“FINGERPRINTING” NATURE-DEPENDENT COMMUNITIES

A flexible framework for linking Earth Observation and ground-based survey data to quantify community dependence

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Fingerprinting forest-dependent communities – Linking EO and household data for assessing sustainability and resilience
Understanding the people-nature relationship

• Flexible conceptual framework that links

1) Earth Observation (EO) to

2) ground-based survey data (in situ)

• for analyzing community dependence and
• depicting communities at risk using specific Community Fingerprints and EO ecosystem profiles
Analysing people-nature dependence

- **EO-based ecosystem profiles**
- **Statistical linkage**

- Nature-dependent communities
- On the ground Household study

- Assessment of functionality
- Insert points for management decisions & interventions
Define nature-dependent communities

• Focus region:
  – 36 selected communities across the ENPI East countries and Russia
    • Community selection by field consultants and FLEG Country Program Coordinators
    • Represent a variety of forest-dependent communities ranging from very small and isolated communities to larger communities that have access to main roads and markets.
Quantify the relationship between communities and their natural environment using satellite imagery
Derive EO-based ecosystem profile

- 76 EO-based variables
- 6 Parameter groups:
  - Landscape characteristics
  - Villages structure
  - Infrastructure
  - Agriculture
  - Forest
  - Hazards
- 10x10km grid (100km²) with grid size of 500m was used to standardize the process
IUCN Household survey

• Intensive household studies were performed by IUCN
  – Criteria of World Bank Living Standards Measurement Survey and the Center for International Forestry Research (CIFOR) Poverty Environment Network applied
  – Approximately 1250 households involved in 7 countries
  – Detailed information on village and household levels was gathered on:
    • Demography and education
    • Forest-based knowledge
    • Household economy and household assets
    • Village infrastructure

3.5 Mio Entries
**Forest Community Fingerprints from IUCN household survey**

- **Centrepiece of the framework**

- **Pre-Assessment:**
  - Helps to define strategic intervention targets (pre-assessment)

- **Post-Assessment:**
  - Were resources used wisely?
  - Did targeted intervention produce desired results?

- Provides a way to identify whether a community is at risk, in transition or stable
Forest Community Fingerprint

- Spider Web Diagrams

- **Community at risk**

  - Tsevlo - Russia

  - Sakdrioni - Georgia

- **Stable community**

  - Allows us to quantitatively represent resource use/consumption and assess functionality
**Forest Community Fingerprint**

- Relative ranking of forest-dependent communities across large region
How to combine the EO-based ecosystem profiles and the ground based survey data?

Spatial pattern

Household pattern

“Fingerprinting” forest-dependent communities – Linking EO and household data for assessing sustainability and resilience
Establish statistical link between HHs and EO data

- **Step 1: General Linear Modelling (GLM)**
  - Extracts the most significant drivers among EO parameters
  - Assesses percentage of variance explained these drivers
Establish statistical link between HHs and EO data

- **Step 2: Principal Component Analysis (PCA):**
  - Defines the direction and confirms the overall strength of the relationship between significant drivers among EO parameters and the six FCF parameters.
Establish statistical link between HHs and EO data

- **Step 2: Principal Component Analysis (PCA)**

<table>
<thead>
<tr>
<th>FCF parameter</th>
<th>Positive correlation with EO parameter</th>
<th>Negative correlation with EO parameter</th>
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</thead>
<tbody>
<tr>
<td>Financial Capital</td>
<td>Elevation Mean</td>
<td>Forest Extent, Forest Gain (2000-2013)</td>
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<tr>
<td></td>
<td>Land cover, mixed cultivated land</td>
<td></td>
</tr>
<tr>
<td>Forest Ecosystem</td>
<td>Elevation, Mean</td>
<td>Forest Extent, Forest Gain (2000-2013)</td>
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<tr>
<td>Market System</td>
<td>Slope, Low Hills</td>
<td>Remoteness, Distance of the most remote house from a main street</td>
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<tr>
<td>Infrastructure</td>
<td>Land Cover, Urban</td>
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<tr>
<td>Development</td>
<td>Slope, Low Hills</td>
<td></td>
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<tr>
<td>Human Resources</td>
<td>Land Cover, Cultivated land</td>
<td>Forest extent, Tree Cover 2000 and 2013</td>
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<tr>
<td></td>
<td>Land Cover, Urban Territories</td>
<td>Land Cover, Trees</td>
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→ **PCA and GLM confirmed the linkage between the HHs data and the EO-based ecosystem profile**
Establish statistical link between HHs and EO data

- Scatterplot for FCF and EO-based ecosystem profile show similar patterns

Forest Community Fingerprint
Establish statistical link between HHs and EO data

- Scatterplot for FCF and EO-based ecosystem profile show similar patterns

**Forest Community Fingerprint**

**EO-based ecosystem profile**

**IUCN Household survey**

**Earth Observation Data**

"Fingerprinting“ forest-dependent communities – Linking EO and household data for assessing sustainability and resilience
Establish statistical link between HHs and EO data

- Comparing the FCF assessment and FCF-PCA results
  – 31 out of 36 communities align (≈86%)

<table>
<thead>
<tr>
<th></th>
<th>EO-PCA</th>
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<tbody>
<tr>
<td>at risk</td>
<td>Artani, Bystrychi, Danachi, Gubichi, Kolodiazne, Krasnyi Luch, Mukhen, Novaya Buda, Rudnya Viktorinskaya, Sikachi Alan, Sita, Strychava, Tsevlo, Volchno Burlinskoe, Yukhari Chardakhlar, Zahorb</td>
</tr>
<tr>
<td>stable</td>
<td>Halidzor, Seredkevichy, Smolyn, Tyumentsevo, Yeltsovka</td>
</tr>
<tr>
<td>at risk</td>
<td>Aknaghbyur, Alexandru cel Bun, Bezhanitsy, Borceag, Chabano, Cioresti, Gargar, Haghartsin, Ivanova Sloboda, Sakdrioni, Tatev, Yeghegnut, Yukhari Tala, Zarinzeebi, Zhebota</td>
</tr>
<tr>
<td>stable</td>
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In a nutshell…

1) A flexible framework to quantify people-nature relationships
In a nutshell....

2) Forest Community Fingerprint:

- identifies insertion points in the community development
- helps to define priorities in community development
- make targeted policy and management strategy
In a nutshell....

3) Community fingerprints can be adapted to specific conditions
   - Change FCF parameters
   - Change the number of FCF parameters
In a nutshell....

4) Accuracy can be improved by using high resolution Data

WorldView-2 – 0,5m

RapidEye – 5m

Landsat – 30m
Outlook

• Additional testing, both deeper application and wider geographic distribution
  – Includes both, other forest ecosystems as well as other ecosystems e.g. agricultural land
Thank you!