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LARGEHOLDER DEFORESTATION AND LAND CONFLICT
IN THE EASTERN BRAZILIAN AMAZON

presented by

Stephen Peter Aldrich

has been accepted towards fulfillment
of the requirements for the

Ph.D. degree in Geography

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LARGEHOLDER DEFORESTATION AND LAND CONFLICT IN THE
EASTERN BRAZILIAN AMAZON

VOLUME I

By

Stephen Peter Aldrich

A DISSERTATION

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Michigan State University
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ABSTRACT

LARGEHOLDER DEFORESTATION AND LAND CONFLICT IN THE
EASTERN BRAZILIAN AMAZON

By

Stephen Peter Aldrich

Over the past thirty years research on land cover and land use change in Amazonia has indicated a number of human –environment interactions which have led to extensive deforestation in the world’s largest and most diverse standing tropical forest. Various underlying socioeconomic causes of deforestation are well explicated in the existing primary literature, and include economic development, concerns of national security, and market influence. However, to date very little attention has been paid to the potential for social interactions between land managers to drive deforestation in the region. This dissertation focuses on one particularly contentious type of interaction – land conflict – in one of Brazil’s most active and controversial deforestation fronts in the South of the state of Pará. Land conflict in this part of Brazil typically pits largeholder ranchers against the landless poor, with conflicts frequently escalating to the occupation of private property and even violent intimidation and murder. A number of factors contribute to this violence, but among the most important is constitutional law, which allows for the expropriation of private property for agrarian reform purposes if land is not considered “productive.” In the Amazon, the most common measure of productivity is the amount of cleared land, leading to a significant incentive for deforestation. When this constitutional law is combined with a socially organized peasantry, largeholders are likely to take extreme measures to protect their property, including significant

deforestation. This work draws from concepts in the land change science literature, a rich concept of geographic “place,” and contentious politics in order to describe how conflict could be an underlying driver of deforestation. Drawing from this integration of political and ecological considerations, I develop a logistic regression model which shows that the social movement organizations which confront wealthy cattle ranchers do so with much greater likelihood on properties displaying various physical and legal characteristics. Drawing from the insights provided by this logistic regression model, I then specify a spatial error regression model which indicates, among other things, that land conflict increases the amount of deforestation on largeholdings in the region. The data used to develop these models involves an extensive archive of newspaper accounts, key informant interviews with a variety of actors on both sides of the ongoing struggle for land, geographic information systems, and remote sensing. Among the chief policy implications of this research is a potential need to rethink the current measure of the productivity of properties in the Amazon to include criteria such as labor conditions, number of people employed, ecologically responsible use, and actual productivity. A redefinition of productivity in this way could both limit environmental wrongs and begin to repair the rift between largeholders and the landless laborers of the region.

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and Tiffany Baker have been “my couple” and Colin and I have discussed the merits and drawbacks of our chosen careers over the many miles of Picture Rocks National Lakeshore Trail.

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LIST OF ABBREVIATIONS

Abertura — opening, the extension of "distensão" bringing about the fall of Brazil's military government

Aforamento perpétuo — a long-term (perpetual) lease granted by the state to landholders for particular uses, often extractive in nature

Avança Brasil — "Advance Brazil" is an infrastructure development plan meant to aid agribusiness through new road and port facility development

Aviamento — an exploitative (wage-slavery) labor system under which most Brazilian latex was extracted

Bandeirante — a "flag-bearer," a rugged explorer/slave raider responsible for colonizing Brazil's hinterlands

Barracão — a large shack

Boi verde — "green cattle," an expression indicating free range, non-feedlot, cattle

BR-010 — the Belém-Brasília highway

BR-222 — a federal highway connecting Marabá with cities in Maranhão

BR-230 — the Transamazon highway

Castanha-do-Pará — Brazil nut (*Bertholletia excelsa*)

CEB — Comunidades Eclesiais de Base, Ecclesiastic Base Communities, a loose community organization supported by ecclesiastic churches of Brazil

Cerrado — grassy savannah

Cesta(s) básica(s) — foodstuffs and other necessities provided as social assistance to the poor by various agencies in Brazil

Choque — "shock," generally used to describe police special forces akin to North American "SWAT" (Special Weapons and Tactics) teams

Correio to Tocantins — A regional newspaper printed in the city of Marabá, Pará

CPT — Comissão Pastoral da Terra, Pastoral Land Commission, a Catholic organization monitoring land-related violence and advocating for the poor

CVRD — Companhia Vale do Rio Doce, one of the largest mining companies in the world, started in Brazil but now a multinational company

DALR — Direct Action Land Reform

Distensão — an initial program of political opening which stopped far short of democratization

Dono(s) — owner(s) or, more accurately in many cases, "master(s)" of a property

DRN — Departamento Recursos Naturais, Department of Natural Resources

EMBRAPA — Empresa Brasileira de Pesquisa Agropecuária, Brazilian Enterprise for Research on Farming and Cattle Raising, a state-owned company focusing on agricultural extension research

Empatê — a non-violent strike-cum-roadblock (a "standoff") employed by rubber-tapper activists in protest of the loss of their extractive zones to ranchers in the early-1990s

ETM(+) — Enhanced Thematic Mapper, an instrument onboard the Landsat 7 satellite

FARC — Fuerzas Armadas Revolucionarias de Colombia, the Revolutionary Armed Forces of Colombia, or "People's Army" is a paramilitary insurgent group in Colombia

FETAGRI — a politically active worker's organization known as the Federação dos Trabalhadores na Agricultura, the Federation of Agricultural Workers

FNO — Fund of the North, a constitutionally mandated fund to develop the North Region of Brazil, which includes Amazonia. Note, however, that another fund, FINAM, is set aside for the Legal Amazon

FUNAI — Fundação Nacional do Índio, the Brazilian national Indian services foundation.

Garimpos — wildcat (or placer) mining, often taking place in huge impromptu communities

Gato — slang for a labor-wrangler, generally the person who promises good pay for hard work which turns out to be a lie

GIS — Geographic Information Systems

Grileiro — land-grabber

IBAMA — Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis, Brazilian Institute of Environment and Renewable Natural Resources

IBGE — Instituto Brasileiro de Geografia e Estatísticas, Brazilian Institute of Geography and Statistics

IDESP — Instituto de Desenvolvimento Econômico-Social, Socio-Economic Development Institute of the State of Pará

INCRA — Instituto Nacional de Colonização e Reforma Agraria, the National Colonization and Agrarian Reform Institute, a federal agency charged with enacting agrarian reform

Invasor — a pejorative term for "posseiro" often used by largeholders to indicate those occupying their property

ISodata — Iterative Self Organizing Data Analysis, a statistical clumping method frequently used in remote sensing

ITERPA — Instituto de Terras do Pará, Pará Land Institute

Jagunço — slang for hired-gunman

Latifundiáristas — landholders who own large, generally unproductive, rural estates

Latifúndio — a large, unproductive landholding

Luta posseiro — "fight for possession," a stage of land conflict described by Simmons et al. 2007 lasting from the mid-1970s until redemocratization

MIRAD — Ministério de Reforma e Desenvolvimento Agrário, Ministry of Agrarian Reform and Development (defunct)

MLT — a social movement known as the Movimento de Liberação da Terra, the Movement for the Liberation of Land

Modulo Fiscal — a management and taxation unit of land measurement, the size of which varies by municipality throughout Brazil

MRN — Mineração do Rio Norte, a multinational company started in 1974 to exploit the bauxite reserves of the Trombetas biological reserve

MSS — Multi-Spectral Scanner, an instrument onboard the Landsat 1-5 satellites

MST — Movimento dos Trabalhadores Rurais Sem-Terra, Rural Landless Workers Movement, a social movement for agrarian reform

Município — a municipality, but closer to the concept of "county"

NGO — Non-Governmental Organization

North Region — an official region of Brazil, consisting of the states of Acre, Amapá, Amazonas, Pará, Rondônia, Roraima, and Tocantins

OLS — Ordinary Least Squares regression

Operation Amazonia — a militaristic initiative to integrate Amazonia with the rest of Brazil

Opinião! — a regional newspaper printed in the city of Marabá, Pará

PA-150 — a major state highway linking cities in the South of Pará with the state capital, Belém

PA-257 — a state highway linking PA-150 at Eldorado do Carajás and the Carajás mine at Parauapebas

PIN — Programa de Integração Nacional, National Integration Program, a program meant to integrate the Amazon with the rest of the nation

Pistoleiro — hired gunman

PMDB-PA — Partido do Movimento Democrático Brasileiro-Pará, Brazilian Democratic Movement Party-Pará Branch

POLONORESTE — Programa Integrado de Desenvolvimento do Nordeste do Brasil, Northeastern Brazil Integration Development Program

Posseiro — a smallholder using property under usufruct land rights, without access to legal title; can be used to describe a property occupier

PPA — Plano Plurianual, multi-year development plans associated with a national development program known as "Agenda 21"

Projeto Grade Carajás/Grande Carajás — A development project focused on the South of Pará meant to develop the ore-rich Carajás mine and its surrounding area

PT — Partido dos Trabalhadores, Labor Party

Quilombo — a rural community, often removed from greater society, typically started when escaped African slaves began intermingling with indigenous groups

RADAM — Radar for Amazonia, a radar flyover mission, focused on the Amazon and natural resources evaluation, run by Brazil and the U.S. in the 1970s

RMSE — Root Mean Squared Error, a measure of standard error where the units are equivalent to input units

Sesmaria — land grants in colonial Brazil established directly by the King of Portugal

SMO — Social Movement Organization

South Region — an official region of Brazil, consisting of the states of Paraná, Santa Catarina, and Rio Grande do Sul

SPVEA — Superintendência do Plano de Valorização Econômica da Amazônia,
Superintendency of the Plan for Economic Development of Amazonia

STR — Sindicato dos Trabalhadores Rurais, Rural Worker's Union

SUDAM — Superintendencia do Desenvolvimento da Amazônia, Superintendency for
Amazonian Development

Terra Devoluta — unowned public land controlled by the federal government

Terra Preta do Indio — Dark earth soils, typically thought to be human-created

TM — Thematic Mapper, an instrument onboard the Landsat 5-7 satellites

UDR — União Democrática Ruralista, Rural Democratic Union, a somewhat militant
rancher group started in response to the landless movement

UTM — Universal Transverse Mercator, a grid-based projection divided into sixty
longitudinal zones

Varzea — floodplain

WGS84 or WGS1984 — World Geodetic Survey of 1984 datum

CHAPTER 1 - INTRODUCTION

“The peasant with his axe is coming,
Something terrible will happen.”

