Earth Observation for enhanced monitoring, evaluation and learning of development programmes

Jameel Observatory drylands food security and resilience early action research and evidence dialogue, Addis Ababa, 15-16 May 2025

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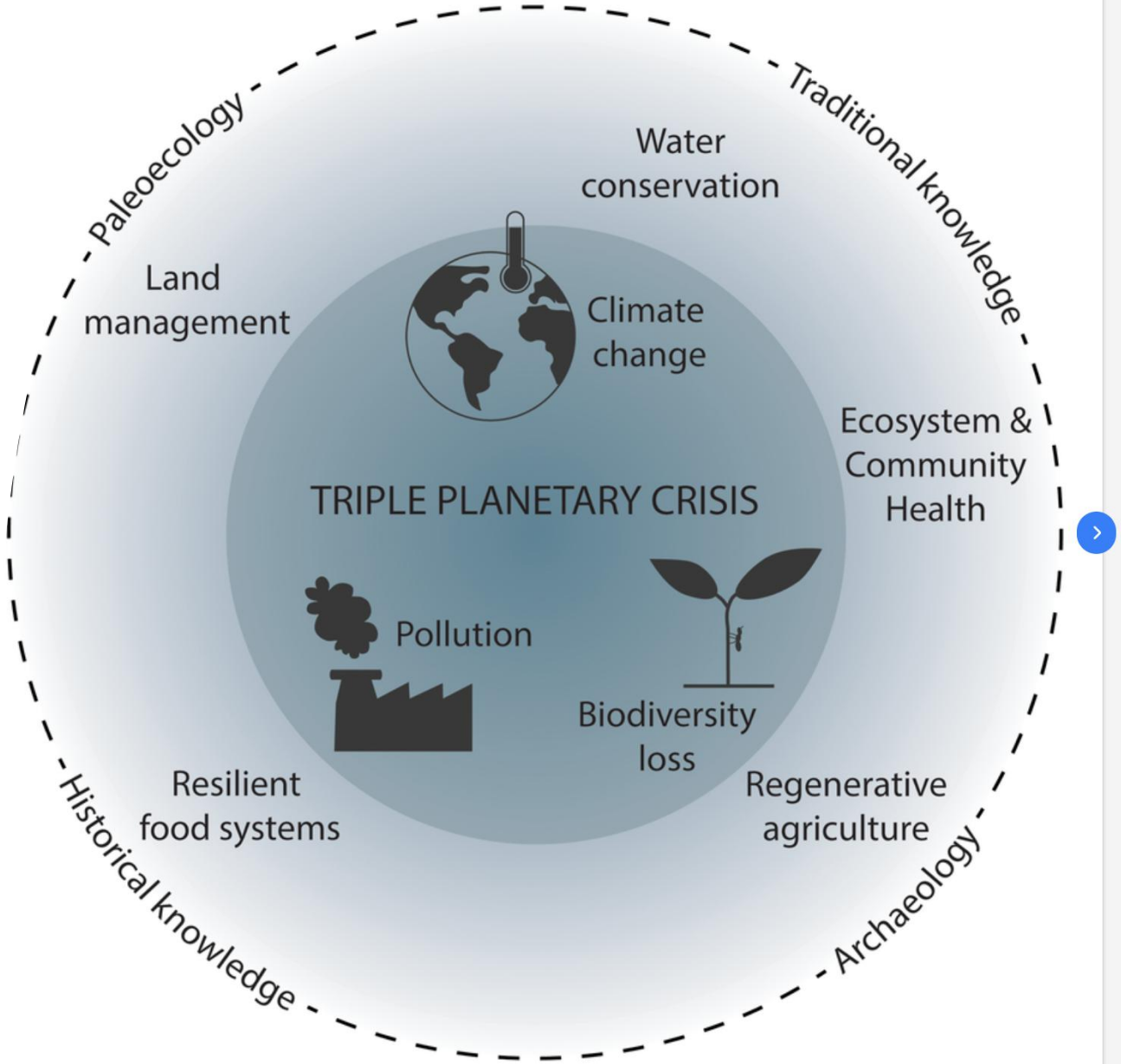
Navigating the Triple Crises: Aligning MEL with Emerging Development Realities

- Climate, biodiversity, and pollution crises intersect with human vulnerability.
- Development efforts are shifting toward integrated and optimized programming to meet growing demands with limited resources.
- MEL is no longer about checking boxes.



