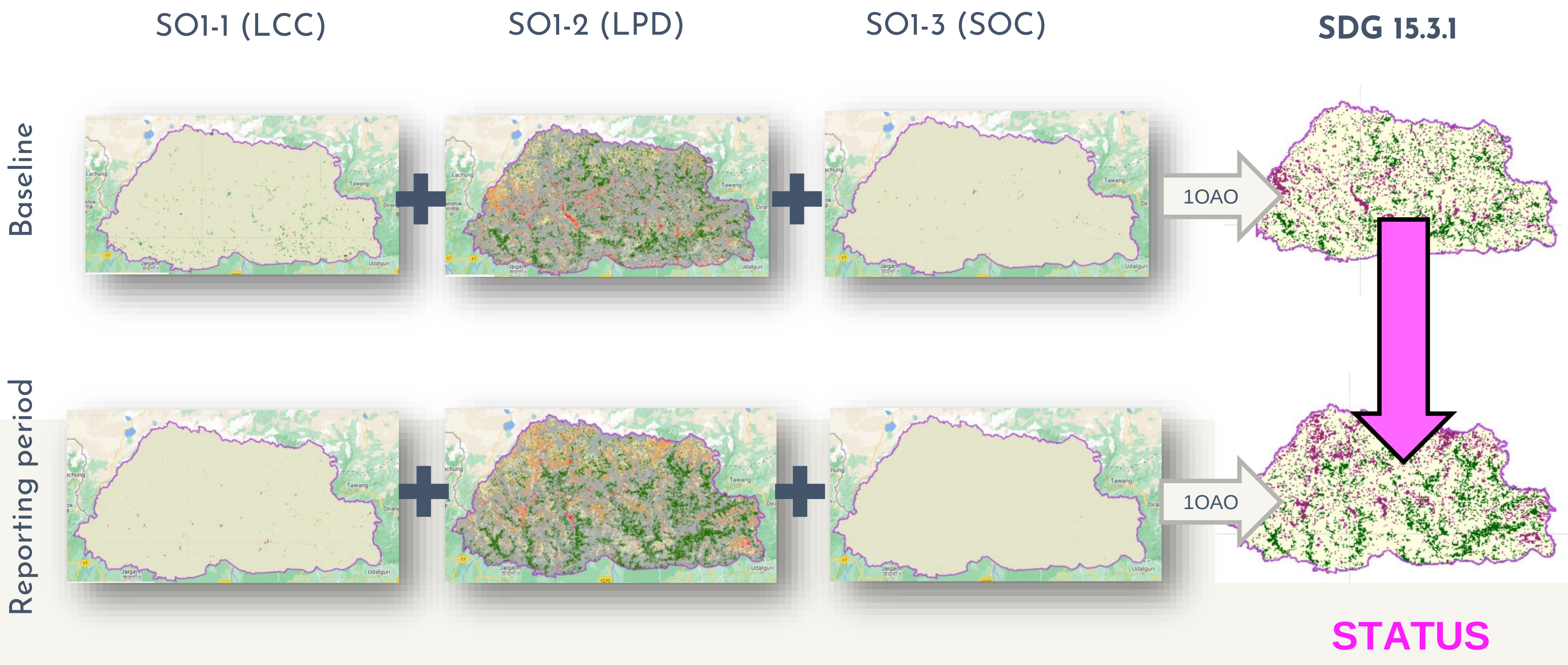
Selection of indicators based on ecosystem services to be monitored

Additional sub-indicators may be required to fully assess land degradation in some areas and under certain conditions. **Countries are encouraged to identify complementary sub-indicators** that address their national and sub-national needs if they will strengthen the interpretation of the 3 globally relevant sub-indicators. These may include variables used for reporting on other SDGs or national assessments.



Source: Orr et. al., 2017

SDG 15.3.1: COMPARISON OF PERIODS



SDG 15.3.1

SO1-4 Proportion of degraded land over the total land area

Proportion of degraded land over the total land area (Sustainable Development Goal Indicator 15.3.1)

This section is pre-filled with national estimates derived from global data sources. Keep the default national estimates or, in the event of data and capacity, replace them with national data.

