

# Ph.D. Thesis Executive Summary

University of Copenhagen, Denmark | Faculty of Science | Department of Geosciences and Natural Resource Management - IGN

Title	Secondary Vegetation Dynamics and Agroecological Forest Restoration in Pará, Brazilian Amazon
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## Problem Statement

Amid the global push for forest restoration during the United Nations General Assembly's Decade of Ecosystems Restoration (2021-2030), this PhD thesis sheds light on the intersection between secondary vegetation dynamics and the strategies for promoting long-lasting forest restoration with socioeconomic outcomes derived from innovative food production systems.

## Background

Pará, the second-largest state in the Brazilian Amazon, covers over 1.2 million km<sup>2</sup> and has potential to hold both natural regeneration and productive forest rehabilitation in large scale. I evaluated the spatiotemporal patterns of secondary vegetation dynamics in Pará, under the light of the Forest Transition Theory, and the reasoning for agroecological transitions in its Northeastern mesoregion, the oldest settled subregion, under the light of the Theory of Change.

## Methodology

The research employed an innovative quali-quantitative approach by integrating spatial data analysis with a stakeholder's survey on the ground. Starting with a spatiotemporal analysis followed by a statistical regression modeling, it was possible to identify relevant socioecological factors and policies influencing gains and losses of secondary vegetation. Later, I went to the field and confronted these results with the stakeholder's opinions (farmers and specialists from private and public sectors) and systematized it. A gamified card-ranking multicriteria approach was used to help elucidate motivators and barriers. The results of the survey were evaluated with a principal component analysis associated with a regression modeling to distinguish characteristics and behavioural traits that make farmers more propense to adopt agroecological techniques. Ranking the most relevant socioecological factors also fed a multicriteria decision analysis used to indicate priority areas for productive forest restoration in the Northeastern mesoregion of Pará.

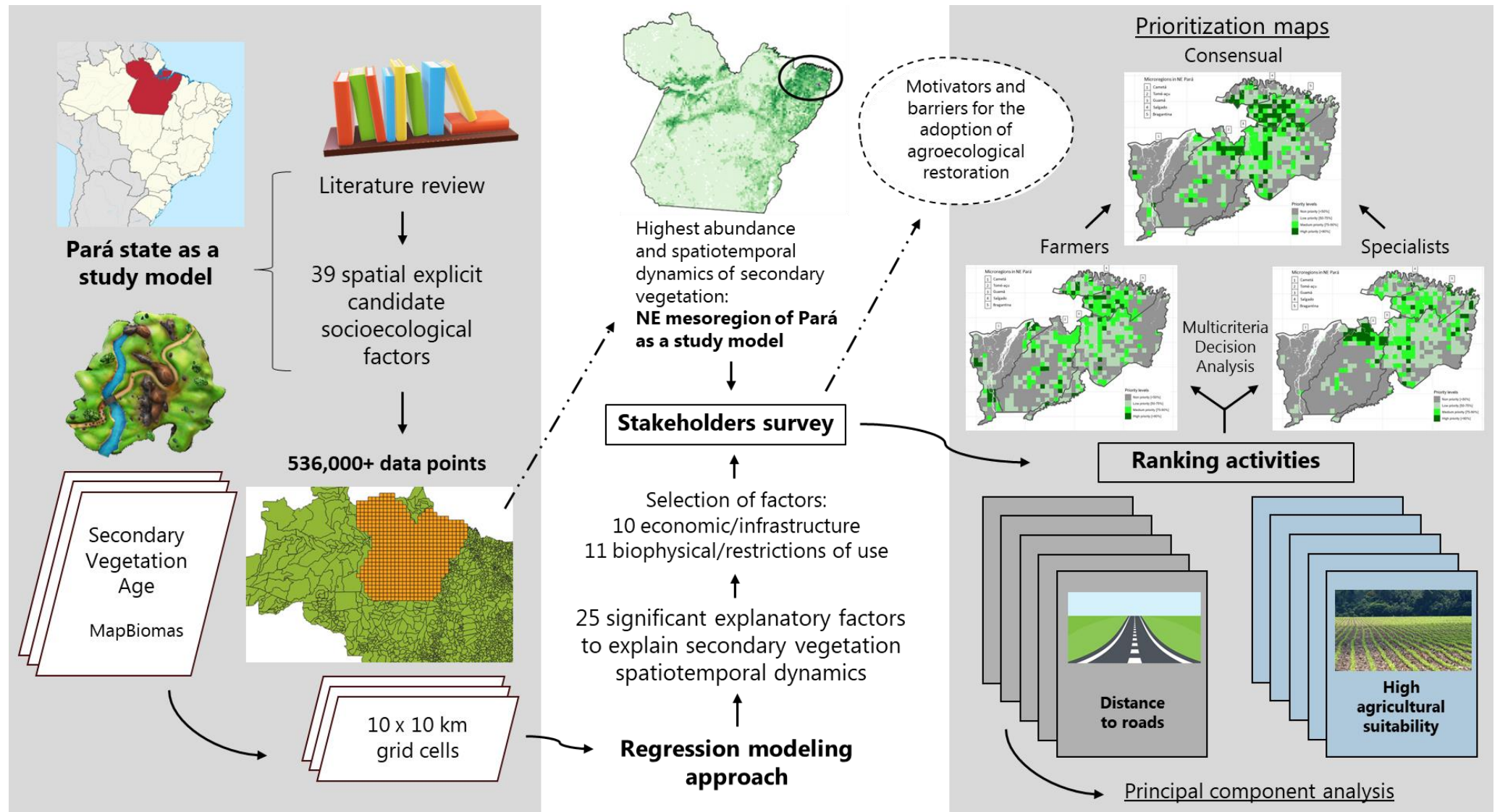
## Key Results

The study indicates an increase in secondary vegetation and anthropogenic land use cover between 2010 and 2018 in Pará, at the expense of old-growth forests. I highlighted the importance of 25 socioecological factors and the neutral impact of a normative ruling (*Instrução Normativa da Juquira*). Combining interviews with 26 specialists and 27 farmers, I assessed barriers and motivators for a large-scale regional developmental restoration plan. I found a near-consensual view that active restoration through agroforestry is the most suitable approach for the Northeastern mesoregion by offering economic and environmental benefits. The role of land tenure and the rural environmental registry (CAR) is highlighted, supported by the statistical regression model with farmers' data. Integrating these results, I underscore the relevance of combining spatial explicit factors in a structured decision-making approach to foster sustainable landscape planning.

## Key Takeaways

The study was divided into three independent research papers that integrate an innovative methodological approach highly transferable to other regional contexts. The simplified stakeholders' engagement methodology can be employed in different participatory contexts aiming to build consensus between different social groups. Collectively, the thesis offers a comprehensive perspective to intersect forest rehabilitation and secondary vegetation dynamics. It provides valuable insights into sustainable land use practices and policy design, relevant to the improvement and integration of e.g., nature-based solutions, carbon and biodiversity credits, sustainable livelihoods and so on. It is also crucial to promote long-lasting ecosystem recovery, connectivity via ecological corridors, and to emphasize the importance of understanding the complex interplay between ecological, socioeconomic, and institutional factors that support effective agroecological transitions in the tropics.

## Workflow of the research design:



After defining the study area and obtaining parameters for variables selection, data was treated into 10 x 10 km grid cell for GIS analysis and submitted to a two-tier regression modelling approach. The Northeastern mesoregion was identified as key for secondary vegetation dynamics, therefore chosen for the stakeholders' survey. The card-ranking activities provided weights for each socioecological factor in the format of a spatial layer to integrate a model for prioritization of productive forest restoration candidate areas.