

Searching for Regional Sustainability in an Interlinked World: Reflections from the Amazon

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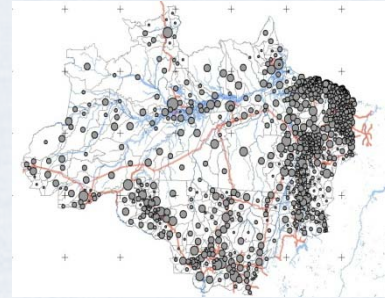
Science Council of Japan
International Conference on
Science and Technology for Sustainable Societies

“Building from regional to global sustainability: Visions from Asia”

Presentation Outline

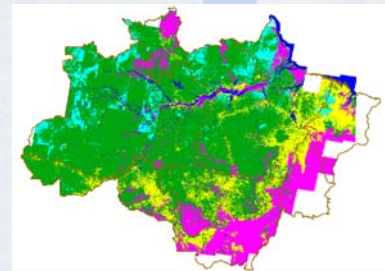
1. A case for parallels between the Amazon and Asian regions

- 1.1 Underlying social and economic contexts
- 1.2 Common analytical challenges



2. A region in transition: the last 40 years

- 2.1 Urbanization
- 2.2 LUCC & Deforestation
- 2.3 Boom of conservation units/Indigenous areas



3. Understanding the underlying mechanisms of change

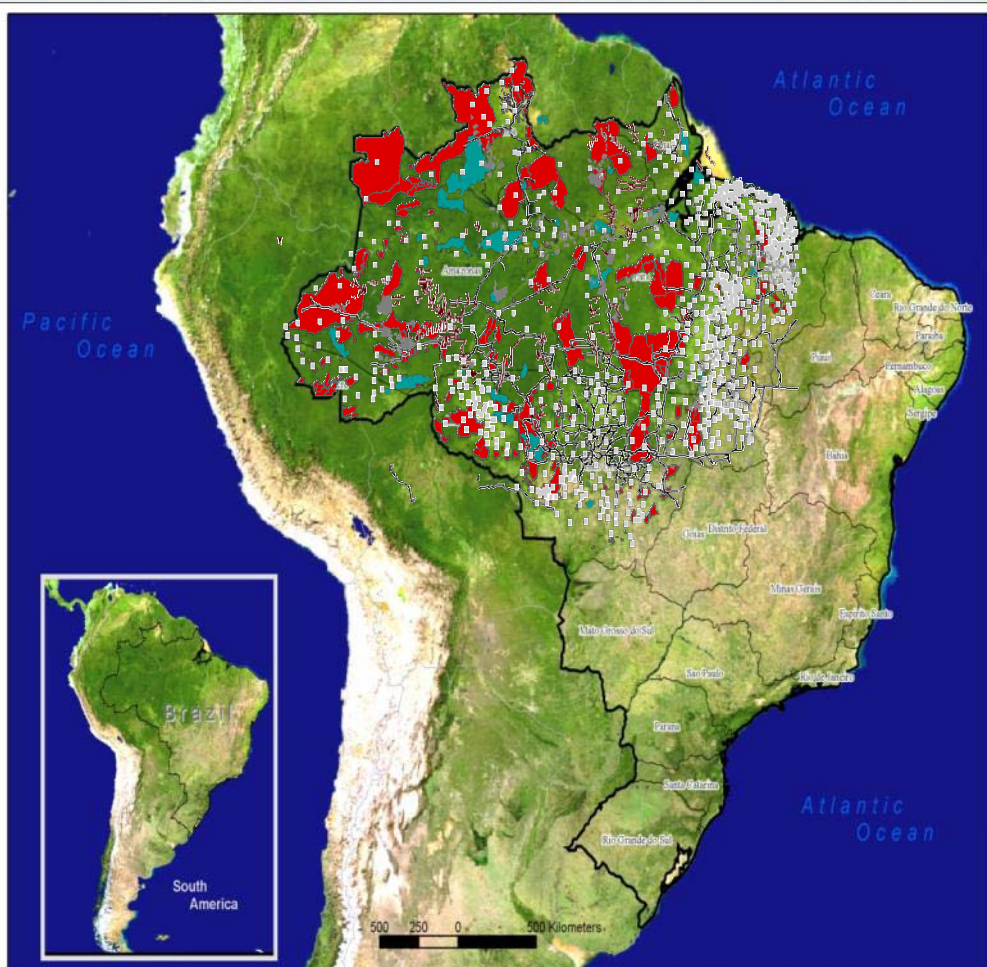
- 3.1. Families, communities, and the rural-urban
- 3.2 LUCC and level-dependent factors
- 3.3 Commodity chains, tele-connections, recurrent under-development

4. Broader implications



1. A case for parallels between the Amazon and Asian regions:

1.1 Underlying conditions and trajectories



Created by Scott Hetrick 11/03. Data Sources include NASA's Earth Observatory Team, Instituto Nacional de Pesquisas Espaciais (Brazilian Space Agency), Instituto Brasileiro de Geografia e Estatística and ESRI.

UNDERLYING CONDITIONS

- . Policies of economic development
 - . Structural adjustments
 - . Demographic transitions
 - . Social and cultural change

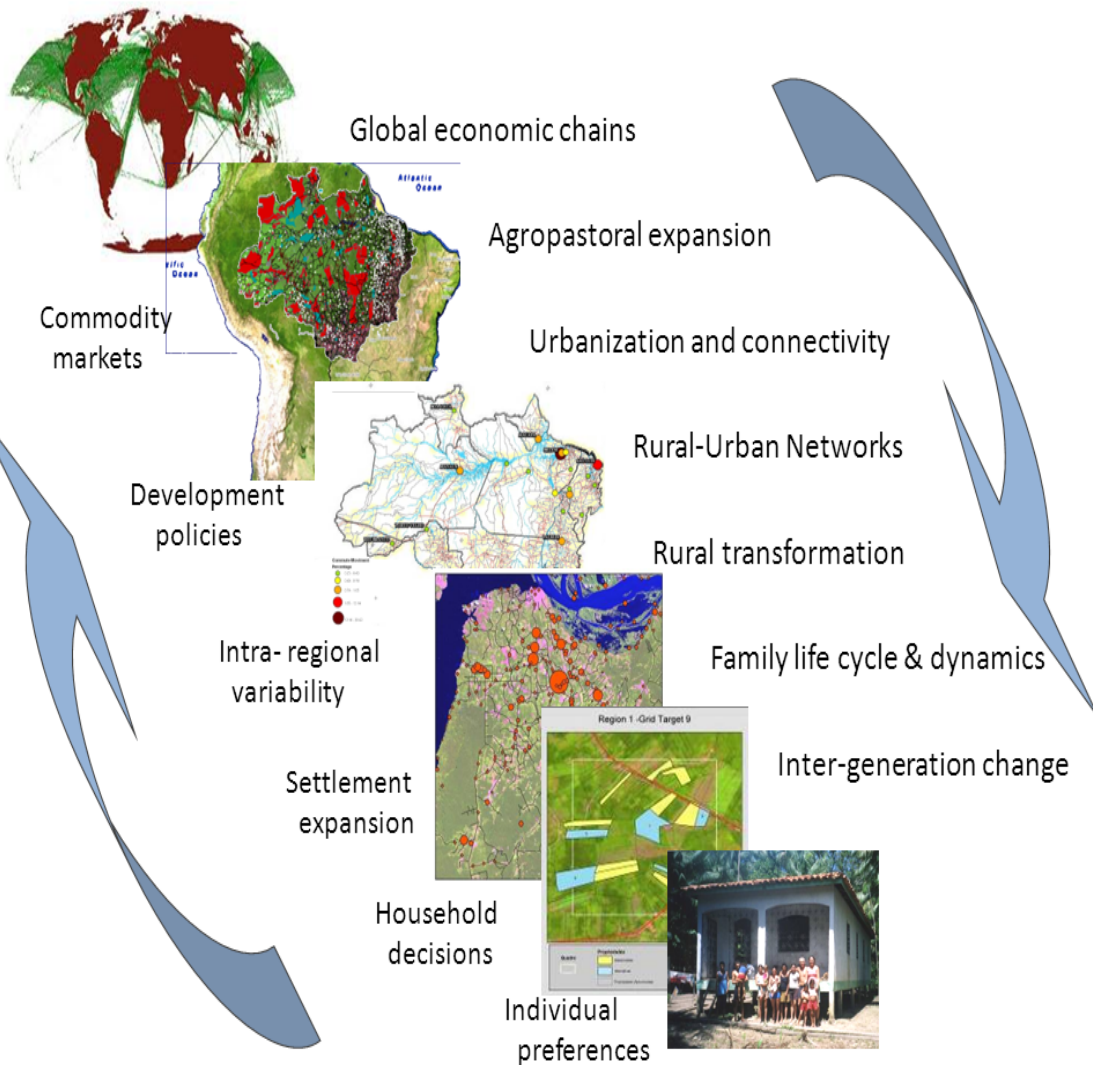
TRAJECTORIES OF CHANGE

- . Intensity of urbanization
- . Deforestation and reforestation
- . Intensification and extensification
- . Complex institutional landscapes
- . Connectivity of economic systems

The Brazilian Amazon: A Transforming Socio-ecological Mosaic

1. A case for parallels between the Amazon and Asian regions:

1.2 Common analytical challenges



- Disciplinary traditions and level specific research
- Structure vs. Agency
- Causality vs. teleconnections
- Historical conditions and intra-regional variability
- Complex systems and policy



Research sites

Longitudinal
Cross-sectional
Nested sampling

INTEGRATIVE METHODOLOGIES

Ethnography

Household and community survey

Historical/Archival

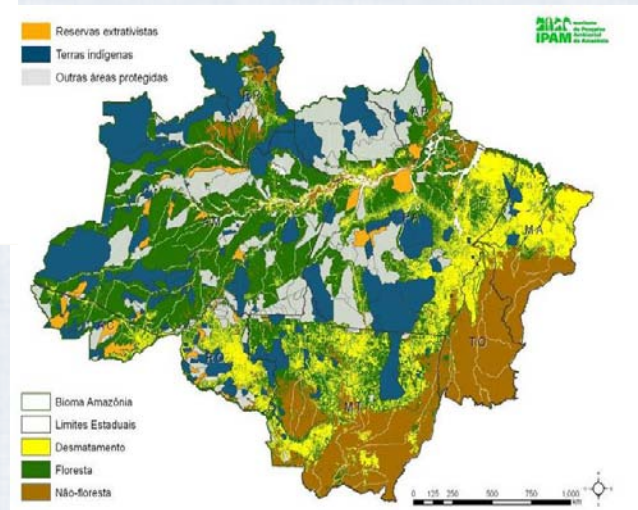
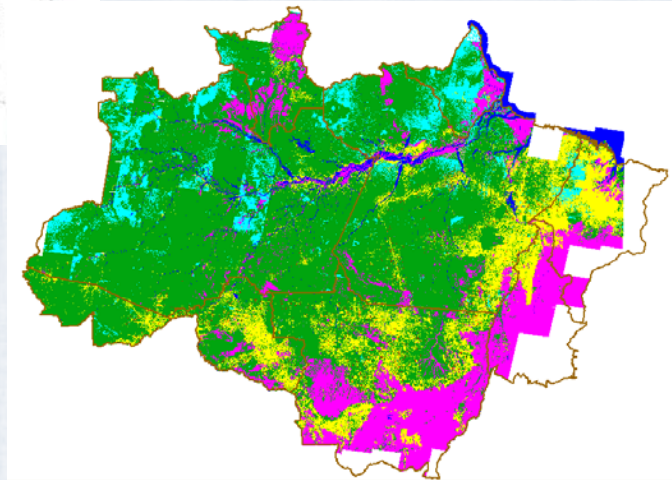
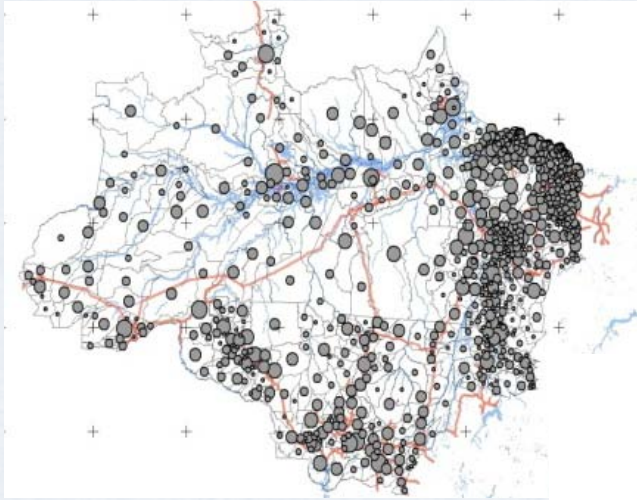
Remote sensing/Geospatial
analysis

