



Independent
Evaluation Office
GLOBAL ENVIRONMENT FACILITY

Geospatial approaches and use of computational social science methods

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Evaluation Officer

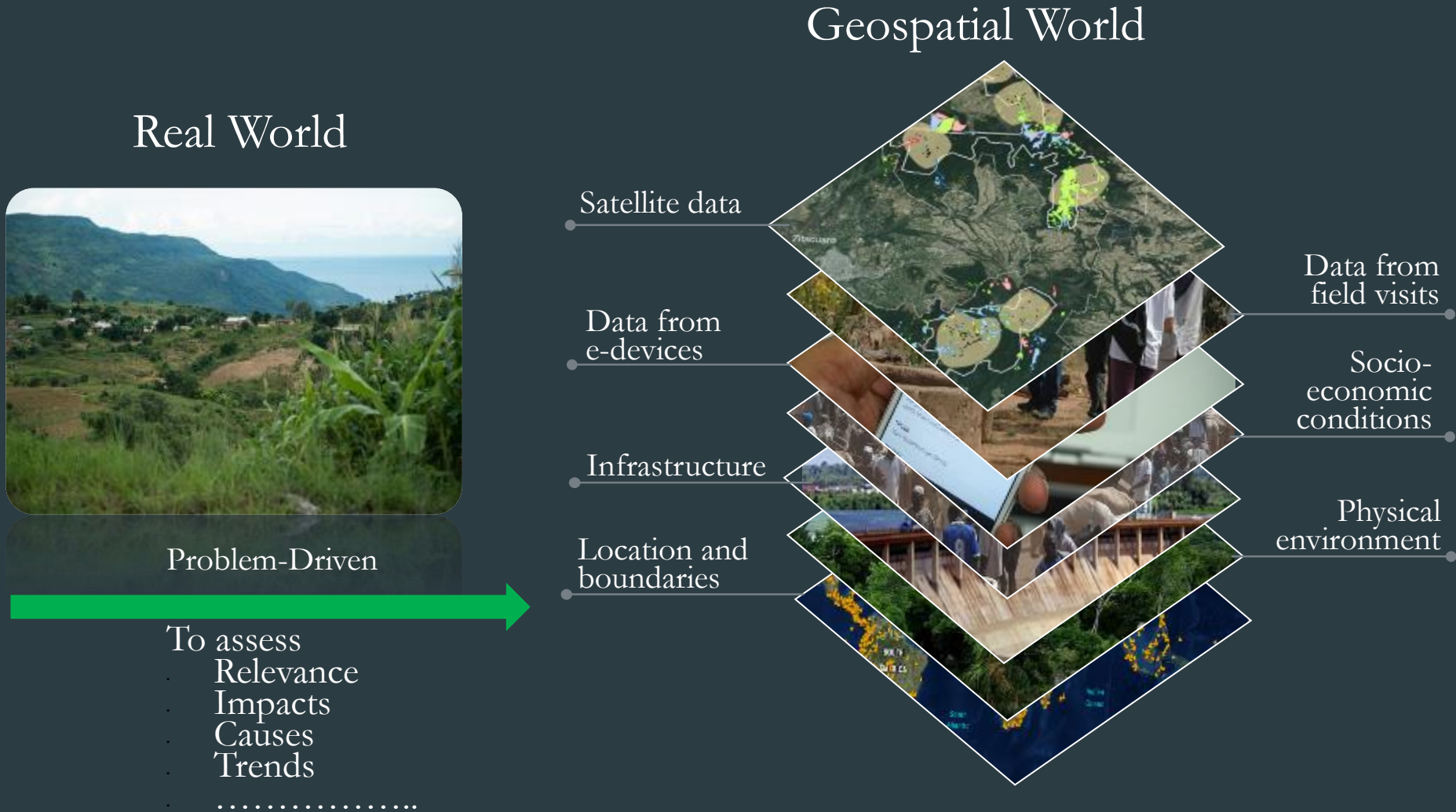
Shanghai International Program for Development Evaluation Training, November 25, 2019



Learning Objectives

- ❑ What is Geospatial Analysis, Remote Sensing?
- ❑ What is computational social science
- ❑ Why use these in Evaluation?
- ❑ Evaluation Questions we can address with these methods
- ❑ Application in environmental evaluations
- ❑ Challenges and Lessons

What is geospatial analysis?

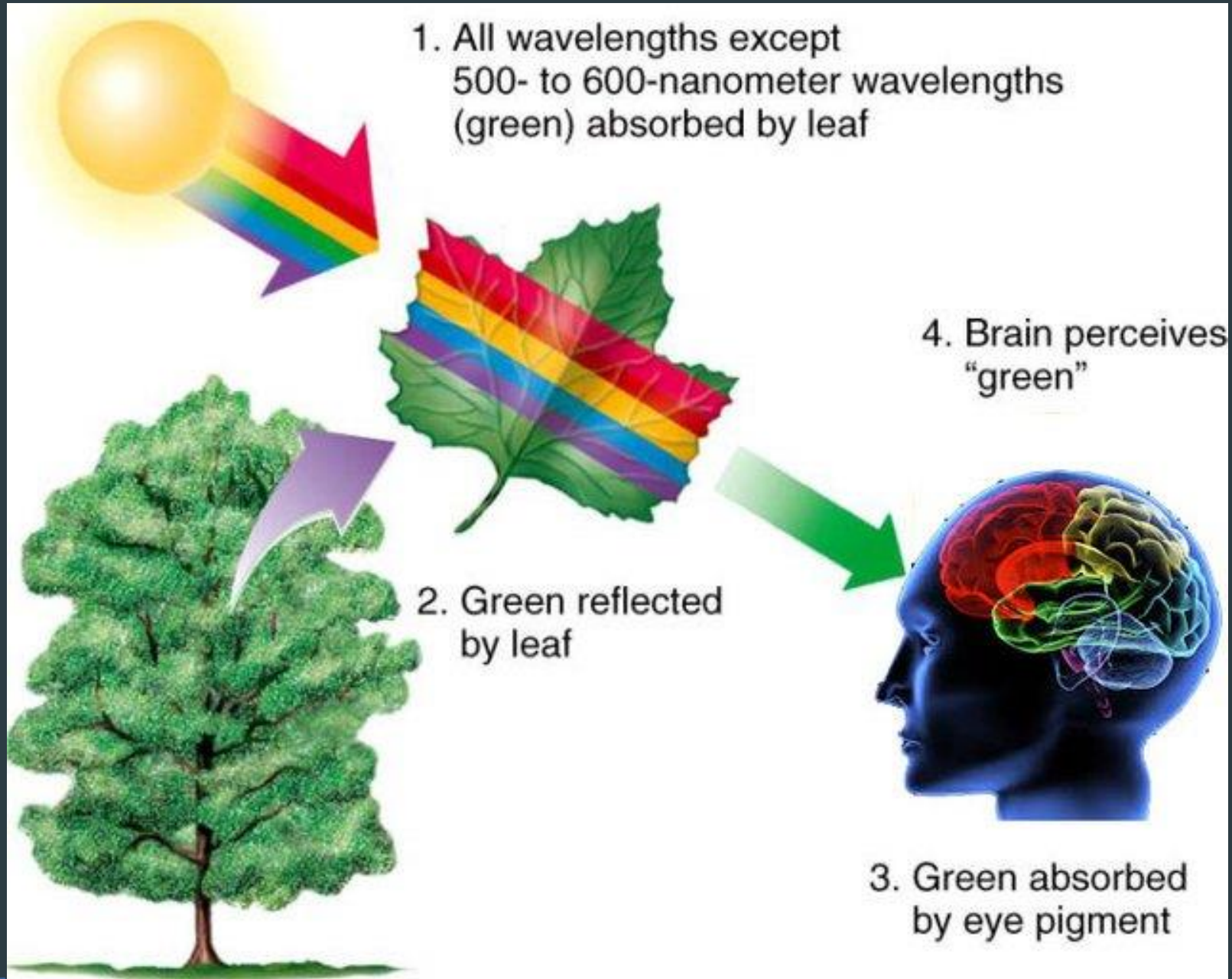


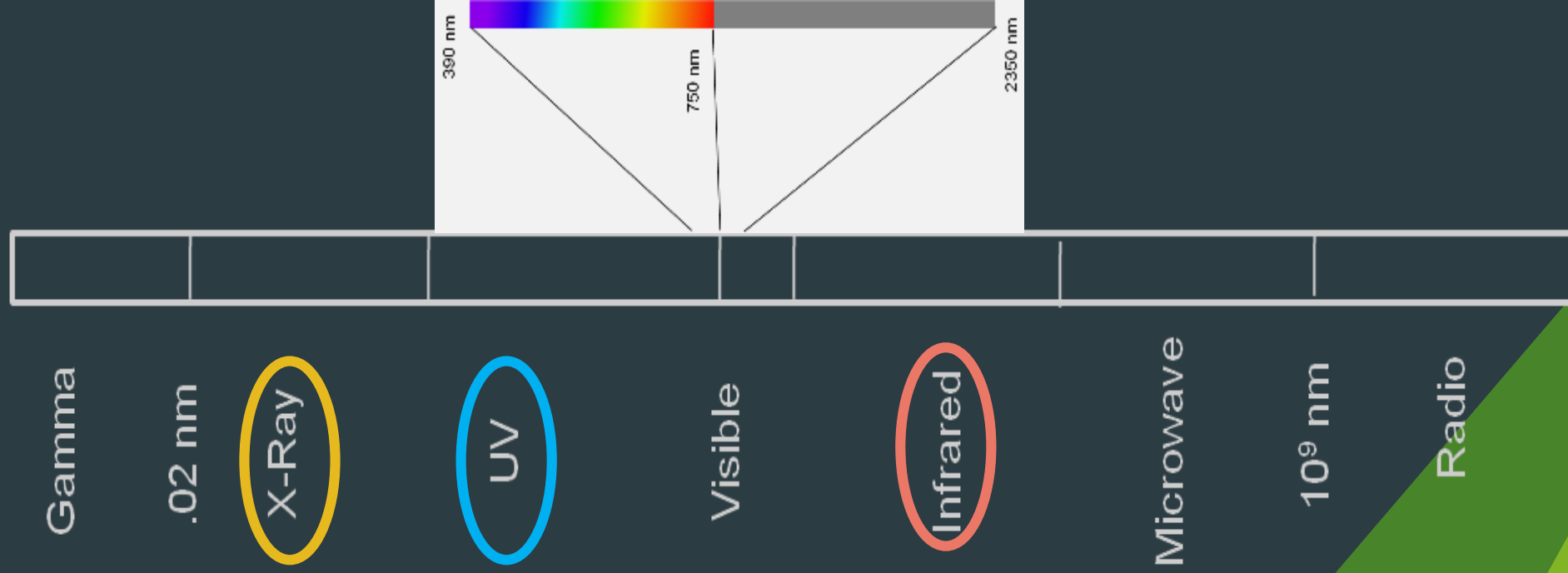
Spatial analysis focuses on the *statistical analysis* of patterns and underlying processes

What is Remote Sensing

- Remote Sensing is the science of **IDENTIFYING**, **OBSERVING, COLLECTING** and **MEASURING** objects without coming into direct contact with them. Similar to humans and animals using eyes, or other senses.
- Satellites record the *electromagnetic energy* reflected or emitted from objects on Earth.







Gamma Ray Exposure

Before

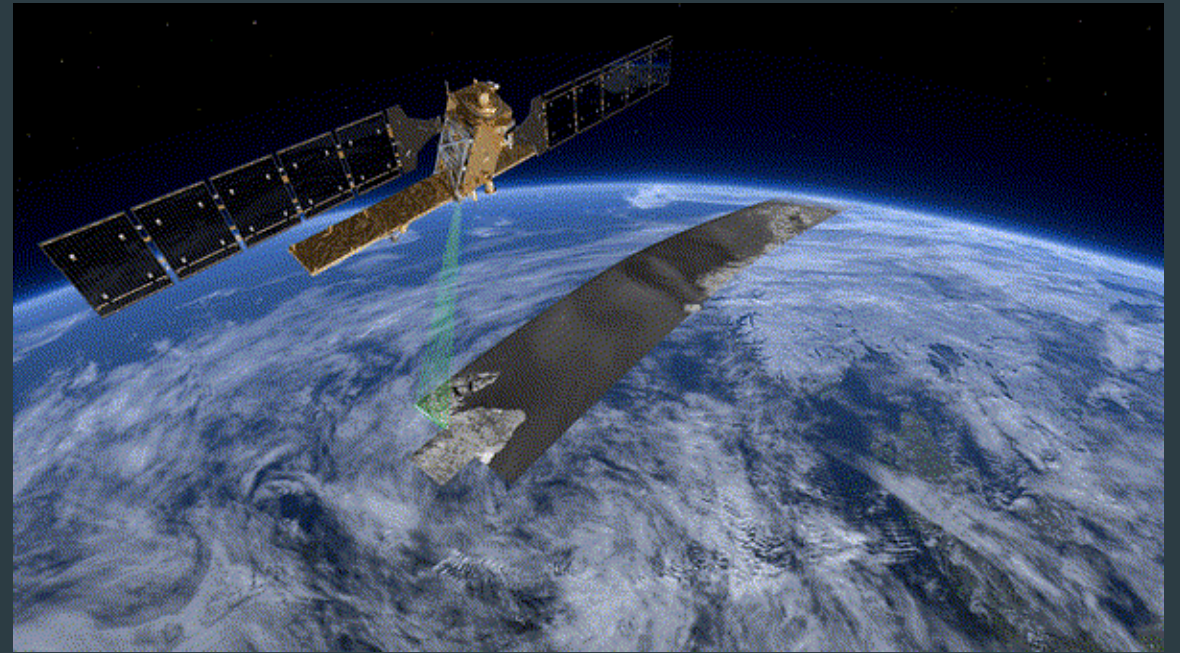
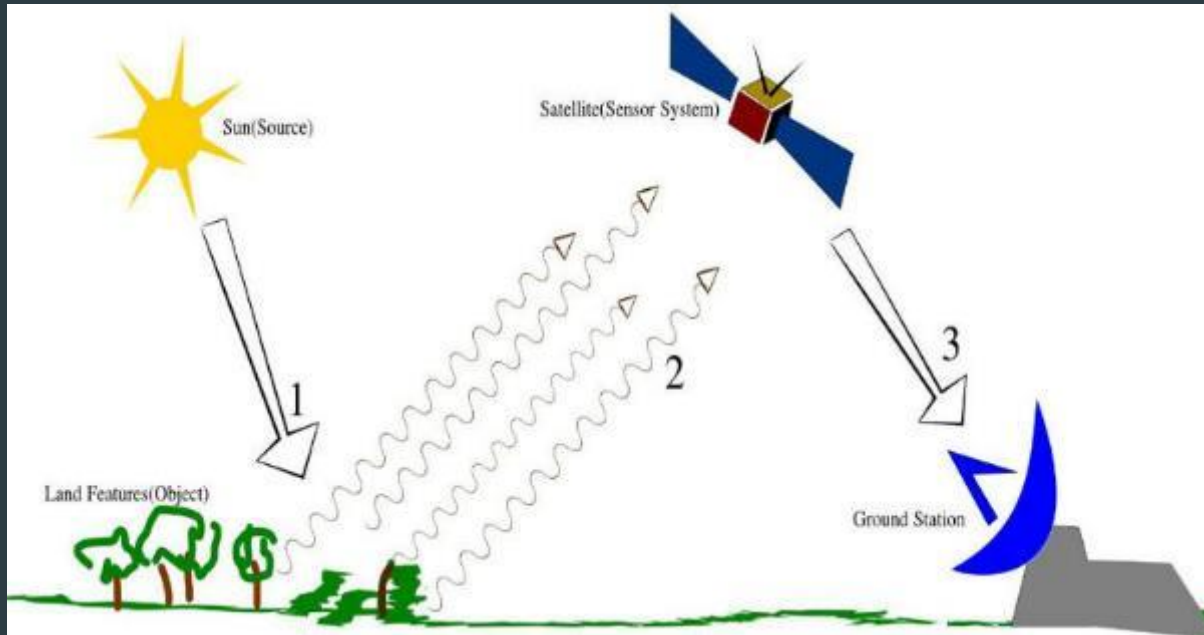


