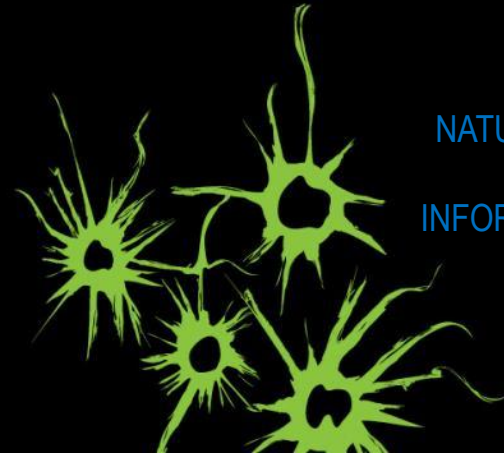# UNIVERSITY OF TWENTE.

# MEASURING LANDSCAPE PERFORMANCE OVER TIME: A SPACE ODYSSEY?
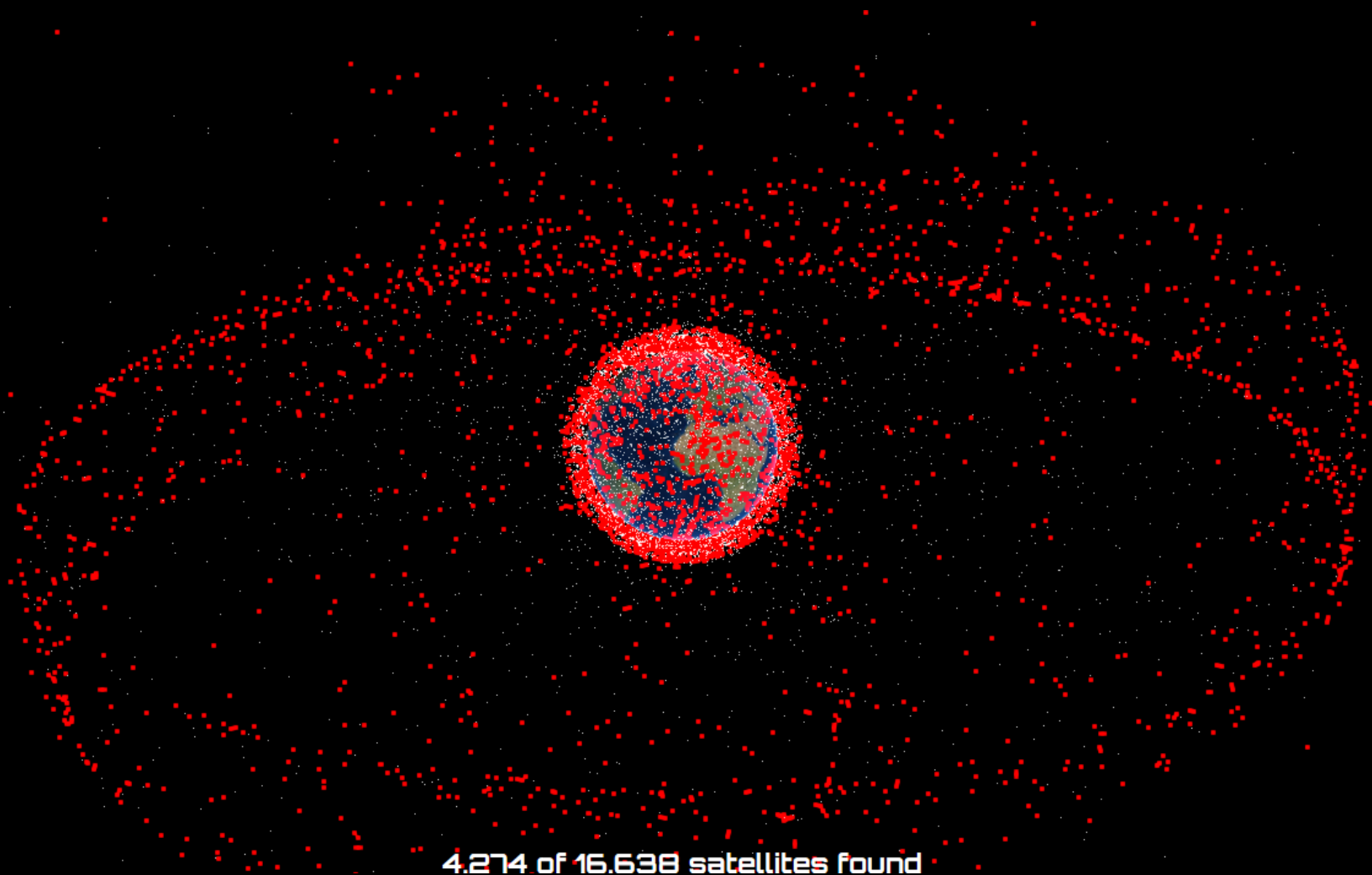
LOUISE WILLEMEN