Social network

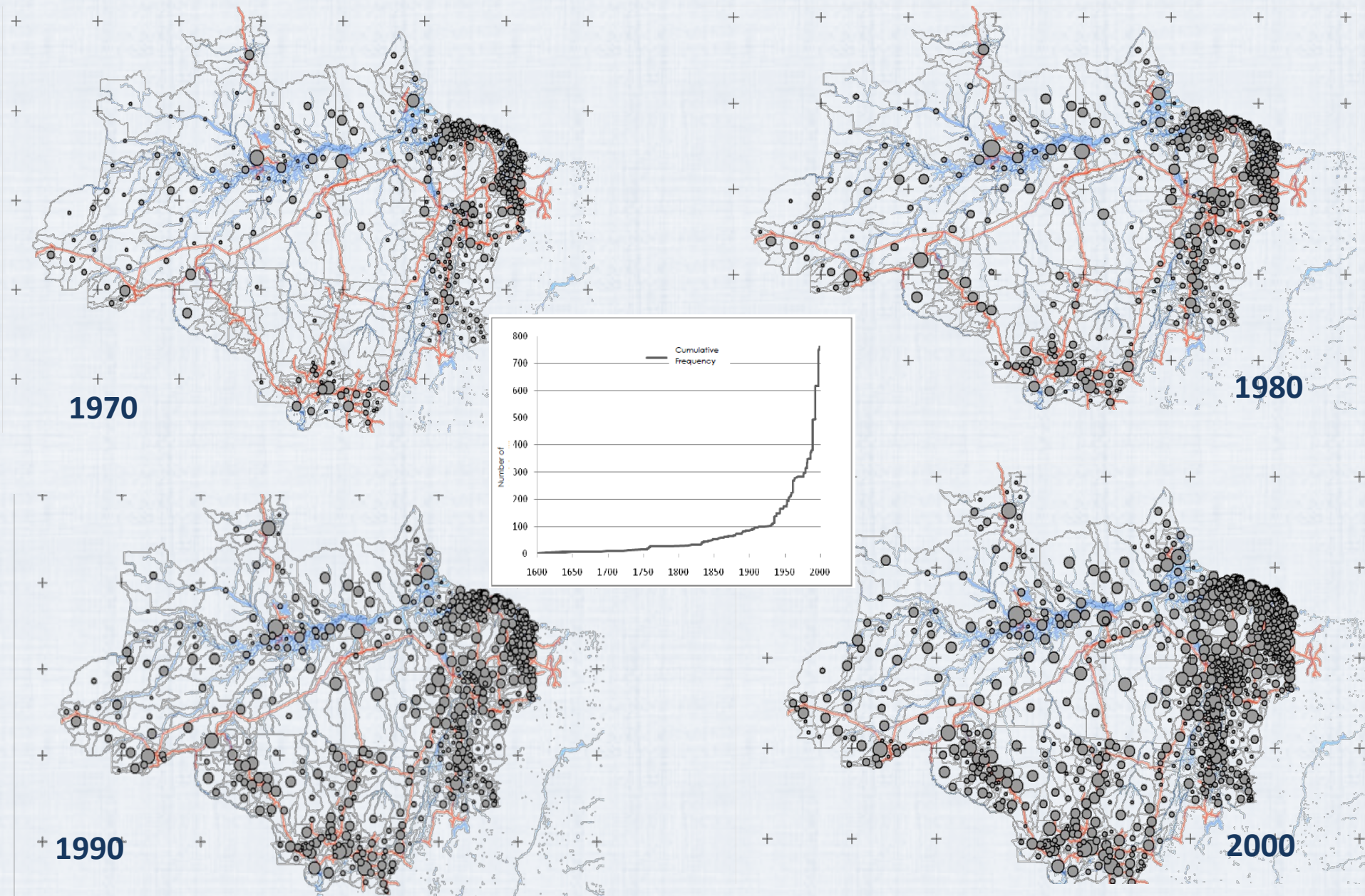
Ecological assessments

2. Regional trajectories: the last 40 years

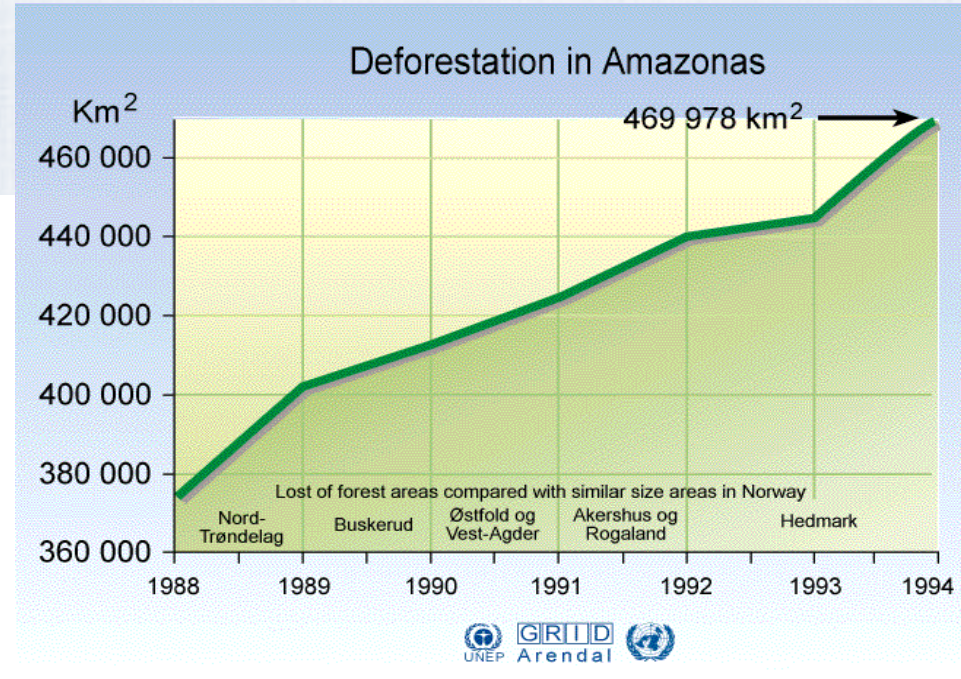
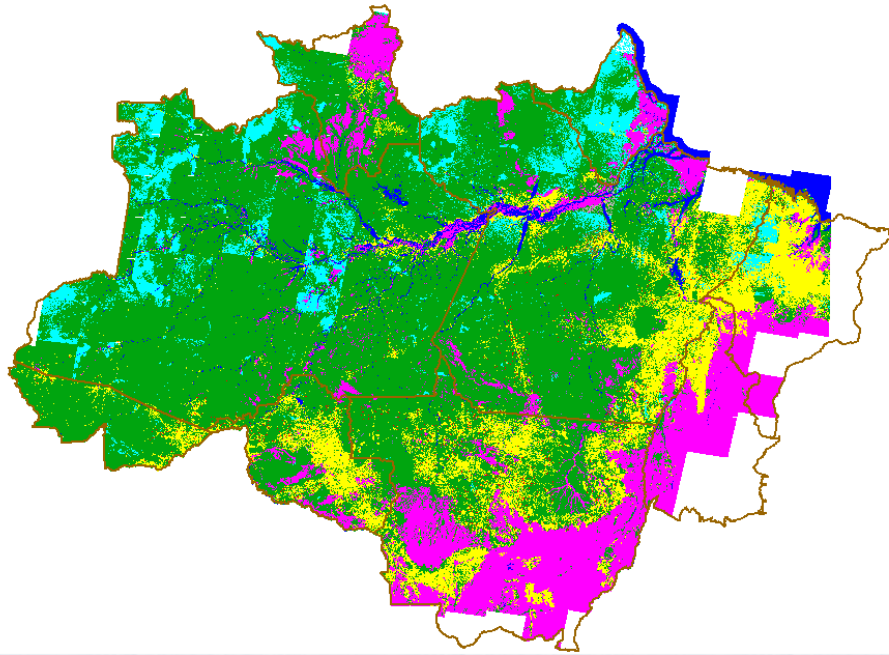
Urbanization, LUCC and Deforestation, and Reserves



Brazilian Amazon: Formation of urban centers and population



Deforestation and land cover change

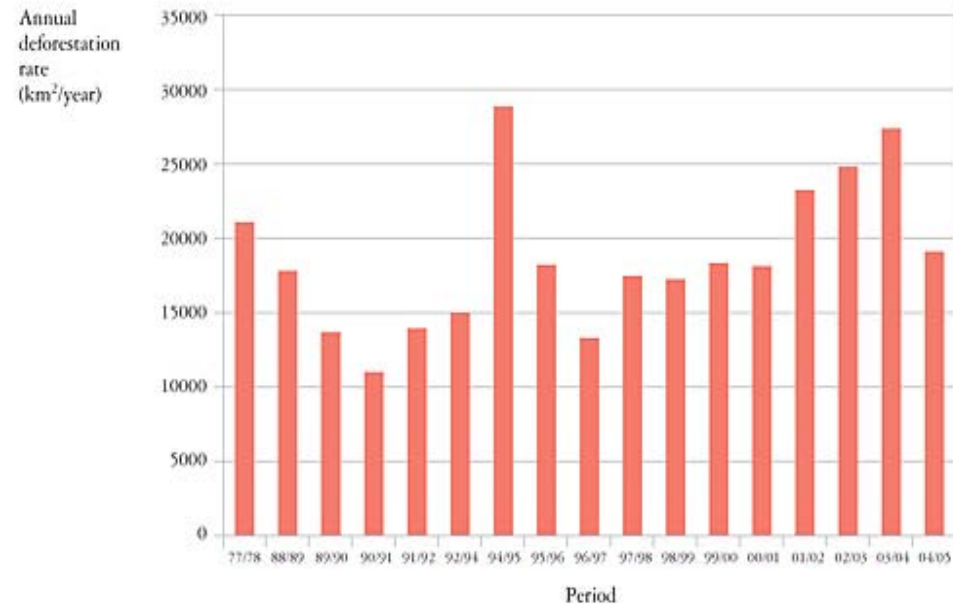


Geopolitical strategy

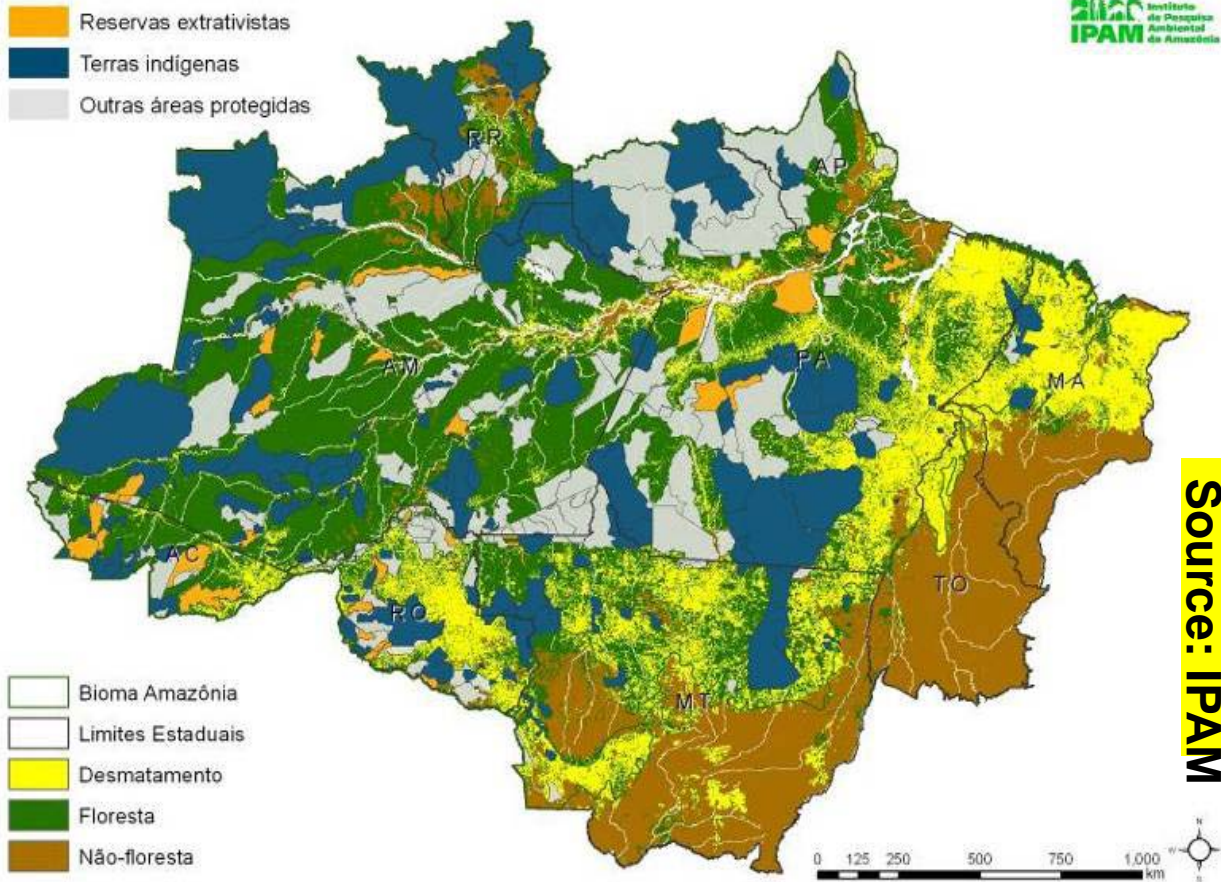
Road network

Agropastoral expansion

Regional trends, intra-regional variability



Conservation units, indigenous reserves, community management areas



- Social movements-
Environmentalist alliance
- International-national
pressure against
deforestation
- Co-existence with
incentives for agro-
pastoral expansion

A mosaic of institutional arrangements: 35% of the region designated as indigenous reserve, protected area, and different types of management reserve

What have we learned about the underlying processes and mechanisms of change?