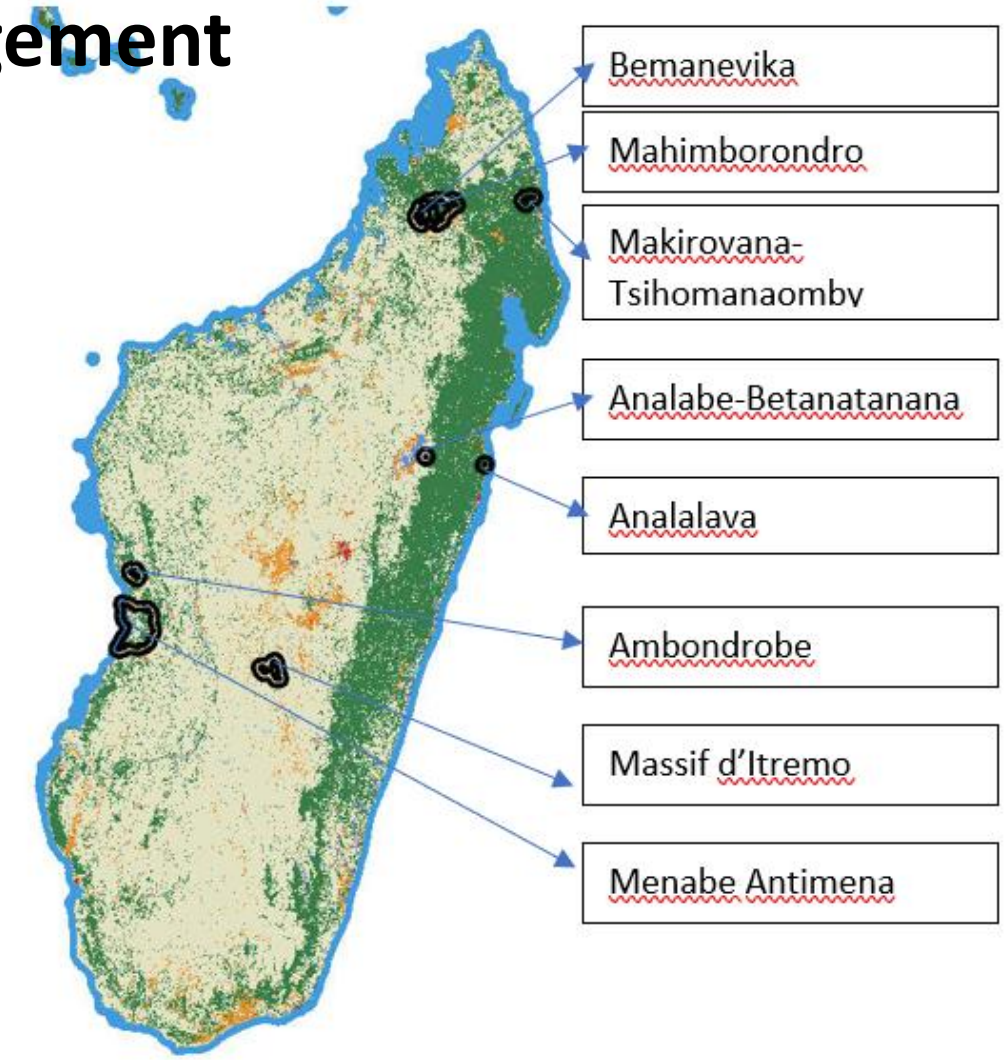
Freire et all, 2024

What we can’t see, we can’t fix

- EO offers a cost-effective solution to fill MEL data gaps that are otherwise difficult or expensive to address.
- EO help us see change as it happens.
- EO supports cross-sector integration in planning, monitoring, and reporting.

Sustainable Landscape Management Project – Madagascar

Objective: prevent the loss of Madagascar's remaining forests and biodiversity, while also ensuring the well-being of communities that depend on nature.