Bruce Banner

After

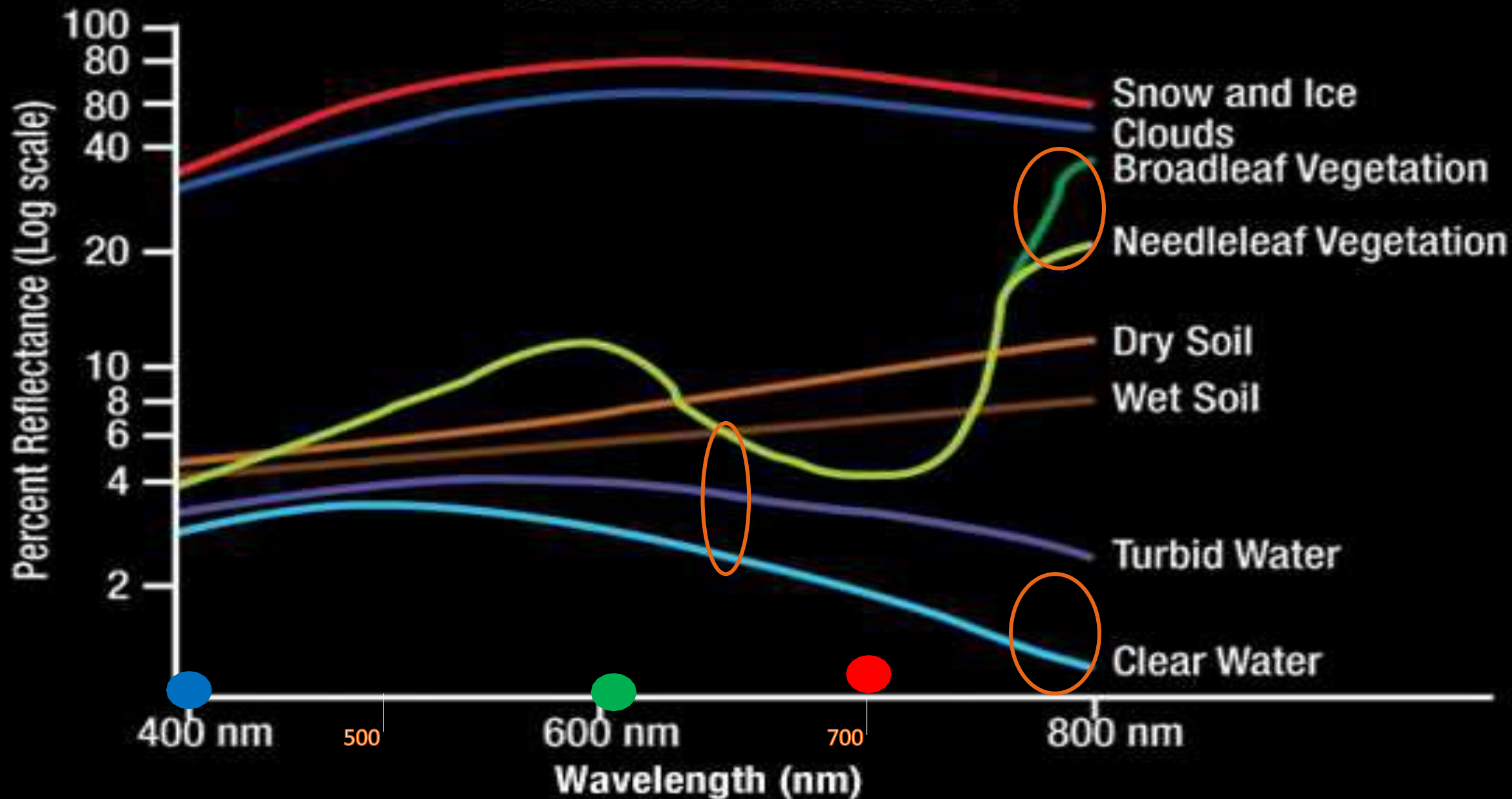


Hulk





SPECTRAL SIGNATURES OF EARTH FEATURES





Visible



Infrared

Geographic Information System (GIS)

Geographic Information System (GIS) is a computer system build to capture, store, manipulate, analyze, manage and display all kinds of spatial or geographical data.



Why use these in evaluation?



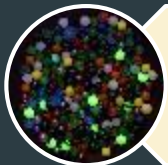
Efficiency



Analysis at different scales



Aiding objectivity and transparency



Applicable to variety of evaluation methods



Helps deal with methodological challenges

SDGs and remote sensing



Credit: ESA

Source: ESA

Data from satellite imagery and sensor networks make environment and development indicators increasingly measurable

Satellite Data revolution

Application in Multiple Areas



Tambopata National Reserve, Peru

- 1,400 active satellites
- Many more planned
- High resolution data available

Questions we seek to answer through evaluation

- ▶ **Relevance of the intervention-** is it in the right context?
- ▶ **Is it effective** -Trends in performance and impacts
- ▶ **Factors associated** with impact
- ▶ **Sustainable**-Likelihood of sustaining the benefits
- ▶ Does the intervention deliver **value for money**?

Biodiversity





Which landscape would you prioritize protecting?



A

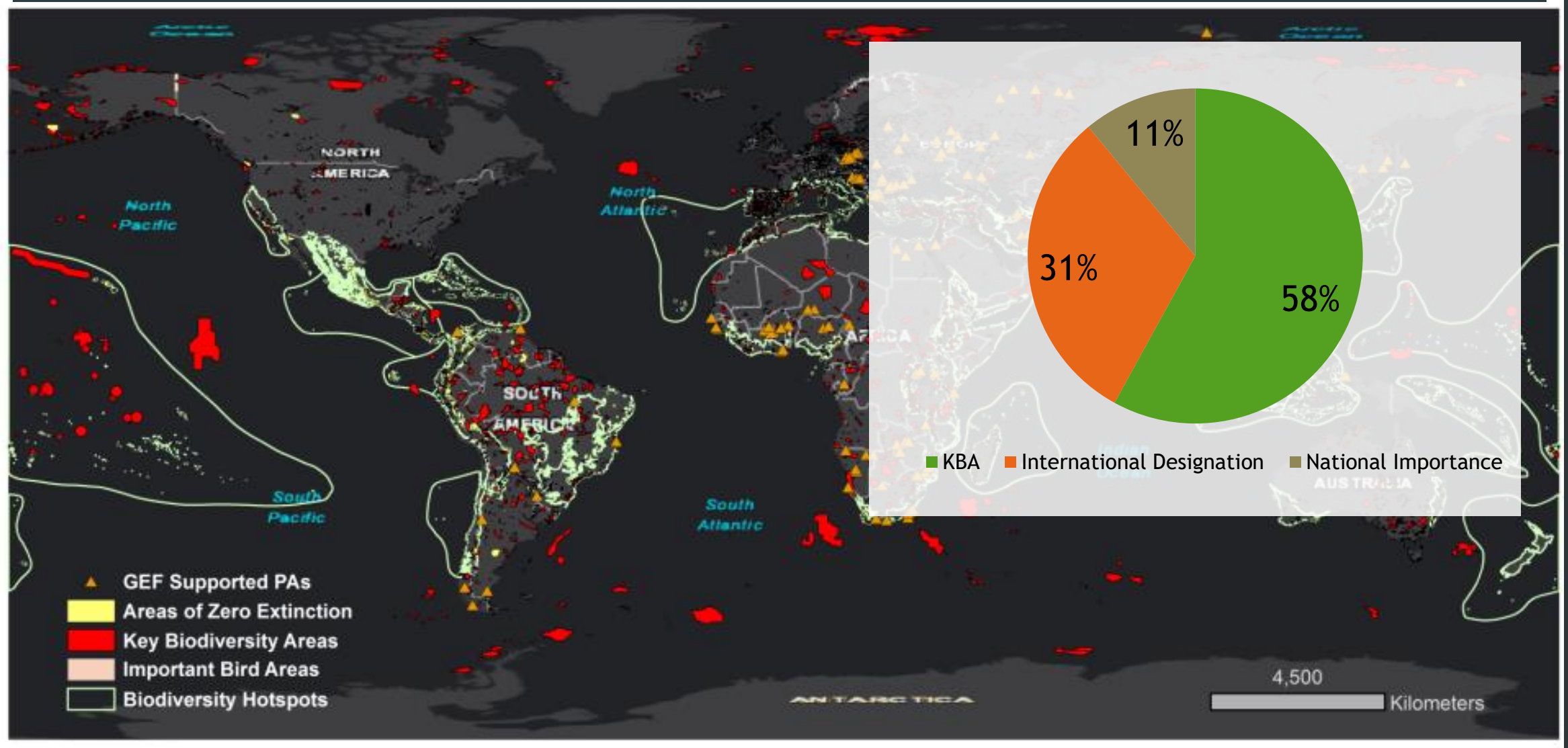


B



Biodiversity: Relevance

Study the impact of GEF support to 1292 global protected areas across 147 countries





Which project has been effective in avoiding deforestation?



2010: Start of the Project



2015: End of the Project



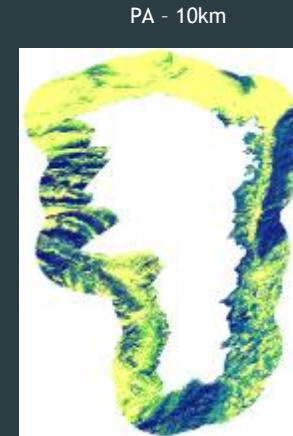
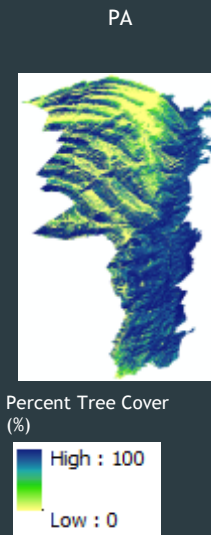
Project Alpha

Project Delta

Forest Cover Change Analysis: Impact



Percent Tree Cover (2000)



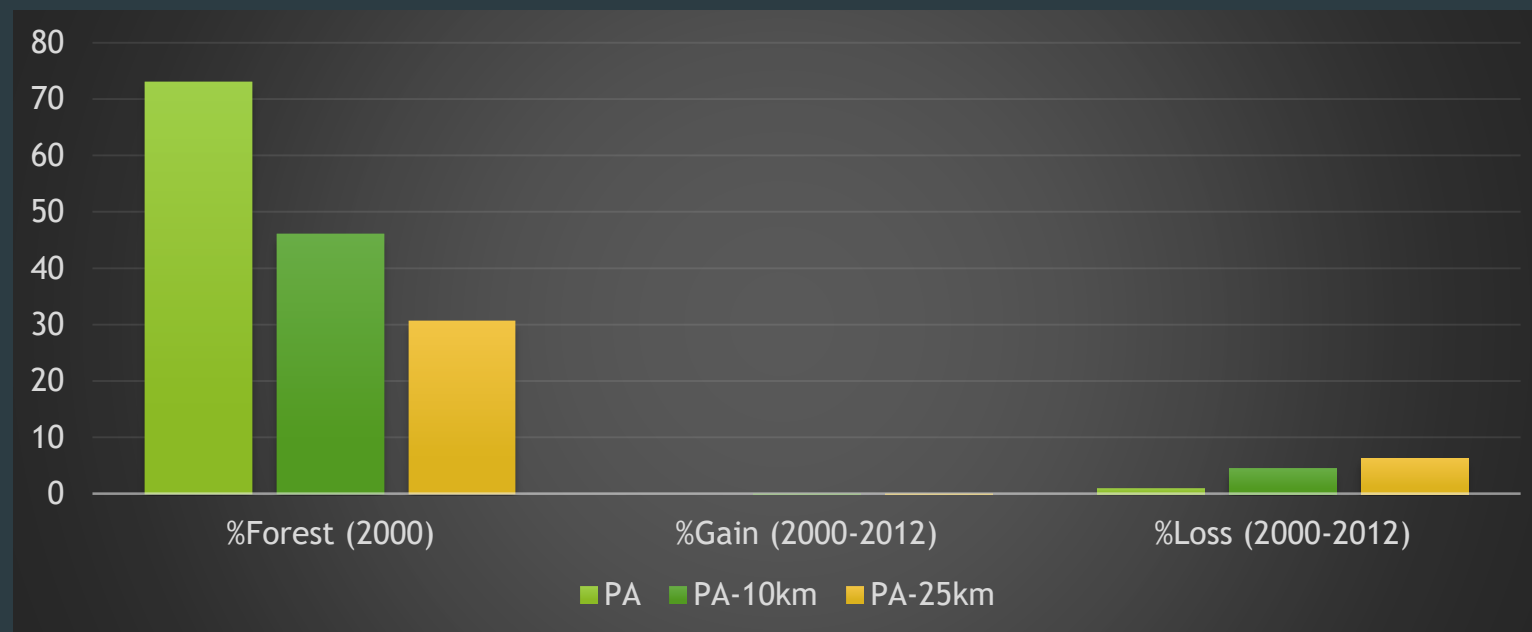
Cumbres de Monterrey, Mexico

Forest Cover Change Analysis: Impact



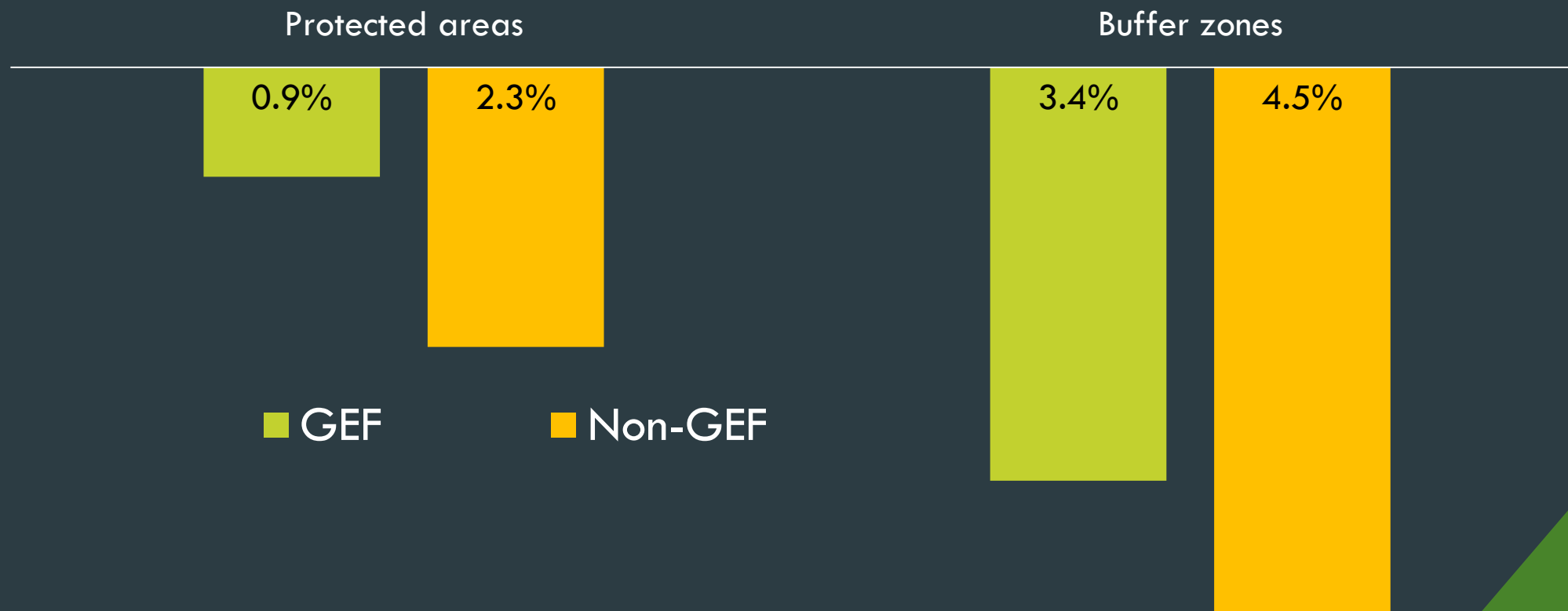
Yearly Percent of Forest Loss (2000 – 2012)

