

**LANDSCAPE CHANGE AND LAND-USE/LAND-COVER DYNAMICS
IN RONDÔNIA, BRAZILIAN AMAZON.**

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To Claudia and my family

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PREFACE

When I was a kid I had a dream. I wanted to buy the entire Amazon, so I could preserve it. Time passed by and my dream did not come true. Neither was I able to buy the Amazon nor was it entirely preserved. On the contrary, I decided to pursue an academic career, and the money necessary to pay for that enormous region went to other hands. But I kept my interest in understanding the region and its paradoxes. As a researcher at the Brazilian Agricultural Research Corporation (EMBRAPA), I had numerous opportunities to visit and study the Amazon, delimiting the first Extractive Reserve decreed in the region (Alto Juruá, Acre), participating in the Land Zoning of the State of Tocantins, studying the ecological and spatial dynamics of grasshopper populations in Mato Grosso, and following the trajectory of production systems in northeastern Rondônia. More recently, at the Anthropological Center for Training and Research on Global Environmental Change, ACT-Indiana University, I had the opportunity to work with other Amazonian sites, particularly Tome Açu and Bragantina, both in Pará State.

This trajectory came along after a master thesis about the Fernando de Noronha Archipelago, a set of islands totaling 20 km² in northeastern Brazil. In that work, I used aerial photos, field surveys, GIS, and ecological cartography to characterize the area in terms of its biophysical aspects as well as alterations in ecological systems produced during its history of occupation. The Archipelago has since become a National Park, and the results of my work have been used to subsidize management plans within the islands.

During my thesis research, I was already working at EMBRAPA and involved with the projects mentioned above. From the small islands of Fernando de Noronha to the

huge areas of Amazônia, my attention was always related to the spatial heterogeneity of landscapes, particularly when altered by human action. Moreover, I became very attracted to the importance of comparative studies and their application to policy making and development plans.

When I first met Professor Emilio Moran in 1996, he was teaching a course on human ecology at the Brazilian Institute for Space Research (INPE). By that time, I already had a dissertation project in mind, focused on comparative analysis of landscapes in Amazônia. Early discussions with him brought to surface the importance of maintaining control over some variables during a comparative research while searching for significant differences among the cases being compared. The settlements of Machadinho d'Oeste and Vale do Anari in the State of Rondônia were then selected for the study. They are adjacent to each other and about the same age, and have similar biophysical features within their landscapes and similar assets among colonists. However, the role of their different architectural and institutional designs in producing distinct land-use/land-cover outcomes and changes in landscape structure were as yet unveiled.

By the beginning of 1997, I was granted with a scholarship by CAPES (Program for the Advancement of Education) and approved for the doctoral program at Indiana University. The coursework as well as the research experience at ACT allowed me to integrate GIS, remote sensing, and spatial and landscape structure analysis to address the questions proposed by this dissertation. Moreover, institutional analysis on the human dimensions of landscape change provided complementary understanding of the colonization processes within the study area. Of course, none of these tasks would have

been possible without fieldwork, when gathering data was not just a part of the project, but an enlightening experience.

Even though I cannot realize my earlier dreams, I hope this dissertation contributes an impartial debate for the sake of the dreams of the Amazonian people.

ABSTRACT

Mateus Batistella

LANDSCAPE CHANGE AND LAND-USE/LAND-COVER DYNAMICS IN RONDÔNIA, BRAZILIAN AMAZON

Deforestation and colonization processes within the Brazilian Amazon have attracted substantial attention since the early 1970s. The phenomenon has been associated with issues related to global change, alteration of biogeochemical cycles, land-use/land-cover (LULC) dynamics, and biodiversity losses. This dissertation focuses on an area of approximately 3,000 km² within the State of Rondônia in western Amazon. Two adjacent settlements of similar age, similar biophysical features, and similar assets among colonists were compared to assess the role of their different architectural and institutional designs in LULC dynamics and landscape change. Vale do Anari was planned as an orthogonal road network system. The majority of Rondônia was colonized following this scheme. Machadinho d'Oeste was designed with attention to topography in laying out the grid of farm properties and included communal reserves with right-of-use to local rubber tappers. Field research was undertaken in conjunction with the use of multi-temporal remotely sensed data (1988-1998), GIS integration, and landscape ecology methods. The results indicate that the communal reserves play an important role in maintaining lower levels of fragmentation in Machadinho, where 66% of forest cover remained in 1998 (after 15 years of colonization), in comparison with just 51% in Anari. Without the reserves, forest cover in Machadinho is also 51%. Although analyses at the property level showed that the area deforested per property per year is the same in both settlements for the entire time period of study, in Anari the rate of deforestation was lower before 1988

and higher between 1994 and 1998. Also, pasture conversion is more significant in the fishbone scheme of Anari. Analyses of landscape structure confirmed that Machadinho is less fragmented, more complex, and more interspersed. The combination of privately based decisions for the properties and community-based decisions for the reserves clearly indicates that this architectural and institutional design can produce positive social and environmental outcomes. By comparing different settlement designs, this dissertation contributes to the rethinking of colonization strategies in the Amazon.

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LIST OF ACRONYMS

ACT - Anthropological Center for Training and Research on Global Environmental Change, Indiana University

CAPES - Fundação Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (Federal Agency for Post-Graduate Education)

CIPEC - Center for the Study of Institutions, Populations, and Environmental Change, Indiana University

CEPLAC - Comissão Executiva do Plano da Lavoura Cacaueira (Executive Commission for Cacao Crop Implementation)

EMATER - Associação de Assistência Técnica e Extensão Rural do Estado de Rondônia (Rondônia State Agency for Technical Assistance and Rural Extension)

EMBRAPA - Empresa Brasileira de Pesquisa Agropecuária (Brazilian Agricultural Research Corporation)

IBAMA - Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (Brazilian Institute of Environment and Renewable Natural Resources)

IDARON - Agência de Defesa Sanitária Agrossilvopastoril do Estado de Rondônia (Agency for Agrosylvopastoral Sanitary Defense of the State of Rondônia)

INCRA - Instituto Nacional de Colonização e Reforma Agrária (Brazilian Agency for Colonization and Agrarian Reform)

LULC – Land use/land cover

PLANAFLORO - Plano Agropecuário e Florestal de Rondônia (Rondônia Natural Resource Management Project)

POLONOROESTE - Plano Integrado de Desenvolvimento do Noroeste do Brasil

(Northwestern Brazil Integration Development Program)

RO - Rondônia

SEDAM - Secretaria de Estado do Desenvolvimento Ambiental (State Office for Environmental Development)

SPEA - School of Public and Environmental Affairs, Indiana University