Sustainable Land Management:
A holistic approach to preserve 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.
MOTIVATION

Need to map degradation in a meaningful way to make decisions and prioritize sites of interventions.

Countries and experts often find that the LPD maps do not represent the reality.

Regional assessments: i.e. Overview of LDN in Central Asia and Eastern Europe

GEF funded LDN Projects - ILUP

Requests of support from countries

Central Asia and Turkey in CACILM2 project: e.g. declining trends in deserts lead to overestimation

Argentina: previous experience with PRAIS 3 (Teich et al. 2019) comparing LPD maps

Colombia, Uruguay, Ecuador, etc: high discrepancies with national estimations
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/e0032bfa4dec08f77d8dd5408d1ed67
GLOBAL RESULTS of the previous script for different periods

**Baseline Period 2001 - 2015**
- 10.2%
- 5.7%
- 20.1%
- 48.9%
- 15.1%

**Reporting Period 2005 - 2019**
- 12.4%
- 5.1%
- 17.6%
- 50.1%
- 14.8%

**Long-Term 2001 - 2021**
- 21.8%
- 4.4%
- 13.1%
- 47.9%
- 12.8%
HOW IS IT CALCULATED?

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

SUB-INDICATORS
Steadiness (trend + MTID), initial biomass, State

CLASSIFICATION
36 categories groups in 5 LPD categories (see table)

MASKS
Deserts and water
01 DATA

Seasonality is removed by calculating the annual means.

Quality correction QC: Pixels with SummaryQA of 2 and 3 are replaced by the annual mean value.
**TREND**

The significance is considered Mann Kendall ($\alpha=0.05$)

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)
**Baseline:** 15 years

**Time 1:** Mean of First 4 years

**Time 2:** Mean of last 4 years

1. Locate the position of these values

Threshold is a percentile jump larger 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
### CATEGORIZATION:

<table>
<thead>
<tr>
<th>Steadiness (ST)</th>
<th>ST1 (T-/MTID-)</th>
<th>ST2 (T-/MTID+) (T0/MTID-)</th>
<th>ST3 (T0/MTID+) (T+/MTID-)</th>
<th>ST4 (T+/MTID+)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial mean biomass low/medium high</td>
<td>L</td>
<td>M</td>
<td>H</td>
<td>L</td>
</tr>
<tr>
<td>GPP change (negative - neutral n, positive +)</td>
<td>-/n/+</td>
<td>-/n/+</td>
<td>-/n/+</td>
<td>-/n/+</td>
</tr>
</tbody>
</table>

---

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

var steadiness = ee.Image(8)
  .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(3)), 2) // T 0 MTDI-
  .where(finalTrend.eq(2).and(MTDIcode.eq(2)), 3) // T 0 MTDI+
  .where(finalTrend.eq(3).and(MTDIcode.eq(3)), 3) // T4 MTDI-
  .where(finalTrend.eq(3).and(MTDIcode.eq(2)), 4) // T4 MTDI-
  .where(waterMask.eq(2), 0);
```

---

**Tabulation and labelling of above variables.**

- ST1/L-: 1
- ST1/M-: 2
- ST1/H-: 3
- ST2/L-: 10
- ST2/M-: 11
- ST2/H-: 12
- ST3/L-: 19
- ST3/M-: 20
- ST3/H-: 21
- ST4/L-: 28
- ST4/M-: 29
- ST4/H-: 30

**Assignment of 36 sub-classes to final 5 LPD classes**

- ST1/L+: 4
- ST1/M+: 5
- ST1/H+: 6
- ST2/L+: 13
- ST2/M+: 14
- ST2/H+: 15
- ST3/L+: 22
- ST3/M+: 23
- ST3/H+: 24
- ST4/L+: 31
- ST4/M+: 32
- ST4/H+: 33
- ST5/L+: 7
- ST5/M+: 8
- ST5/H+: 9
- ST6/L+: 16
- ST6/M+: 17
- ST6/H+: 18
- ST7/L+: 25
- ST7/M+: 26
- ST7/H+: 27
- ST8/L+: 34
- ST8/M+: 35
- ST8/H+: 36

**LPD Class**

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

**Range of Labels included**

- 1-8
- 9-14
- 15-22
- 23-32
- 33-36
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
16-days NDVI time series

If NDVI is always below 0.25

Masked as desert

STABLE
WHERE HAS IT BEEN USED/TESTED?

01
Eastern Europe and Central Asia

02
PROJECTS
Uruguay, Cabo Verde, Brasil, Kazakhstan, Colombia, Panamá, Madagascar, Sri Lanka, Ecuador, Turkey, Bosnia & Herzegovina, and more...

03
PRAIS4
Colombia, Panamá, Ecuador, Turkey, Bosnia & Herzegovina, Bhutan

https://doi.org/10.4060/cb7986en
THANKS!

For more info please contact

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