TRINIDAD DEL RIO

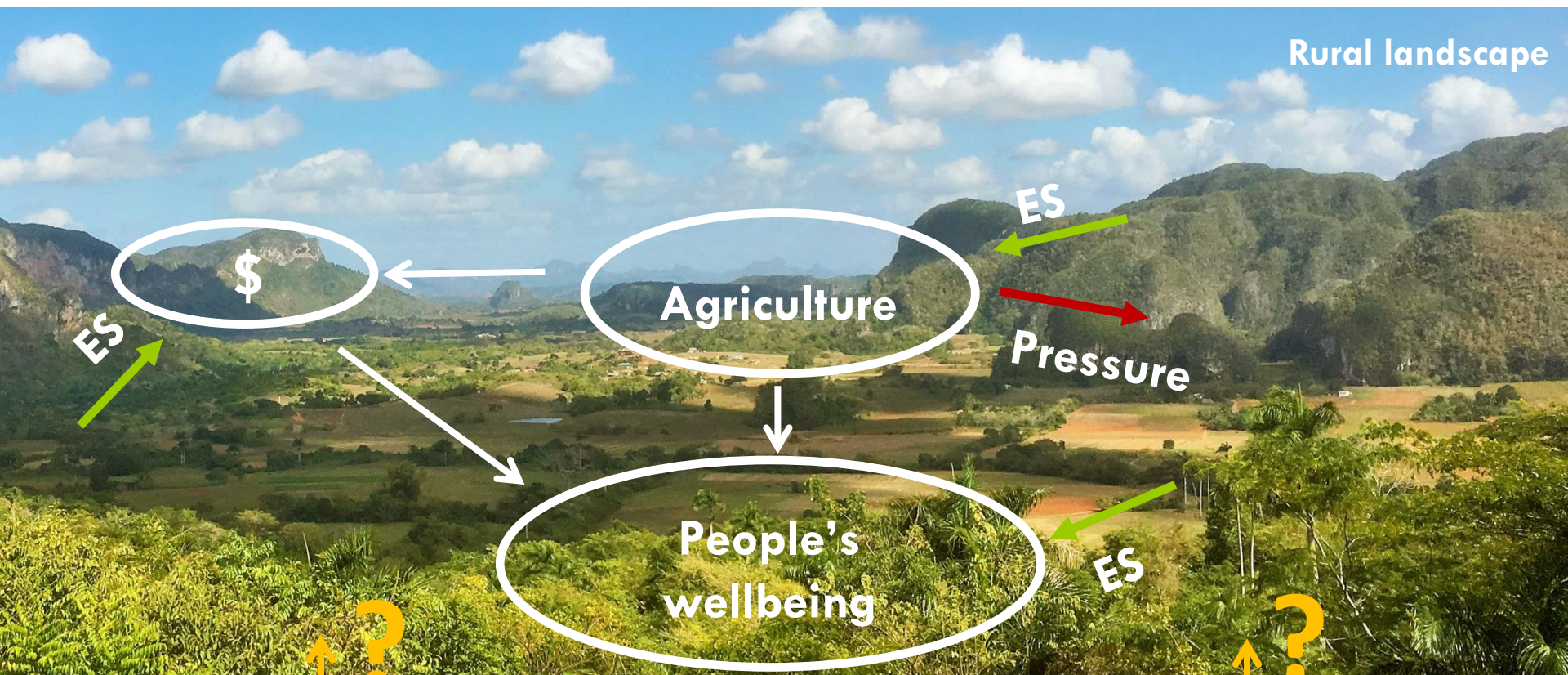ARCHFORD MUCHANDO

ANDY NELSON

DEPARTMENT OF NATURAL RESOURCES FACULTY OF GEO-INFORMATION SCIENCE AND EARTH OBSERVATION