(From a Russian Folk Song, Cited by Dostoyevsky – *The Possessed*, Page 32)

On April 24, 1986, Fazenda Bamerindus, an enormous farm in the Southeastern corner of the Brazilian State of Pará, was occupied by over 300 landless rural workers in coordinated groups of ten to twenty people. Their objective was, by their own admission, two-fold; the occupation of this property was meant to win the group land through meaningful agrarian reform, and was meant to be part of a wider fight against what their social movement saw as traditional *latifúndio*¹ in Brazil. Though Fazenda Bamerindus was large by almost any measure, at over 62,000 hectares, it was also highly productive according to many in the region (e.g., one key-informant said the farm was "a marvel," Gil 2007). Moreover, it was also supposedly well within environmental laws at the time, which mandated that every property must retain twenty percent forest cover². That the farm was occupied, and then subsequently expropriated, is not necessarily unusual in modern Brazil. What is extraordinary is that the region of the country which was host to this property, generally known as the South of Pará, has experienced a significant number of these occupations and expropriations, with 99 of the former 180 largeholdings in the

¹ A large estate in Latin America, often conceived of as being only marginally productive.

² For an explanation of former and current forest reserve law under Brazil's national forest code, see Table 4.2 and the text of section 4.2b.

area immediately around the primate city of Marabá³ having been wholly or partially converted to smallholder agriculture on settlement projects by 2002.

While hostility over the past 25 years has been severe in the South of Pará, the region has a long history of land conflict and more general insurgency. Even before the April 23, 1500 arrival of Pedro Álvares Cabral marked the beginning of Brazil's colonial era, conflict over land among those living in what would become the South of Pará was likely a common occurrence (Hemming 1978; Meggers 1996; Mann 2005). However, the region's conflict was probably limited to the uncharacteristically (for indigenous groups in the Amazon) territory-hungry Kayapó and their neighbors (Meggers 1996). It was not until the arrival of Portuguese slave raiders in the region, starting around 1611, that tensions between Jesuit priests and *Bandeirantes* gave rise to widespread conflict over land and resources in this part of Brazil (Hemming 1978: 321-350). In the midst of the nearly 300-year period of conflicts between would-be settlers and the area's indigenous residents, a group of explorers (probably slave raiders) "confronted the aggressiveness of the brutal natural environment" and laid the groundwork for the small settlement which would eventually become the city of Marabá (Jadão 1984, though see footnote 3 above).

In addition to a history of conflict, the South of Pará became a much more contentious landscape in the mid-20th century with the arrival of tens of thousands of rural workers and thousands of urban capitalists accompanying the opening of the

³ The primate city of the South of Pará, Marabá, began as a licensed occupation of a part of the State of Pará in 1892. Later, in 1895, an expedition led by Carlos Leitão discovered caucho rubber (*castilla ulei*) along the banks of the Itacaunas river at the present-day site of the city. Shortly thereafter, in 1897, the confluence of the Itacaunas and the Rio Tocantins/Araguaia was the new site of the area's first permanent settlement, a shack (*barracão*) named after a commercial house owned by the shack's constructor, Francisco Coelho. In 1913, the city and *município* (county) of Marabá were formed through State Law 1.278 of February 27th, which made the *município* from land formerly belonging to the *município* of São João do Araguaia. This *município* was then incorporated with Marabá as county seat in 1922 under the authority of State Law 2.207 of October 27th, 1923 (Jadão 1984).

Amazonian agricultural frontier (Schmink and Wood 1992). Not only were the speculative interests of urban capitalists piqued at the newly opened possibility for a particularly large and untapped land market, but promised road construction projects also brought massive migration from Brazil's increasingly crowded and stressed Northeast and South. Even so, the region had already been spoken for in the decades before, when rubber and castanha-do-Pará (Brazil nut, *bertholletia excelsa*) extraction reserves had been established as political favors by and for the state's political elite (Emmi 1999). On top of these land claims, other cadastral instruments allowing for mining, ranching, and smallholder settlement had all been distributed, long before any road made the area accessible. The end result was that many arrived to find their landholdings already occupied with multi-layered titles and complicated, expensive, and slow bureaucratic problems to resolve. Of course, due to their limited means and access to state institutions, the would-be smallholder agriculturalist was the most frequent loser in the rabid frenzy over land as the region's highways, PA-150 and BR-230 (the so-called Transamazon highway), were built and settled (Figure 1.1).

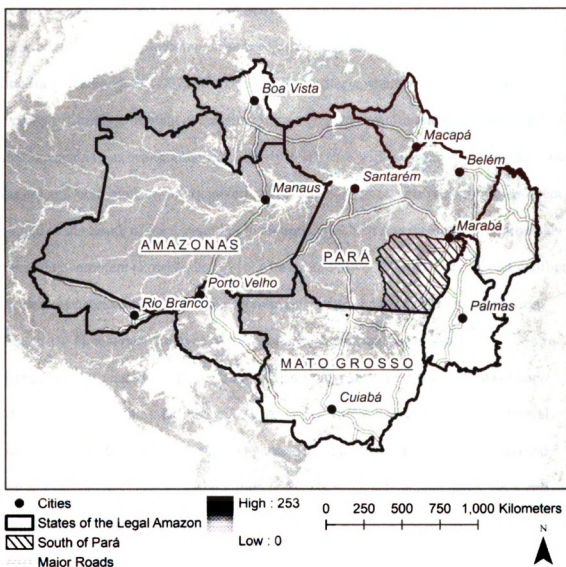


Figure 1.1. The Brazilian Legal Amazon with key states, cities, and highways.

However, the newly arrived peasantry of the South of Pará would not sit idly as their lands were taken from them. Being primarily from the long-organized Brazilian Northeast where the *Ligas Camponesas* (the Peasant Leagues, which arose during President Getúlio Vargas's efforts to co-opt union activities) provided a long history of organizing the peasantry of the region. Drawing in part from previous mobilization, the poor of the South of Pará (and elsewhere) began to organize themselves (with help from

the then-illegal *Partido Comunista do Brasil* [Communist Party of Brazil]) against the injustices of Brazil's speculative frontier (Foweraker 1981b; Morais and Silva 2005; Simmons, Walker et al. 2007). The organized peasantry, whether engaged in anti-state uprising or simply a militant expression of outrage at the painful realities stemming from frontier speculation, was countered in nearly every case with severe brutality by the cold-war era anti-communist military government. In one instance, true communist insurgency erupted in the South of Pará, resulting in an uprising which was meant to overthrow the national government (Foweraker 1981b; Morais and Silva 2005). This particular conflict, which at its heart was a struggle for agrarian reform, lasted for nearly ten years (from 1966 to 1974), and cost the lives of 61 organizers (who were either killed or disappeared), at least five peasants (but likely many more), and ten Brazilian soldiers (Morais and Silva 2005). Despite efforts of varying strength and organization, the real force behind conflict in Amazonia, and particularly the eastern reaches of it, was (and continues to be) the widespread condition of land scarcity due to land speculation and extensive land uses such as cattle ranching (Sawyer 1984; Fearnside 1987; Schmink and Wood 1987; Hecht and Cockburn 1990; Mertens et al. 2002; Simmons 2004).

During the military period, starting in 1964 and continuing for twenty years, the landless peasantry displaced by farm mechanization in the south of Brazil, awful conditions in the northeast, and land conflict events in Amazonia were considered a serious national security problem (Foweraker 1981b; Hall 1989; Hecht and Cockburn 1990; Binswanger 1991; Simmons, Walker et al. 2007). Land invasions and other protests (especially over labor conditions in the industrialized south) were approached as acts of terrorism or overt defiance of state control. The state continued to crush any

resistance, perceived or real, during the military period until the late-1970s when President João Figueiredo finally solidified ex-President Ernesto Geisel's "*distensão*" by instituting a program of political opening, partially because the powerful right-wing assumed that all undesirable elements of society had been chased away, disposed of, or collapsed under the weight of government repression (Sader and Silverstein 1991). Ultimately, this political opening, known as *abertura*, would be the leak in the levee which unleashed a flood of popular opinion and eventually the re-democratization of Brazil.⁴

In the twenty-plus years of new democracy in Brazil, incidents of land conflict have not decreased; an accountable state has in many ways emboldened the landless and the poor of the nation to struggle more fervently for access to social support and better livelihoods, which in Amazonia often means direct access to land. In many ways, despite a multitude of government efforts to integrate Amazonia, the region has remained autonomous either by design or by its very remoteness. This unique autonomy has led to an often bewildering array of government agencies, agricultural strategies, land tenure arrangements, and even economic activities that has done little to alleviate tensions involving land resources.

The semi-organized occupation of the Amazon in the post-1964 period has led to another national ill in Brazil; between the advent of "Operation Amazonia" in 1966⁵ and

⁴ I write "re-democratization" despite the fact that many authors use the term "democratization" instead. In Brazil's case, the nation had been democratic before Vargas's dictatorial years during his first term as President of the Republic in the early 1930s. This period is often referred to as Brazil's "Old Republic" and lasted from 1889 to 1930, at which point Vargas was placed in power as part of a military *coup d'état*.