SO1-4.T1: National estimates of the total area of degraded land (in km²), and the proportion of degraded land relative to the total land area

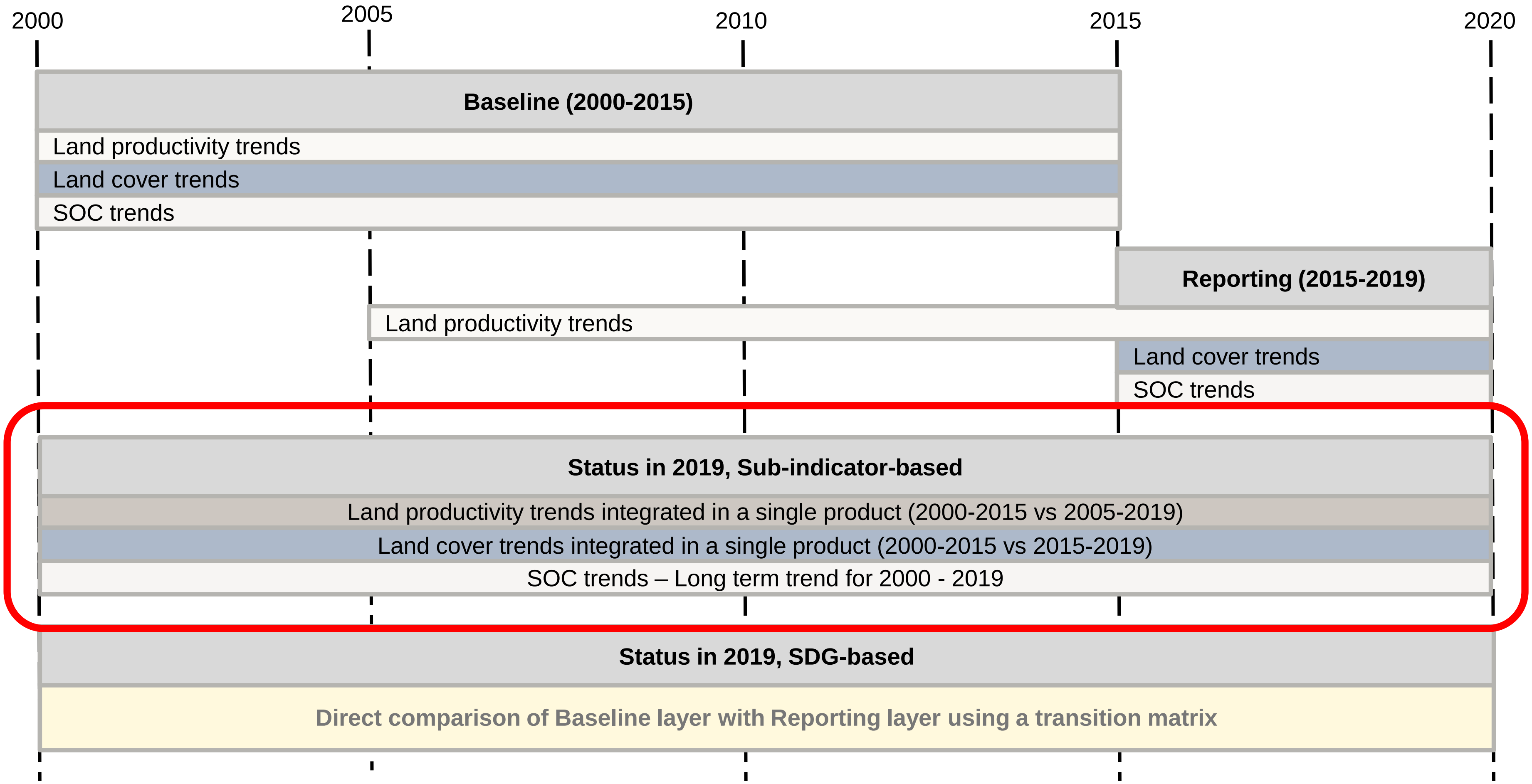
	Total area of degraded land (km²)	Proportion of degraded land over the total land area (%) ⓘ
Baseline Period ⓘ	541	1.4
Reporting Period ⓘ	2218	5.7
Change in degraded extent ⓘ	1677	