4.274 of 16.638 satellites found

# CHANGING LANDSCAPES

- Large areas, hard to access…and changing!
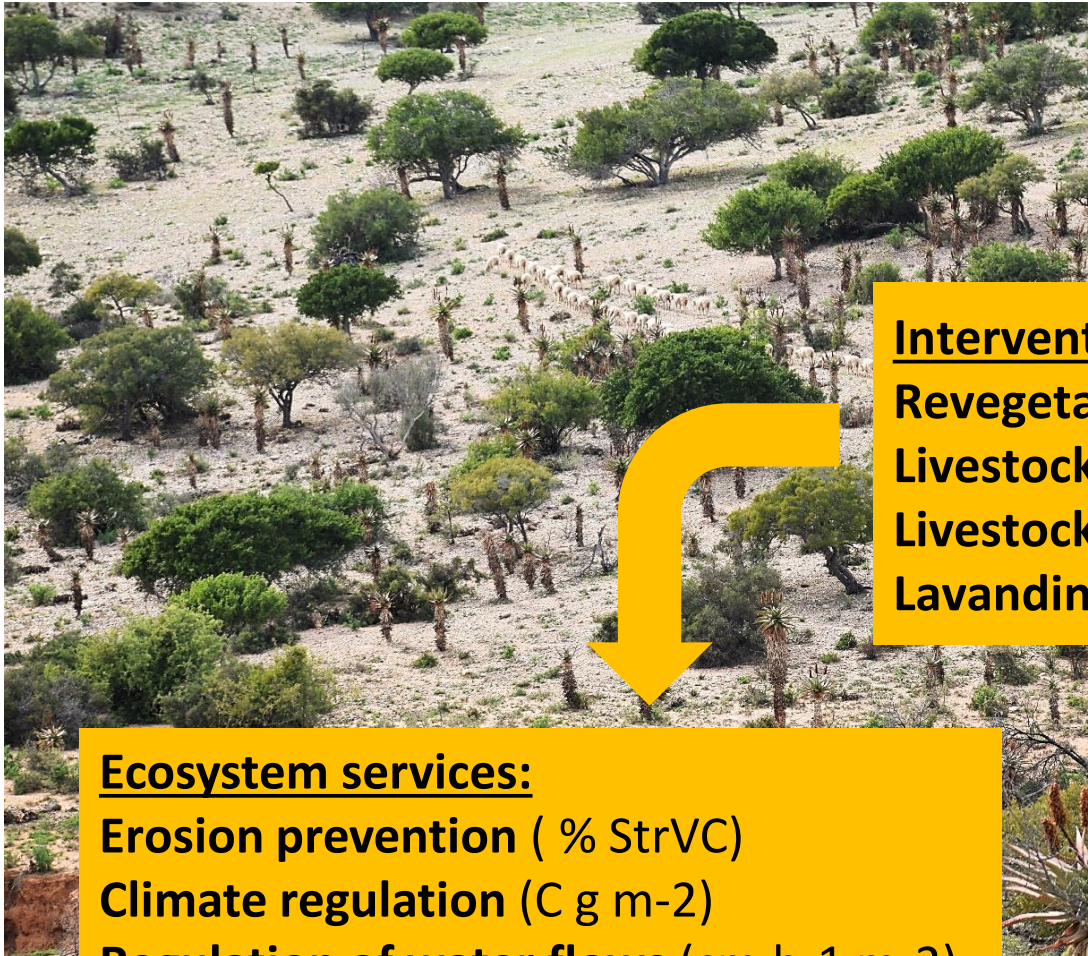- Ecosystem services (ES): linking people's wellbeing to nature

