“FINGERPRINTING” FOREST-DEPENDENT COMMUNITIES

Linking Earth Observation and household survey data for assessing sustainability and resilience

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Understanding Human-Nature Dependance

**Topic for the presentation:**
- Conceptual framework that links household survey data and Earth Observation (EO) to assess the functionality and resilience of communities

**Main objectives:**
- Better understand the interaction and relationship between forest-dependent communities and their surrounding ecosystems
- Explore the potential of EO for supplementing field surveys and early identification of at-risk communities in unsurveyed regions

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"Fingerprinting" forest-dependent communities – Linking EO and household data for assessing sustainability and resilience
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Framework overview

• Novel approach for assessing the resilience, well-being and sustainability of rural forest-dependent communities

• Rationale:
  – Strong link between the resilience of a community and the spatial pattern of the surrounding landscape
Framework Overview

1) Forest-dependent communities
2) EO-based Ecosystem profiles for all communities
3) Community clusters based on EO characteristics
4) Selection of representative communities for surveying
5) On the ground household survey in selected communities
6) Forest Community Fingerprint & Poverty Assessment for survey communities
7) Statistical link between household patterns and EO-based ecosystem profiles

EO-based ecosystem profiles

Identify communities at risk and provide political guidance

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1) Define forest-dependent communities

- Focus region:
  - 36 selected pilot communities across the ENPI East countries and Russia
  - Community selection by field consultants and FLEG Country Program Coordinators
2) Derive EO-based ecosystem profile

- 6 Parameter groups:
  - Landscape characteristics
  - Villages structure
  - Infrastructure
  - Agriculture
  - Forest
  - Hazards

- In total 76 variables

- 10x10km grid (100km²) with grid size of 500m was used to standardize the process
3) Perform cluster analysis

- Partition Around Medoids (PAM) cluster analysis
  - Categorize the communities according to their similarities in the EO-based ecosystem profiles
  - First impression about the level of similarity between communities across the focus region
  - All communities are used for further analysis (4)
5) Household survey

• Intensive household studies were performed by IUCN
  – Approximately 1250 households involved
  – Criteria of World Bank Living Standards Measurement Survey and the Center for International Forestry Research (CIFOR) Poverty Environment Network applied
    – Detailed information on village and household levels was gathered
      • Demography
      • Household economy and household assets
      • Infrastructure, ..... 

• Data was used for developing the proposed conceptual framework
6) Forest Community Fingerprint

• Centrepiece of the framework

• Helps to define strategic intervention targets

• Serves as link to understand the poverty-forest interaction

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

- Ranking forest-dependent communities

<table>
<thead>
<tr>
<th>Functionality</th>
<th>Name of community</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community at risk</td>
<td>Artani, Smolyn, Tsevlo, Rudnya-Viktorinskaya, Danachi, Zahorb, Ivanova Sloboda</td>
</tr>
<tr>
<td>Rather at risk</td>
<td>Borceag, Bystrychi, Gubichi, Halidzar, Kolodyazne, Novaya Buda, Seredkevychi, Sikachi-Alan, Strychava, Yukhari Chardakhlar, Zhebota</td>
</tr>
<tr>
<td>Transition</td>
<td>Alexandru cel Bun, Aknaghbyur, Chabano, Gargyar, Haghartsin, Krasny Luch, Mukhen, Sita, Tatev, Volchno-Burlinskoe, Yeghegnut, Yeltsovka, Zardzeebi</td>
</tr>
<tr>
<td>Rather stable</td>
<td>Bezhanitsy, Cioresti, Sakdrioni, Tyumentsevo, Yukhari Tala</td>
</tr>
</tbody>
</table>

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6) Forest Community Fingerprint

- Spider Web Diagrams

**Community at risk**

**Stable community**

*Tsevlo - Russia*  
*Sakdrioni - Georgia*
7) Establish statistical link between HHs and EO data

- **Step 1: General Linear modelling**
  - Extracts the most significant drivers among EO parameters
  - Assesses percentage of variance explained these drivers
7) 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

```
-1,0 -0,5 0,0 0,5 1,0
Factor 1 : 27,16%
-1,0
-0,5
0,0
0,5
1,0
Factor 2 : ...
```

```
Active variables  Passive variables
-1,0 -0,5 0,0 0,5 1,0
Factor 1 : 27,16%
-1,0
-0,5
0,0
0,5
1,0
Factor 2 : ... ext., F. Loss (2000-2013)
*Forest ext., Tree cover 2000
*Forest ext., Tree cover 2013
*Flood risk, High risk
```

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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
```
7) 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>
</tr>
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<tbody>
<tr>
<td><strong>Financial Capital</strong></td>
<td>Elevation Mean</td>
<td>Forest Extent, Forest Gain (2000-2013)</td>
</tr>
<tr>
<td></td>
<td>Land cover, mixed cultivated land</td>
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</tr>
<tr>
<td><strong>Forest Ecosystem Stability</strong></td>
<td>Elevation, Mean</td>
<td>Forest Extent, Forest Gain (2000-2013)</td>
</tr>
<tr>
<td></td>
<td>Land cover, mixed cultivated land</td>
<td></td>
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<tr>
<td><strong>Forest-based Knowledge</strong></td>
<td>Forest Extent, Forest Gain (2000-2013)</td>
<td></td>
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<tr>
<td><strong>Market System</strong></td>
<td>Land Cover, Urban</td>
<td>Remoteness, Distance of the most remote house from a main street</td>
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<td></td>
<td>Slope, Low Hills</td>
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<td><strong>Infrastructure Development</strong></td>
<td>Land Cover, Urban</td>
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<td><strong>Human Resources</strong></td>
<td>Land Cover, Cultivated land</td>
<td>Forest extent, Tree Cover 2000 and 2013</td>
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<td>Land Cover, Urban Territories</td>
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<td></td>
<td>Land Cover, Trees</td>
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</table>
7) 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
7) Establish statistical link between HHs and EO data

- Comparing the FCF assessment and FCF-PCA results
  – 28 out of 36 communities align (≈78%)

<table>
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<th>FCF – PCA</th>
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<tbody>
<tr>
<td>at risk</td>
<td>stable</td>
</tr>
<tr>
<td>Artani, Danachi,</td>
<td>Borceag, Zhebota</td>
</tr>
<tr>
<td>Ivanova Sloboda,</td>
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<tr>
<td>Rudnya Viktorinskaya, Smolyn, Tsevlo, Zahorb</td>
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<tr>
<td>at risk</td>
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<tr>
<td>Bystrychi, Gubichi,</td>
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<td>Halidzor, Kolodiaze,</td>
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<tr>
<td>Novaya Buda,</td>
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<td>Seredkevichy, Sikachi Alan,</td>
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7) Establish statistical link between HHs and EO data

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

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<th>stable</th>
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Conclusion

• The proposed methodology helps to define priorities in community development and make policy and management strategy more focused.

• **FCF** provides a sound representation about the human-nature dependency in the 36 sample communities and clearly identifies weaknesses or insertion points in the community development.

• **Earth Observation** allows generating detailed, consistent information on ecosystem profiles for large areas.

• Preliminary results confirm the potential to identify stable- and at-risk communities through the statistical linkage with representative household survey data.
Questions?

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