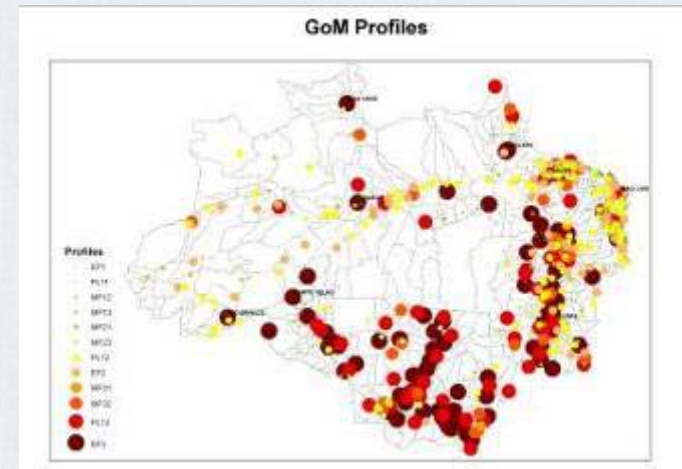
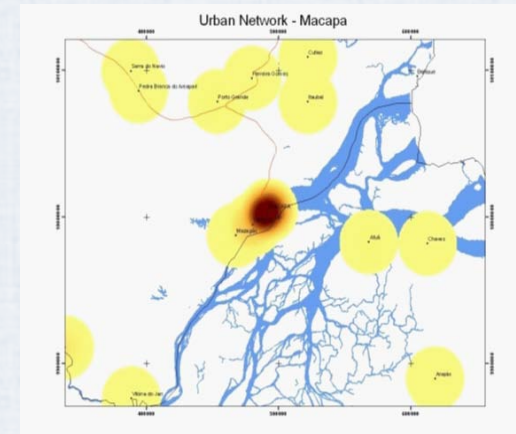
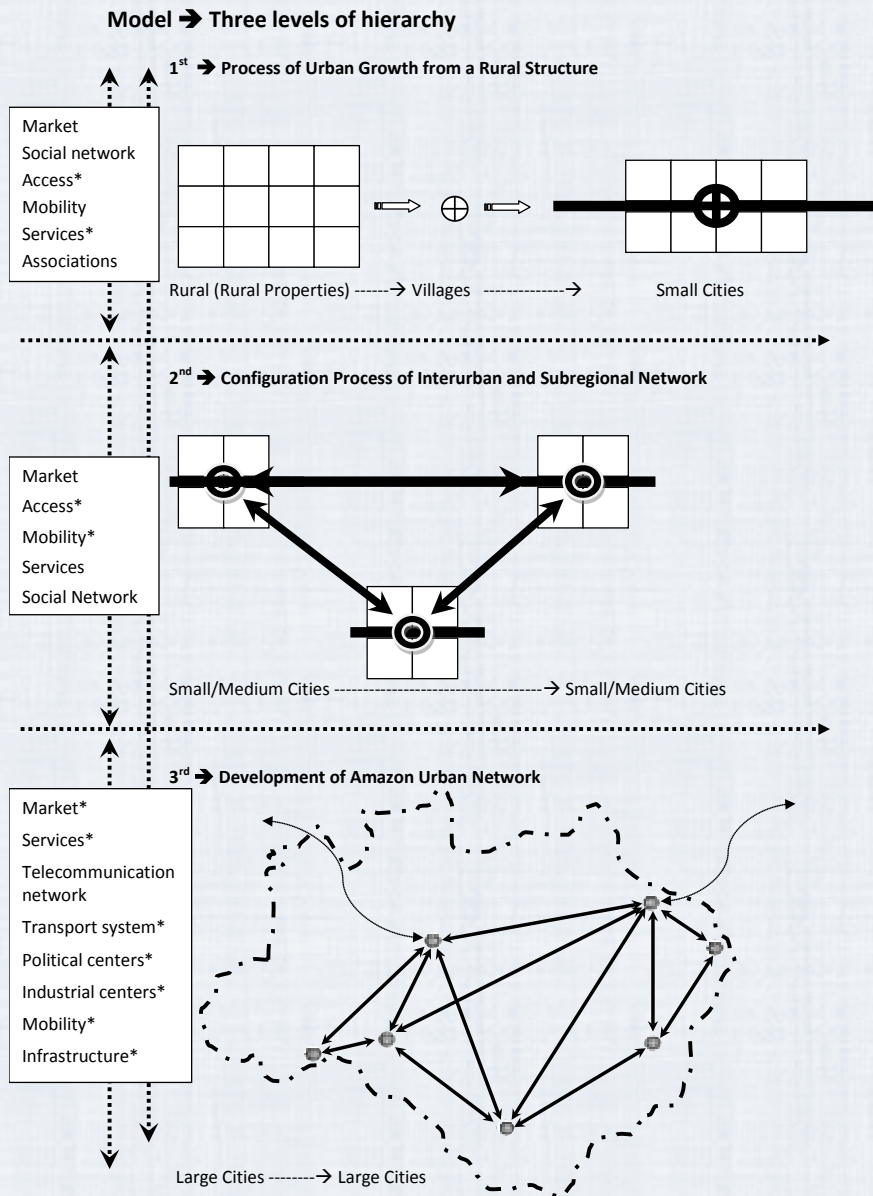
.Formation of rural settlements and urban areas

.Commodity chains and resource export

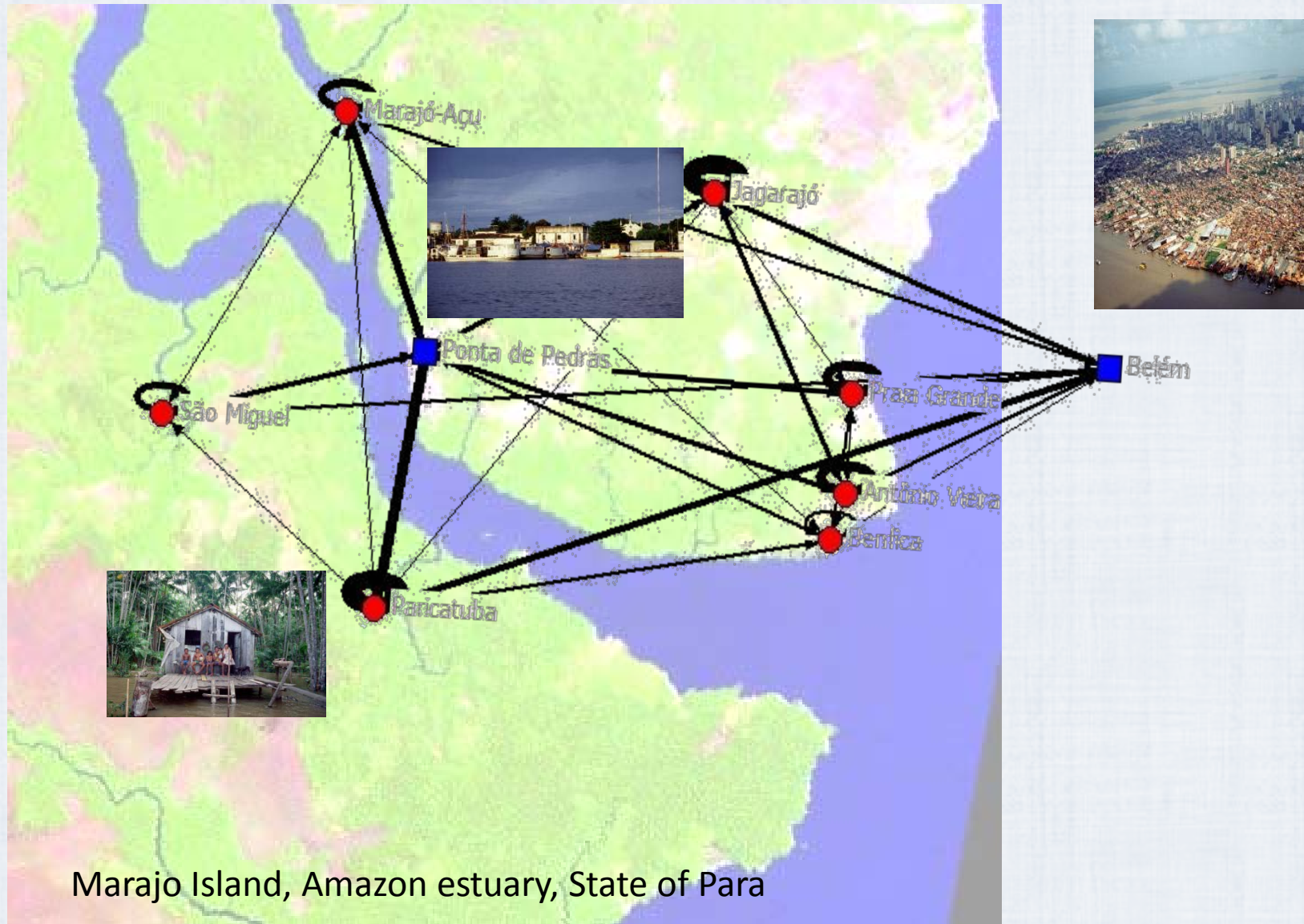
.Scale-dependent LUCC trajectories

.Interdependent institutional arrangements

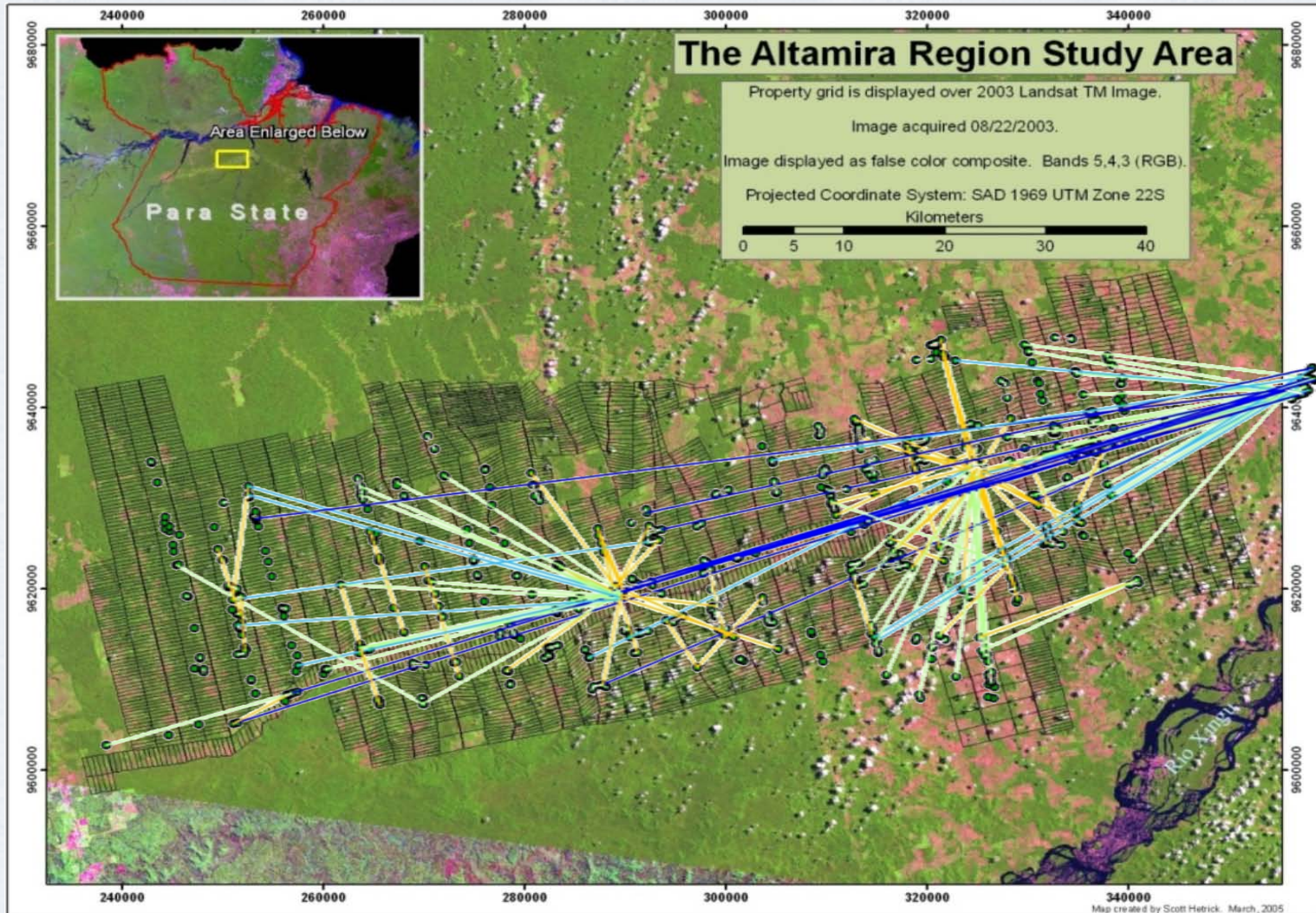
The Formation of Urban Systems and Inter-regional urban networks