Decadal Forest Cover, Gain and Loss (2000 – 2012)



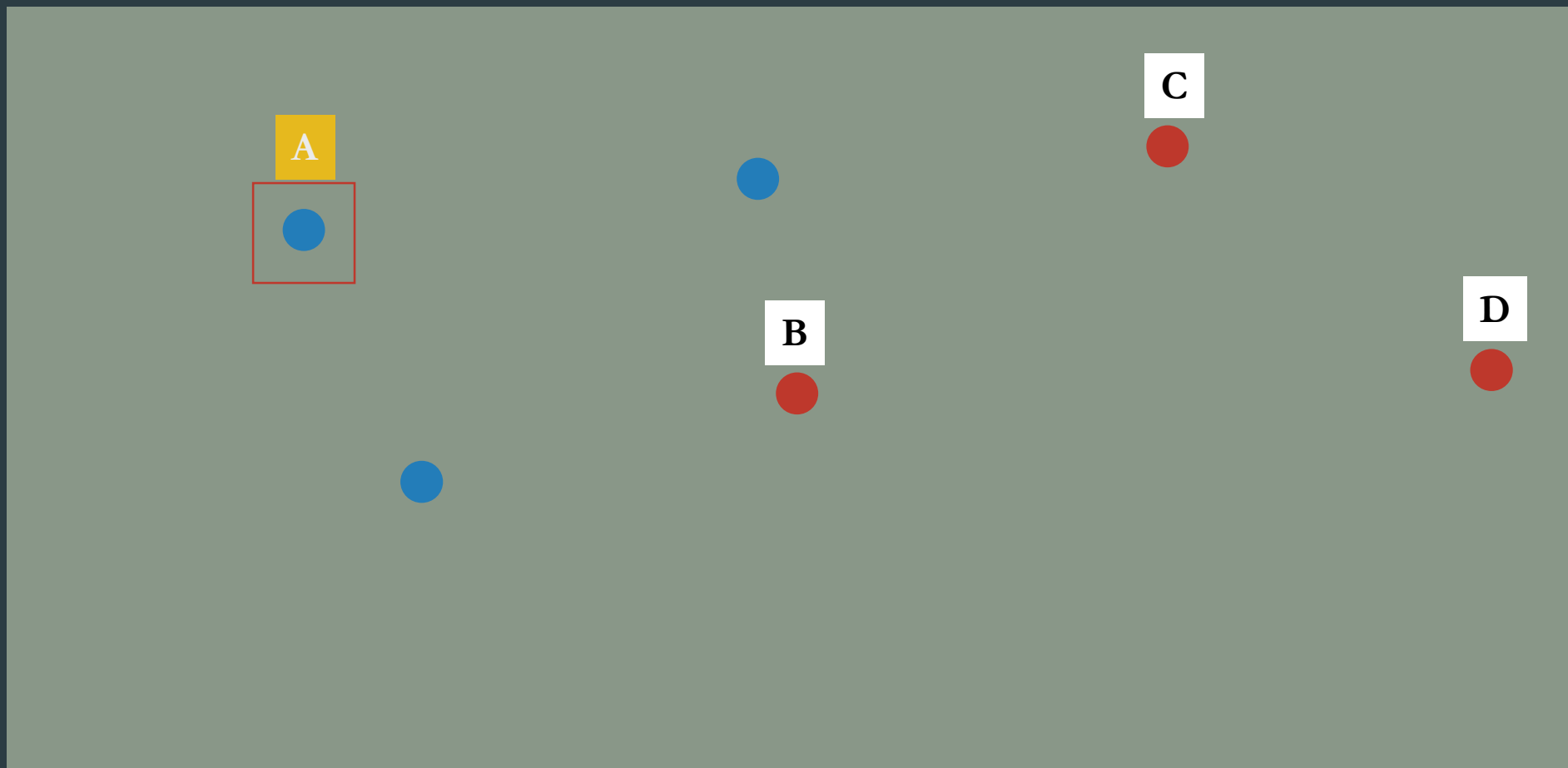
Biodiversity: Global Analysis

Forest cover loss (2000-2012)



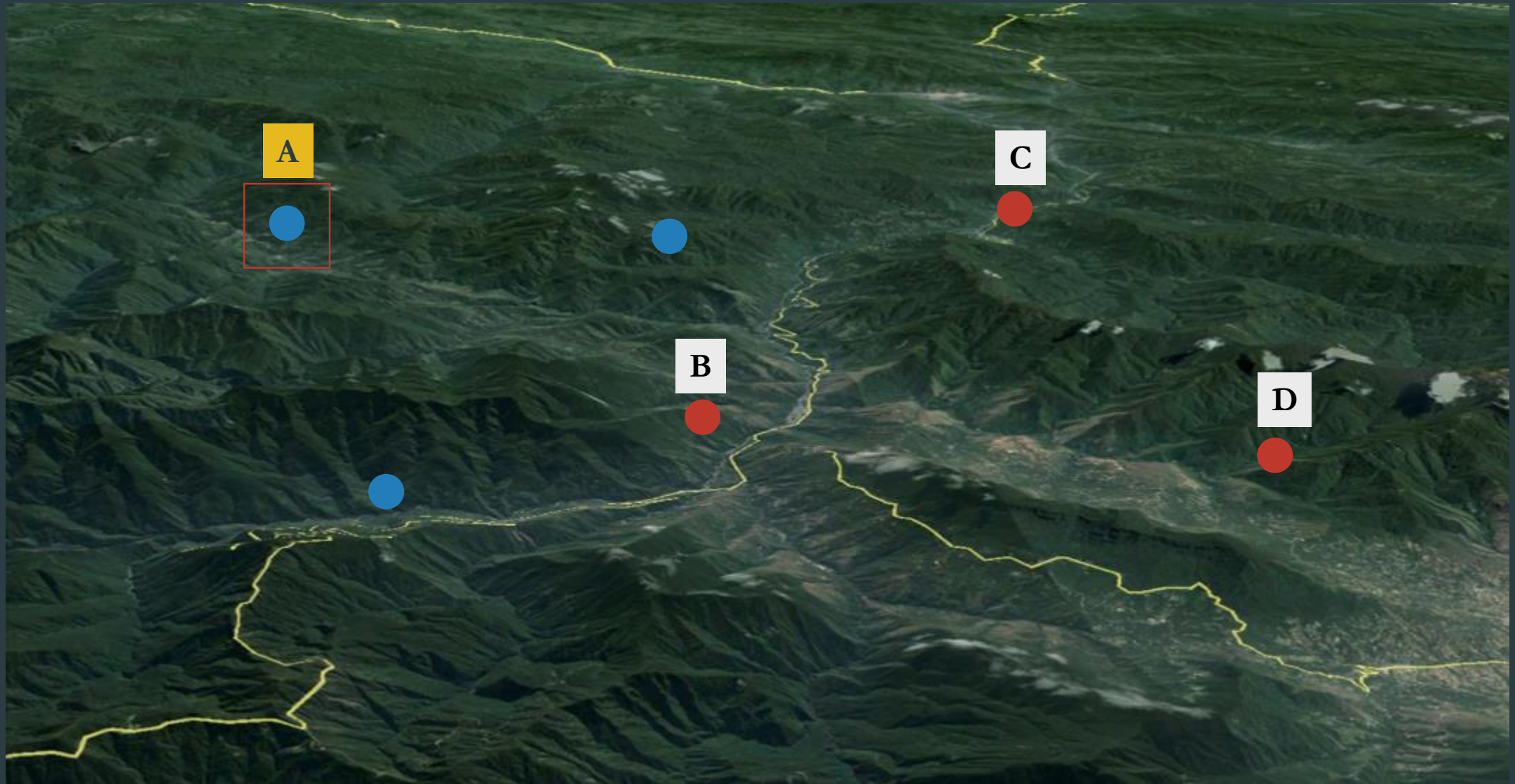


Finding the right counterfactual ?



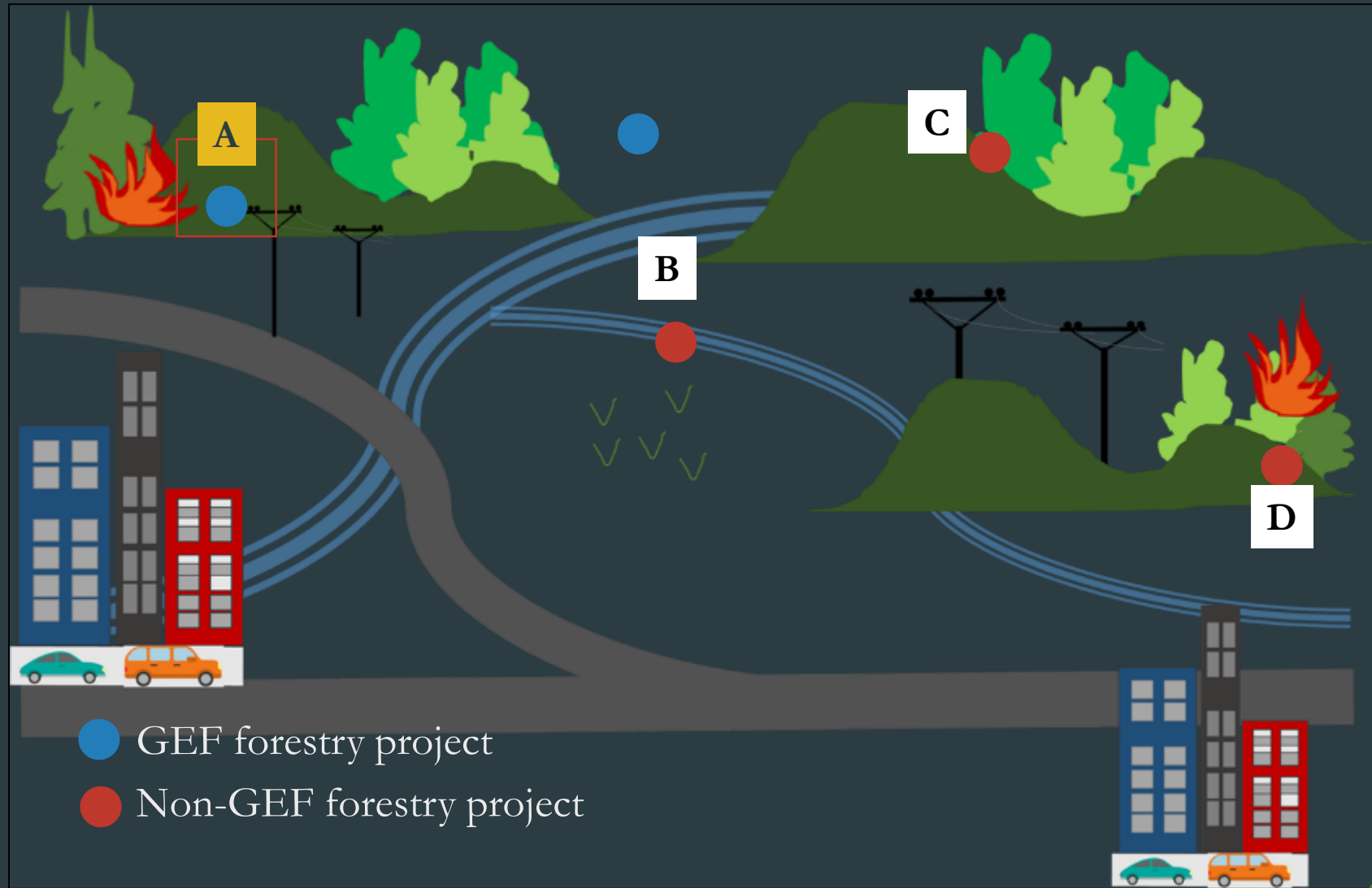
● GEF forestry project(Treatment)

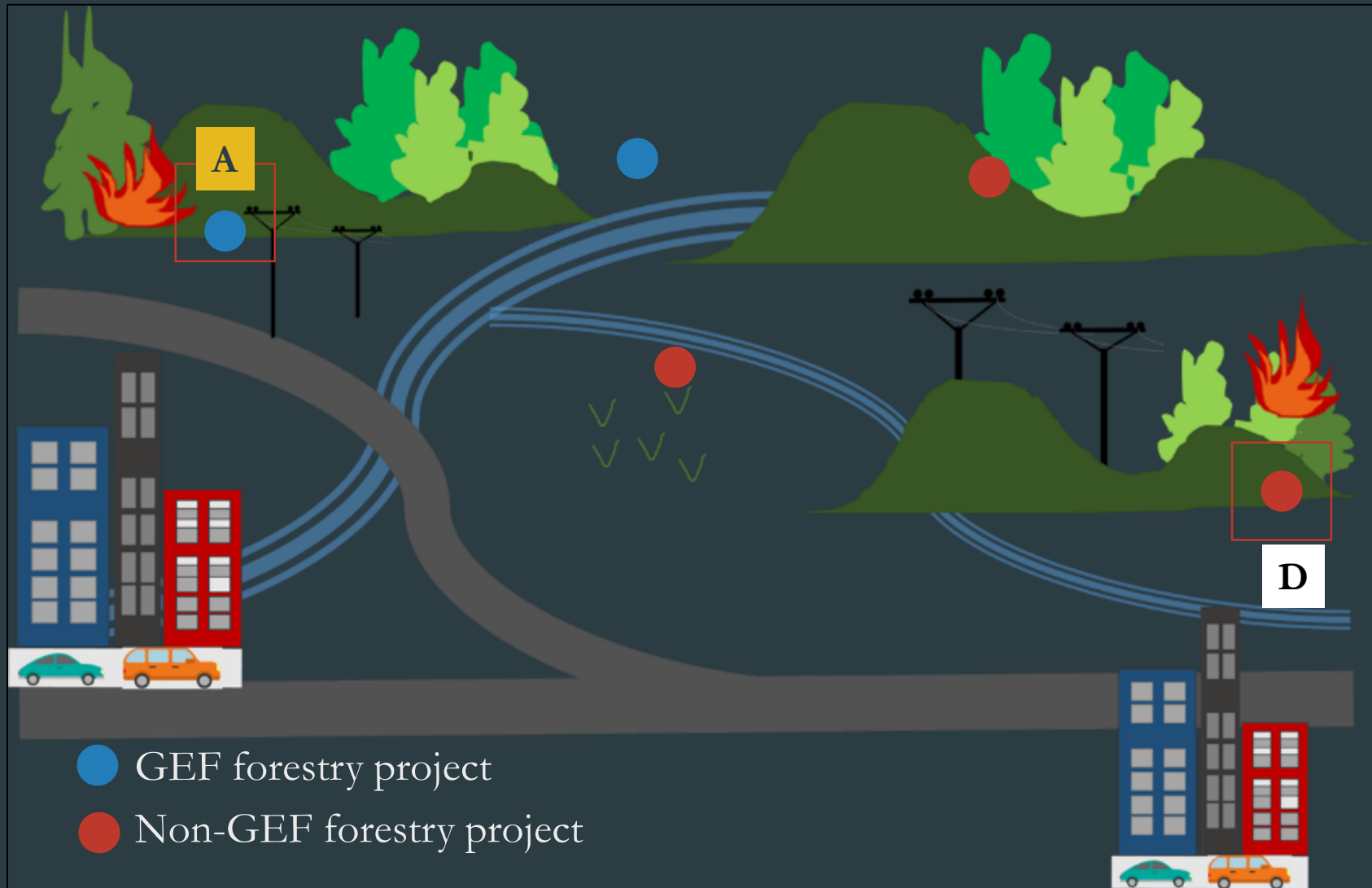
● Non-GEF forestry project(Control)