Checklist for Dataset Selection

Madagascar Sustainable Landscape Management Project	
Dataset	**Key questions**
1. Temporal Coverage and Dataset Continuity	☐ Does the dataset provide historical data from at least 2017 or earlier to establish a healthy baseline? ☐ Is the dataset expected to be available through 2027 and beyond to track post-project impact? ☐ Is there annual or more frequent data availability to enable meaningful before-and-after comparisons? ☐ If no single dataset meets the full 10-year window (2017–2027), can multiple complementary datasets be combined for continuity?
2. Spatial Resolution and Scale Suitability	☐ Does the dataset have a resolution between 10–30m, which is suitable for detecting deforestation, small-scale agricultural changes, and infrastructure expansion in Madagascar's complex landscapes? ☐ Can the resolution differentiate between forest types, degraded vs. intact habitats, and community land-use patterns? ☐ If high-resolution imagery (<10m) is unavailable or costly, can medium-resolution products (30m) still provide useful insights when paired with field data validation?
3. Thematic Detail and Classification Accuracy	☐ Does the dataset provide accurate classification of key ecosystems, including Madagascar's rainforests, dry forests, mangroves, savannas, and agricultural lands? ☐ Can the dataset distinguish between primary forests, secondary regrowth, plantations, and deforested areas? ☐ Are accuracy assessments available for Madagascar or similar tropical regions? (Check independent validation studies) ☐ How well does the dataset capture human-induced land changes (e.g., shifting cultivation, charcoal production, illegal logging)?
4. Accessibility and Usability for Project Teams	☐ Is the dataset open-access and free to use for long-term monitoring, or does it have licensing costs? ☐ Can non-technical project staff easily access and visualize the data through platforms like Google Earth Engine, ArcGIS, or QGIS? ☐ Does it provide pre-processed land cover maps that reduce the need for extensive image classification? ☐ Are there ready-made indicators (e.g., deforestation alerts, carbon stock estimates) that simplify impact tracking?
5. Suitability for Impact Evaluation and Monitoring	☐ Can the dataset support difference-in-differences (DiD) evaluation by comparing PAs inside vs. outside project sites? ☐ Does it allow for yearly comparisons to track incremental progress rather than relying on snapshots before/after? ☐ Can it quantify land cover changes carbon sequestration, habitat connectivity, and ecosystem resilience over time? ☐ Are methodologies available for long-term impact assessment, and can they be replicated with future updates?
6. Alignment with Sustainable Landscape and Community Goals	☐ Does the dataset support tracking community-driven land use patterns, such as agroforestry or restoration initiatives? ☐ Can it detect forest degradation (not just deforestation), which is critical for biodiversity monitoring? ☐ Are there datasets available that track socioeconomic variables (e.g., settlements, agriculture expansion) alongside land cover?
7. Climate and Environmental Factors (Madagascar-Specific)	☐ Can the dataset account for seasonal cloud cover, which affects Madagascar's humid regions? ☐ Does it incorporate Sentinel-1 radar data or other cloud-free methods to improve forest classification in cloudy areas? ☐ Can it track wetland and mangrove changes, given Madagascar's coastal ecosystems' importance for carbon storage?
8. Complementary Datasets and Integration Potential	☐ Can the dataset be integrated with other LULC products (e.g., Esri/IO 10m, Dynamic World, Hansen forest loss, Copernicus 100m) for better accuracy? ☐ If using multiple datasets, how well do their classification systems align for consistency? ☐ Are training data or local field validation datasets available to improve classification accuracy?