The emergence of multi-sited households and rural-urban social networks



Rural properties with Associated Urban Households in 2005



Unpublished A. Cak, dissertation research 2011

External Forces, Lot Turn Over, and Urban Migration

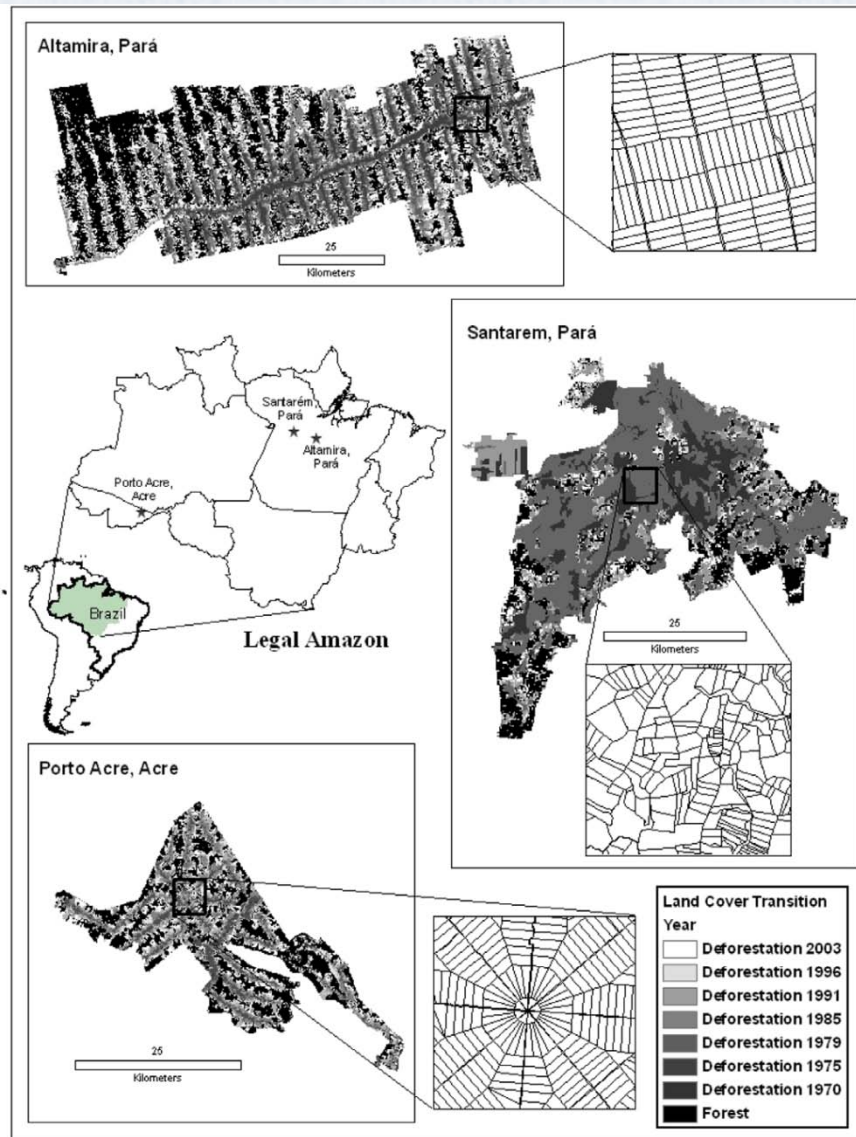


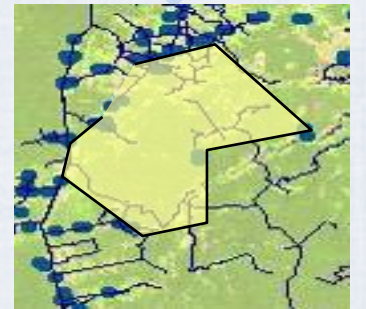
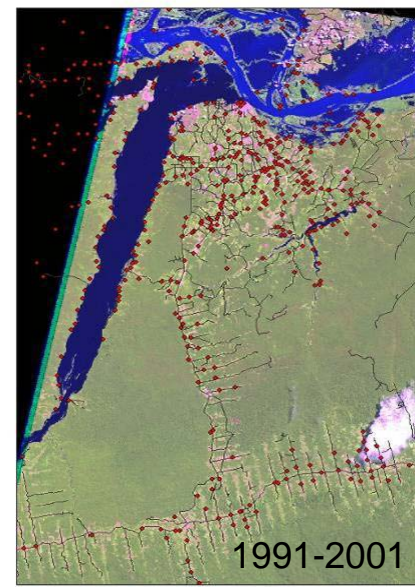
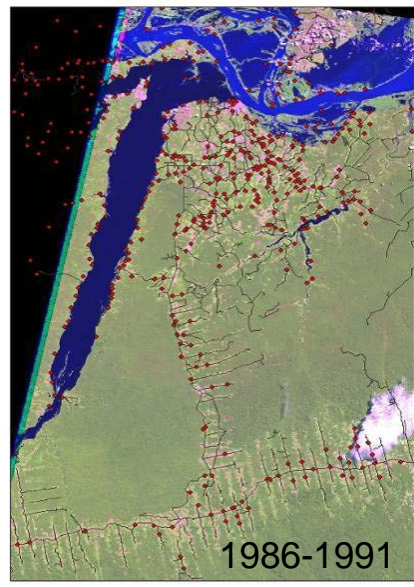
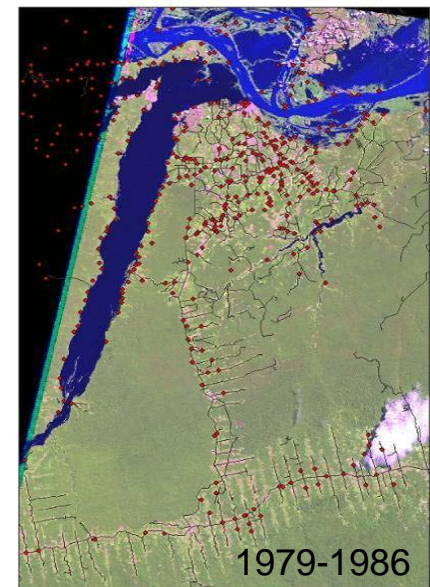
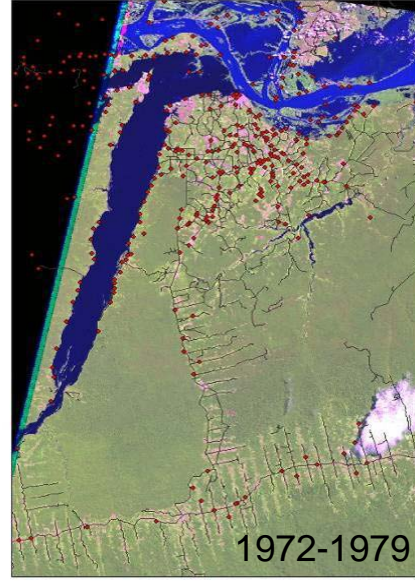
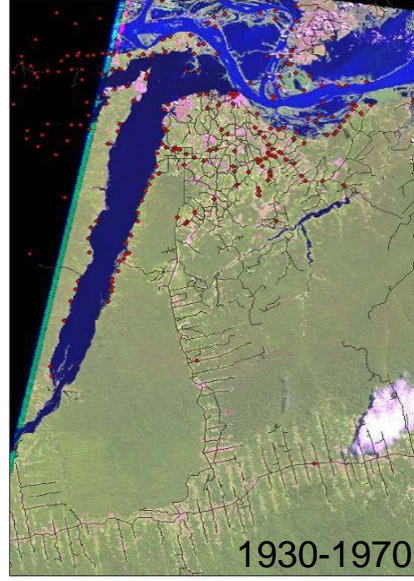
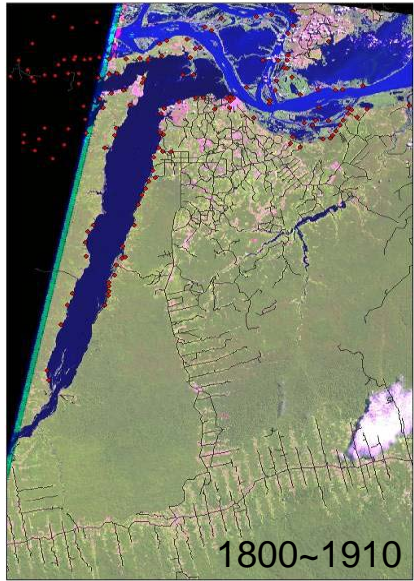
Table 2. Lot turnover since the beginning of settlement

Study site	Lot occupation (%)	
	Continuous ^a	More than one owner
Porto Acre	34.9	65.1
Santarém	25.8	74.2
Altamira	23.7	76.3

^a Farm families who remain on the lots originally assigned by INCRA.



From individual farm settlements to community formation



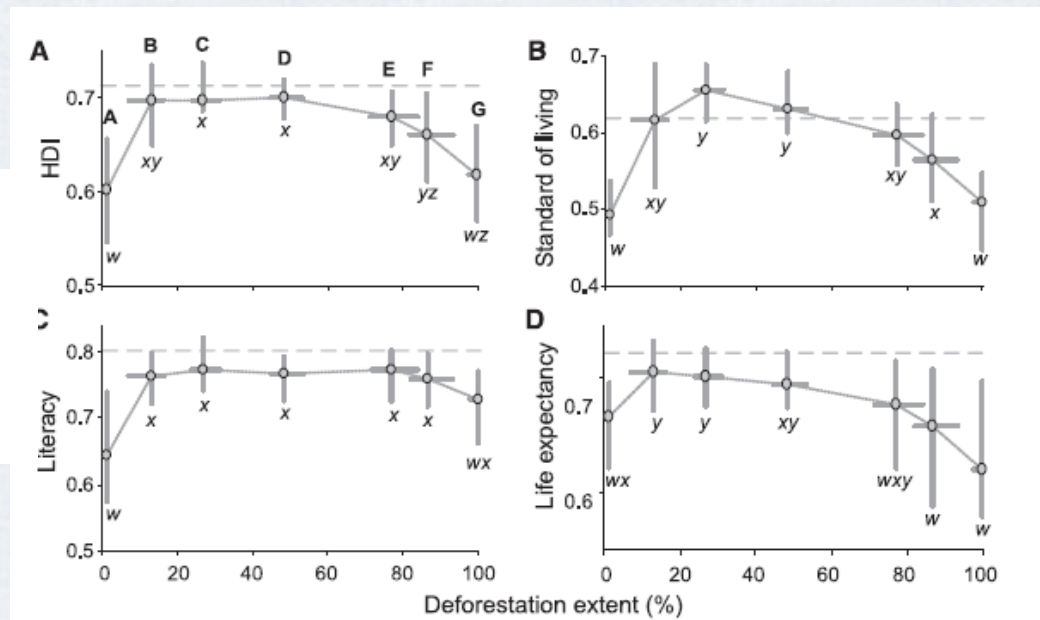
Extractivist Economies and Municipal Underdevelopment

	Pre-frontier \longrightarrow Post-frontier						
Code	A	B	C	D	E	F	G
Def. activity	inactive \longrightarrow			very active \longleftarrow		inactive	
	<0.5%	0.5-5%	$\geq 5\%$	$\geq 5\%$	$\geq 5\%$	0.5-5%	<0.5%
Def. extent	very low \longrightarrow			very high			
	<5%	<25%	<40%	40-60%	$\geq 60\%$	$\geq 75\%$	$\geq 90\%$
Example							

Boom-and-Bust Development Patterns Across the Amazon Deforestation Frontier

Ana S. L. Rodrigues,^{1,2,3*} Robert M. Ewers,⁴ Luke Parry,⁵ Carlos Souza Jr.,⁶ Adalberto Veríssimo,⁶ Andrew Balmford¹

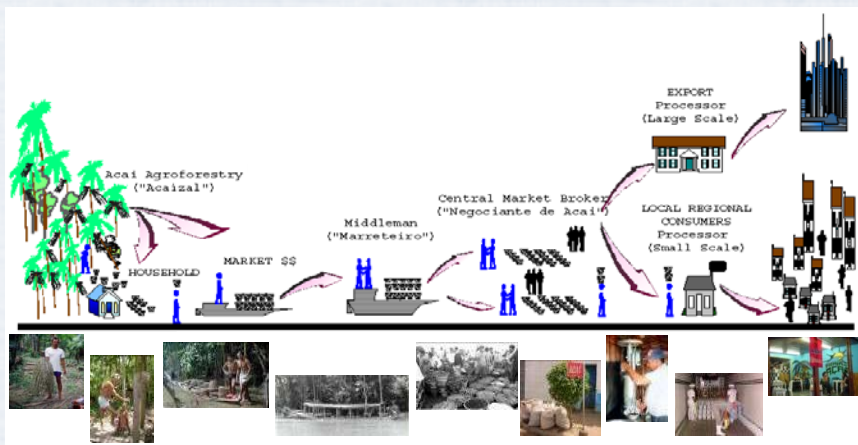
Science, (2009) 324: 1435-1437



Resource export economy:

Local demands, tele-connections and drivers of change

Examples: Acai palm fruit and Soybean



The globalization of acai fruit (*Euterpe oleracea*)



From Rural Staple Food ...



... to Fashion Food

Oprah names Acai Fruit #1 Superfood for Age-Defying Beauty.

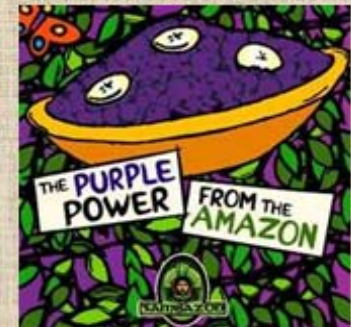


Added: Dec 07 04
Expires: Dec 07 05
Views: 218

Oprah names Acai Fruit #1 Superfood for Age-Defying Beauty.