# THE BAVIAANSKLOOF, SOUTH AFRICA

Total 40 000 ha



**Interventions:**
**Revegetation** (1200 ha)
**Livestock exclusion** ( 4400 ha)
**Livestock exclusion & Revegetation** (535 ha)
**Lavandin and rosemary fields** (60 ha)

**Ecosystem services:**
**Erosion prevention** ( % StrVC)
**Climate regulation** (C g m-2)
**Regulation of water flows** (cm h-1 m-2)
**Fodder availability** (Green ABM kg m-2)
**Essential oil production** (ABM g m-2)
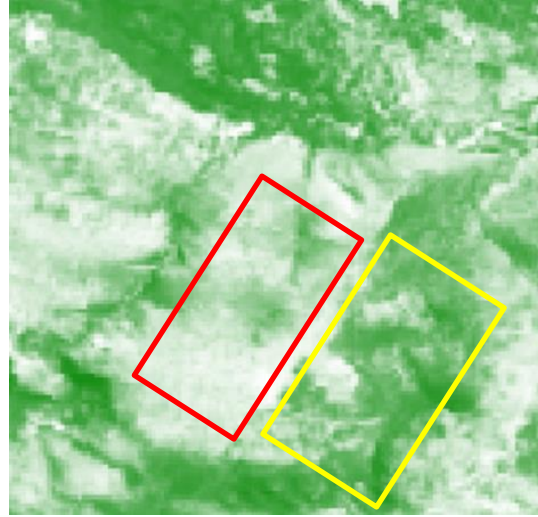**Presence native species** (%)

Spatial data to capture change in performance?

# CAPTURING ECOSYSTEM SERVICES WITH RS & GIS



*T Del Rio*



*NDVI ESA Sentinel 2*

- 32 paired plots (30mX30m)
- Measured the ES in the field
- Tested 10 Sentinel-2 2A indices + GIS topographic data