⁵ "Operation Amazonia had the stated goal of "...establishing 'development poles' and stable, self-sustaining population groups (especially in frontier areas), encouraging immigration, providing incentives

2001 over 60.5 million hectares, or some sixteen percent, of the original forest cover of the Legal Amazon was removed due to human occupation and economic development (Pacheco Balanza 2002). Not only had Brazil's successive military governments been unable to solve growing social problems, but their attempted solutions resulted in the creation of another: deforestation, an environmental problem that continues to be synonymous with economic development and human settlement in the Amazon.⁶

The projects associated with Operation Amazonia, and more than a dozen official plans that have followed since, have had mixed success, albeit a mixture containing more failure than triumph, considering both social and environmental criteria. Brandford and Glock (1985) and Mahar (1979) point toward the frequent inversions in policy focus in regional development plans as being one reason why social problems have continued to haunt the state's efforts in the Amazon. Essentially, the focus of enacted development plans for the region (as many plans were never actually acted upon in a meaningful fashion) started by emphasizing the need for the settlement of the landless poor on the abundant, and supposedly highly fertile, land of the Amazon. The goal of this settlement was to alleviate land tensions and desperate human conditions in other parts of the country. Despite incredibly ambitious programs, including a strategy to settle over 100,000 smallholder families within the formidable Transamazon (BR-230) corridor, the settlement of smallholder peasants quickly gave way to incentives for big business to

to private capital, infrastructure development, and research on natural resource potentials" (Mahar 1979: 11).

⁶ However, not all human settlements have been the environmental disasters that others have been (such as the settlement projects of BR-364 in Rondônia or the Grande Carajás project in Pará). Indeed, some settlement projects have been more or less environmentally benign (Futemma and Brondizio 2003), and some development projects have been designed to have a less significant environmental impact, such as the Trombetas mine run by the now multinational company Mineração do Rio Norte (MRN).

operate heavily subsidized industry and agriculture in the region (Brandford and Glock 1985; Hall 1989; Hecht and Cockburn 1990; Moran et al. 1994; Smith et al. 1995).

Whether development efforts focused on largeholder or smallholder settlement and development, in many ways the outcome has been nearly identical; deforestation in the Amazon basin has outstripped that in every other tropical moist forest environment in the world, when area deforested is considered (FAO 2005). The result has been the elimination of closed canopy forest in favor of cattle pasture, strip mining, smallholder settlements, and even speculative development activities. As with any complex environmental problem, the global environmental outcomes associated with these landscape-level changes are not well known, with predictive research indicating the impacts of deforestation on global climate change being disastrous (Fearnside 1996; Eltahir and Humphries 1998), or perhaps not of great concern (Steffen et al. 2004b).

Among the certainties associated with deforestation in Amazônia is the concomitant loss of biodiversity when standing tropical forest is removed. Frequently, within one hectare of the Amazon, one can identify over 350 different tree species with diameters greater than ten centimeters (Terborgh 2000 documents over 350 tree species per hectare on some long-term research plots in the eastern Amazon not far from the city of Marabá, Pará; Vormisto et al. 2004 indicate in the central and western Amazon that over 300 tree species of this size per hectare is not uncommon), compared to 10-14 per hectare in most temperate forests. The species counts for other forms of life are even greater, especially including microscopic life, birds, and insects (e.g., Borneman and Triplett 1997). Indeed, the region as a whole is home to the greatest number of bird

species on earth, with a significant proportion of these spending some or all of their time living within the Amazon basin (Haffer 1990).

Measures of biodiversity can seem rather abstract, however, and claims supported by biodiversity indicators and appeals to existence values have led to sometimes tiresome rhetoric about the need to preserve the standing forests of the Amazon. Despite this, the decrease in biodiversity potential which occurs with each lost hectare of tropical forest may have a latent economic cost as well; over 7,000 medical compounds have been commercialized throughout the world's humid tropics, many of which can be found in Latin America's tropical forests (PANOS 1995). Beyond medicine, however, many of these plant-derived compounds may have other uses as well. For each of these known (and often economically valuable) compounds, tropical deforestation may be removing many more from future human use and economic exploitation.

Global discomfort with the rate of deforestation in the Amazon is therefore sourced in a number of economic and ecological concerns, including many not addressed here. Biodiversity loss concerns both those within the Amazon and those outside of it for at least economic (in the sense that potentially profitable biological compounds are being lost along with forest cover) and environmental reasons (existence values, the value a person sees in a particular environment solely existing, and concerns about global climate change both play into these anxieties). At the same time, social concerns are not to be underestimated, and many, Brazilians and foreigners alike, have become concerned by problems involving human rights and welfare that have cropped up as the Amazon region has been more heavily settled (Rohter 2007).

In particular, development attempts in the Brazilian Amazon have oscillated between encouraging a populist frontier and a more economic one. What this has meant is that big business has found the region a tax-friendly location to develop new, and often speculative, industrial and agro-industrial enterprises in areas that immediately before (and often immediately afterwards) have been subject to massive migratory flows of impoverished landless farmers looking for a plot of land to settle on (Schmink 1982; Brandford and Glock 1985; Hecht and Cockburn 1990; Schmink and Wood 1992; Simmons, Walker et al. 2007). In many cases, the result of this often rapid influx of settlers into areas already claimed by elite businessmen has resulted in violent conflict, assassinations, and human-rights abuses. This dissertation is an examination of a region of the Brazilian Amazon that is known for violent clashes between landed economic elites and landless peasants, the so-called “South of Pará,” and will explore the implications of these conflicts for the environment and its forests.

1.1. The South of Pará

In most recent accounts, the South of Pará (Figure 1.2) is described as a region of 212,375 square kilometers in the far eastern reaches of the Amazon basin. The area consists of 28 municípios (Table 1.1, generally likened to “counties” in English), all of which were initially part of two municípios, Marabá and Conceição do Araguaia (Simmons, Walker et al. 2007). Others have defined the region slightly differently, especially Schmink and Wood (1992), Emmi (1999), and Foweraker (1981b), but the movement to cleave Pará into separate states tends to follow the outline described by Simmons et al. (2007), with the 28 municípios displayed in Table 1.1 roughly being the basis of the proposed state of Carajás.

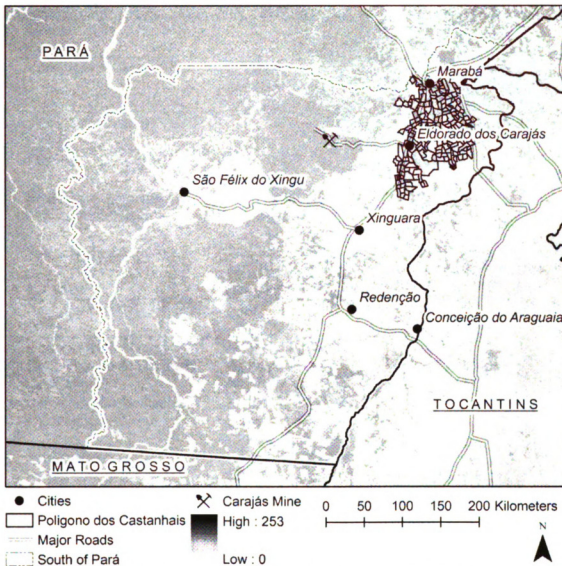


Figure 1.2. The South of Pará and the Polígono dos Castanheais.

The South of Pará includes an area known as the *Polígono dos Castanheais*, the Brazil-Nut Polygon (in the Northeastern corner of the South of Pará), a planning unit put together to encourage agro-industrial extraction of Brazil-Nuts and other natural products on 180 largeholdings leased by the State of Pará. These 180 largeholdings are the subject of this dissertation.

Original Município	New Município	Legal Reference
<i>New Municípios in 1985</i>		
<i>Census</i>		
Conceição do Araguaia	Redenção	no. 5.028 5/13/82
	Rio Maria	no. 5.028 5/13/82
	Xinguara	no. 5.028 5/13/82
<i>New Municípios in 1990</i>		
<i>Census</i>		
Marabá	Curionópolis	no. 5.444 5/10/88
	Parauapebas	no. 5.443 5/10/88
Santana do Araguaia	Santa Maria das Barreiras	no. 5.451 5/10/88
São Felix do Xingu	Ourilândia do Norte	no. 5.449 5/10/88
	Tucumã	no. 5.455 5/10/88
São João do Araguaia	Bom Jesus do Tocantins	no. 5.454 5/10/88
	Brejo Grande do Araguaia	no. 5.448 5/10/88
Xinguara	São Geraldo do Araguaia	no. 5.441 5/10/88
<i>New Municípios After 1990</i>		
<i>Census</i>		
Bom Jesus do Tocantins	Abel Figueiredo	no. 5.708 12/27/91
Brejo Grande do Araguaia	Palestina do Pará	no. 5.689 12/13/91
Curionópolis	Eldorado do Carajás	no. 5.687 12/13/91
Conceição do Araguaia	Floresta do Araguaia*	no. 5.769 10/15/93
Ourilândia do Norte	Bannach*	no. 5.761 10/15/93
	Cumaru do Norte	no. 5.710 12/27/91
Parauapebas	Agua Azul do Norte	no. 5.694 12/13/91
	Canaã dos Carajás*	no. 5.860 05/10/94
Redenção	Pau D'Arco	no. 5.696 12/31/91
São João do Araguaia	São Domingos do Araguaia	no. 5.706 12/27/91
São Geraldo do Araguaia	Piçarra	no. 5.934 12/29/95
Xinguara	Sapucaia	no. 5.961 04/24/96

* created 1994, effective 1997

Table 1.1. Município change in the South of Pará, Brazil. Reproduced from (Simmons, Walker et al. 2007: 570).