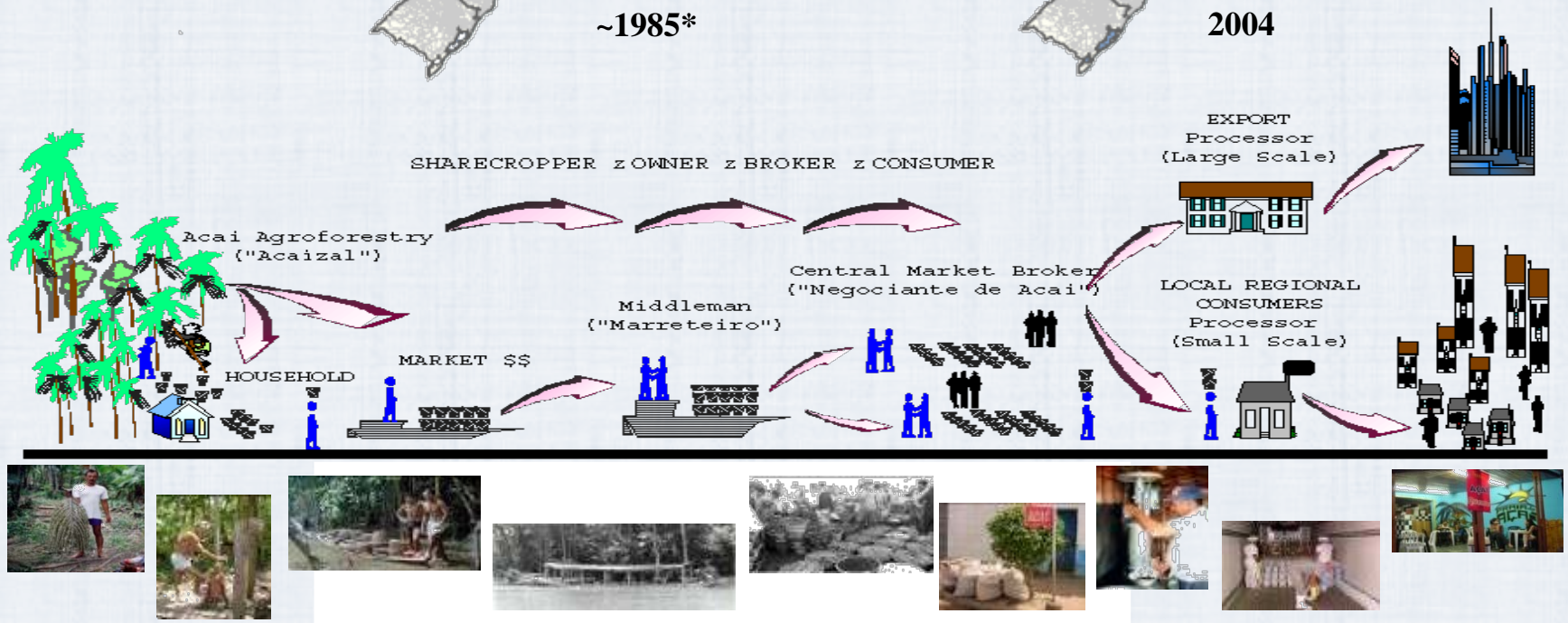
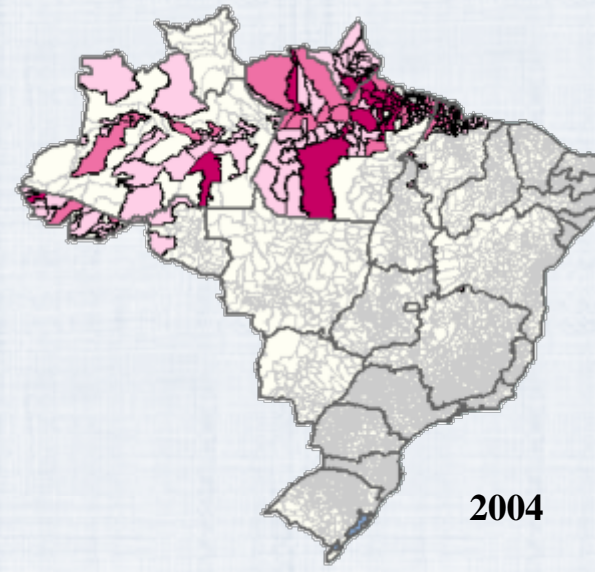
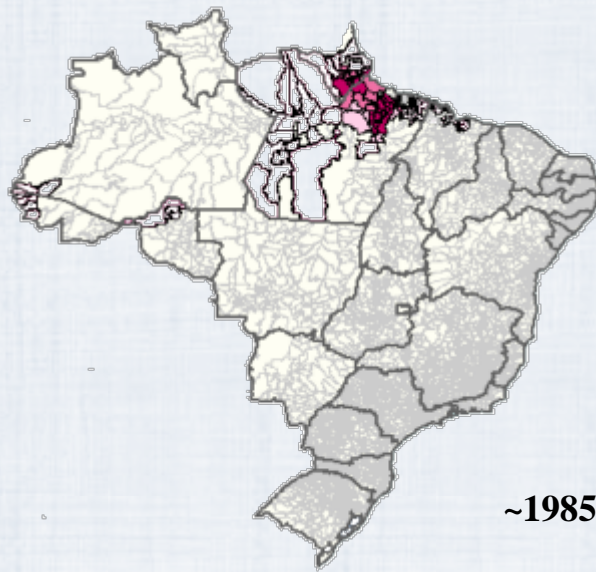
Description

Team O Five is the ONLY group entering this new program! By fully concentrating on promoting your Team O Five website, as much as you can, over the next 7 days, you could find yourself in a position in 2005, that many others only dream of. Success is not just about being in the right place at the right time. It is about taking action, when you are in the right place at the right time. You've nothing.

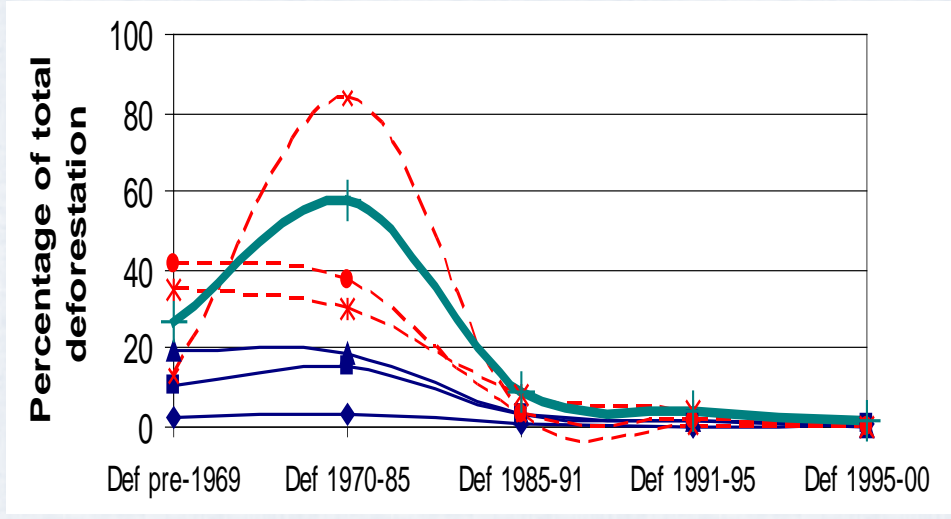


From localized to a regional forest-based economy (1985-2004)

(Map derived from IBGE – SIDRA)*

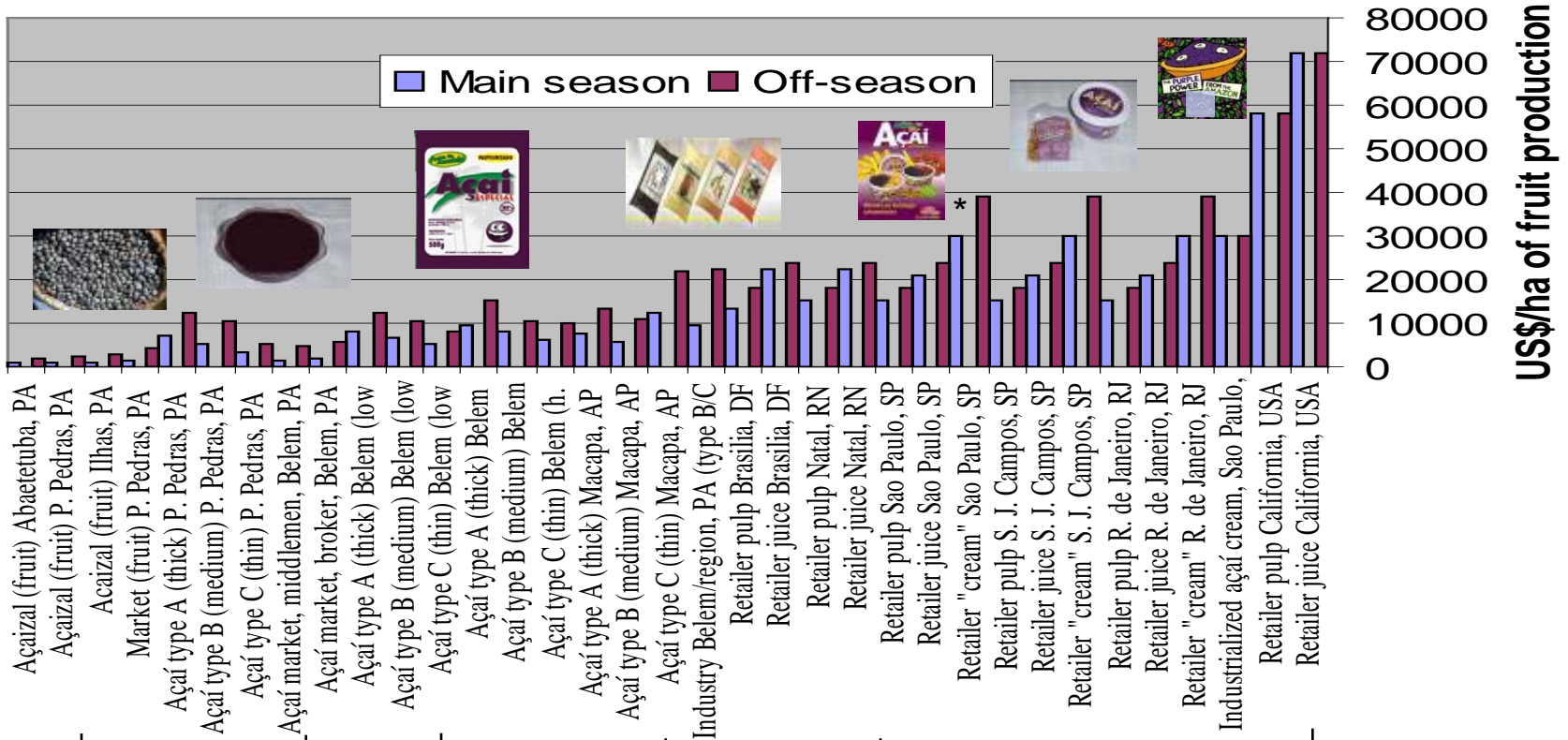


Intensively managed Acai agroforestry and regional forest transition

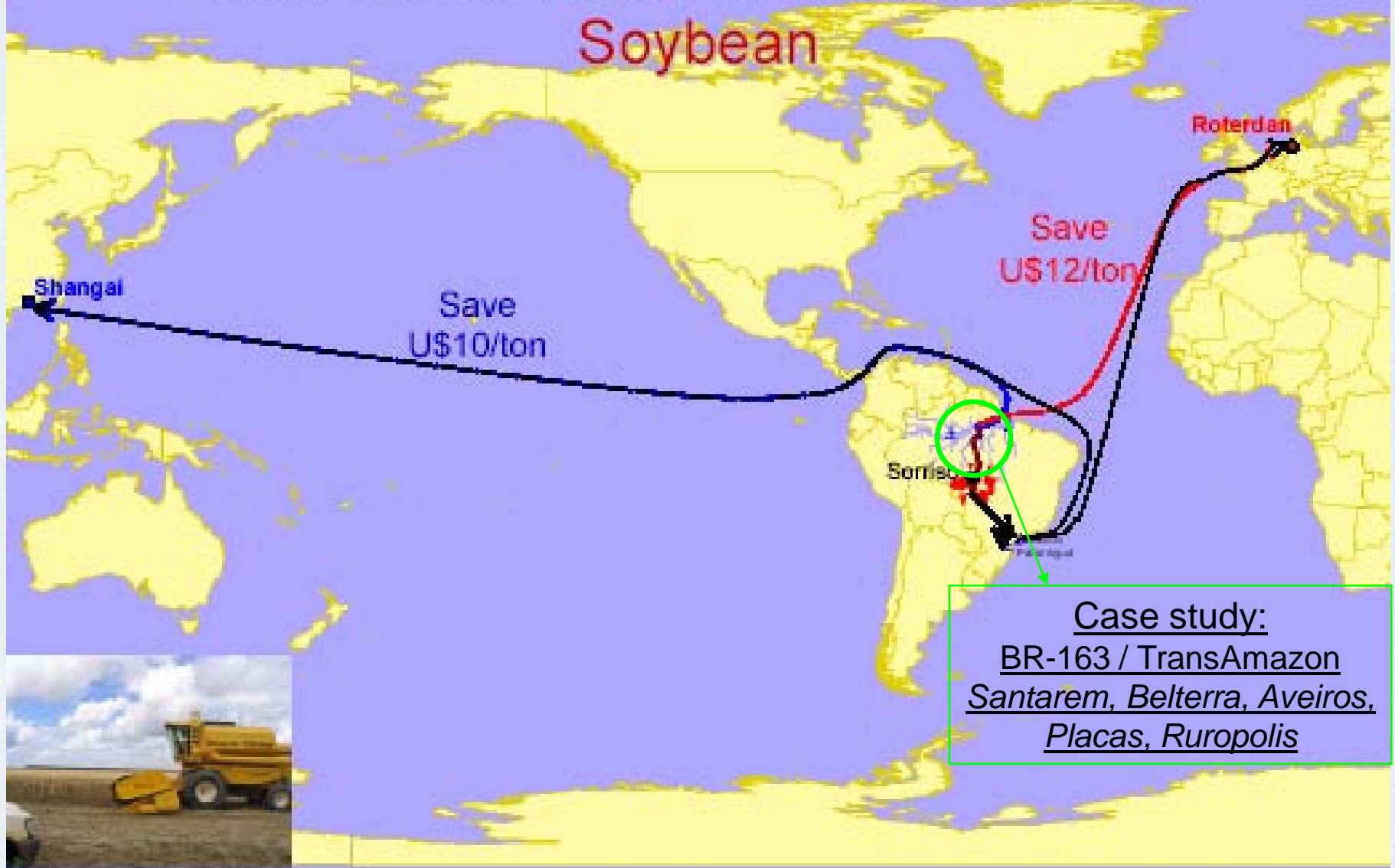


Value added to açai fruit and transformed products across commercialization venues