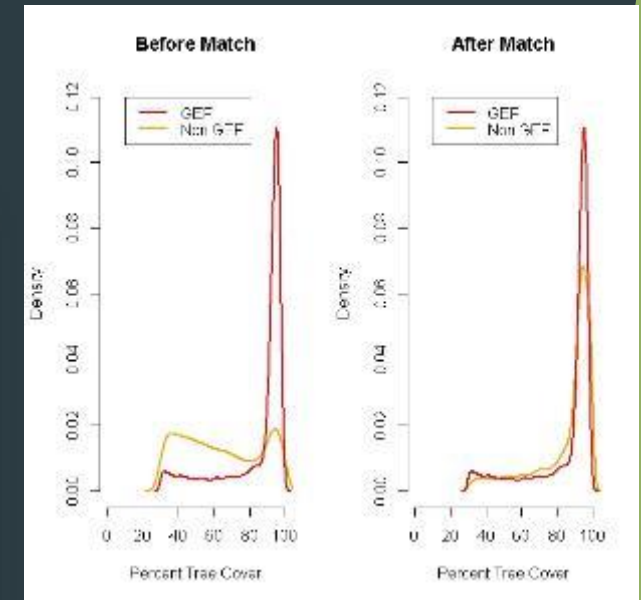
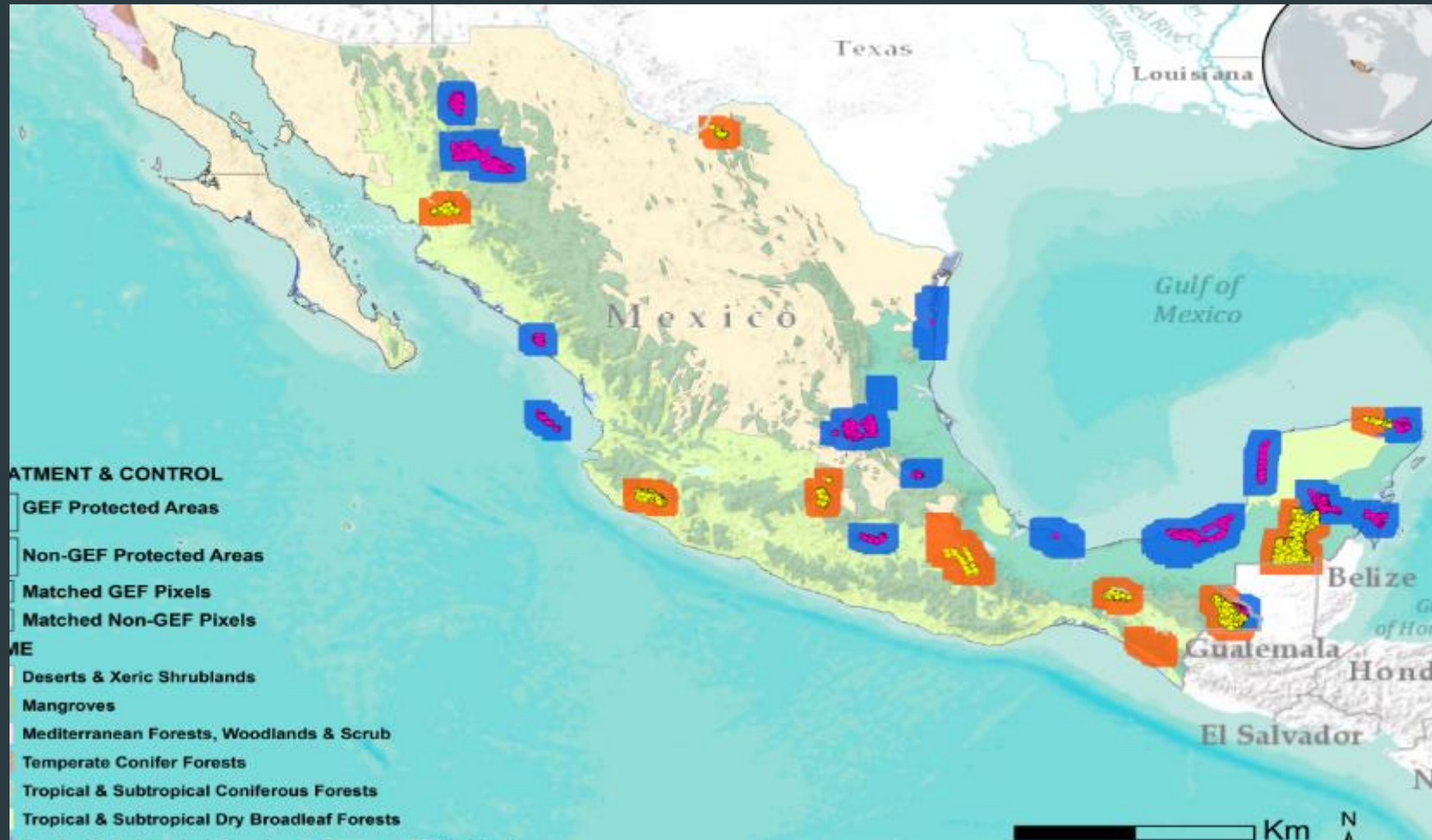
● GEF forestry
project(Treatment)

● Non-GEF forestry
project(Control)





Did the intervention cause the change?

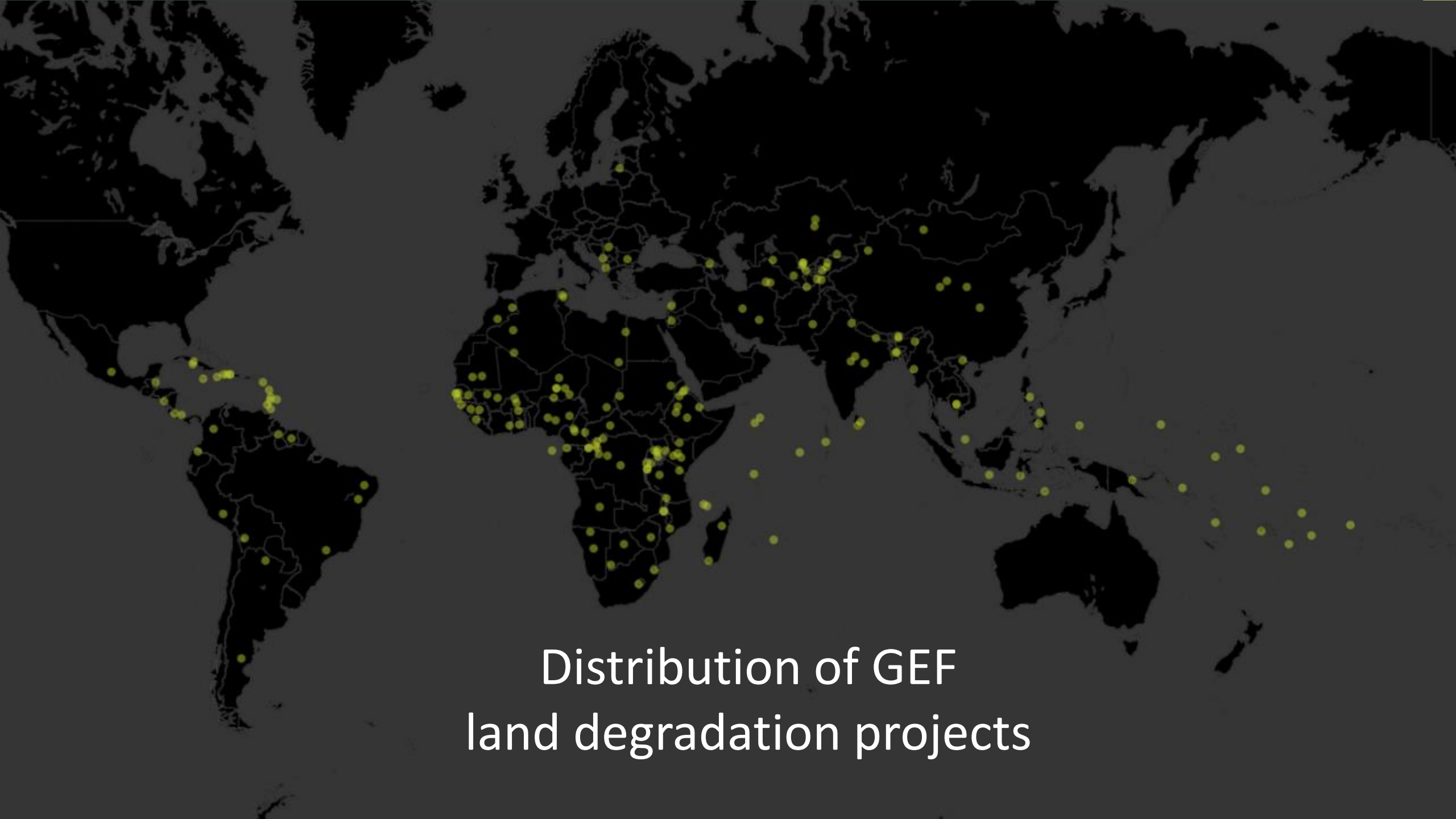


GEF-supported PAs have
23% less forest loss

Quasi-experimental evaluation design based on Propensity score matching

An aerial photograph of a dry, hilly landscape. The terrain is covered with sparse, small trees and shrubs, indicating land degradation. In the foreground, there is a small, simple building with a flat roof, possibly a guardhouse or a small structure, situated near a road or path. The overall scene suggests a semi-arid or desert environment.

GEF Land Degradation and SFM Projects



Distribution of GEF
land degradation projects

Methodology

- Analysis both at portfolio level, and case study at country level



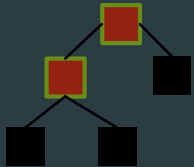
Precise geolocation



Satellite data



Integration with socio-economic data (SFM)



Causal trees machine learning



Estimation of carbon sequestered

Novel approach to address data gaps through integration of satellite data with local survey data (Uganda)