**ES =**

**Vegetation indices:** NDVI, SAVI, MSAVI, IRECI, $NDVI_{705}$, GNDVI, $NDVI_{45}$, MTCI
**Water index:** NDWI
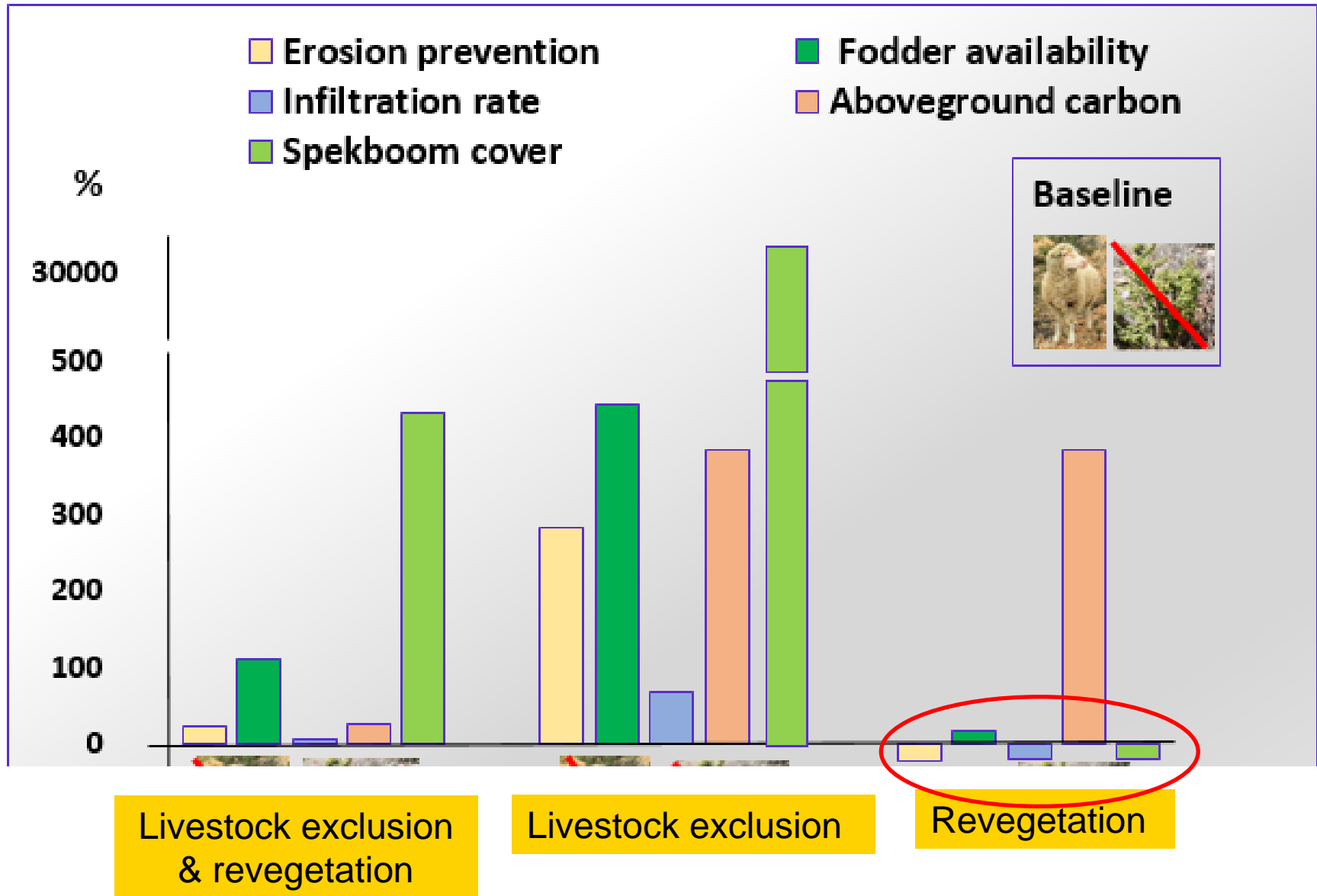**Soil index:** Brightness index (BI)

**+**

Slope
Aspect
Elevation
Soil types
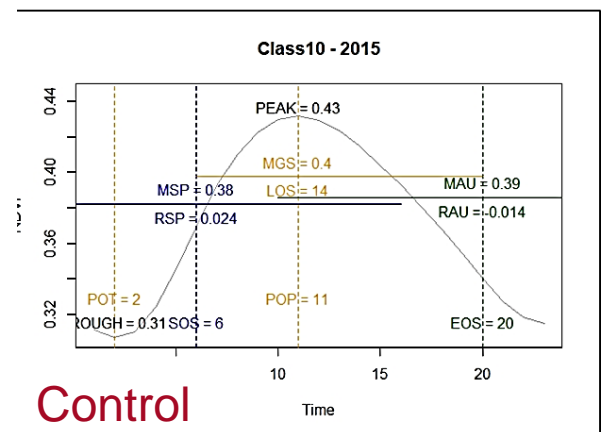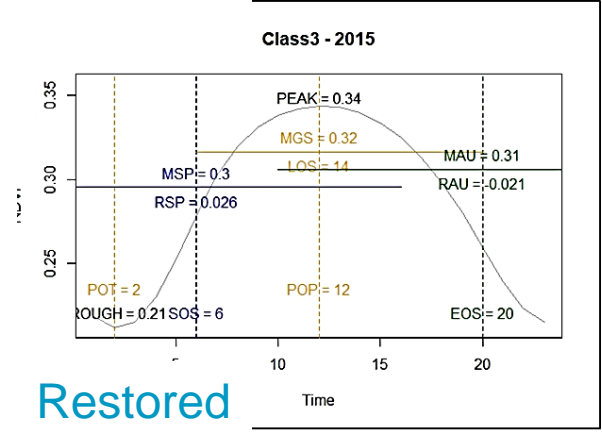Distance to main road