Global LULC Datasets for Madagascar Study

Dataset Name and Sensor(s)	Data Product Link	Resolution & Classes	Temporal Coverage	Access & Continuity	Key Features / Limitations	References
Esri/Impact Observatory 10m Land Cover Sentinel-2	- Esri Living Atlas - Impact Observatory	10 m; 9 classes	Annual 2017–2023 (ongoing)	Available via Esri Living Atlas, Microsoft Planetary Computer, AWS Open Data, and Google Earth Engine	- High-resolution 10m data, suitable for detailed monitoring. - May overestimate shrub/scrub cover. - Consistent classification across years for long-term change detection.	Impact Observatory (2023); Venter et al. (2022)
Dynamic World (Google) Sentinel-2	- Google Earth Engine (GEE) - Dynamic World App	10 m; 9 classes (probabilistic model)	Continuous (2016–present)	Available on Google Earth Engine	- Near real-time updates, suitable for flexible change monitoring. - Requires Google Earth Engine proficiency. - Lower classification accuracy for shrub/scrub, grassland, and bare ground.	Venter et al. (2022)
Hansen Global Forest Change Landsat	- Global Forest Watch (GFW) - Google Earth Engine (GEE) - University of Maryland	30 m; Tree cover loss/gain	Annual 2000–2023 (ongoing)	Available via University of Maryland, Global Forest Watch, and Google Earth Engine	- Best for historical deforestation tracking. - Cannot detect non-forest land changes or selective logging.	Hansen et al. (2013); Vieilledent et al. (2018)
Custom Landsat-Based Supervised Classification Landsat (5–9)	- USGS Earth Explorer (Raw Landsat Data) - Google Earth Engine (Processed Landsat)	30 m; User-defined LULC classes	Flexible (project-specific)	Available via USGS Earth Explorer	- Requires expertise in supervised classification. - Accuracy depends on quality and representativeness of training data. - Suitable for tailored, region-specific studies.	Burivalova et al. (2015); Congalton & Green (2019)
ESA WorldCover Sentinel-1 & 2	- ESA WorldCover Viewer - Google Earth Engine (GEE) - Download via Zenodo	10 m; 11 classes	2020, 2021 (two epochs only)	Available via ESA Viewer and AWS	- Provides radar-optical fused classification, improving performance in cloudy areas. - Limited to two years; lacks updates beyond 2021.	Zanaga et al. (2021)
Copernicus Global Land Cover (100m) PROBA-V	- Copernicus Land Monitoring Service - Google Earth Engine (GEE)	100 m; 23 classes + fractional layers	Annual 2015–2019 (discontinued)	Available via Copernicus Portal and Google Earth Engine	- Useful for historical baseline assessments. - Resolution too coarse for small protected areas. - No updates beyond 2019.	Buchhorn et al. (2020)
MODIS Land Cover MODIS	- NASA Earthdata - Google Earth Engine (GEE)	500 m; 17 classes	Annual 2001–present	Available via NASA Earthdata and Google Earth Engine	- Best for regional-scale trends but too coarse for protected area monitoring. - Continuous updates allow long-term assessments.	(Wan, 2014)
GlobeLand30 Landsat, HJ-1	Direct Download	30 m; 10 classes	2000, 2010, 2020 (decadal)	Free with registration	- Good for long-term change analysis but lacks annual updates. - Accuracy varies by region and class. - Decadal gaps limit use for short-term monitoring.	Chen et al. (2017)

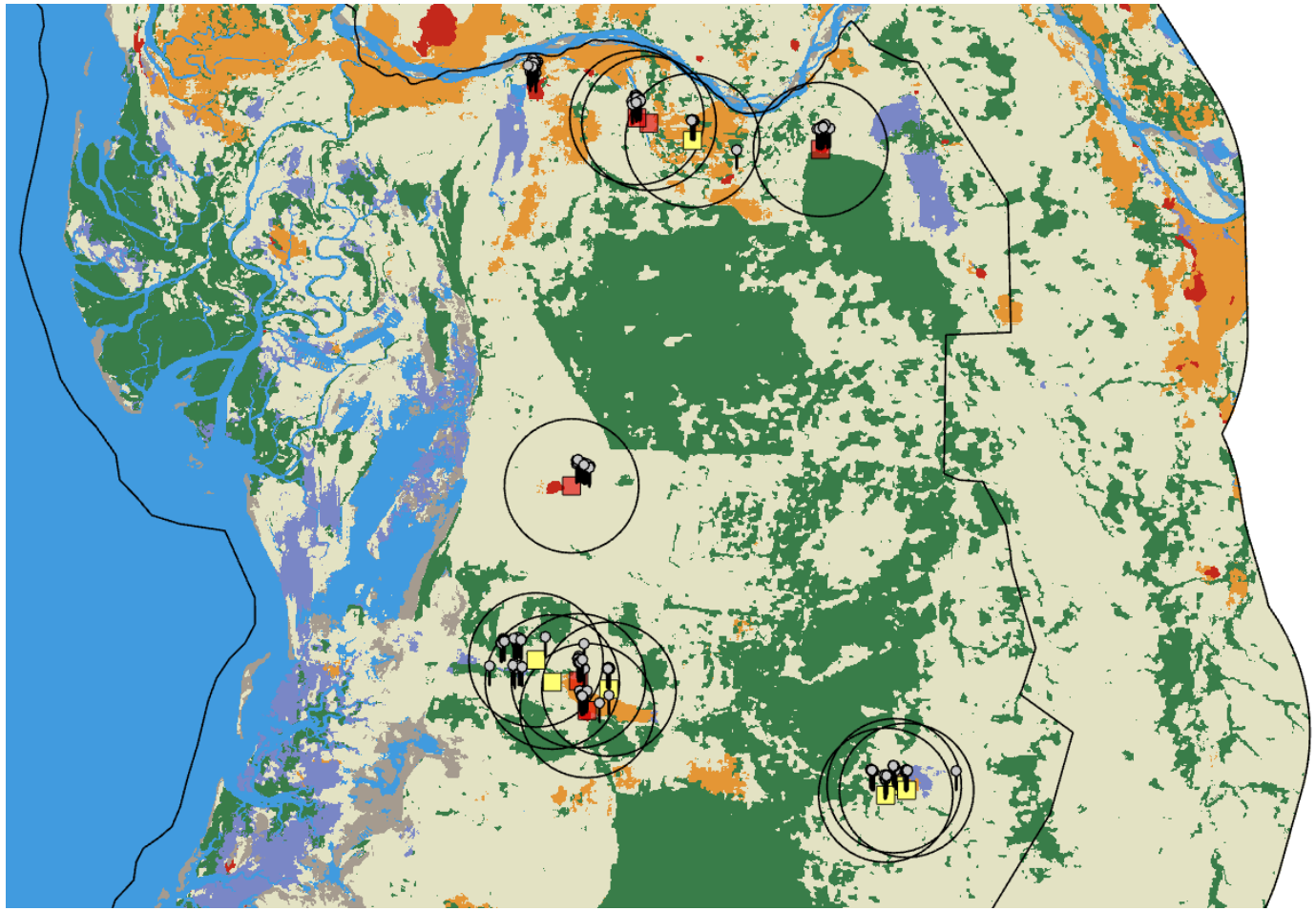
Suitable Dataset for the Madagascar Study Based on Selection Criteria