STATUS

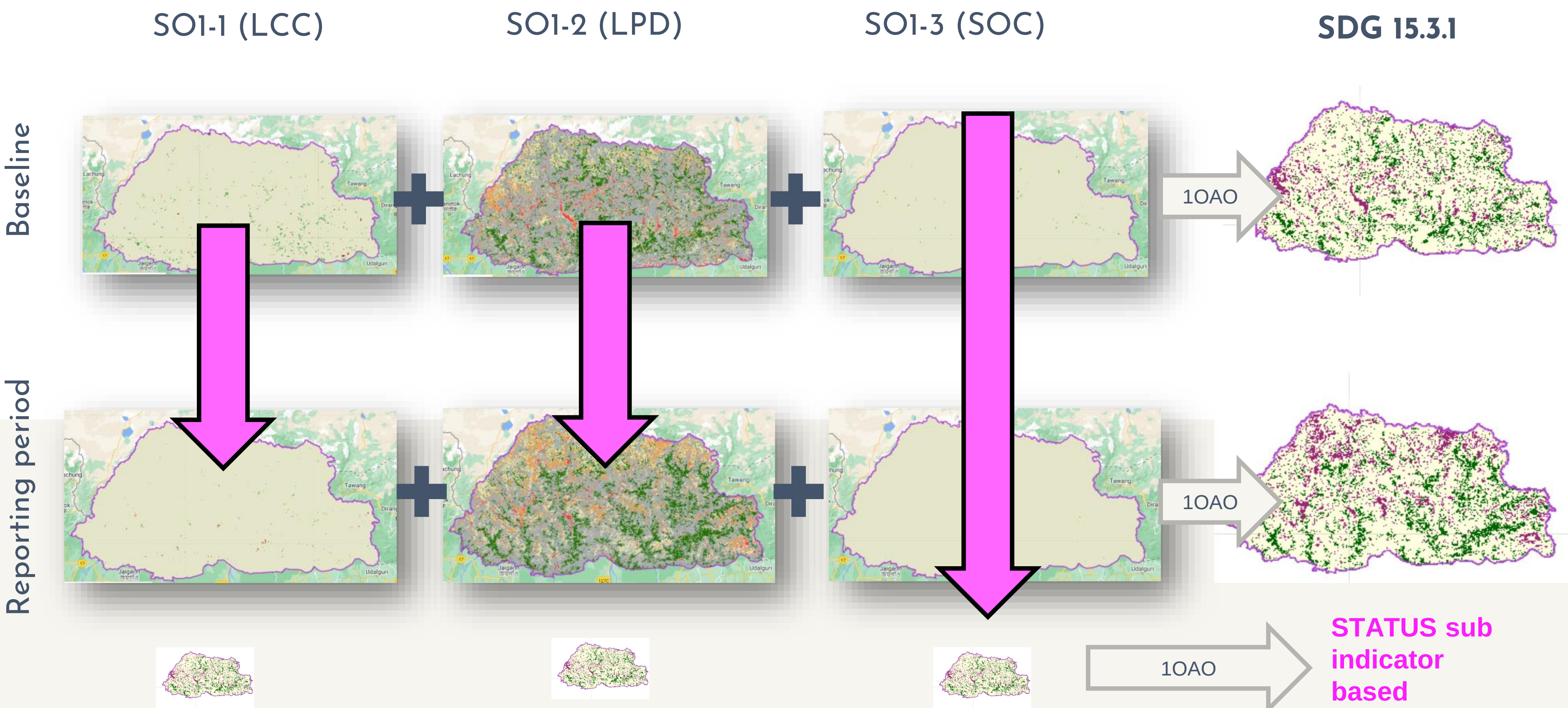
The reporting period estimate includes (i) areas of land with new degradation since 2015; and (ii) areas of land that have persisted in a degraded state since the baseline period (i.e. have not improved to a non-degraded state).

Baseline period \ Reporting Period			
Classes	Degraded	Stable	Increasing
Degraded	Degrading	Degrading	Stable
Stable	Degrading	Stable	Improving
Increasing	Degrading	Stable	Improving

Time periods on which the SDG 15.3.1 layers are calculated



SDG 15.3.1: COMPARISON OF PERIODS



RESULTS OF THE PARTICIPATORY PROCESS

COLOMBIA

SO1-4.T1: National estimates of the total area of degraded land (in km²), and the proportion of degraded land relative to the total land area

	Total area of degraded land (km²)	Proportion of degraded land over the total land area (%) ⓘ
Baseline Period ⓘ	85348	7.6
Reporting Period ⓘ	98370	8.8
Change in degraded extent ⓘ	13022	