The region is primarily within the closed tropical forest vegetation type for which the Brazilian Amazon is known; closed-canopy forest and open *cerrado* (savannah environments, open woodlands or grasslands) are the most common vegetation types (aside from anthropogenic land-covers), with the western portion of the sub-region being

mostly forested and the extreme southeastern corner being dominated by *cerrado* grasslands (Figure 1.3).

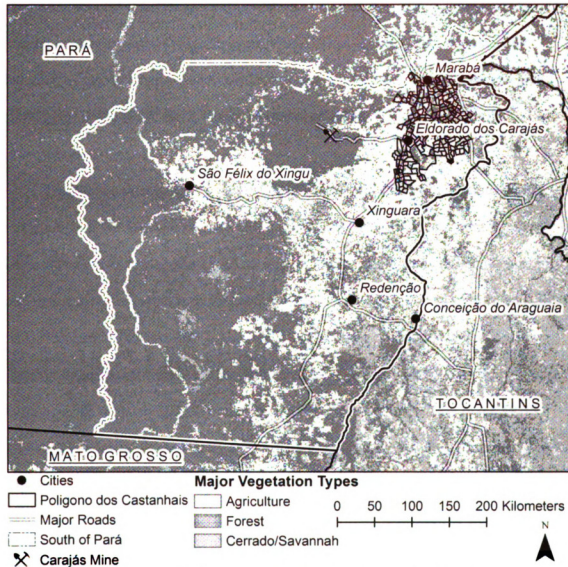


Figure 1.3. Major vegetation types in the South of Pará

As mentioned at the beginning of this chapter, human settlement in this part of the Amazon began with the arrival of indigenous peoples, sometime between 12,000 and

30,000 years before today.⁷ While the indigenous groups inhabiting this portion of the Amazon did not sit idly for between 11,500 and 25,000 years awaiting the arrival of Europeans, our information about their history is somewhat sparse and much of it is based on somewhat questionable extrapolation of current-day activities backwards toward prehistoric periods (e.g., Meggers 1996).⁸ This, however, has been steadily changing, as research has begun to confirm or reshape the inferences of past research efforts (e.g., Balée 1987, 1992; Heckenberger et al. 2003; Heckenberger 2005; Heckenberger 2006).

Despite the uncertainties, we know that different groups of indigenous people associated with the *Kayapó*, a *Gê* speaking group known for inter- and intra-tribal warfare (Posey 1985; Meggers 1996), as well as *Araras* and *Gavião* indigenous peoples, were native to the area that is today the South of Pará (Posey 1982; Brandford and Glock 1985; Hecht and Cockburn 1990). Despite the dominance of indigenous groups, the arrival of intensive settlement efforts associated in large part with the construction of the Belém-Brasília highway (BR-010) throughout the 1960s and especially in the 1970s (after the highway was completed) was particularly disastrous for the indigenous peoples of the South of Pará. As one *Kaingang* woman in the south of Brazil said:

⁷ The exact, or even approximate, arrival date of humans in the Amazon is a matter of particularly intense debate among (and between) anthropologists and geographers. While I will not delve into this contentious issue in this dissertation, I recognize the wealth of opinion on when and how indigenous people arrived in Amazônia. For an overview of these issues, Mann (2005) provides a good treatment of the controversies and current thinking.

⁸ While in Asia, the Middle East, and even Europe “prehistoric” generally connotes a period of many millennia before the current year, in the New World, and particularly in Amazônia, the prehistoric period ended with the arrival of Europeans in the late 15th century and early 16th century. This is primarily due to a lack of written history and the annihilation of oral history with Christianization and the accompanying deaths of thousands indigenous people through conquest and disease.

The blood of our people can no longer be contained in our veins, seeing our tiny reserves, the remains of eight million square kilometers of this our beloved Brazil, over which the Indian people had full dominion and right of occupation, being usurped by disorganized and destructive white people disguised as farmers, but with the spirits of vandals. Today, my people see their lands invaded, their forest destroyed, their animals exterminated, and their hearts lacerated by this brutal weapon that is civilization... (a letter to the president of FUNAI in 1975, quoted by Brandford and Glock 1985: 100).

Both largeholder and smallholder settlers moved into the Amazon at an incredible pace, as has been observed whenever state or federal highways have been built in the region (Smith 1982; Fearnside and Ferreira 1984; Schmink and Wood 1992).

Starting in 1967⁹, the South of Pará received a new impetus for development and occupation; the federal government, facing the potential of communist insurgency (mentioned above) and desirous of integrating far-flung corners of the Amazon basin into a more closely connected Brazil, started a program called the *Superintendência de Desenvolvimento da Amazônia* (Superintendency for the Development of Amazonia, but often referred to as SUDAM in both English and Portuguese, Mahar 1979: 13-26).

SUDAM was a government program which sought to bring agroindustrial development to the Amazon through tax rebates that encouraged investments by companies from Brazil's more heavily industrialized South region. By offering companies tax rebates for any investment or industrial development in the Amazon, the Brazilian government hoped to encourage economic growth and regional integration. SUDAM was established to administer the tax rebate scheme and to approve projects which were to be part of the program (Brandford and Glock 1985; Schmink and Wood 1992: 97). SUDAM approved

⁹ SUDAM was enacted through Decree 60.296 of March 3, 1967 in order to remedy perceived failures in much older development and integration programs such as SPVEA (*Superintendência do Plano de Valorização Econômica da Amazônia*) which had been enacted in the early 1950s, and *Operação Amazônia* which had been announced in 1966.

over 637 projects, at least 503 of them ranching projects (Bunker 1985: 85; Hecht 1985: 671; Schmink and Wood 1992: 98), mainly in the South of Pará and northern extents of the states of Mato Grosso and Goiás¹⁰, though a few were located immediately near the city of Manaus in Amazonas state (Brandford and Glock 1985; Hecht and Cockburn 1990).

The SUDAM tax rebate scheme functioned by allowing investors, typically medium-to-large companies from the south (e.g., São Paulo, Espírito Santo, or Santa Catarina), to receive tax credits for the establishment and operating costs of agroindustrial ventures – the most common of which were cattle ranches. Indeed, in the mid-to-late 1970s, an entire economy of land speculation and investment schemes sprang up around the SUDAM program, with companies seeking to invest even in parts of the region where environmental conditions were such that ranching was not advisable (Hecht 1984; Brandford and Glock 1985; Hecht 1985). To be fair to investors, at the time the soils of the Amazon were, at least in the popular imagination, still thought to be highly fertile and even soil science evaluations of the region tended to be positive. In fact, one of the most infamous of these evaluations was (and sometimes continues to be) taken to indicate that ranching would benefit the soils of the Amazon (Falesi 1976), a position that, at least in the moderate interpretation that ranching is not *bad* for soils, has yet to disappear among some cattle rearers in the South of Pará.¹¹ SUDAM payouts quickly

¹⁰ Goiás was split in 1989, with the northern portion of it becoming the state of Tocantins. Tocantins is immediately to the east of the South of Pará.

¹¹ One rancher I spoke with in 2007 insisted that ranching, when done properly, is actually beneficial for soils in the region (Raul 2007). “Raul” is a pseudonym meant to protect this respondent’s privacy. All named key-informant interviewees will be referred to through pseudonyms in this dissertation.

reached astronomical (for the Amazon) levels, over 1.9 billion 2006 U.S. Dollars¹², and new projects were constantly being started in the region of heaviest investment – the South of Pará. The victims of these new ranches were the tropical forests of the region, indigenous communities who were never compensated or considered, and the vast extractive reserves of Brazil nuts and natural rubber which had driven the economy of the region until shortly after the construction of the Belém-Brasília highway, BR-010 (Jadão 1984).

Brandford and Glock (1985) argue that SUDAM was more than a program to integrate the region and encourage economic development, however. A secondary and implicit goal was to pave the way, in some cases literally through road expansions, for significant capital investment in the region. In other words, according to Brandford and Glock (1985), SUDAM's actual goal was to exclude the poor rural worker from the land and instead offered it at substantially discounted prices, and with little or no taxes, to the most wealthy companies and individuals in Brazil (Brandford and Glock 1985). This bias towards capital is particularly nefarious given the focus of Brazilian military governments on averting communism within the mass of poor rural residents who at this stage (in the early and mid-1970s) was becoming radicalized through the Catholic Church's ecclesiastical base communities (CEBs, or *Comunidades Ecclesiásticas de Base*). Though at early stages the military governments of Brazil focused on smallholder settlement as a way to relieve pressure on land resources (Foweraker 1981b; Schmink and Wood 1987), the focus of government-run development and integration efforts quickly shifted toward capitalized agroindustrial development (Foweraker 1981b; Wood

¹² Approximately \$1 billion 1985 U.S. Dollars, which is the total payout of SUDAM between 1966 and 1978 according to Hecht (Hecht 1985: 671), inflates to \$1,917,852,286.28 dollars in 2006 (Bureau 2006).

1983; Sawyer 1984; Schmink and Wood 1987; Hecht and Cockburn 1990; Thiesenhusen and Melmed-Sanjak 1990; Schmink and Wood 1992; Hecht 1993; Schneider 1995).

The SUDAM tax incentive program for ranching in Amazonia was officially cancelled in 1979 due to corruption, inadequate monitoring, and ongoing social conflict in the regions where the tax scheme most commonly operated (Mahar 1979). However, to some degree payments from SUDAM offices, especially in the South of Pará, were still forthcoming through the mid-1980s, and the same often corrupt officials remained in charge of managing formerly SUDAM-funded projects for the state. Furthermore, SUDAM still operates, providing tax incentives for industrial development in such areas as the free-trade zone of Manaus. Though much maligned, tax incentive programs such as the SUDAM initiatives are beginning to be recast from universal failure to perhaps farsighted in developing agro-industry in the region, especially with regards to ranching (Walker et al. 2008). In other words, evidence is beginning to mount that such programs “worked” in the sense that some of the economic production they encouraged is now profitable.