ESRI/IO Sentinel-2 landcover datasets

Selection Criteria	Evaluation	Key Considerations
Temporal Coverage & Dataset Continuity	Partially Meets Criteria	• Covers 2017–2023 but future availability is uncertain. • Lacks pre-2017 data, requiring supplementation with Hansen forest loss or Copernicus 100m.
Spatial Resolution & Scale Suitability	Meets Criteria	• 10m resolution captures small-scale changes. • Detects localized conservation impacts better than coarser datasets like Copernicus 100m.
Thematic Detail & Classification Accuracy	Partially Meets Criteria	• 9-class system includes key LULC types but overestimates shrub/scrub. • Accuracy (~75%) is comparable to or better than Dynamic World (~72%) and ESA WorldCover (~65%).
Accessibility & Ease of Use	Meets Criteria	• Available via ArcGIS, AWS, and GEE. • Pre-processed and analysis-ready for easy use. • Suitable for non-technical users, unlike Landsat-based classifications.
Suitability for Impact Evaluation & Change Detection	Best Available Option	• Annual updates support year-to-year change detection. • More stable classification model than Dynamic World. • Suitable for difference-in-differences (DiD) evaluations.
Suitability for Madagascar's Ecosystems & Climate Constraints	Meets Criteria	• Effective for rainforests, croplands, and urban areas but needs validation for dry forests. • Good performance in cloudy regions. • Lacks mangrove-specific classification.
Complementarity with Other Datasets	Best Combined with Historical & Specialized Data	• Pre-2017 baselines: Combine with Copernicus 100m or Hansen forest loss. • Small-scale degradation detection: Supplement with Sentinel-2 or commercial imagery. • Socio-environmental integration: OpenStreetMap for settlements and REDD+ assessments.