Impact and Value for money

LD
\$1:1.08

SFM
\$1:1.17



Vegetation productivity

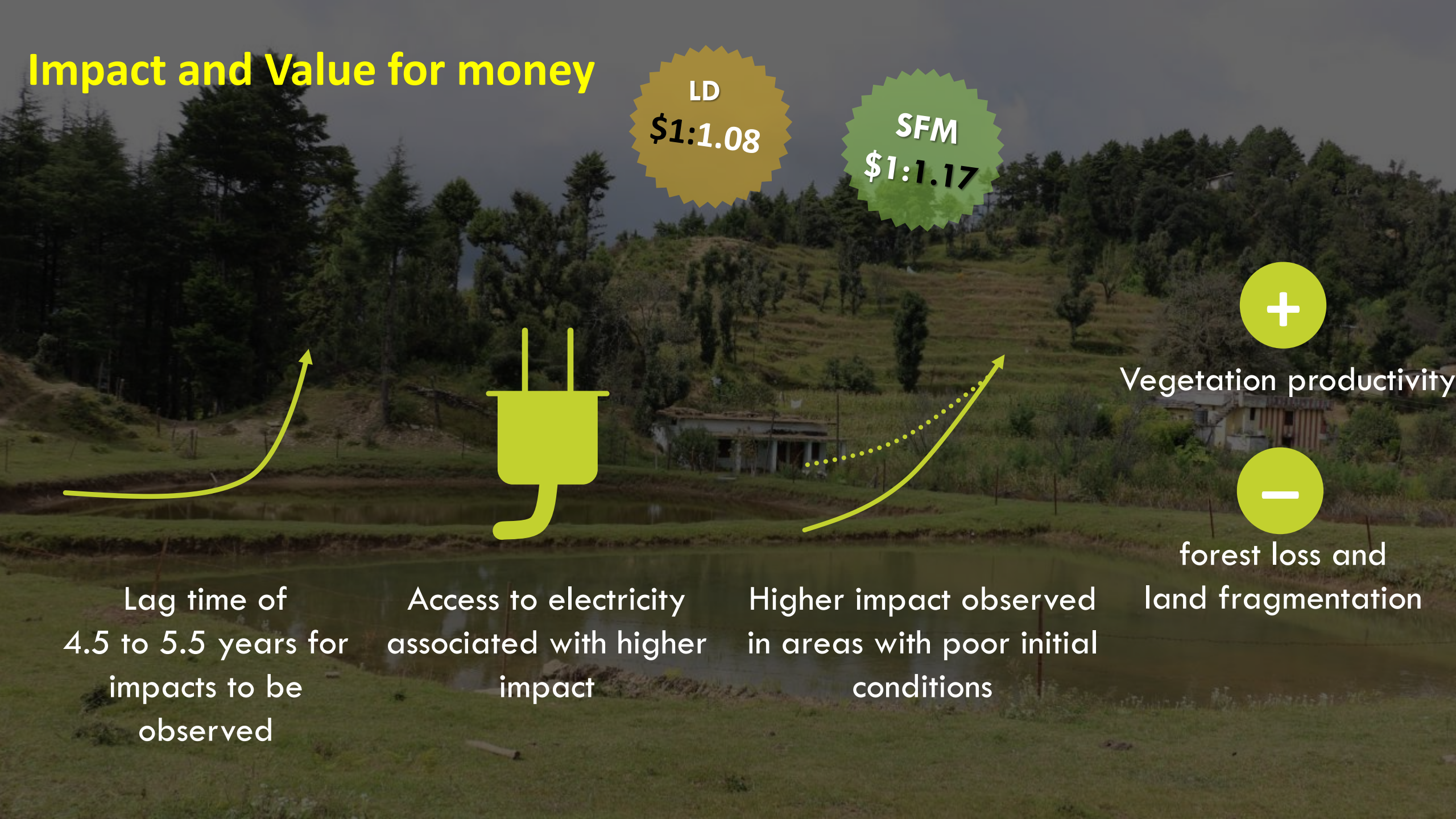


forest loss and
land fragmentation

Lag time of
4.5 to 5.5 years for
impacts to be
observed

Access to electricity
associated with higher
impact

Higher impact observed
in areas with poor initial
conditions

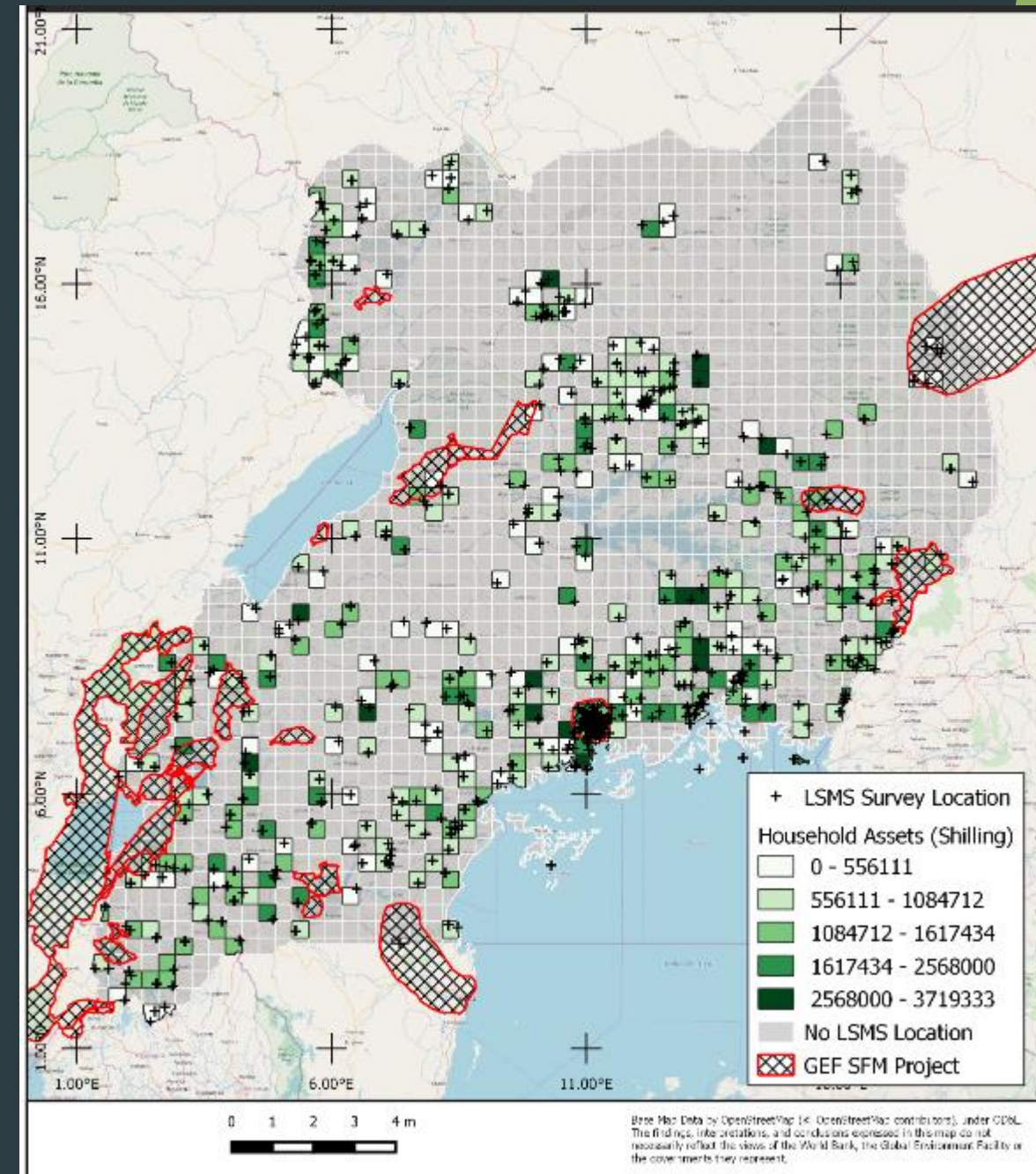


Sustainable Forest Management(SFM): VALUE FOR MONEY

Socioeconomic Co-benefits(Uganda)

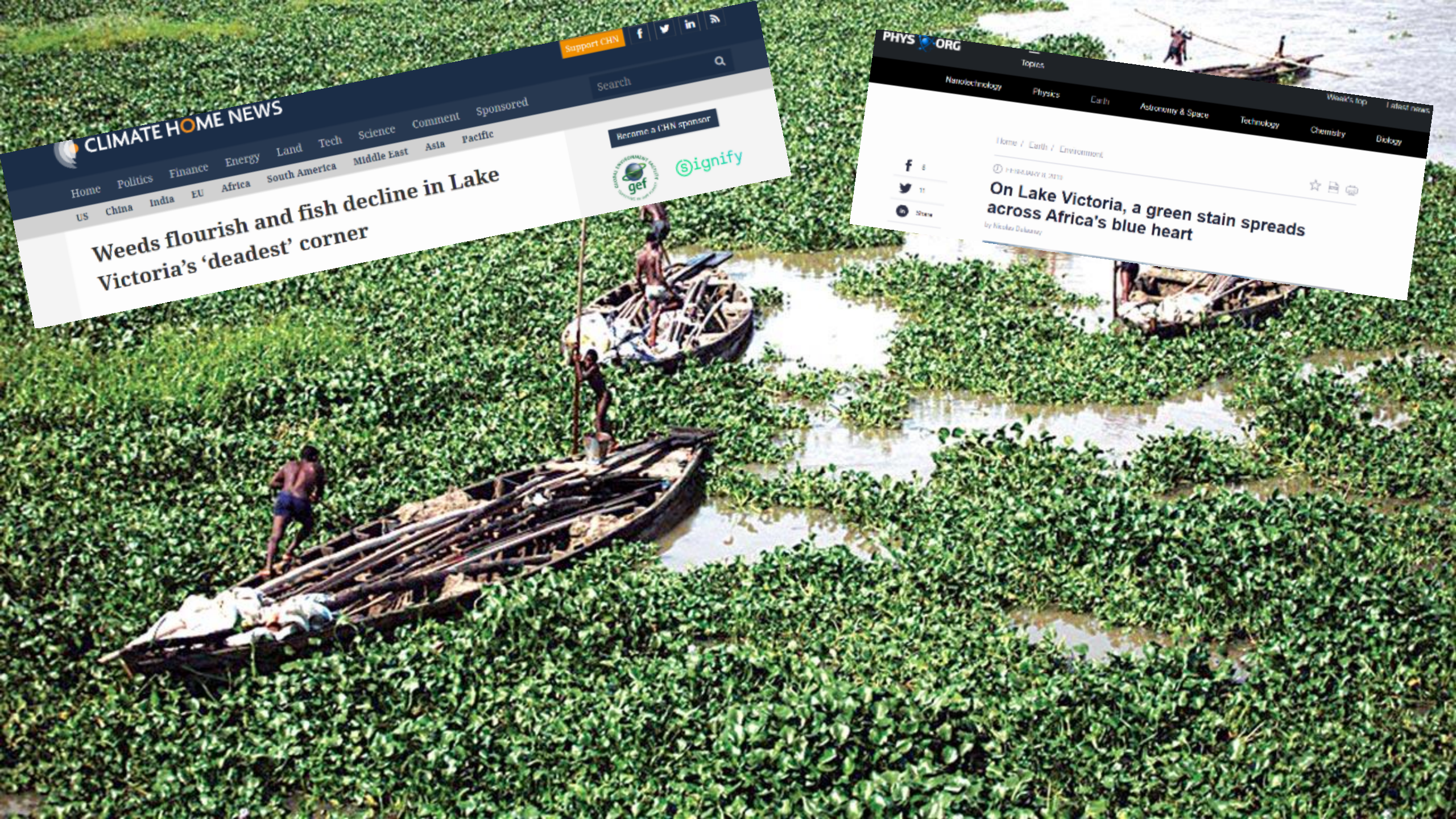
- ▶ Households in proximity to GEF SFM interventions have more in **Household Assets** as compared to households further away.

Positive Correlation with GEF,
not causation



International Waters





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Weeds flourish and fish decline in Lake Victoria's 'deadest' corner

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1 FEBRUARY 11, 2019

On Lake Victoria, a green stain spreads across Africa's blue heart

by Nicolas Delany

f 6 | t 11 | 50 more



Lake Victoria: Vegetation presence



2000

2003

2005

2007

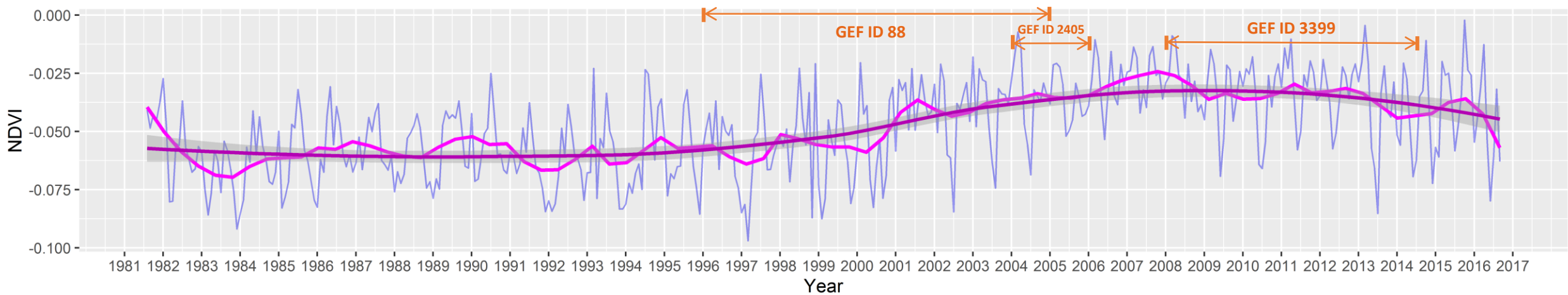
2009

2011

2013

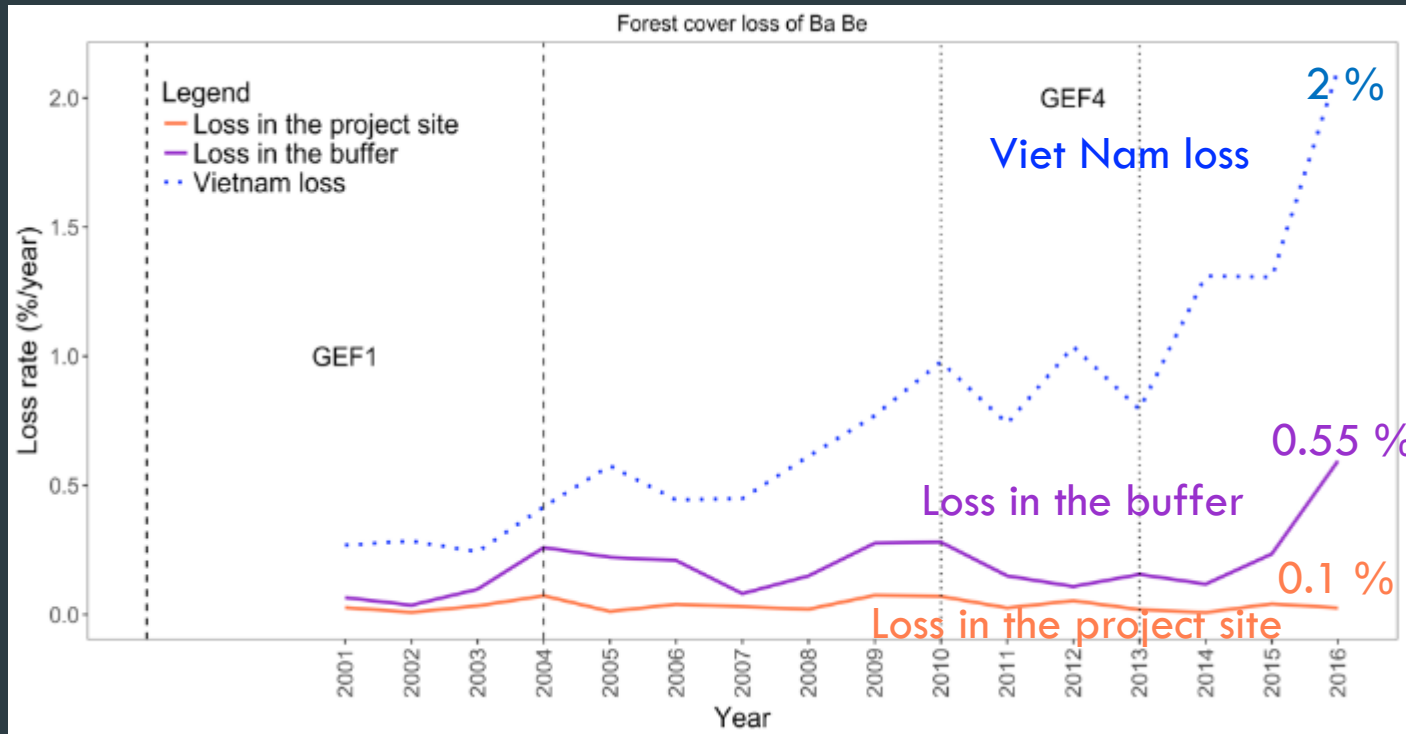
2015

2016

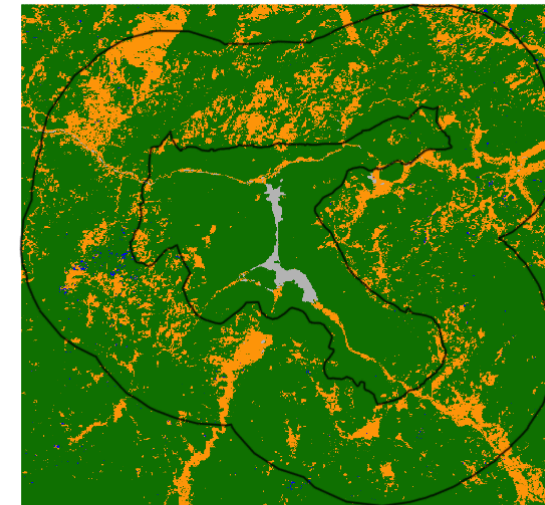


SUSTAINABILITY

Ba Be: Sustainable Forest Management, Viet Nam



2000



Cover

- Forest
- Non-forest
- Forest gain
- Forest loss
- Water
- No data

Region

- GEF1_209_Ba Be

SUSTAINABLE OUTCOME

Forest loss did not increase despite unprecedented increase in the buffer and at country level