Default

SO1-4.T1: Estimaciones nacionales de la superficie total de las tierras degradadas (en kilómetros cuadrados), y proporción de tierras degradadas en comparación con la superficie terrestre total

	Superficie total de las tierras degradadas (km²)	Proporción de tierras degradadas en comparación con la superficie terrestre total (%)
Período de Referencia	331 897	28 ,8
Período sobre el que se informa	343 934	29 ,8
Variación de la extensión de las tierras degradadas	12037	

Reported

RESULTS OF THE PARTICIPATORY PROCESS

SDG 15.3.1: DEFAULT AND REPORTED

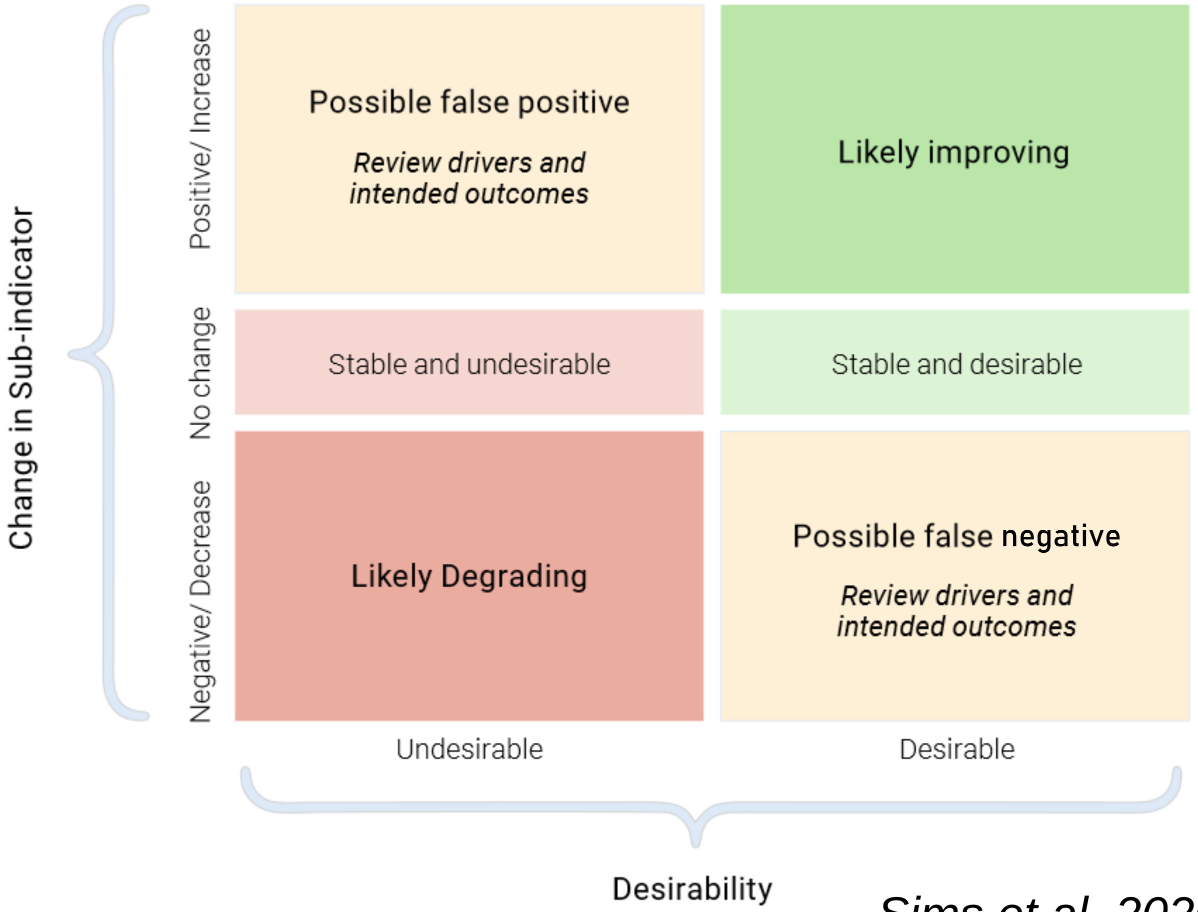
REPORTED DEGRADATION WAS USUALLY HIGHER THAN DEFAULT ESTIMATIONS

	BASELINE		REPORTING PERIOD	
	Default	Reported	Default	Reported
Panama	9.4	35.2	10.4	32.2
Colombia	7.6	28.8	8.8	29.8
Ecuador	8	21.9	10	12.8
Bosnia and Herzegovina	7.9	8.5	7.9	6.8
Turkey	1.4	14.3	3.4	13.4
Bhutan	2.7	11.9	11.1	13.5