Simultaneously at work in the region, and contributing to the development of infrastructure and further industrialization was *Projeto Grande Carajás* which focused on the establishment of a development pole with the Carajás iron ore mine at its center. Located only 140 kilometers from Marabá (Figure 1.2) the Carajás mine is among the most extensive and rich iron ore mines in the world, able to sustain present levels of production for over 400 years (Hall 1989). The development of this mine led to the paving of state and federal highways in the region, the construction of a rail link between the mine and cities like Marabá and São Luis in the state of Maranhão, as well as the

necessity for small pig-iron smelting and charcoal production in an extensive and impressively environmentally damaging regional economy (Hall 1989; Hecht and Cockburn 1990).

Between SUDAM's fiscal incentives and the *Grande Carajás* program, the region was set to be almost completely focused on extensive agriculture and mineral production on large properties, at the cost of outright neglect of smallholder agriculture. However, smallholder agriculturalists had actually arrived first, long before the first tax rebate check was signed and iron ore was discovered. Indeed, development efforts led to a significant eviction of smallholders producing subsistence and market crops throughout the region, and established a substantial population of landless rural laborers unable to gain employment on the extensive mining and ranching enterprises in the region. A class of landless agriculturalists with little to no chance of acquiring property in order to undertake the only production strategy they knew – smallholder farming – have been left with few options to provide for their families.

The outcome of the trajectory of Amazonian development in the South of Pará has been land occupations by a critical mass of landless people, many of whom are displaced smallholders or migrant farmers who feel their chance of acquiring land lays in *direct action land reform* (DALR) (Simmons, Walker et al. 2007). These landless people have been able to organize into social movement organizations (SMOs) which focus on ameliorating the current state of highly concentrated landholdings throughout Brazil, and particularly in the south and north regions of the country. The strategies of SMO-led DALR vary widely, but include protests in urban areas, occupations of government land reform agencies, occupations of private properties, and long marches meant to increase

awareness of the greater social issue of landlessness. DALR outcomes vary widely and include land conflict-related violence, increased national awareness of the plight of the landless, and, occasionally, expropriation of largeholdings for settlement formation.

Land conflicts between SMOs and large-scale agriculturalists have the potential to lead to substantial deforestation, at least according to anecdotal accounts and a limited set of observations in various parts of the Amazon. In the South of Pará, accounts of conflict from newspapers (*Correio do Tocantins*, *Opinião*!) and various books on the subject (e.g., Barata 1995) indicate at least two agents of deforestation in cases of occupation or threat of occupation; property occupiers are likely responsible for deforestation associated with their efforts to produce subsistence crops and to acquire some cash income from the sale of stolen timber, while largeholder ranchers who control a property are likely to deforest preemptively in order to capture surplus value from timber (before property occupiers get a hold of it), or in order to show productive use of their property and hopefully avoid expropriation. Of these two agents, this dissertation addresses the latter more than the former, though the former is addressed briefly as well.

Despite many claims about the capability of land conflict to drive deforestation, little is known about how increasingly strong and varied social movements focused on agrarian reform are impacting the region's environment. Our knowledge-gap involving social movement-driven environmental change is a serious omission considering the area of the Amazon now devoted to agrarian reform. Between 1979 and 1999 the states of Pará and Rondônia together accounted for one-third of all occupied land in Brazil, affecting 70,760 square kilometers overall, or an average of about 3,500 square kilometers per year (Fernandes 2000). In 2004, the Brazilian government expropriated

approximately 875,700 hectares of land for agrarian reform purposes, nearly half (49 percent) of which was located in the Amazon basin (Scolese 2005). The vast land resources of the Amazon have typically been viewed as a solution to the unequal distribution of land and rural poverty, representing a “safety valve” which may decrease the chances of social conflict (Mahar 1979; Foweraker 1981b; Hecht and Cockburn 1990; Schmink and Wood 1992). Enacting land-reform in the Amazon is a politically expedient solution given that settling people on unoccupied federal land (*terra devoluta*), which the Amazon region has significant reserves of, is less contentious than expropriating private farms. A number of researchers have suggested that the unintended results of this strategy may be significant deforestation in the fragile, and globally valuable, environments of the Amazon (Alston et al. 2000; Bobrow-Strain 2001; Simmons et al. 2002; Futemma and Brondízio 2003; Simmons, Walker et al. 2007). However, the actual effects of land reform on the environment are only now beginning to be studied (Simmons et al. 2005), and the environmental impacts of the largeholder response to land-reform are unknown. This study defines to what extent land reform efforts by social movements lead largeholders to deforest their properties, and therefore contributes to uncovering the environmental impacts of DALR.

1.1. Research Questions and Problem Statement

In the South of Pará, the trajectory of development, combined with a long (and ongoing) history of social ills and unstable government policies, has led to a situation in which a substantial demand for land exists where there is little or none available to those who need it most. Furthermore, in the struggle for land resources, landless folk and the important environments of the eastern Amazon have been put at high risk for

annihilation; land conflict can lead to death for landless workers and forest ecosystems alike. Though the human suffering due to land conflict in the region is not to be discounted, the environmental concerns which accompany these social issues must not be neglected. The purpose of this research is to empirically describe the process by which land conflict may be a driver of deforestation in the interest of contributing to our knowledge involving land-cover and land-use change in Amazonia, and hopefully elsewhere.

Specifically, the goal of this work is twofold; here I seek to determine the targeting strategies of SMOs in selecting largeholdings to occupy and to determine the extent to which largeholders respond to the threat of land occupation through preemptive deforestation (deforestation preceding property occupation). The problem, therefore, is to determine (1) what makes properties attractive for DALR in order to isolate physical environmental characteristics and social factors which may significantly influence the site selection for new property occupations, and (2) to show whether largeholders actually respond to DALR in an environmentally harmful fashion in an effort to show productive use of their property to avoid expropriation under eminent domain.

The specific research questions this work addresses include how specific characteristics, such as the amount of forest cover on a property, its location relative to cities with markets or bureaucratic capabilities, its agricultural potential, or proximity to transportation corridors, predispose it to occupation by SMO groups. Going hand-in-hand with this investigation is an analysis of how largeholder ranchers respond to these occupations; the important question in this case is whether largeholders deforest their holdings in advance of occupations on or near their properties in order to stave-off

seizure of their land for agrarian reform purposes. This preemptive behavior has substantial potential to impact land-cover when undertaken by largeholders who have the means to remove vast tracts of forest from their properties in a short amount of time.

The overarching research problem, the connection between land conflict (e.g., land-related murders, property disputes), DALR events (e.g., protests, occupations), and changes in forest cover on large properties, and the more specific research questions which stem from it, allow for the statement of a number of hypotheses which can be directly implemented and tested.

1.1a. Research Hypotheses

In order to address the connection between DALR and largeholder deforestation as outlined above, I state the following two primary hypotheses and accompanying sub-hypotheses:

Hypothesis 1: SMOs enacting DALR target private holdings with specific characteristics.

Hypothesis 1a: Properties targeted by the landless for DALR are more likely to have a larger proportion of forest cover as significant stands of forest may facilitate expropriation under the Beneficial Use Clause of Brazil's 1988 constitution.

Hypothesis 1b: Properties targeted by the landless for DALR are more likely to be of higher potential for agriculture, which would improve the chances of successful settlement.

Hypothesis 1c: Properties targeted by the landless for DALR are more likely to be located near regional centers where land reform agencies are more accessible and are more likely to be aware of the plight of the landless and take action.

Hypothesis 1d: Properties targeted by the landless for DALR are more likely to be accessible in efforts to raise awareness of the conditions of landlessness in the region.

Hypothesis 2: Largeholders in the South of Pará preemptively deforest their holdings when they are directly threatened with, or perceive the threat of, land occupation as a strategy to discourage occupation and/or lessen the likelihood of expropriation of their land by state-sanctioned land reform.

Hypothesis 2a: Largeholders directly and specifically threatened with DALR on their properties deforest in advance of actual occupation.

Hypothesis 2b: Instances of DALR on nearby properties lead largeholders to deforest their properties to discourage occupation.

1.2. Dissertation Outline

This dissertation continues in **chapter 2** with a summary of land-use and land-cover change research in Amazonia, and how deforestation has been viewed in both the region and throughout the rest of the world. In particular, chapter 2 outlines how largeholders and smallholders have both been important in the deforestation of vast areas of the Amazon basin, though in different time periods and different locations, as well as how research of how these landscape changes occur is conceptualized. In **chapter 3**, I

establish a conceptual framework which describes how land conflict and environmental change in the form of deforestation are linked, by drawing on conceptual foundations in the literature on political ecology and contentious politics. Chapter 3 will close with a section of how these ideas mesh with the framework of underlying drivers and proximate causes of land-use and land-cover change from the land-change science framework.

Chapter 4 introduces the empirical analysis which deals with the selection strategies of social movement organizations bent on forcing land reform in the study area. The chapter starts with a section discussing the characteristics which may predispose certain properties for occupation, while leading others to be neglected, and why these characteristics may be at work. From there, quantitative evaluations of the importance of selection criteria are presented, showing that some characteristics mentioned by social movement members, government officials, largeholder ranchers, and the academic literature are very important in this region while others are not. Chapter 4 closes with the results of the analytical portion of the chapter, leaving discussion of their implications and conclusions which can be drawn from them for the final chapter of this document.