Adding value, 1 hectare production of acai fruit



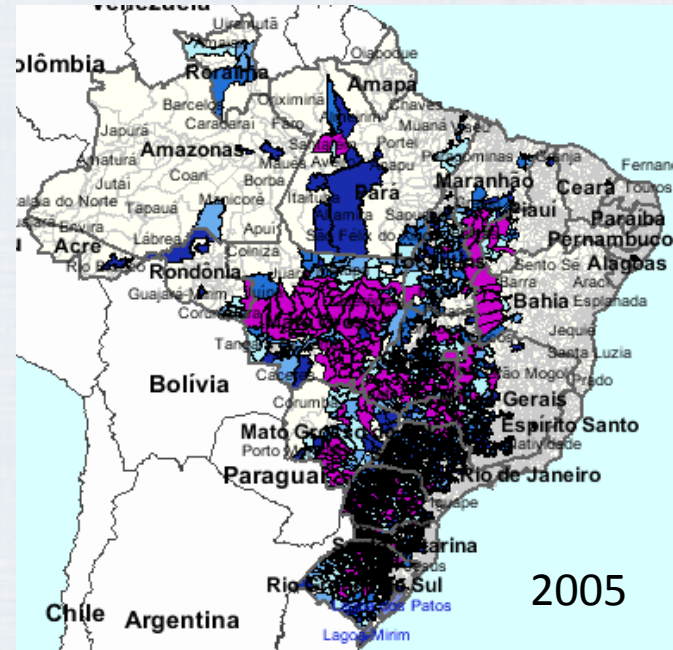
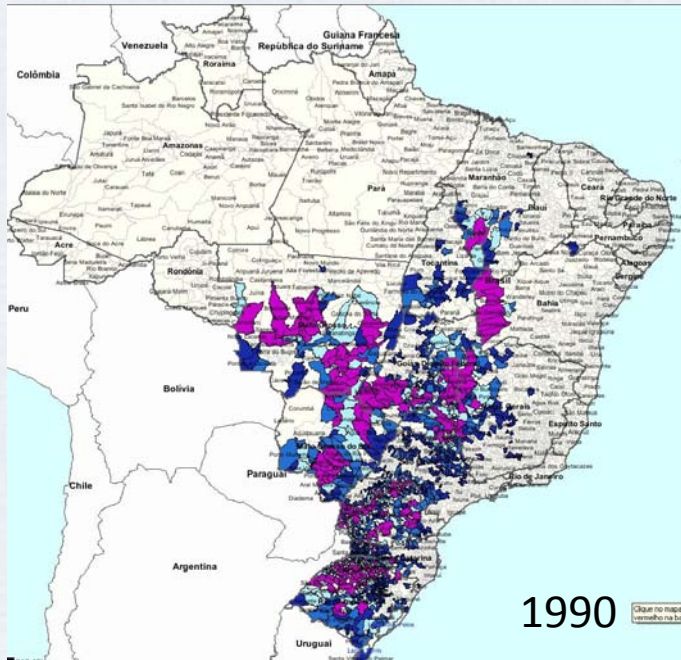
New routes for Central Mato Grosso Soybean



Source: IPAM 2004

Municipalities producing Soybean 1990 - 2005

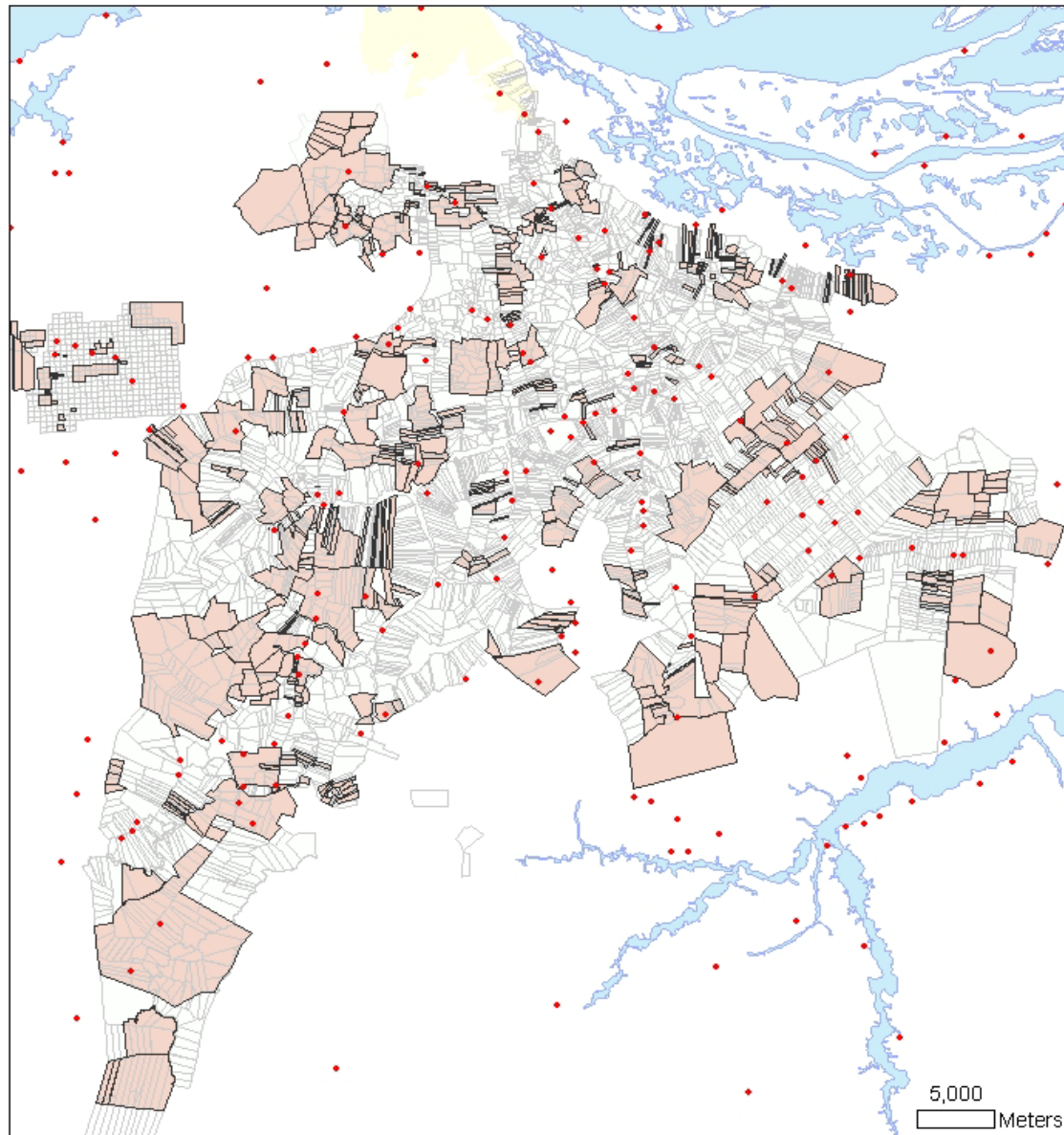
(Map derived from IBGE – SIDRA)*



Global demands, national policies, regional impacts

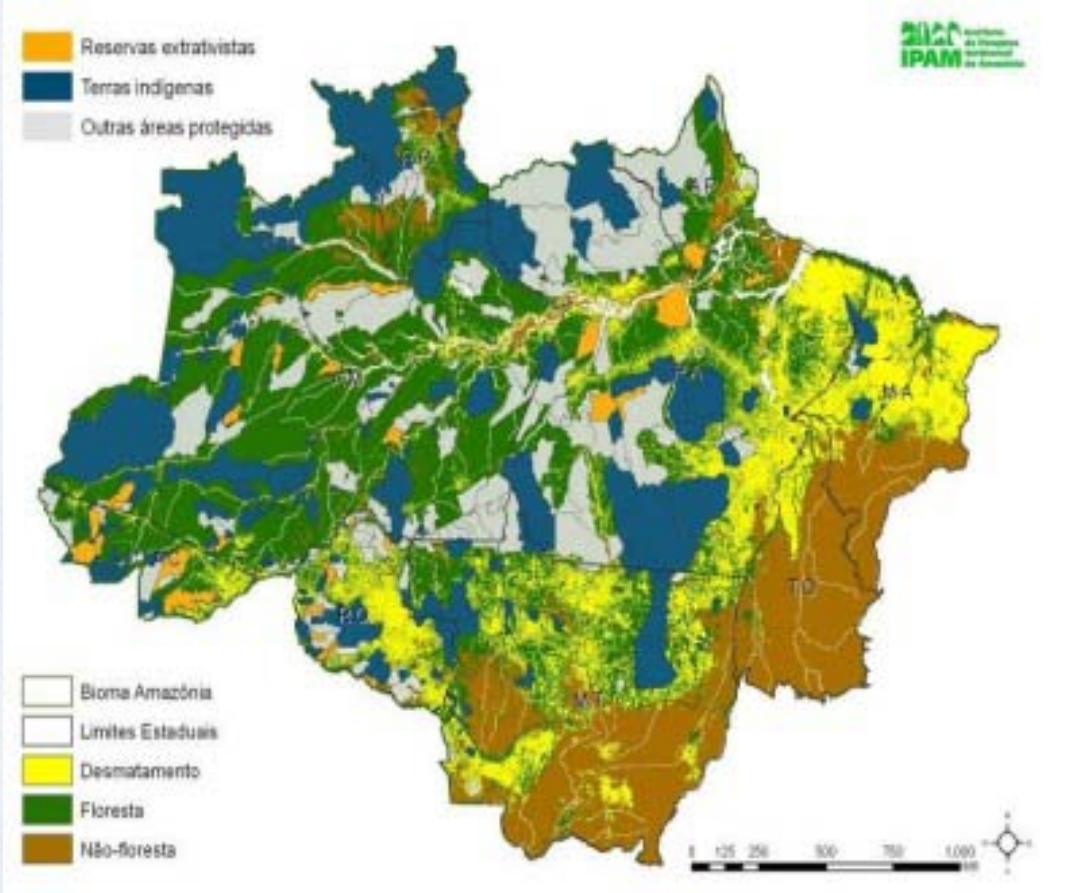


Soybean expansion and Land Aggregation at a regional level

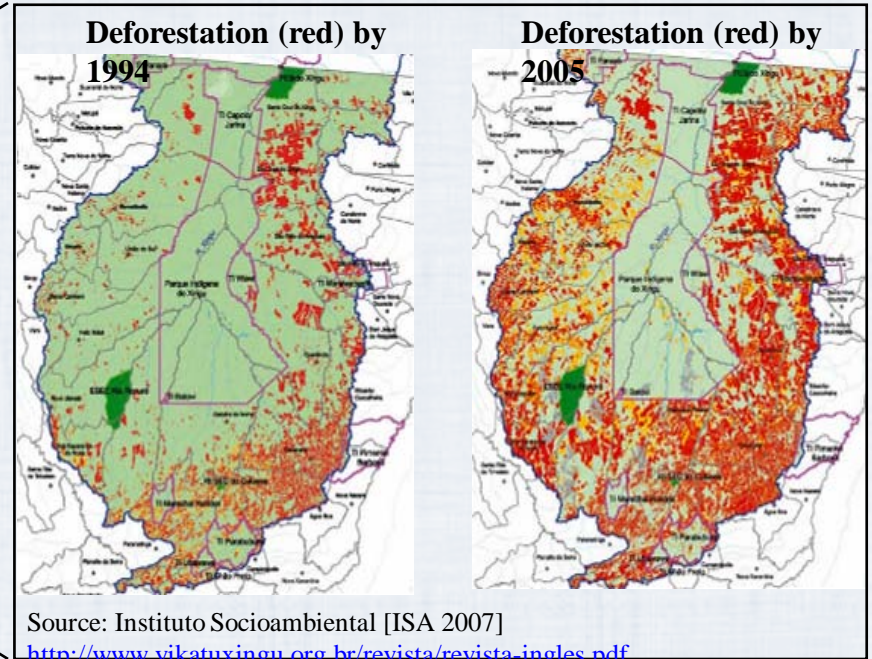


- Land Aggregation and Community disappearance
- Pressure on urban areas
- Pressure on forest land
- Economic polarization