FALSE POSITIVES AND NEGATIVES

*"Countries have the option to identify areas of '**false negative**' degradation, in which the outcome of the 1OAO process has **incorrectly resulted in an area being identified as degraded**. A similar opportunity is also available to identify areas of '**false positive**' degradation, where the 1OAO process has **incorrectly indicated that an area is not degraded even though the change in land condition is considered to be sufficiently negative to qualify as degraded** in the context of Indicator 15.3.1. Readers are referred to Sims et al. (2020), which provides more guidance on how to address false positives and false negatives for reporting on Indicator 15.3.1 and LDN, including an interpretation matrix to guide countries in labelling areas where the outcomes of the 1OAO process appear counterintuitive."*

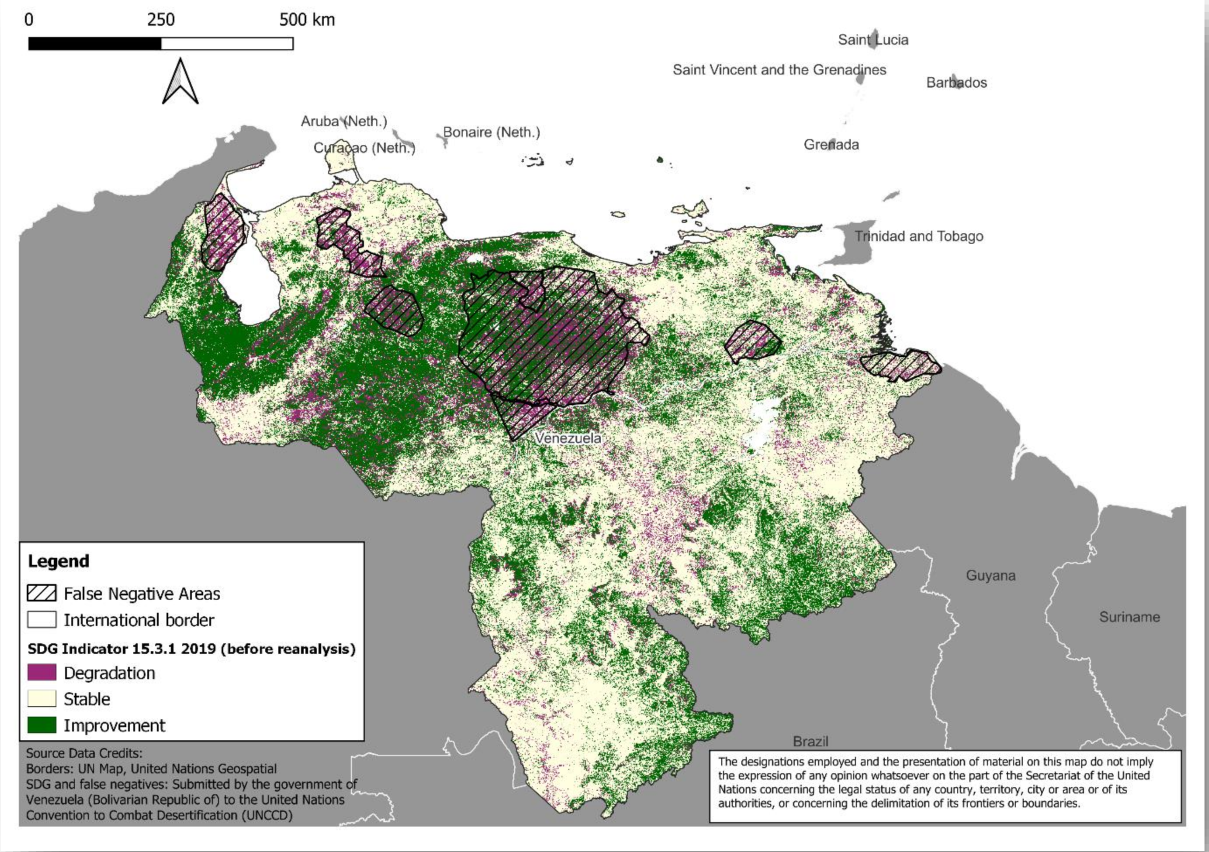
CONSENSUS between Scales - biological meaning