Chapter 5 begins with a discussion of preemptive deforestation, illustrating how this land-cover change pathway has significantly changed the landscape of a number of large ranches in the study area through a series of ‘conflict ethnographies’ – descriptions of conflict between initial occupation/DALR events and the resolution of the land conflict on each property. This chapter also includes evidence for the wider claim of conflict-driven deforestation being the responsibility of property occupiers. Though this particular pathway of deforestation is not the focus of this work, significant evidence is present in both the ethnographies of conflict and key-informant interviews. Chapter 5 closes with a

discussion of data sources and processing steps, and presents the analysis and results from both OLS and spatial error regression models.

The **final chapter** draws conclusions from the analyses presented in chapters 4 and 5. In addition, this chapter shows how these results may be able to influence policy surrounding both forest reserves and land reform in Amazonia, showing some of the pitfalls of current policy in both regards. This analysis has some theoretical implications as well, including how environmental managers (in this case largeholders) decide to use the environments under their control. Finally, this chapter concludes with the opportunities for future research which this line of inquiry has pointed to.

The work presented in this dissertation is not an attempt to undermine the efforts of the rural poor in Brazil to meet their needs through the acquisition of smallholdings for subsistence and market production. Instead, this work stems from a desire to both raise awareness of the intractability of certain social problems which are simultaneously environmental ones, and to call attention to the ineffectiveness of current social and environmental policy in the Amazon. Instead of blaming class conflict for environmental and social depredations, this dissertation contributes to the growing awareness of how well-intentioned but rudderless development policy over the past half-century has led to a situation where social wrongs perpetuate environmental ones. It is my hope that this work will in some small way lead to work in the future which addresses these problems and potentially gives pause to researchers and policy makers who make policy declarations unsupported by substantive inquiry and research.

Despite the problems surrounding research and policy in Amazonia, a significant amount of top-notch research has been undertaken to illuminate the drivers of

deforestation and social wrongs throughout the region. I turn to this history and literature in the next chapter and use it to show how the link between land conflict and deforestation fits within the literature on development and deforestation in the Amazon.

CHAPTER 2 - DEVELOPMENT AND DEFORESTATION: DRIVERS OF LAND-COVER CHANGE IN AMAZÔNIA

Deforestation of the biologically rich and politically controversial Amazon basin has been a much studied, and highly-visible, environmental issue. A large number of journal articles, books, and reports have been approved, written, and filed on this vital world region which is home to significant numbers of threatened and endangered plant and animal species, as well as quickly disappearing human cultures and indigenous knowledge. Despite the academic and popular attention the Amazon basin has received, particularly over the past forty years, significant knowledge-gaps still exist. This dissertation addresses one of those knowledge-gaps, that of a specific land conflict-related deforestation driver.¹³

2.1. Development in the Amazon

There has been a good deal of debate on the human carrying capacity of the Amazon (see Mann 2002a for a review)¹⁴, though current opinion is that fairly large human settlements existed in Amazonia before European colonization of the new world

¹³ In this review, I do not address the significant drivers of deforestation in other world regions such as Asia and Africa, which vary somewhat in relation to drivers of concern to the Amazon (Pfaff 1999; Geist and Lambin 2001, 2002; Lambin et al. 2003; Steffen et al. 2004a). Though the pathways to deforestation in Africa and Asia are particularly important given the critical speed at which forests are falling in these world regions, I will neglect them in this review as they are, for the most part, either tangential or duplicative to the problem of focus in this dissertation.

¹⁴ The previous orthodoxy on the human carrying-capacity of the Amazon basin was defined largely through the work of anthropologist Betty Meggers who was convinced that “the low mineral content of most Amazonian rivers and streams... have such low subsistence potential that they are notorious throughout Amazonia as ‘starvation rivers’” (Meggers 1996: 12). According to Meggers and those who felt similarly, substantial and advanced human settlements were impossible under these conditions given the low potential for agriculture that ‘most’ of the Amazon possessed. Denevan (1966, 1973, 1976, 1992; 1983, 1992b; 1996) was an early critic of Megger’s views.

began in earnest (Denevan 1992b; Woods and McCann 1999; Cleary 2001b; Erickson 2003; Heckenberger et al. 2003; Heckenberger 2005; Mann 2005). This human settlement was first recorded by Europeans when Francisco de Orellana, a Captain under Gonzalo Pizarro's command, descended the Amazon from Peru to its delta on the Atlantic Coast (Hemming 1978). Along this trip, which started in late 1541 (or early 1542) as a search for food, Orellana encountered numerous indigenous communities which, from his accounts, could only be referred to as cities (Hemming 1978; Denevan 1992b; Denevan 1996; Mann 2005). For quite some time, this and other historical reports were discounted as fantastical revelations meant to impress those Europeans who wanted fervently to believe in the presence of mythical cities (e.g., the long sought-after City of El Dorado), and even the presence of long-lost European settlements (e.g., Antillia). The lack of faith in these reports was largely supported by the fact that subsequent visits turned up none of the magnificent cultures which Orellana and his troops described, though this is probably due to population decimation from disease brought by the Spaniards themselves (Hemming 1978; Denevan 1992a). However, as field-based archeology and geography (among a few other disciplines) has expanded in Brazil since the nation's political opening in the early 1980s, a number of discoveries have begun to undermine the dictates of previous research. Substantial pre-historical human settlement in the Amazon is beginning to be recognized not as an unlikely radical viewpoint, as it was twenty years ago, but instead is now a relatively common view among geographers, anthropologists, and soil scientists specializing in the region (Denevan 1996; Woods and McCann 1999; Cleary 2001b; Denevan 2001; Erickson 2003; Raffles and WinklerPrins 2003).

Among these revelations has been the strength and sustainability of a number of Native Amazonian agricultural systems, including fish weirs, confined turtle feeding operations, and manioc cultivation, along with archeological evidence that Native Amazonians significantly altered not only the vegetation of their forest (and *cerrado*) home sites, but also the very soils they lived on and farmed (as in the case of terra preta do índio, or Amazon Dark Earths, Woods and McCann 1999; Cleary 2001b; Mann 2002b; Erickson 2003; German 2003; Lehmann et al. 2003). Also important have been more subtle elements of the landscape that are increasingly recognized as being the remnants of large earthworks or human modifications to existing landforms (Roosevelt 1996; Heckenberger 1998; McCann 1999a, 1999b; Erickson 2000; Heckenberger et al. 2003; Raffles and WinklerPrins 2003; Mann 2005). The sum of these discoveries is significant evidence for a new state of the art which recognizes the possibility for dense human settlement in the Amazon basin.

Despite the fact that many have doubted and then reconsidered the ability of the Amazon environment to support substantial human populations, at the beginning of intense modern (mid-1950s) efforts to integrate the region with the rest of Brazil the region's potential was considered bright (Mahar 1979). Though Brazilians and others who were familiar in some way with the Amazon felt it a "green hell," the potential of the region to be converted into a developed "paradise" was seized by government agencies and the institutions providing funds as an inspiration to develop the region (Goodland and Irwin 1975; Hecht 1989; Cleary 2001a; Hecht 2004b). A resulting smorgasbord of government programs over a fifty-year period was the result. These programs ranged from the infamous and militaristic "*Operation Amazonia*" to the underachieving and

much maligned SUDAM (Superintendancy for Development of the Amazon, still running today) and PIN (Program for National Integration) programs (Hall 1989; Mahar 1989b). Though each program's individual goal was different (e.g., for *Operation Amazonia* the goal was national integration of the Amazon, for SUDAM the goal was agro-industrial development), the broad objective of each was a robust and developed region in a zone that was (it was hoped) formerly a massive, dangerous, and unruly jungle. Even when the goals of these programs were biased toward the industrial and agricultural, the result was generally that the Amazon frontier was opened to smallholder settlement and largeholder speculation in a patchy and grossly inefficient manner (Mahar 1979; Foweraker 1981b; Mahar 1989b; Hecht and Cockburn 1990).

It would be misleading to terminate the discussion of national development programs with SUDAM, PIN, and *Operation Amazonia*; despite a myriad of setbacks, the integration of the Amazon region with the rest of the nation through investments in industry and transportation infrastructure is ongoing. New projects and programs, including the constitutional Fund of the North (FNO), multi-year plans, known as PPAs (Plano Plurianual) associated with the ongoing Agenda 21 program (Hill et al. 2006), and *Avança Brasil*, a nationwide infrastructure development program primarily meant to improve market access for agro-industry (Caldas et al. 2003; Pfaff et al. 2007), have largely continued the original tendency toward infrastructure enhancement to bring the wild lands of Brazil into the reach of the federal government. Over decades of development programs, one of the strongest influences on infrastructure development and opening of the frontier outside of ranching and settlement formation, especially in the

Eastern Amazon and the South of Pará, has been development for mineral extraction (Denevan 1973; Fearnside 1987; Browder 1988a; Hall 1989).

