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Towards shifting paradigms in agriculture for a healthy and sustainable future
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Mapping Tree-based Systems in Tropical Landscapes: Fostering Sustainability at Agricultural(-Forest) Frontiers

Ruben Weber[1,2], Melvin Lippe[1], Sven Günter[1,2]
[1]Institute of International Forestry and Forest Economics, Johann Heinrich von Thünen Institute, Hamburg, Germany.
[2]Ecosystem Dynamics and Forest Management Group, School of Life Sciences, Technical University of Munich (TUM), Freising, Germany.

Highlights

- Pantropical in situ verification with info on land use and forest disturbance.
- Multi-sensor mapping and evaluation of seven national/global forest datasets.
- Our maps outperformed the secondary sources, which mostly overestimated FC.
- Lower accuracies in advanced forest transition contexts and for regrowth forests across contexts, countries and datasets.

1. Introduction

- Accurate maps of tree-based systems can support natural resource management and the achievement of international environmental objectives, e.g. SDG, UNFCCC.
- Global maps harmonize forest and vegetation definitions and provide comparable results between regions.
- But: the quality of remote sensing products is specially critical in tropical landscapes.
- Reasons: lack of reference data, cloud cover, mixed tree-based systems, fast-growing vegetation, strong regional differences.

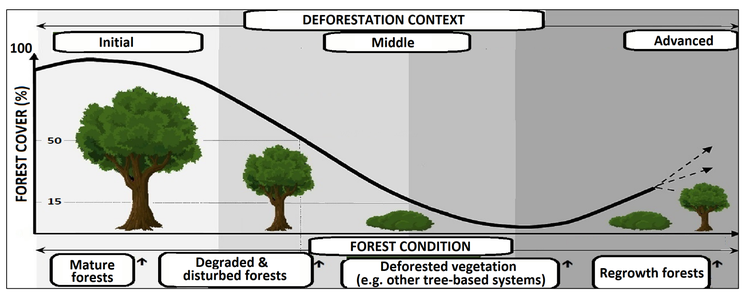

FIG 1: Deforestation contexts and forest conditions (forest transition).

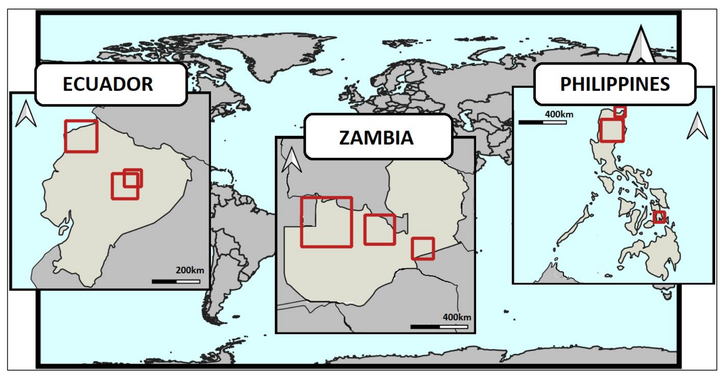

FIG 2: Selected countries (regions and studied landscapes highlighted).

2. Research Questions

1. How is the quality of the existing global and national forest maps in different landscapes of the pantropics?
2. Can we generate better maps, using data collected in situ and up-to-date remote sensing techniques (Landsat8, Sentinel-1)?
3. How is the influence of different deforestation contexts and land cover types (Fig.1) in the classification outputs?

3. Methods

- Design: 36 landscapes of ~100km^2 each in agricultural frontiers, deforestation contexts gradient (Fig.1), 9 regions, 3 countries (Fig.2).
- Data collection: Sep.2016 - Oct.2019. ~16k ground control points and ~18kha with land use & disturbance history (Fig.3).
- Creation of regional maps: Supervised classification multi-sensor (optical & radar).
- Quality analysis and comparison with relevant national and global secondary maps (Table 1).

4. Results

- National maps show best results, with exception of Zambia. Global maps are very unsatisfactory in certain regions (Tab. 1).
- Our maps outperform the global datasets in all countries (Tab.1), with achieved accuracies similar to the national maps in Philippines, worse than in Ecuador, better than in Zambia.

TAB 1: Overall accuracies of the compared maps for the total sample and subsamples. *: Global Forest Change, Copernicus CGLS, JAXA FNF, TanDEM-X FNF. **: ILUA-II, MAE, NAMRIA.

Map sources	Overall accuracies (%)						
	TOT	Countries (Fig.2)			Context (Fig.1)		
		ZMB	ECU	PHL	INI	MID	ADV
Own production	92	96	79	96	96	89	90
Global maps (avg.)*	82	93	65	85	88	73	83
National maps (avg.)**	91	88	90	95	93	93	88

TAB 2: Average sensitivities of the compared maps for different land cover types and subsamples

Land cover type	Producer accuracy (%) or sensitivity						
	TOT	Countries (Fig.2)			Context (Fig.1)		
		ZMB	ECU	PHL	INI	MID	ADV
Mature forest	93	93	98	85	96	93	72
Disturbed forest	91	92	95	85	95	94	54
Regrowth forest	74	75	80	51	79	78	50
Other tree-based sys.	57	-	46	69	44	52	67
Annual crops	89	85	54	96	92	81	94
Shrublands	49	48	-	64	29	50	67
Grasslands	65	75	56	85	66	59	73

- For all maps and forest types: increased difficulties in medium-advanced stages of deforestation (Tab. 2).
- Worst sensitivities: regrowth (succession), other tree-based systems (agroforestry, palms), shrubs and grasslands (Tab. 2).

5. Conclusions

- We produced accurate forest maps for various tropical areas with a common method, which outperformed the compared global datasets.
- Importance of updated in situ reference data: integration to monitoring/inventory systems.
- Lower accuracies in advanced deforestation stages and regrowth forests: cautious use of forest maps to monitor environmental goals.

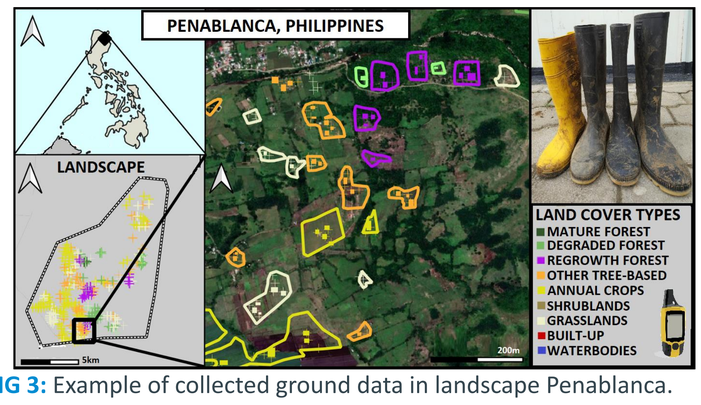

FIG 3: Example of collected ground data in landscape Penablanca.