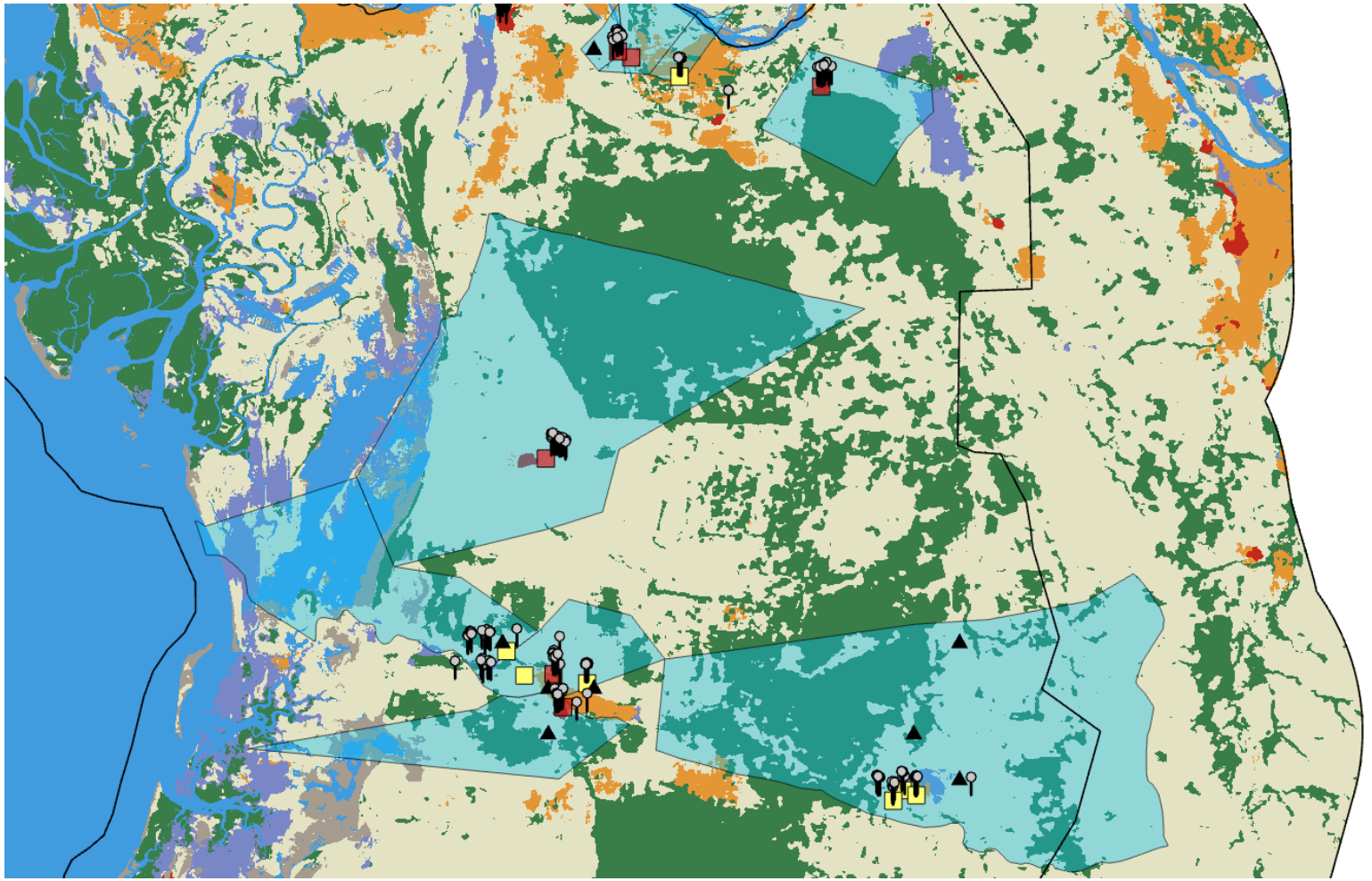
Initial buffer_3km fixed buffers

- Created 3km radius buffer around each project villages
- Problem: buffer overlapped heavily between nearby villages
- Impact: double-counting values
- Not acceptable without adjustments



HDX settlement catchment areas, sub-district boundaries - OCHA

- Results: Found 9 ADM4 units containing the 13 project villages.
- Many ADM4s had non-project villages.
- Advantage: nationally recognized unit.
- But does not solve the problem.



Spillover Effects: Opportunities and Challenges for MEL

Benefits

- Extend project benefits beyond target groups
- Indicate broader landscape or system-level change
- Increase cost-effectiveness and policy relevance

Challenges

- Hard to isolate project impact (attribution issues)
- Risk of contamination between treatment and control
- Unclear exposure boundaries
- Requires broader monitoring coverage and data

Customized Buffering?

- Distance to Nearby Villages
- Population Size (WorldPOP Data)
- Land Use Context
- Treatment–Control Separation

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