2.1a. Mining and Development in the Amazon Region

Fitting tightly within the overarching strategy of development was the establishment of large mining projects meant to bring modern industrial mining to the Amazon. After the successful completion of the RADAM missions of the 1960s, which involved radar over-flights of the Amazon basin, significant subsoil mineral reserves were found in many parts of the region. In particular, thanks in part to data collected during the RADAM missions, two locations were found to be very attractive sites for mines given their accessibility and high concentration of mineable ore (Figure 2.1). Because the RADAM missions were the exploratory initiative which provided the information about mineral deposits in both cases, it is unknown which reserve, Carajás or Trombetas, was discovered first. However, of the two, the Carajás mining complex was opened first, in 1970. This vast open pit is one of the world's largest and richest iron ore mines and was discovered when a geologist made a forced landing in a natural opening in the region's forests (Brandford and Glock 1985: 117). The wealth of this particular mine is extensive and has led to a major push for the region, the South of Pará, to become a development pole through a program known as *Grande Carajás*. The *Carajás* program was meant to both establish the Carajás mine and develop the infrastructure necessary to send its ore to other parts of Brazil and the rest of the world (Hall 1989). The true outcome of this particular project arguably fell short of the goals of agricultural and industrial development; in typical fashion for the Amazon, the development pole became one which attracted misery and violence on the coattails of capital, and lead to a situation

where the region it was meant to develop and integrate became violent and tumultuous, and remains so today. The mine itself is a clear example of how damaging pit-mining can be to a landscape, even when vast nearby areas are set aside as nature preserves. The 910 kilometer rail corridor between the mine and the port town of São Luis in the adjacent state of Maranhão has been subjected to massive deforestation in the supply of charcoal for mining and transport purposes (Hecht and Cockburn 1990; Schmink and Wood 1992). The only unequivocally clear beneficiary of this project has been the *Companhia Vale do Rio Doce* (CVRD), a truly massive mining company (second largest in the world since 2006, BBC 2006) which is responsible for the Carajás mine.

The second mining pole, the Trombetas mine (Figure 2.1), developed under much different circumstances but has had similarly mixed results for the communities it was meant to develop. A direct discovery of the aforementioned RADAM missions, this area of 15,000 hectares (only 5,000 or so of which has been subjected to strip-mining) of forest preserve was first opened for the mining of its rich bauxite assets in 1972 by the Canadian mining firm Alcan, Inc. and the Brazilian government. However, shortly after the first strip-mine cells were opened, a decline in the demand for aluminum, which is derived through industrial processing from bauxite, led the mine to practically shut down. Despite this setback, by the mid-1980s the mine was again functioning under the direction of a public-private firm known as *Mineração Rio do Norte* (MRN). While the Trombetas mine is likely more environmentally benign than the Carajás mine in the Eastern Amazon, it is still a high-impact activity, especially with respect to the runoff associated with sediments which are washed from mined material and the extensive deforestation within a biological reserve which must take place. MRN runs an impressive

reforestation program, complete with programs in local communities to collect seeds meant to encourage a diversity of livelihood strategies. The company is, of course, eager to claim that its reforestation programs show promise in restoring biodiversity and the commercial viability of stands within a few decades of clear-cutting (e.g., Parrotta and Knowles 1999). Though outreach to local communities, many of which are *quilombos* (runaway slave and indigenous settlements), through health and economic development programs are admirable, the social impacts of the Trombetas mine are not inconsequential. Malaria and other diseases have arrived with the mine, and many of the interactions between MRN and local communities in terms of financial exchange (primarily through the sale of tree seeds and foodstuff purchases, as well as the illicit economy which frequently accompanies mining) are not conducted on equal or fair-market principles. Despite these caveats, the social impacts on local communities are far less severe on communities near Trombetas than the impacts within the development pole of the Carajás program. The reduced environmental and social impact of the Trombetas mine has come at a cost, however, and the region around Trombetas has experienced almost no development of any kind besides that immediately associated with the mine. Part of this outcome is likely associated with the fact that the mine itself is in the middle of a biological reserve and development is forbidden, but even the closest towns and cities have little to do with mine business.

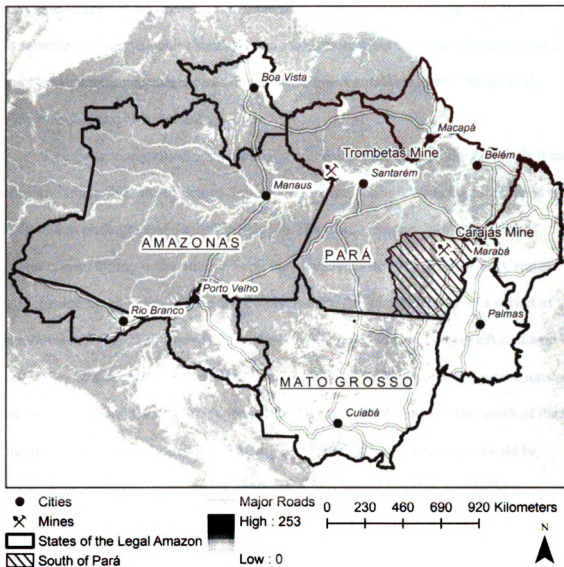


Figure 2.1. Amazon basin with the South of Pará and major mining development poles highlighted.

Mining in the Amazon is actually more extensive than just two major projects; wildcat mining (placer mining, *garimpos*) is a significant livelihood strategy throughout Amazonia. In fact, very few regions have escaped the impacts of wildcat mining, which brings violence, corruption, disease (especially malaria and sexually transmitted diseases), and environmental devastation wherever it occurs. Wildcat mining involves blasting away sediments with high-pressure water hoses and then placing the resulting

slurry into sluices which allow for the separation of valuable minerals (generally gold, but sometimes other valuables such as diamonds) through both natural deposition and the use of amalgamating agents such as mercury (Schmink and Wood 1992; Smith et al. 1995; Boischio and Henshel 2000).

One particularly striking example of the impact of mining and the social ills it can contribute to involves the infamous *Serra Pelada* mine, made famous in photographs by the Brazilian photographer Sebastião Salgado. His iconic imagery of mud-splattered wildcat miners toiling in the enormous pit they had excavated not far from the Carajás iron ore mine in the South of Pará are widely known. At Serra Pelada, over a period of six months in 1980, 25,000 newly arrived *garimpeiros* (wildcat miners) excavated a pit over 180 meters deep in their search for what would end up being over 6.5 metric tons of gold (Brandford and Glock 1985; Cleary 1990). This particular region, the South of Pará (Figure 1.2), was also the location of a long-term conflict over which areas could be mined. Wildcat miners, colonization companies, indigenous peoples, smallholder colonists, ranchers, and even the CVRD itself struggled to gain control over mineral resources (Hecht and Cockburn 1990; Schmink and Wood 1992). While wildcat mining may not be as extensive in Amazonia as it once was, new gold strikes rapidly lead to significant migrations of miners and their associated industries (especially loan-sharks and prostitutes) and mining is far from gone. Despite being illegal in most cases, as of 2009 it was not uncommon to see mining dredges on rivers as well as evidence of wildcat mining along roads and in riparian zones.

Going hand-in-hand with the expansion of mechanized and state-sanctioned mining (as opposed to the wildcat variety) has been the development of infrastructure for

the industrialized activities which occur in conjunction with mining and other industry. While at MRN's Trombetas mine, as mentioned earlier, these impacts are more or less constrained to the mining area itself (and primarily include things like miles of conveyor belts leading to washers, driers, and a short rail link to the Trombetas river where ore is loaded into freighters for shipment) at CVRD's Carajás mine the impacts have been completely different and altogether more clearly severe. Because of the wealth and quality of the ore at Carajás, as well as its prospects for long-term productivity (it is estimated to be able to sustain full production for a period in excess of fifty years, Hall 1989), the mine has driven a significant investment in infrastructure ranging from the paving of state highways (such as PA-150 and PA-257) to the construction of a 910 kilometer railway linkage between the Carajás mine and the port at São Luis which was mentioned above. Also associated with the development of the Carajás mining pole has been an extensive supporting industry which includes not only the agriculture necessary to support the food needs of the extensive mining operation, but also the industrial support necessary to refine the raw iron ore into pig-iron through hundreds of small smelters. These smelters have relied on an extensive, and now quite illegal¹⁵, industry of charcoal producers who supply the smelting industry with the energy necessary to refine the raw ore. This has obviously led to severe deforestation along more accessible transportation corridors, including the Carajás railway itself, meaning the development

¹⁵ Illegal in that the wood used for charcoal production is typically illegally logged and taken from forest areas which do not have the legally mandated forest management plan. In addition, many charcoal operations function on the urban periphery, which can lead to grief from environmental protection agencies when air quality in cities suffers due to smoke (Allen and Barnes 1985; Smith et al. 1995; Coomes and Burt 2001; Brasil 2008b).

pole has in a way been established on the natural capital available in the region in the form of forest resources (Hecht and Cockburn 1990).

2.1b. Other Mega-Development Activities and the Rebirth of Development

Going hand-in-hand with many of the mining and agroindustrial projects undertaken in the past 50 years in Brazil has been an extensive, and still ongoing (Hurwitz 2007), drive to develop the nation's hydroelectric potential. An iconic, though by no means extraordinary, example of this strategy is the Tucuruí hydropower facility in the South of Pará. Tucuruí is iconic due to the fact that, though in the same region as many other important development projects, it was undertaken in a completely disarticulated manner, and in some respects clashed with other plans for infrastructure development in the region. The vast area which was flooded (over seventy kilometers across at its widest point) when the dam was completed was never stripped of all of its forest cover, which meant the reservoir became contaminated by toxic acids, coming from biomass decomposition. These toxins not only degraded the quality of fish in the reservoir but also rapidly destroyed the dam's hydropower turbines (Brandford and Glock 1985; Ciccantell 1999). Worse, after the government relieved private contractors of the job of clearing the area to be flooded, evidence surfaced that some of the area had been exposed to defoliants supposedly akin to Agent Orange (mostly a chemical known as Tordon 101 BR), meaning that the impounded water might have dangerous levels of dioxins (Brandford and Glock 1985: 120; La Rovere and Mendes 2000: xv, 98, 158). Despite some significant setbacks for Brazil's hydropower initiative there are still a number of hydroelectric projects in various stages of planning and construction

throughout the Brazilian Amazon, including two on the fast-moving Madeira River (Switkes 2007).