*Akaike Information Criterion (AIC)*
*100 times repeated 5-fold cross-validation*

| Ecosystem service | $R^2$ | Explanatory Variable | Partial $R^2$ |
|---|---|---|---|
| **Erosion Prevention** | 0.82 | **IRECI** | 0.81 |
| **Climate Regulation** | 0.62 | **IRECI** | 0.6 |
| **Regulation of water flows** | 0.61 | **NDWI** | 0.31 |
| | | Slope | 0.36 |
| **Fodder Availability** | 0.89 | **NDI45** | 0.38 |
| | | **NDWI** | 0.6 |
| | | Slope | 0.16 |
| **Biomass essential oils** | 0.77 | **NDVIre2n** | 0.74 |
| | | Herb cover | 0.74 |
| **Presence of native trees** | 0.64 | **IRECI** | 0.64 |
| | | Elevation | 0.23 |
| | | Slope | 0.17 |

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# Comparison intervened & non-intervened areas in space



Legend:
- Erosion prevention
- Infiltration rate
- Spekboom cover
- Fodder availability
- Aboveground carbon

Baseline

% (y-axis): 0, 100, 200, 300, 400, 500, 30000

Livestock exclusion & revegetation

Livestock exclusion

Revegetation

# Comparison intervened & non-intervened areas in time



**Restoration**

**Animal exclusion**

**Revegetation**

**Baseline** — Class3 - 2007

**Restored** — Class3 - 2015

**Control** — Class10 - 2015

SiteClass
- Control
- Restored

*Muchando, 2019*

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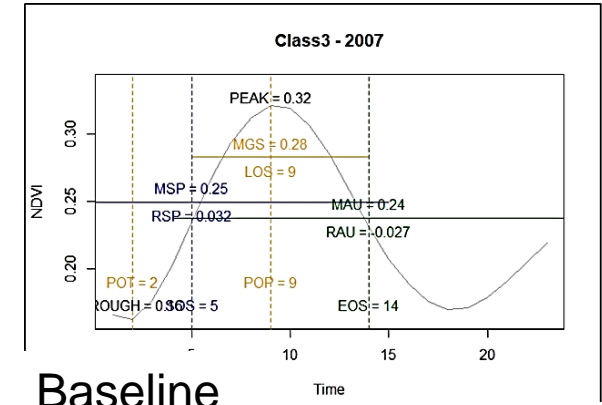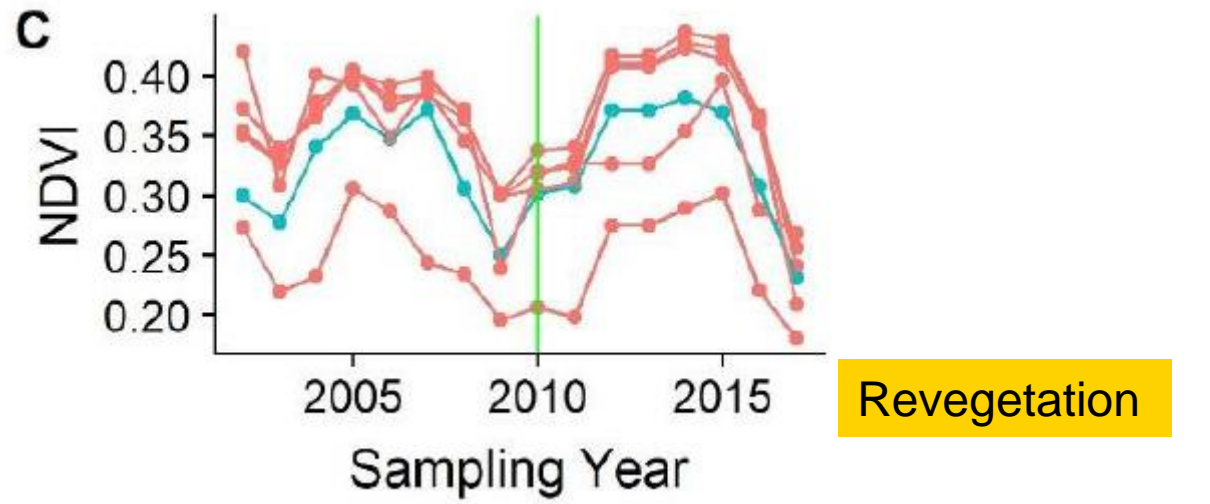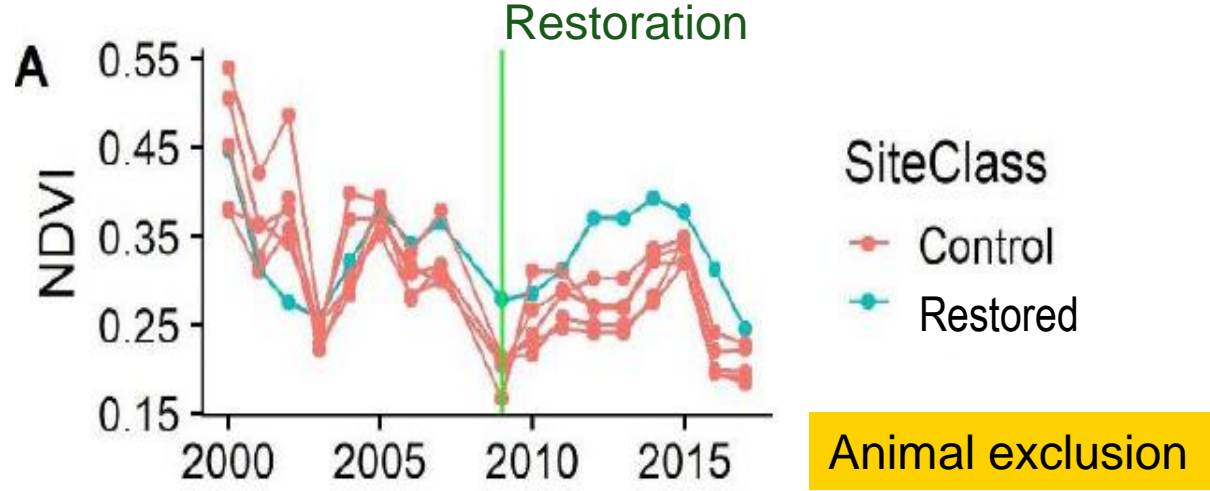
# CLASSIFYING M&E APPROACHES

**For whom?**

| | | |
|---|---|---|
| **Evaluation goal** | formative ————————●——— | summative |
| **Point of reference** | local —●————————————— | universal |
| **Data collection/processing** | collaborative ——————————●— | unilateral |
| **Sector integration** | integrated ———●——————— | sectoral |

*Four dimensions that qualify monitoring and evaluation approaches. Goal: Learning vs. concluding. Reference: local values vs. universal values (e.g. SDGs). Collection: using data collected specifically for this purpose and in contact with concerned actors vs. using existing data. Integration: trade-offs between sectors explicit vs. focus on one sector.*