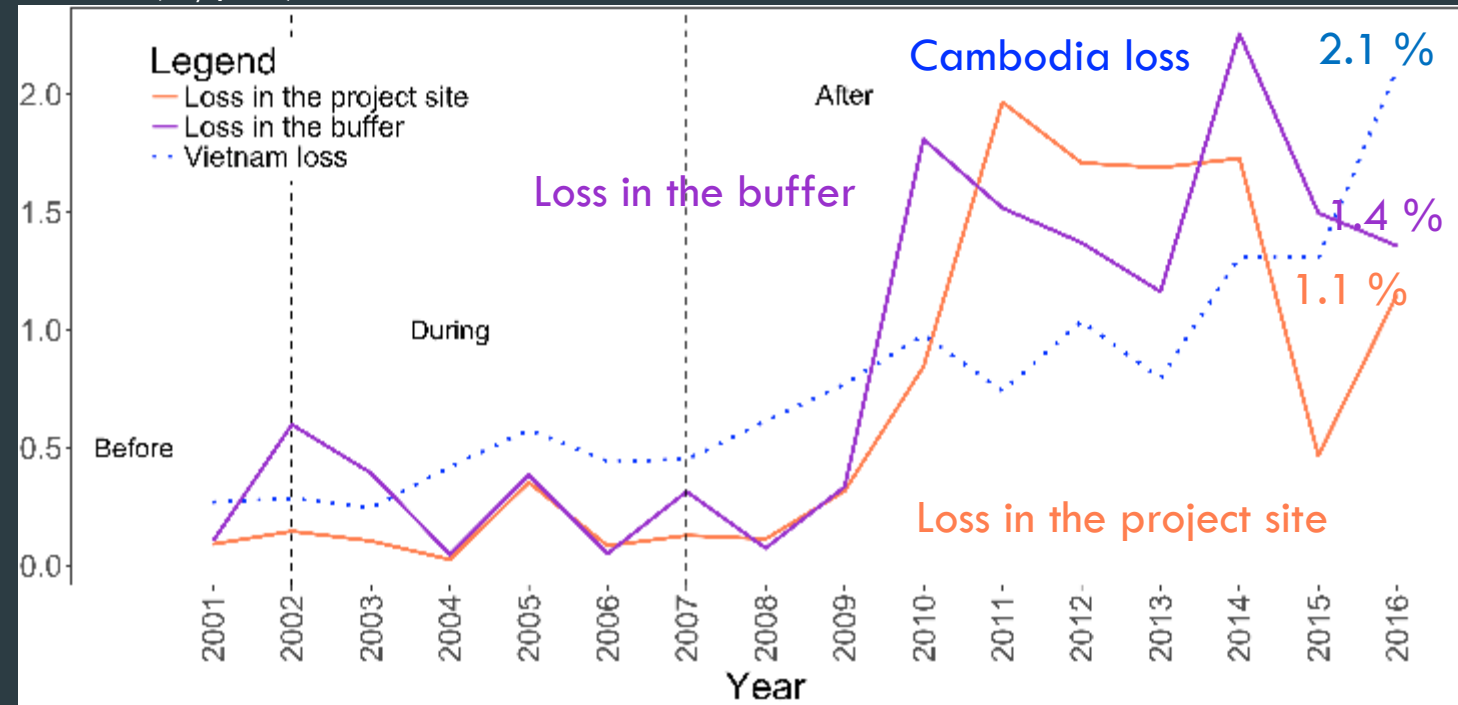
SUSTAINABILITY



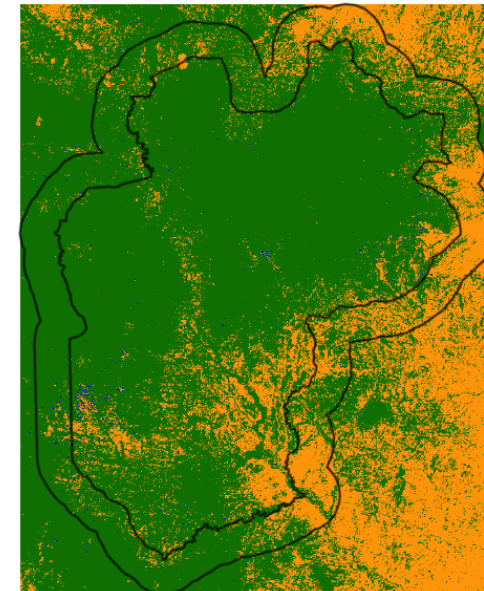
Cardamom Mountains

Integrated Protected Area System, Cambodia

Loss rate (%/year)



2000



Cover

- Forest (green)
- Non-forest (orange)
- Forest gain (blue)
- Forest loss (red)
- Water (grey)
- No data (black)

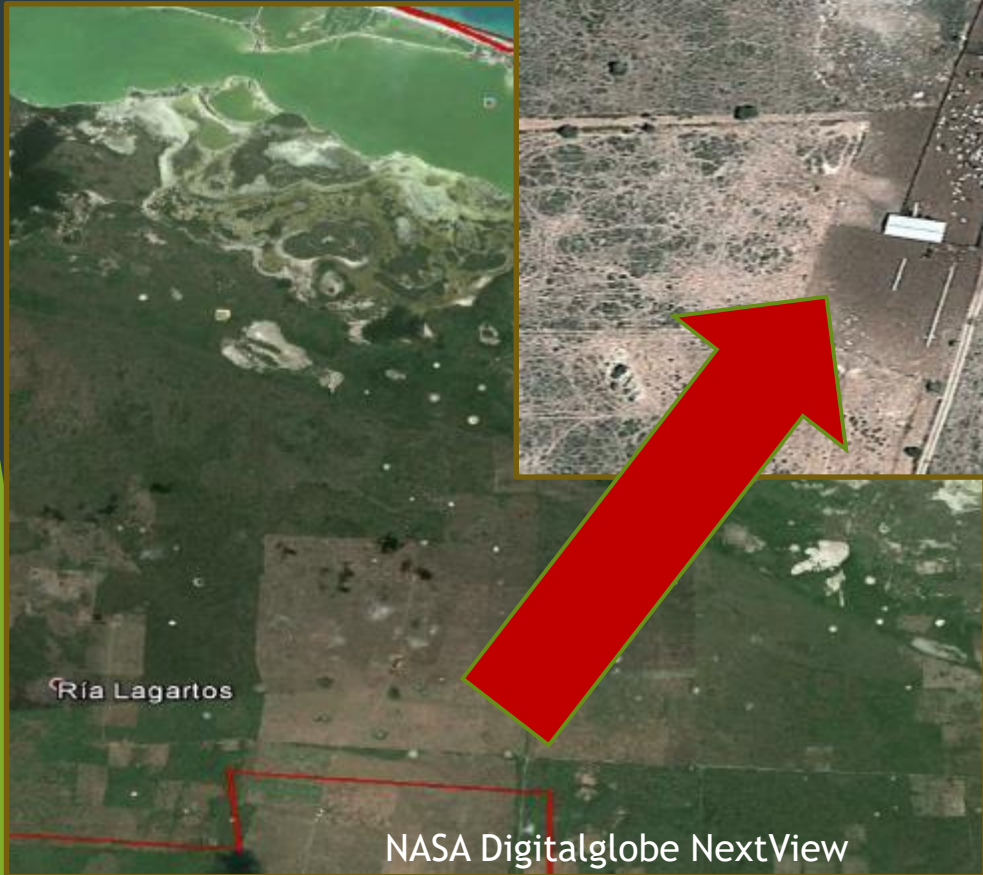
Region

— GEF2_1086_Phnom Aural

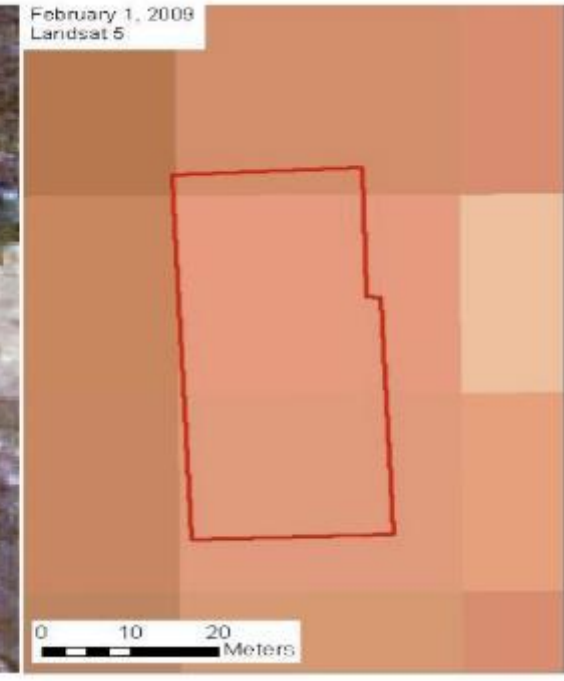
Was this intervention sustainable?

Few other applications

Identify the drivers



2.5 m



30 m zoomed in to
2.5 m

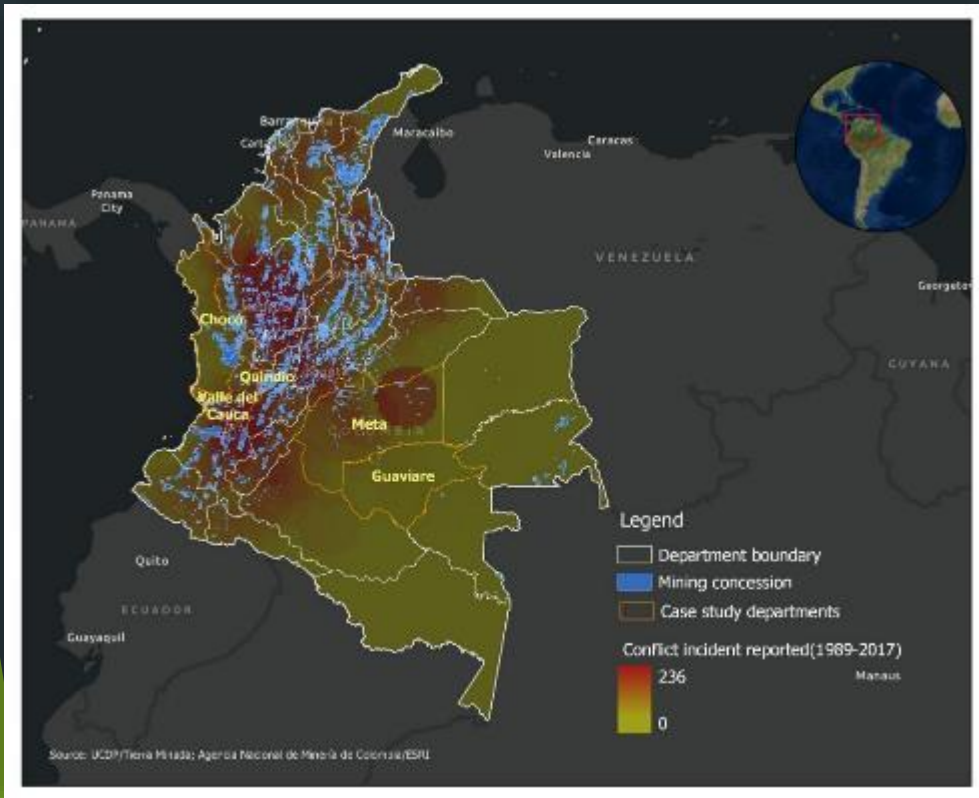
Images at 2.5 to 0.5 m resolution used to identify drivers of change that hinder success of GEF support

Hard to reach, isolated and unsafe areas

Tracking illegal mining in Choco, Colombia



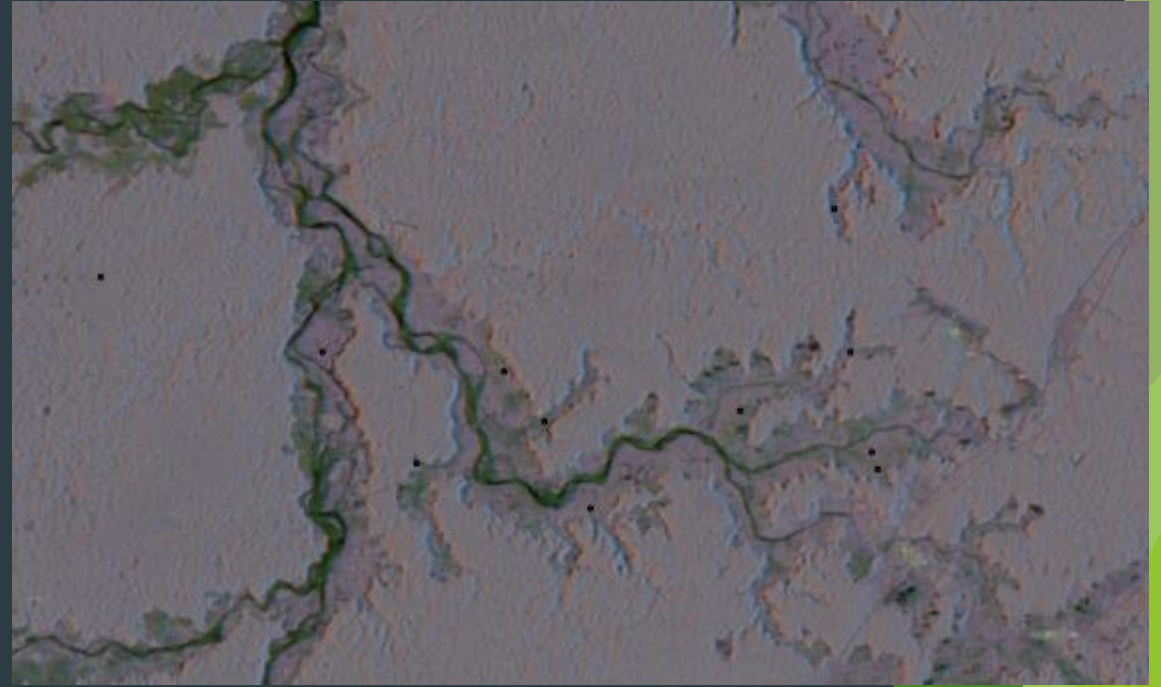
Tracking illegal mining in Choco, Colombia



Challenges in mining mapping using remote sensing data

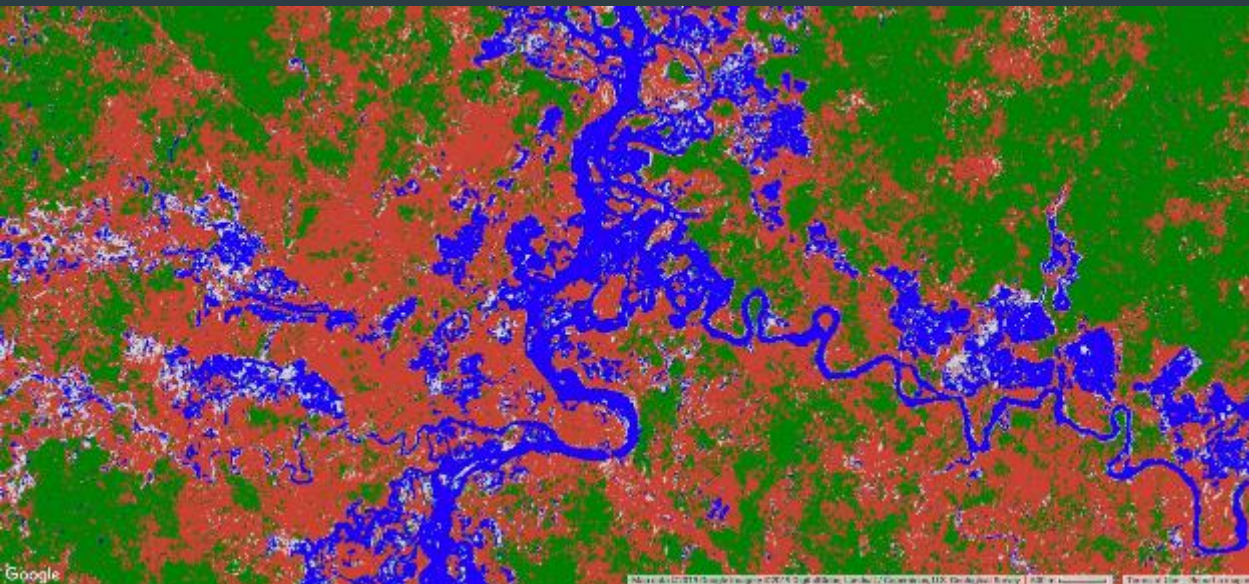


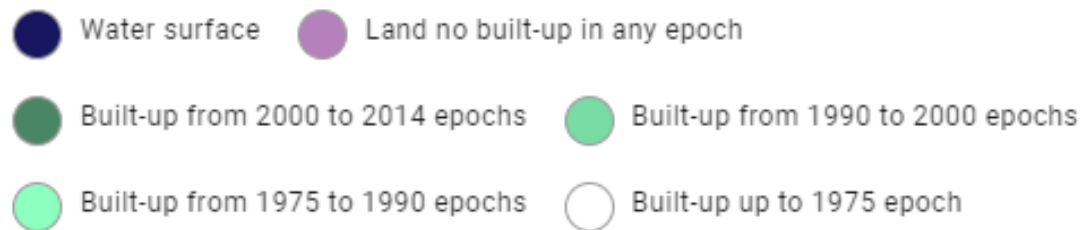
Optical



Radar

Results





Triangulating Across Methods





India: SLEM PMIS 3472(2009-2015)