An evolving complex sociocultural and institutional landscapes:



Functional Inter-dependence: Social, physical, institutional connectivity within watersheds



The Xingu Indigenous Park within the larger watershed



Governance challenges created by cross-level interactions

a. Fit: level of (mis)matches between environmental and institutional boundaries;

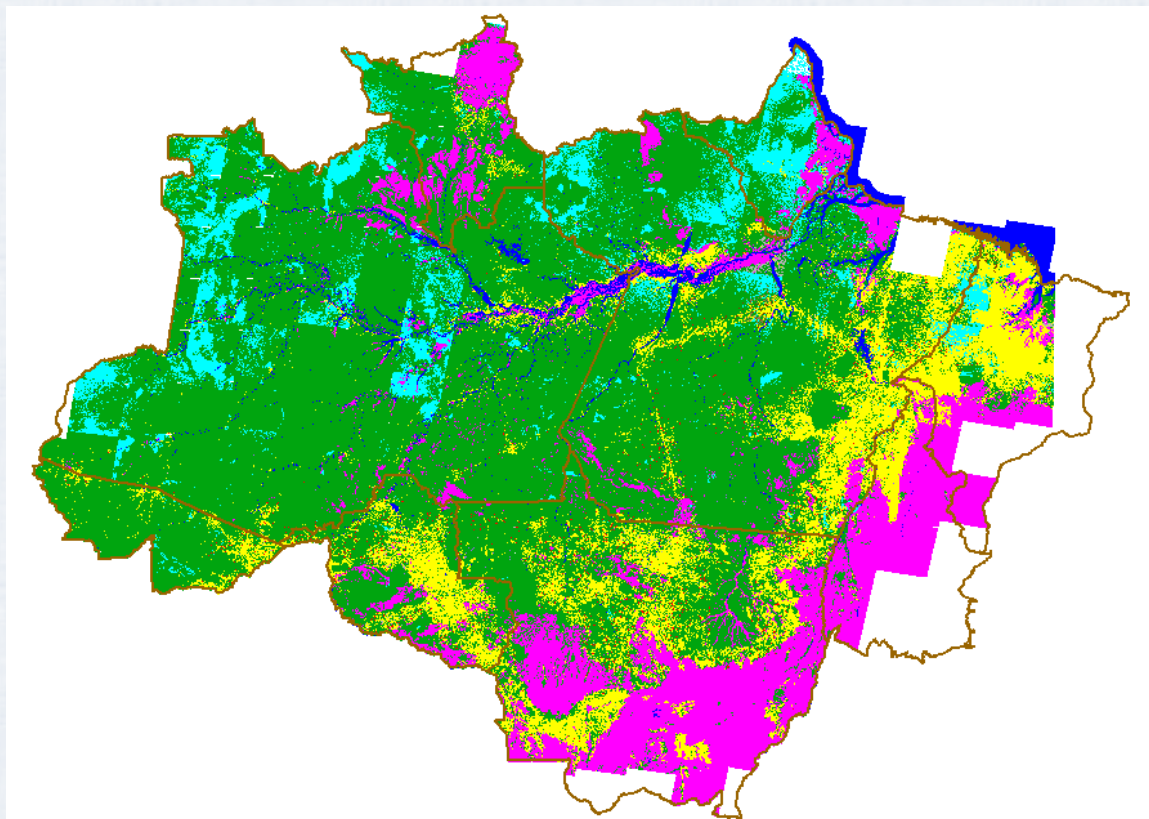
b. Boundaries: competing rules of subtractability and exclusion operating in different parts of the same ecosystem;

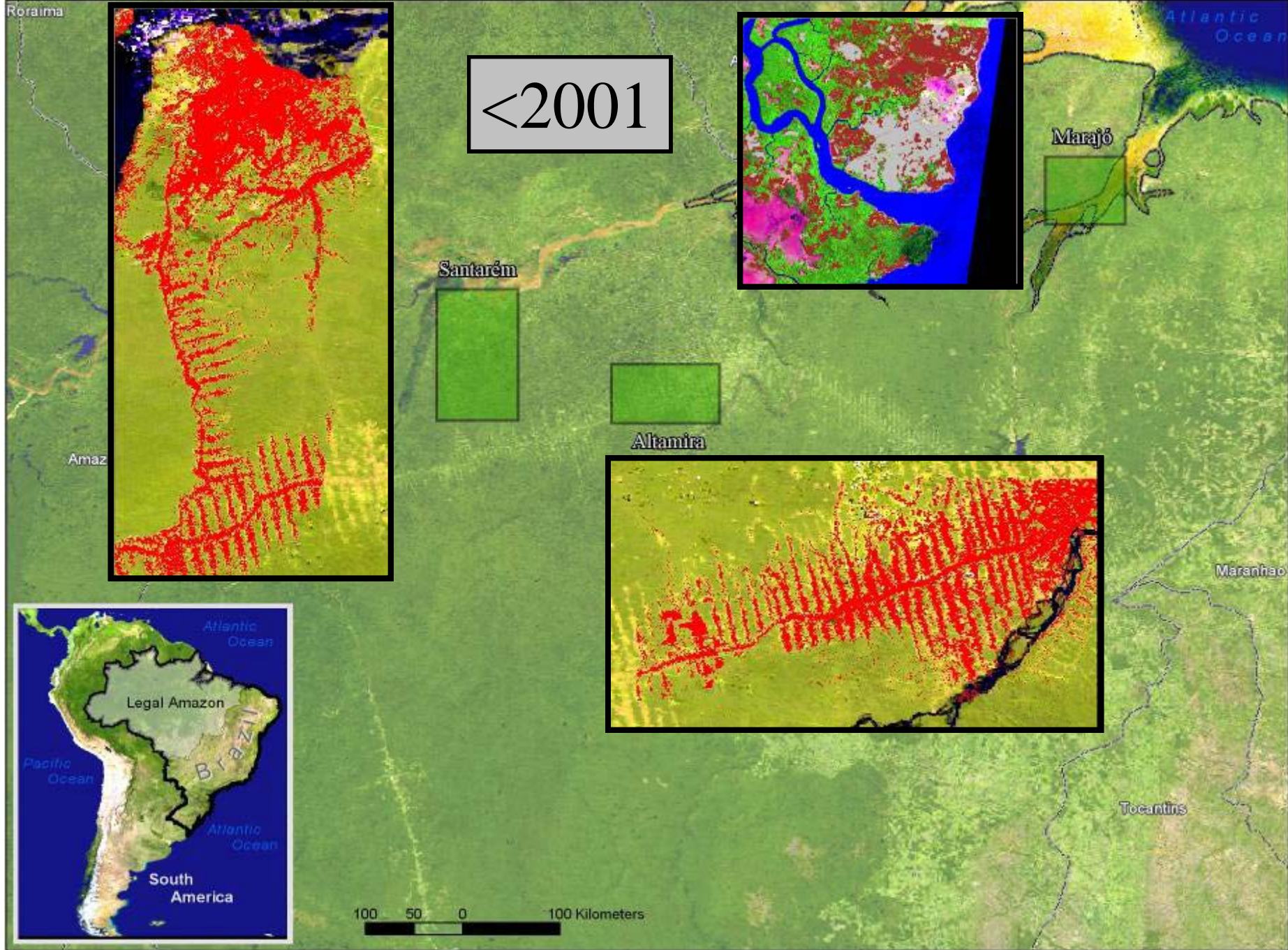
c. Authority: shifts in jurisdiction and authority over resources, including overlaps, at different levels;

d. Sanctions: inverted correlation between compliance with rules and scale (i.e., level of compliance decreases as you move from local to international levels);

e. Knowledge and information: problems of credibility, saliency, and legitimacy resulting from differences in knowledge systems and access to information at different levels and by different groups.

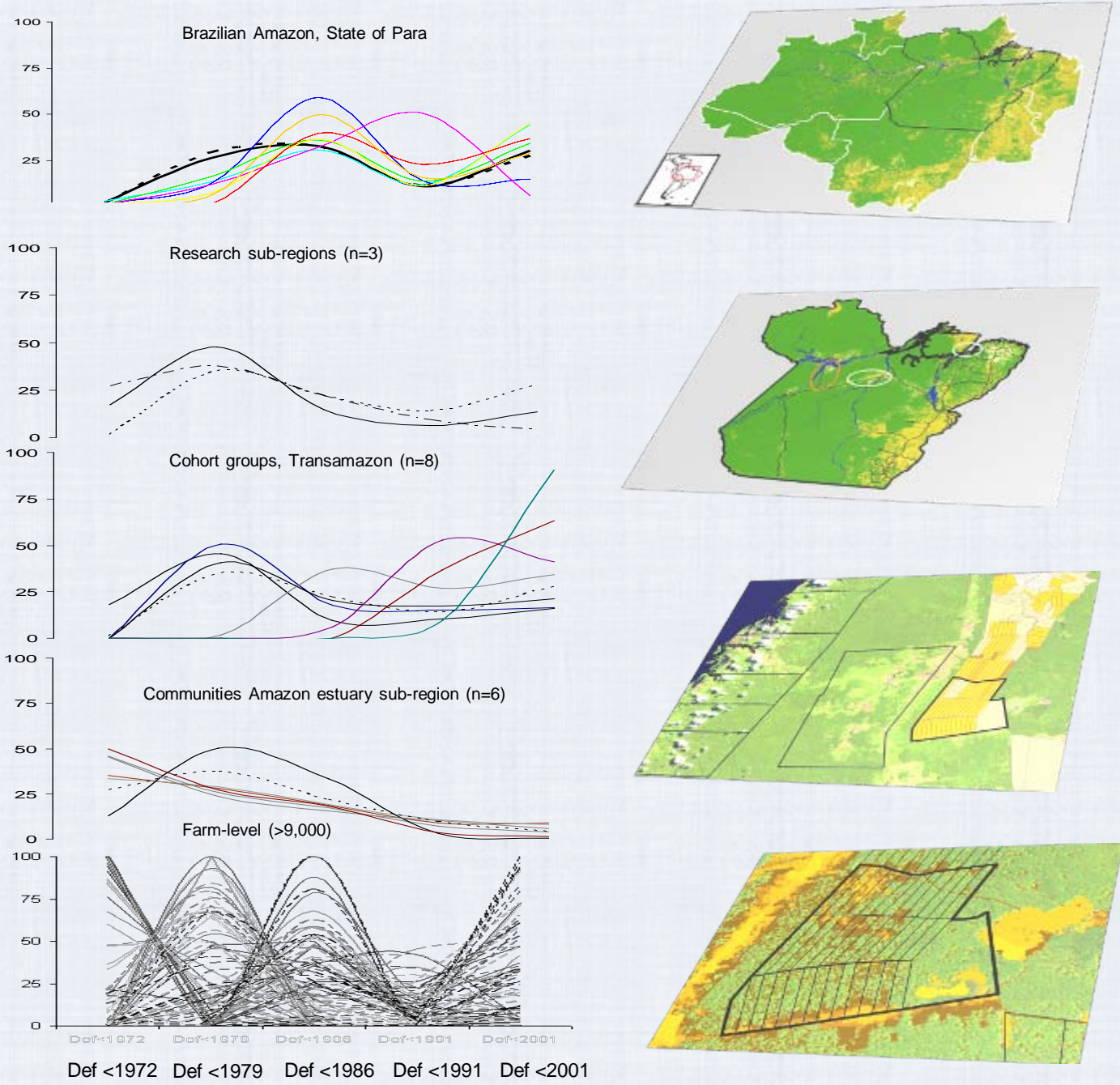
Untangling factors underlying trajectories of deforestation and LUCC change as level-dependent





Multi-Level Deforestation Trajectories 1972-2001

(a) Regional
 (b) Sub-regions
 (c) Farm cohorts and Communities
 (d) Farm Lots



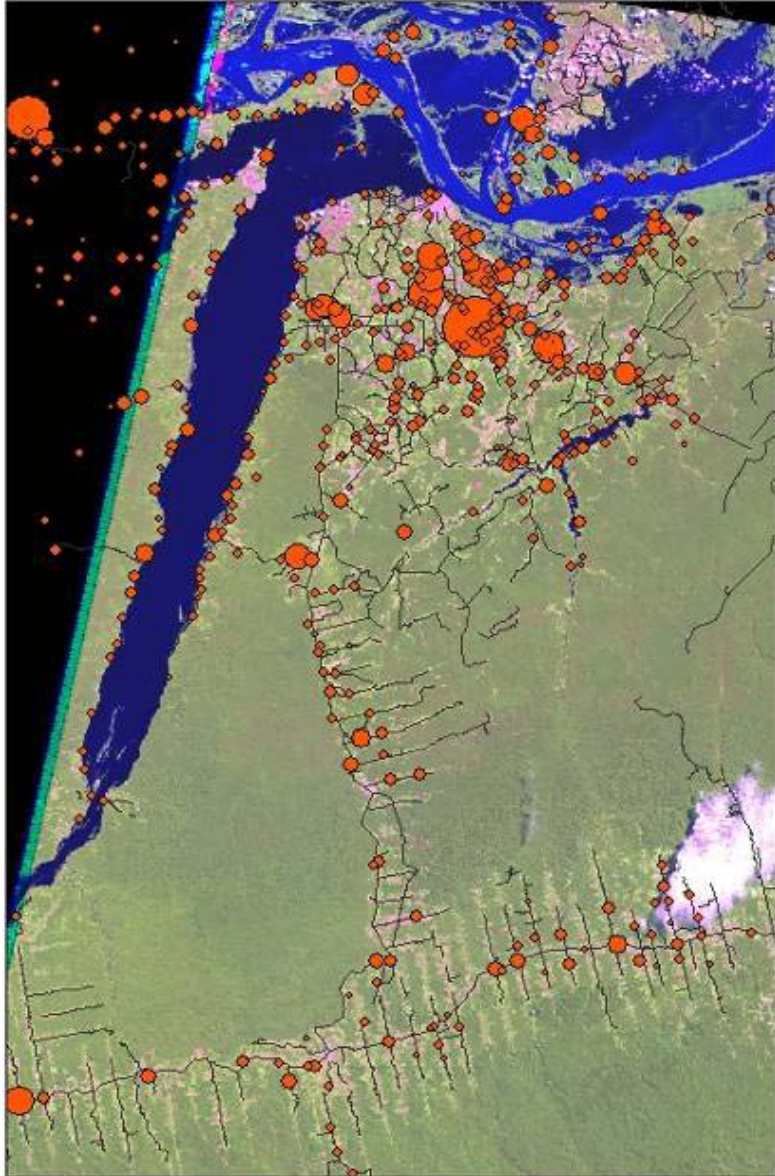
From: Brondizio, E. and E. Moran (under review) Level-dependent deforestation trajectories in the Amazon, 1970-2001, Population and Environment.