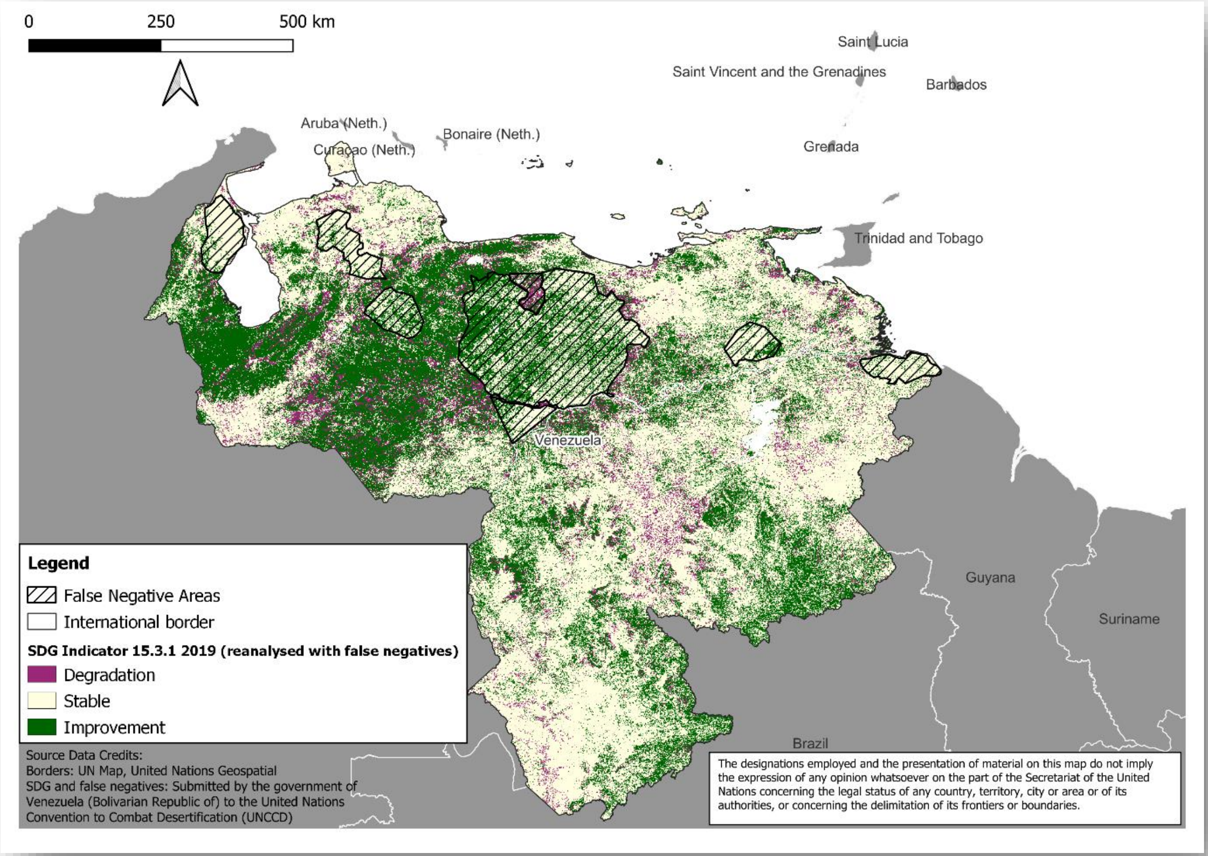
Sims et al. 2020

FALSE POSITIVES AND NEGATIVES IN PRAIS4 Platform

The SDG Indicator 15.3.1 output spatial layer for Venezuela, based on default data, with the areas of false negative processes superimposed on the map.



The SDG Indicator 15.3.1 final and reported spatial layer for Venezuela, based on the recalculation of areas of false negative processes, with the degraded areas recalculated as improvement or stable areas.




WOCAT
THANK YOU!