Beneficiary survey

Bamboo Forest

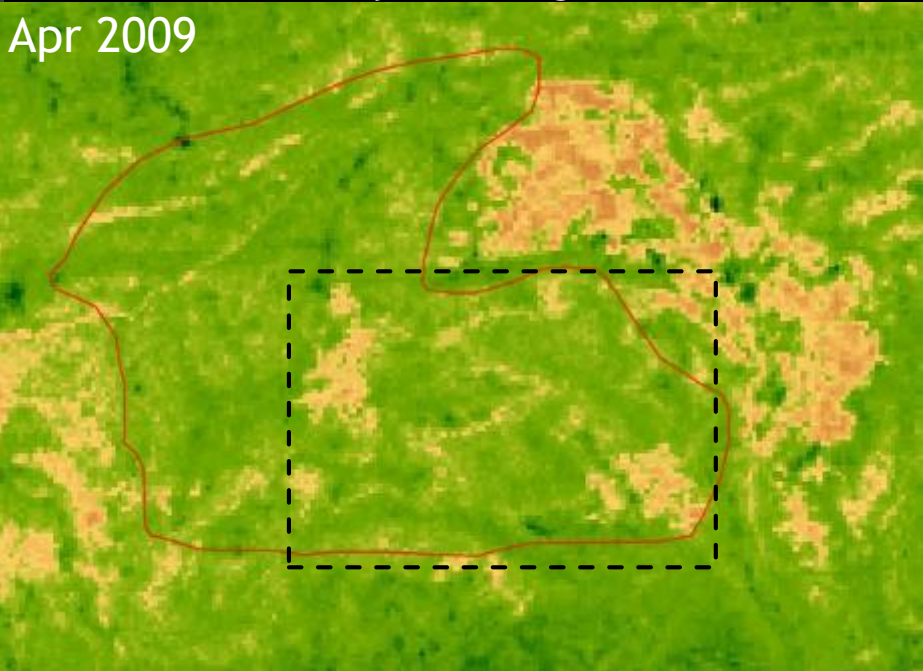


Question	Response
Whats the current date and time	2016-09-18T13:27:00.000+05:30
Where is this interview taking place?	21.76722166205057 78.66110602300134 486.3959563433866 24.0
Can I take a picture?	
Name of Interviewee(s)	Premal anke
What is your role in the project?	beneficiary
Name of Organization	Borpani
Is the project creating any positive impact in the area/region/site?	yes
Did this project contribute to better land management ?	to_a_moderate_
Has the project increased productivity in rangelands? (Y/N)	yes
Has the project allowed for creating of new jobs and livelihood?	yes

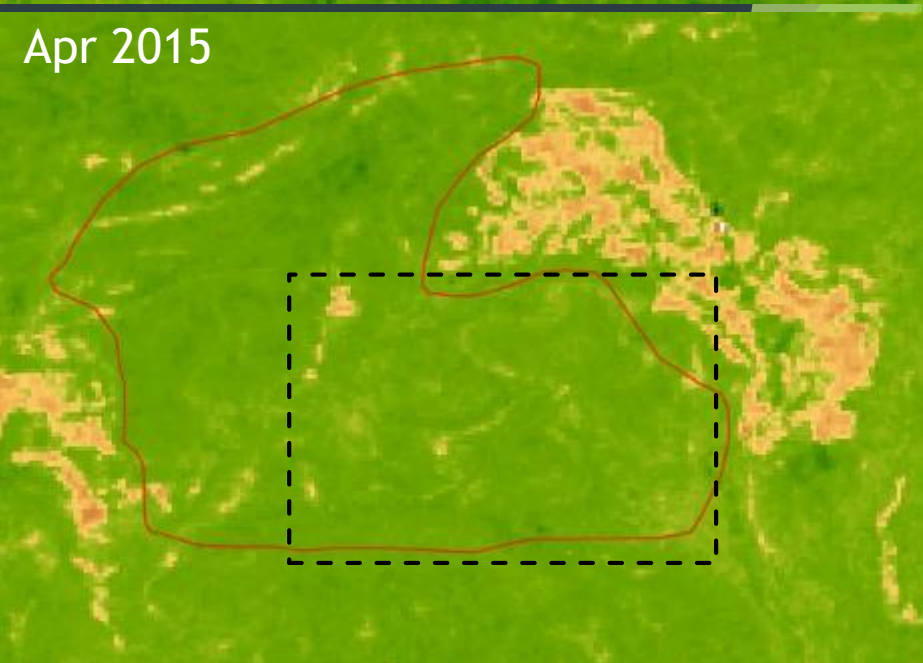


Time series analysis using Satellite data

Apr 2009



Apr 2015



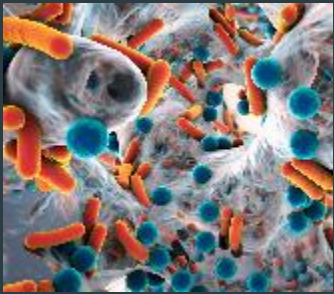


Innovative Methods in M&E

Computational Social Science?

Combination of Big Data, Computer Science, and Social Sciences

- Instrument enabled discipline!



microbiology

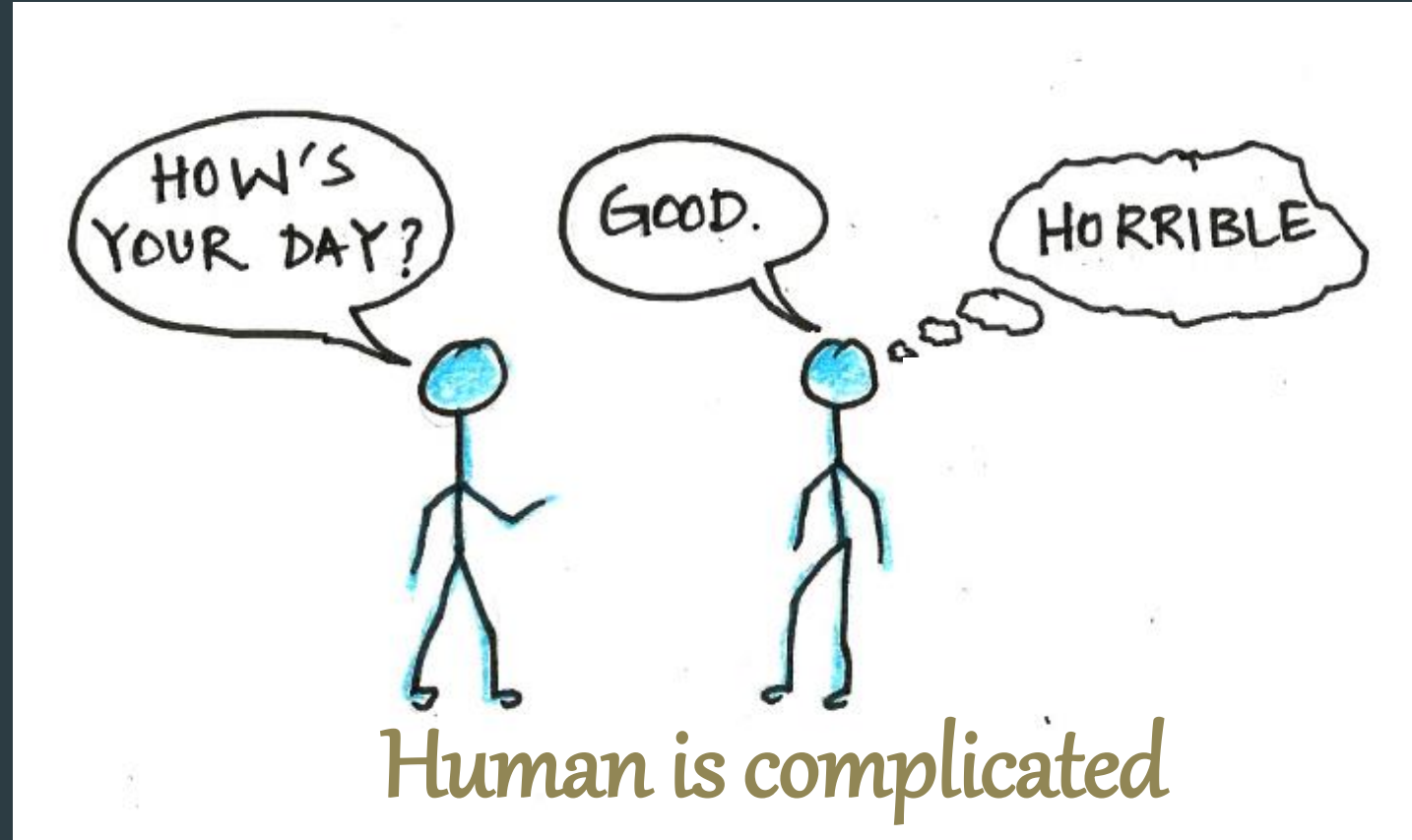


microscope

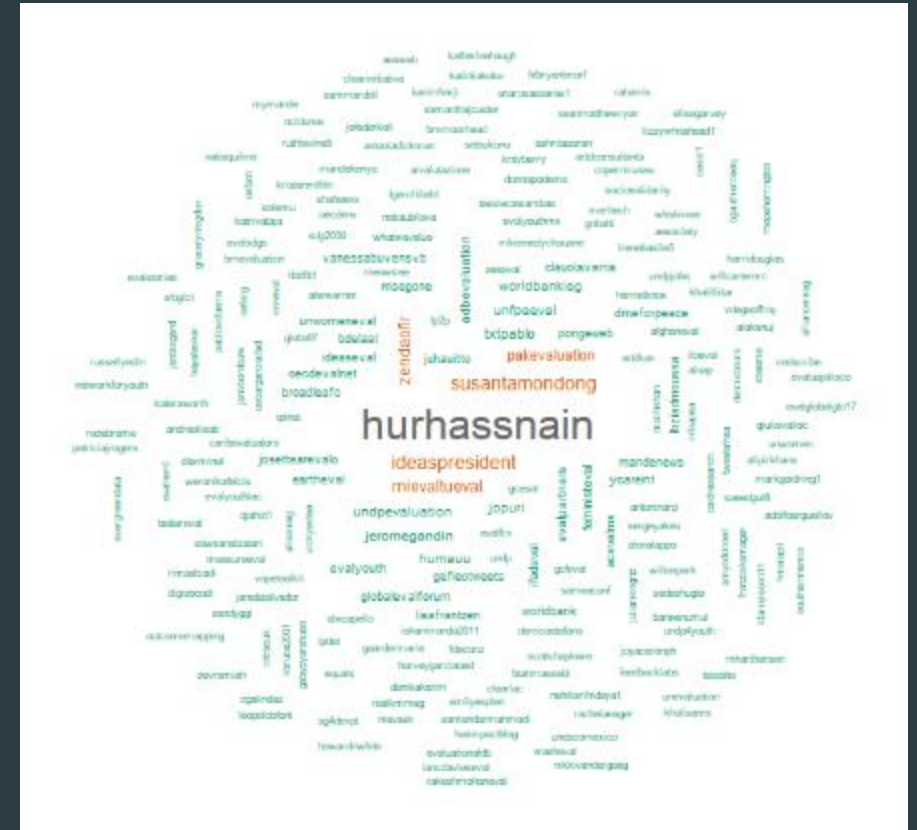


Why do we need it ?