3. Implications for sustainability

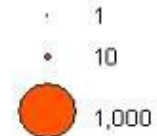
- Not complexity for the sake of complexity: It matters to policy
 - Functional inter-dependence and linkages between levels and different institutional arrangements and economic systems
 - Evolving rural-urban network systems defining future regional landscapes
- From 'panacea' to 'mesoscopic' approaches to policy
 - Account for intra-regional variability and underlying persisting structural problems
 - Limitations of level specific policy approaches → 'Policentrism'
 - Link regional models of climate change to local level needs
- Towards a transformative economy
 - Limitations of compensation mechanisms to deal with regional complexity
 - Aggregating resource value and generating employment at the local and regional levels
 - Overcome disconnection of municipalities from regional resource economy
 - Locally developed solutions for environment management and agropastoral intensification

THANK YOU!

Rural community formation, Santarem region



Households



Growing pressure on urban infrastructure, employment

Table 2 - Distribution of Urban Infrastructure of Households (%) in Municipalities (%) of the Legal Brazilian Amazon, from IBGE Micro Data of the 2000 Census (IBGE 2000)

Percentage of households	Electric Energy	Public Electric Light	Pavement	Water system	Pipe Water System in at least one room	Sewage system	Waste - City collection
0 - 10%	0.8	4.0	47.7	15.1	15.3	96.1	32.3
10 - 20%	4.2	8.6	24.6	12.1	25.7	2.1	17.3
20 - 30%	12.6	15.0	14.6	15.5	19.3	0.8	12.5
30 - 40%	17.0	16.6	7.8	16.5	14.1	0.4	10.6
40 - 50%	18.1	16.3	2.8	13.5	9.5	0.4	9.1
50 - 60%	15.9	15.5	1.7	10.8	5.1	0.1	6.4
60 - 70%	11.7	10.7	0.4	7.8	6.2	0.0	5.2
70 - 80%	10.8	8.0	0.4	5.2	3.2	0.0	3.8
80 - 90%	5.8	4.6	0.0	2.8	1.7	0.0	2.7
90 - 100%	3.2	0.7	0.0	0.7	0.0	0.0	0.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Derived from Brazilian Demographic Census - microdata (IBGE, 2000)

Table 3: Employment sectors (%) in 2005 for 8 Amazonian states according to RAIS (Annual Report of Social Information)

IBGE ECONOMIC SECTORS	RONDÔNIA	ACRE	AMAZONAS	RORAIMA	PARÁ	AMAPÁ	TOCANTINS	MATO GROSSO
Mineral extractive	0.3	0.1	0.2	0.1	0.6	0.9	0.3	0.3
Industrial sector	9.2	4.9	25.6	4.1	10.9	3.4	4.1	11.9
Public services	1.2	1.5	0.9	3.0	0.7	1.3	1.6	0.9
Construction	2.3	5.1	3.2	4.7	4.4	3.7	3.9	3.1
Commerce	19.2	16.9	12.9	22.8	17.7	19.2	12.8	21.3
Services	19.8	16.8	25.9	27.7	24.9	24.9	13.2	23.2
Public administration	45.4	51.9	30.9	36.0	37.7	46.1	58.9	29.4
Agropastoral, extractivism, hunting and fishing	2.7	2.8	0.5	1.7	3.2	0.5	5.1	9.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: RAIS / MTE, Brasil.

Vicious cycle:

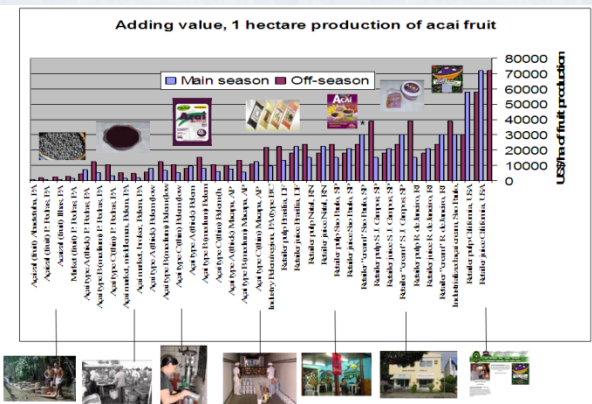
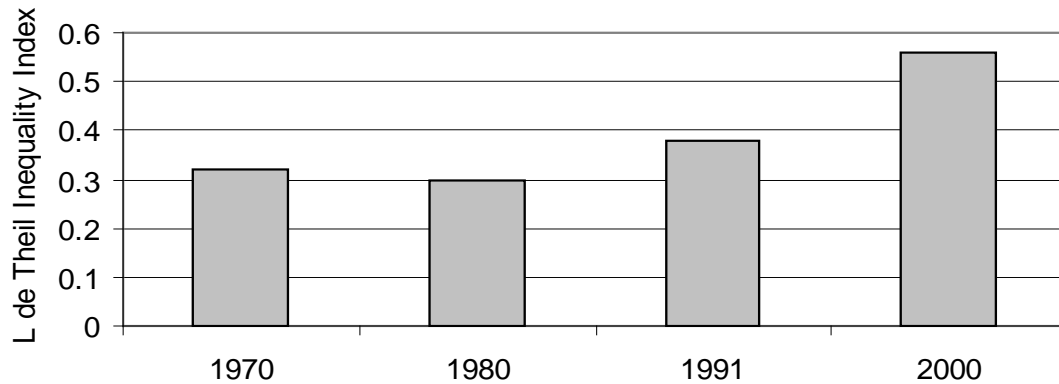
-Increase urban population and demand for services

-Lack of ability to provide urban infrastructure and public goods

-Persistent unemployment

Concentration of Wealth in the Amazon estuary

Inequality in Income Distribution (L de Theil index)
IPEA data
Ponta de Pedras 1970-2000



Forest-based economy

Lack of transformative industries

Value added away from the region

Competitive disadvantage for producers

- Municipalities disconnected from resource economies

Small Farmers, Food Production, and Security

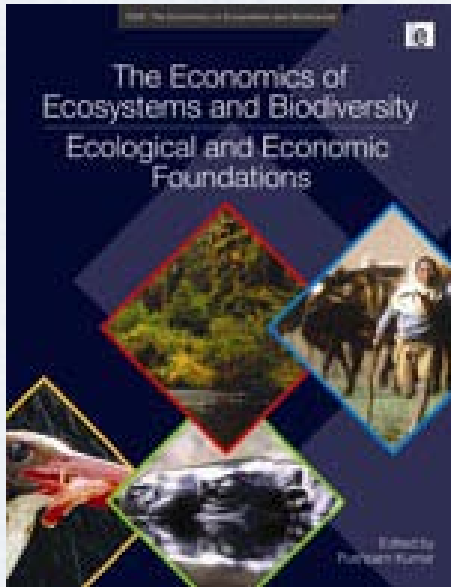
IBGE Agropastoral Census 2006

- Properties <10ha=2.4% area → 75% of rural employment
- Properties >1000ha=44% area
- Properties > 2000ha > 80% deforested area

- Small farmers: 24% agropastoral area (% national prod):
 - -87% Manioc -38% Coffee -21% Wheat
 - -70% Beans -34% Rice -16% Soybean
 - -46% Corn -58% Milk



Limitations of Ecosystem Services Valuation



Chapter 4 The Socio-cultural Context of Ecosystem and Biodiversity Valuation

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In: Pushpam Kumar (editor) *The Economics of Ecosystems and Biodiversity: Ecological and Economic Foundations*. London, UK: Earthscan. 2010. 400pp.



- Contrasting cultural perspectives to nature
- Long-term implications of commodifying nature as property
- Resource value aggregated outside the region
- Local efforts undermined by regional changes

Factors affecting small farmers adaptive responses to climate change

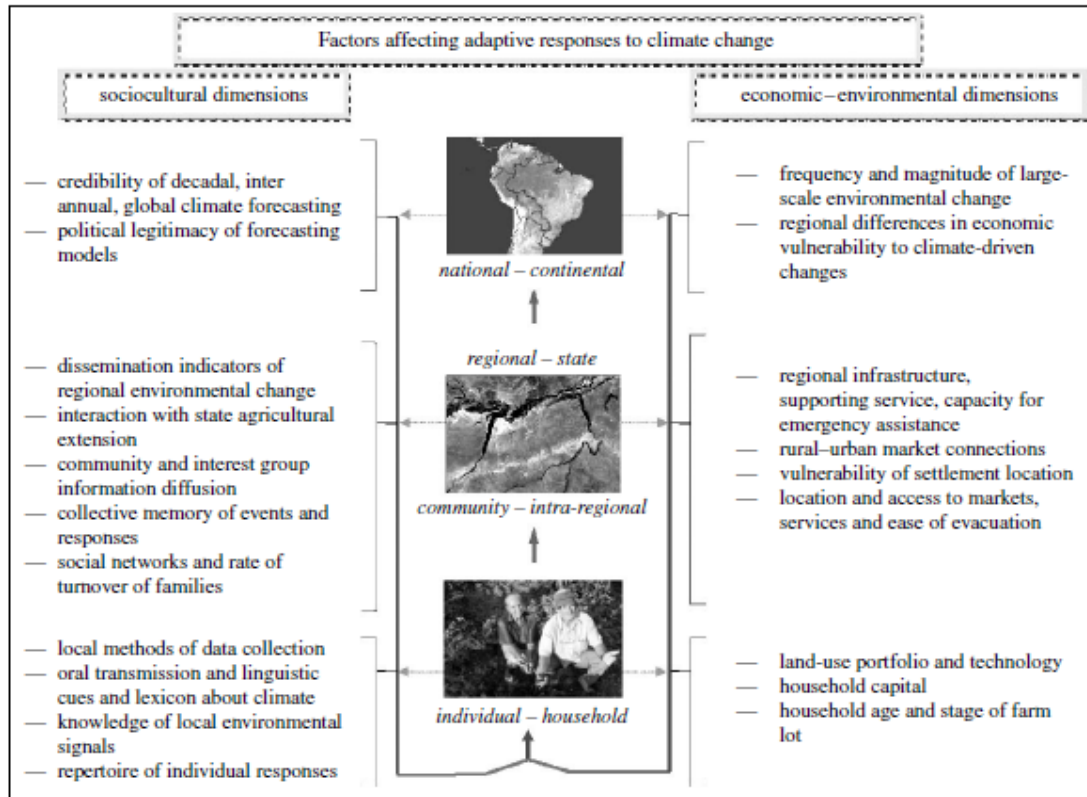


Figure 1. Conceptual framework: factors affecting adaptive responses to climate change in a multilevel perspective.

- Mismatch in scale between climate information and farmers needs

- Technology bottleneck, limited ability to respond to climate variability

- Poor infrastructure

Untangling level specific factors affecting spatial pattern & temporal intensity

Table 1. Suggested variables explaining the spatial pattern and temporal intensity of deforestation trajectories at different levels of analysis, 1970–2001.

Spatial patterns	Temporal intensities
Brazilian Amazon	
Federal transportation network	Policy and credit incentives for land use
Colonization and settlement	Fluctuations in interregional migration
Distribution of institutional arrangements	Macroeconomic stability
Regional geography and topography	Regional, national, global market demands
Sub-regional level	
Spatial distribution of settlements	History of settlement occupation & land conflicts
Spatial organization of and tenure systems	Rates of in- and outmigration
Environmental endowments and topography	Market prices for dominant commodities
State and municipal transportation networks	Economic incentives and subsidies
	Changes in land use regulations
Settlement level	
Density of local transportation network	Rates of in- and outmigration
Types of land tenure and institutional arrangements	Rates of lot-turn over Fluctuation in market opportunities
Dominant land-use system and technology	Cycles of development projects and subsidies
Spatial variability in environmental endowments	
Farm location and proximity to roads	
Farm-lot level	
Farm size and shape	Size and composition of household
Local environmental endowment & topography	Access to capital
Land-use technology available	Family short- and long-term goals
Proximity to roads and type of access	

- Long-lasting effects of regional structural factors, but differential distribution of effects

- Level specific processes, but cumulative effects of local decisions

- Limited effects of region-wide policies