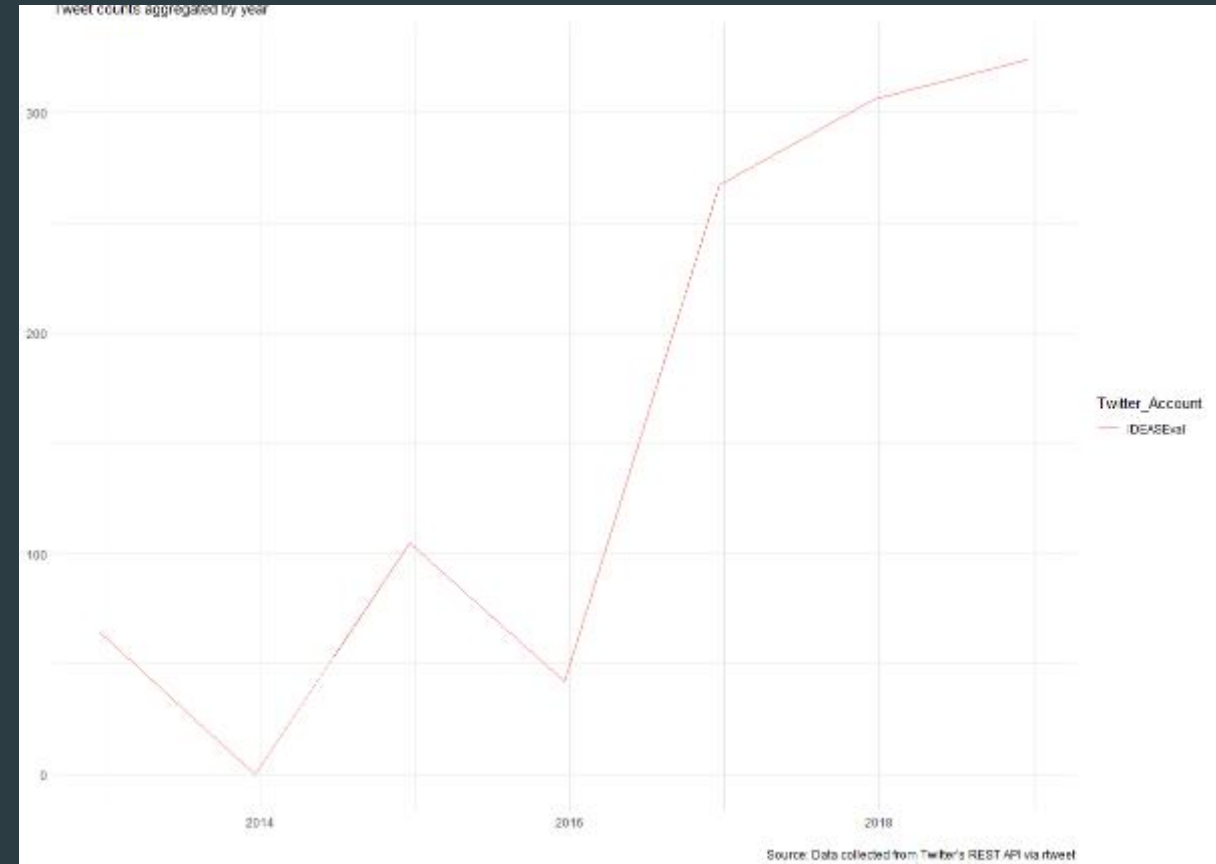
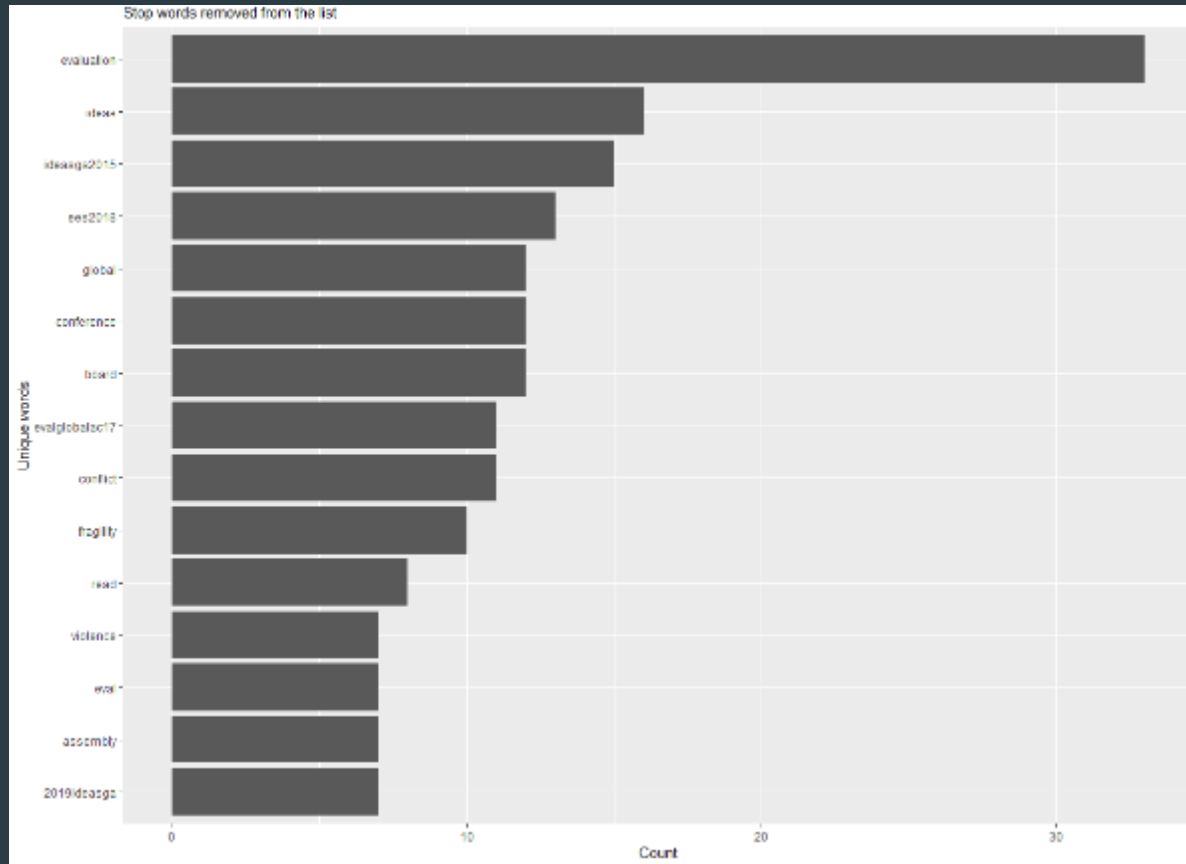
- Social phenomena involve many individuals interacting to produce *collective entities*
- Micro-macro problems are hard to study empirically



"@IDEASEval"

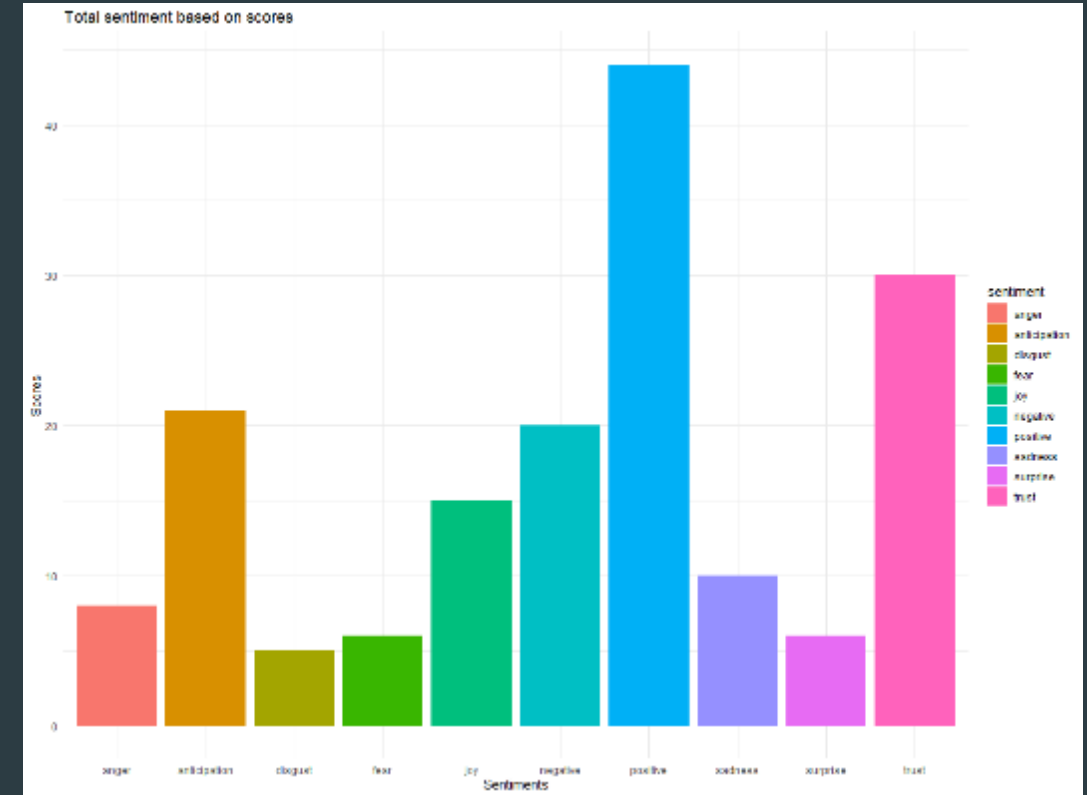
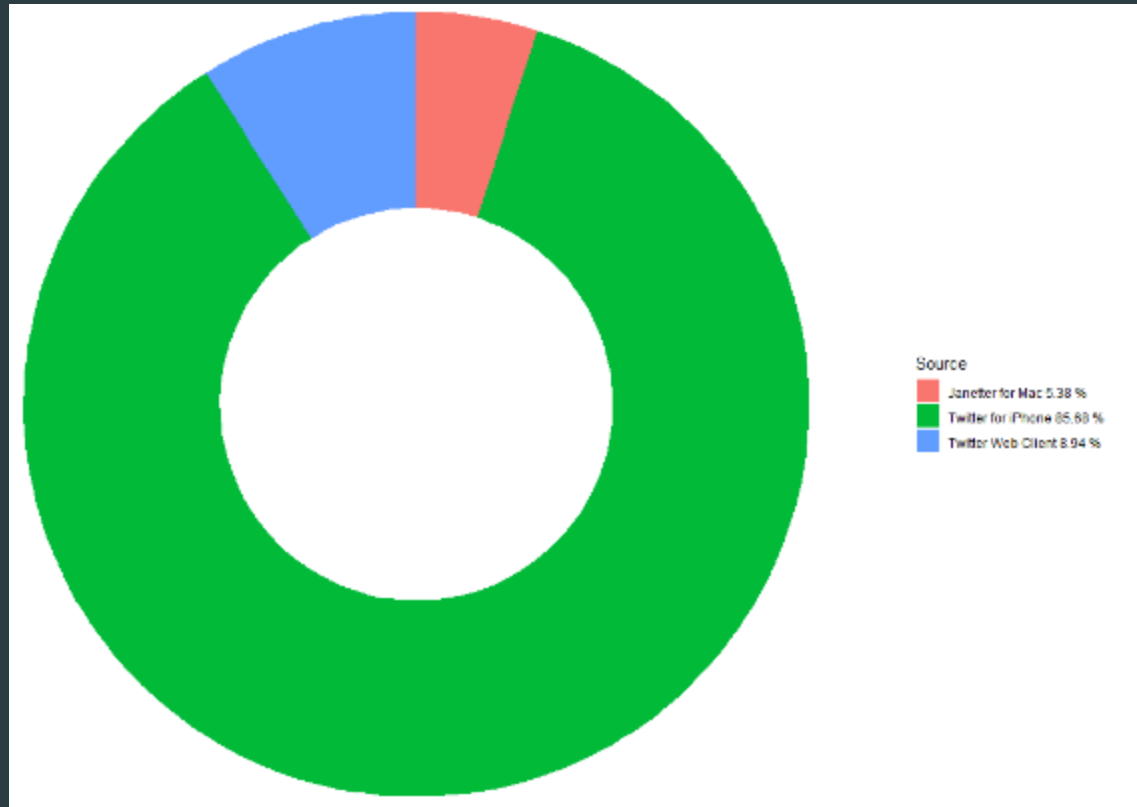


Example: Social Media Data Analysis



"@IDEASEval"

Example: Social Media Data Analysis



"@IDEASEval"

Challenges

- ▶ Need to manage costs
- ▶ Require good technical skills
- ▶ Requires multidisciplinary teams for evaluation
- ▶ Requires keeping up with dynamic learning and upgrading of skills
- ▶ Data ethics

Lessons for the future



**Partner with
global institutions**

**Use mixed
approaches and
methods**

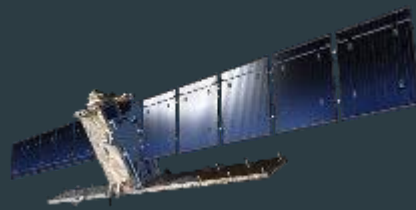


**Continue exploring
new methodologies and
data sources**

**Approach evaluation as
a dynamic learning
process**



Resources



Interactive tools

<http://www.globalforestwatch.org/> : GFW offers data, and tools for forests monitoring

<https://global-surface-water.appspot.com/> : Global Surface Water

Data visualization and download

<http://earthexplorer.usgs.gov> : NASA-USGS Earth Explorer for raw data

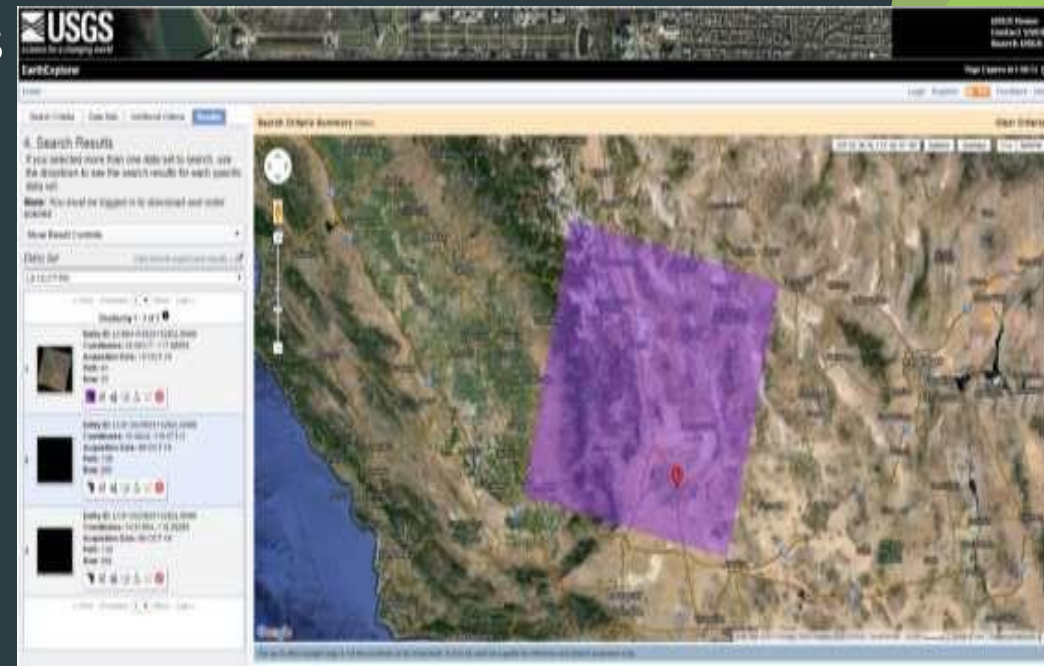
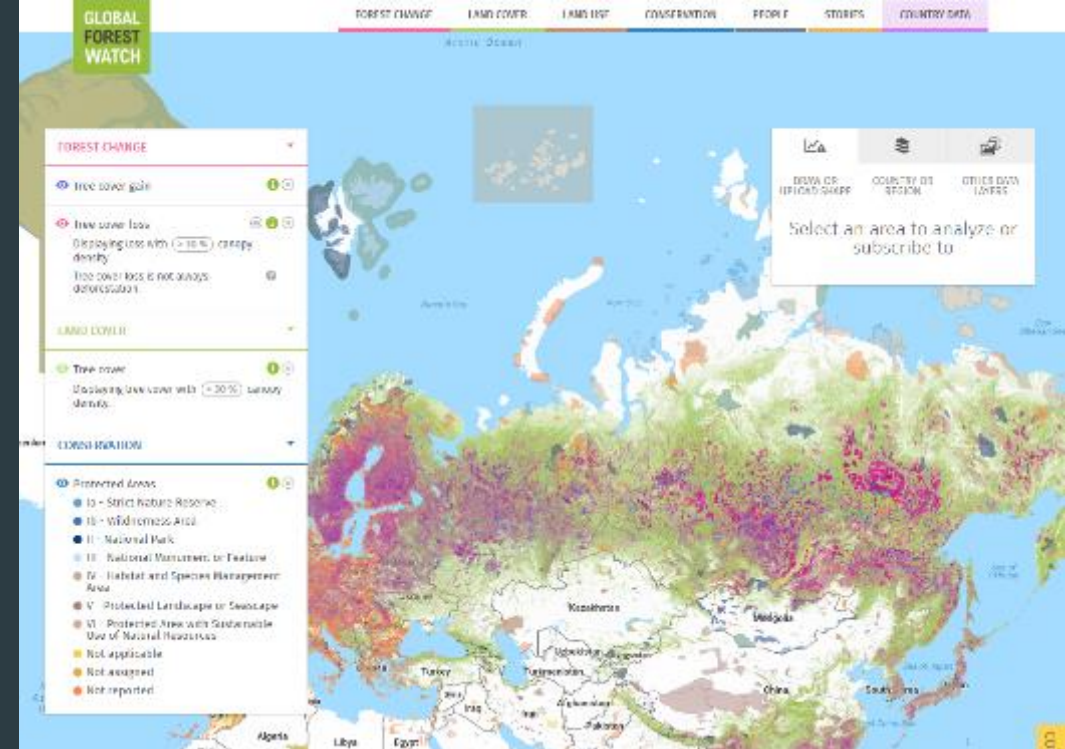
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Analytical tools(Open Access or Free)

<http://www.qgis.org/en/site/> : QGIS

<https://earthengine.google.com/> : Google Earth Engine(requires CODEING)

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Thank you

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