Essentially, the commonly-cited take-home message regarding the history of Amazonian development is that the countless programs meant to integrate and develop the region, while simultaneously alleviating poverty and decreasing regional land scarcity have resulted in widespread deforestation and potentially irreparable environmental harm (Foweraker 1981b; Smith 1981; Smith 1982; Hecht and Cockburn 1990; Schmink and Wood 1992). The goals of these programs were often generally named, and actions funded by them undertaken, with no regard for the potential environmental implications or for long-term project viability. The parade of development programs has lasted for nearly fifty years and did not begin to slow until the massive POLONORESTE and POLOAMAZONIA projects, focused on road-building and partially funded by the World Bank, caused enough deforestation to bring the plight of the Amazonian environment to the attention of enough people that international funding of the project was frozen in 1995 (Mahar 1989b; Hecht and Cockburn 1990: 137; Redwood III 2003). This decision came during perhaps the most feverish period of concern over the Amazon's environmental distresses, but it also marked a turning point in Brazil's national habit of massive development projects and government-directed settlement¹⁶. It is important to note, however, that even though some large-scale development efforts have floundered

¹⁶ However, the World Bank decision by no means ended such undertakings. During the early 1990s the Brazilian government pledged to end federal land settlement, decreeing that it could only be undertaken through private colonization companies. Unsurprisingly perhaps, this pledge has largely been ignored as land conflict has become an ever more visible national crisis. This process has been discussed in greater detail by many authors (e.g., Foweraker 1981b; Schmink 1982; Brandford and Glock 1985; Berno de Almeida 1990; Schmink and Wood 1992; Simmons 2002; Wright and Wolford 2003; Simmons, Walker et al. 2007), and will be the subject of subsequent chapters of this dissertation.

and come to a (often widely celebrated) close, this has not meant the end of programs meant to improve access and quality of life for smallholders and largeholders alike.

Many development programs and policies in Amazonia also resulted in widespread artificial land scarcity¹⁷, as lands tied up in agro-industrial development projects, national security zones, and other military government period artifacts, along with more recent ecological reserves, have limited the land accessible to would-be colonists of the region (Santos 1984; Hecht 1985; Alston 1996a; Simmons 2002; Simmons et al. 2002; Simmons 2004). The shift from development-oriented policy to those focusing on cultural and ecological preservation has not put a stop to the trend of enormous set-asides in the Amazon, leading some to claim that environmental consciousness is as a new form of colonialism by European and North American interests (see Rohter 2007). Despite this, enormous extents of unclaimed, unoccupied, and unprotected federal land still exist. However, these areas, referred to as *terra devoluta*, are largely inaccessible, existing only at the very margins of the reach of the state and its infrastructure. Artificial land scarcity in Brazil rests on the fact that the expansive areas of *terra devoluta* which do exist are inaccessible, while nearly every bit of accessible land throughout the rest of the region is spoken-for, putting it out of reach for the thousands of landless families who find themselves in a daily struggle for survival.

These landless families, even once they have access to land, make up one of the more significant forces among the many that cause deforestation in Amazonia. In

¹⁷ Simmons et al. (2007) argue that the issue of land in the Amazon is important not because land is actually scarce – indeed, as a resource land is still available in the Amazon region at little or no cost – but instead because the resource needed is actually *accessible land* which is in short supply. Essentially, in many parts of the Amazon an immature transportation network combines with high levels of land concentration to lead to a situation where the demand for land resources is clustered in locations where little land is actually available.

particular, smallholder colonists and their largeholder counterparts both undertake activities which cause substantial environmental modification. I turn to both of these groups, as well as other drivers of deforestation, in the next section.

2.2. Drivers of Deforestation

As hinted at previously in this chapter, the drivers of deforestation both globally and within the Amazon itself are legion; government policy, logging, mining, agricultural development, and increased migration rates have all been named as significant factors leading to deforestation (Fearnside 1985; Browder 1988a; Mahar 1989a; Serrão and Homma 1993; McCracken et al. 1999). Obviously, state-led development efforts have been instrumental in summoning these deforestation drivers seemingly from nowhere in a region with very low population densities and nearly no previous infrastructure. While the propellants of deforestation mentioned above are some of the most severe examples, these, and a number of other drivers, have been studied at length in the Amazonian context.

Many research programs over the past decade have pointed to two contexts within which proximate drivers, those “human activities (land-uses) that directly affect the environment” (Geist and Lambin 2001: 5), of deforestation in the Amazon operate. The first, and perhaps most addressed, context is that of the peasant or colonist agriculturalist. This vein of research focuses primarily on individual or community-level household dynamics and their impacts on the local environment through their land-use system, generally centered on some combination of subsistence and for-market production. The second, though perhaps less extensively addressed, context is that of the largeholder rancher or agro-industrialist. The small, but nevertheless growing, number of studies

which have focused on the contributions of largeholders to Amazonian deforestation have indicated that in some parts of the region their environmental impacts are substantial and their contribution to deforestation can be as high as 100 percent (Walker et al. 2000). In general, with a few notable exceptions, the majority of research in the Amazon finds one or the other of these groups responsible for the massive deforestation that has occurred there since the opening of the agricultural frontier. The basic trajectories of deforestation within each of these contexts are worth describing in greater detail as this dissertation addresses each of them, but primarily focuses on the context of largeholder deforestation.

2.2a. Smallholder Deforestation

As mentioned above, a majority of studies, and particularly the most recent ones, have been set within the context of smallholder, peasant, or colonist deforestation¹⁸. This recent focus on the smallholder is understandable given that they make up the most significant part of the rural population in the Amazon (Caldas et al. 2007). Furthermore, smallholders also account for substantial deforestation, and in some areas even the majority of it (e.g., Aldrich et al. 2006). This considerable land-cover impact stems from the smallholder's agricultural system, which is often extensive and relies on fallow cycles and primarily annual production (Wood and Schmink 1978; Anderson and Ioris 1992; 2002; Simmons et al. 2002; Walker et al. 2002; Muchagata and Brown 2003; Browder, Pedlowski et al. 2004).

¹⁸ Here I use these words, somewhat incorrectly, as synonyms. Caldas et al. (2007: 87 & 88) describe the differences between two of these categories – the peasant and the colonist – in some detail, including various subdivisions which denote the land tenure status of peasant colonists. In this dissertation, I will instead rely on the term “smallholder” which admittedly glosses over some of these distinctions. The term “smallholder” denotes a rural resident, generally of poor means, who in some way controls a plot of land whose agricultural system is primarily, though generally not exclusively, oriented towards subsistence production.

While initial studies of smallholder deforestation were relatively late in appearing and were focused on the activities of individual agents, our knowledge of smallholder deforestation has advanced considerably over the past two decades. Currently, one of the most prevalent explanatory devices for deforestation by smallholders in the Amazon is the household lifecycle. Drawing heavily from the work of A.V. Chayanov (1986 [1925]), researchers who have used this explanatory device hold that household demographic change can lead to land-use and land-cover change (Walker and Homma 1996; McCracken, Siqueira et al. 2002; Perz and Walker 2002; Walker et al. 2002; Moran et al. 2003; Walker 2003).

Studies using the household lifecycle concept have found that the demographic change can have a highly irregular impact on the expansion of the agricultural frontier and accompanying deforestation. However, many researchers have described a stylized story of how the household lifecycle may function in the Amazon. The story begins with the arrival of a would-be smallholder family on the frontier, ready to stake their claim. Initially, their use of whatever land was granted to them, or whatever land they occupied for use¹⁹, is solely survival-oriented and therefore based entirely, or nearly entirely, upon subsistence agriculture undertaken in a largely swidden system with an exclusive focus on annuals and extractive activities (Beckerman 1987; Walker and Homma 1996). However, over time as the family is successful at meeting its subsistence needs, the

¹⁹ I will discuss the differences in property claims throughout the Amazon at another point in this dissertation. For the time being, suffice it to say that land is often not officially “owned” in the Amazon, at least not by smallholders. Indeed, some smallholders in settlement projects in the South of Pará actually indicate they do not desire land title as it would interfere with their ability to collect state social welfare aid (“*Cesta Basica*”). Definitive legal title is a rarity on properties in the Amazon, even for large agroindustrial properties. The standard situation is some sort of provisional title which protects the initial claim of the property “holder” from competing land claims, but does not establish legal ownership. For this reason the terms “smallholder” and “largeholder” will be used throughout this dissertation, rather than terms which more explicitly imply ownership.

household grows; children provide the household with joy and pride, but also with the potential for future labor. A constant progression of deforestation accompanies this gradual demographic change due to the household's need for fertile land (Walker and Homma 1996; Perz and Walker 2002; Walker et al. 2002). At this point in the lifecycle, household heads often have learned to farm with a greater level of success, and potentially have access to much greater available labor as their children grow up (Moran et al. 2003). This surplus labor generally leads households to begin to plant perennial crops and establish pasture, which are mostly commercially oriented, in an effort to gain cash income (Walker 1996; Walker and Homma 1996; Walker et al. 2002). Expansions in the form of commercially-oriented perennial crops often lead to more labor intensive agricultural practices and associated land-cover and land-use change (Walker 1996; Walker and Homma 1996; Walker 2003). The household lifecycle device also considers households with a smaller labor pool; those households with fewer children or without the means to hire day laborers often choose to use their least fertile lands to ranch cattle, a land-use requiring much less labor than other agricultural strategies (Pichón 1997).

The household lifecycle does not end at this stage, however. As a colonist family continues to mature, children or other relatives may be tempted, or may find it necessary, to move off the property to start their own household (Ozorio de Almeida and Campari 1995; Perz and Walker 2002). Also an option, in some cases property subdivision occurs, and formerly large (for a smallholder) properties upwards of 100 hectares become smaller cadastral units of fewer than 40 hectares (Perz and Walker 2002; Walker 2003; Browder, Wynne et al. 2004). Obviously, both of these strategies can lead to further deforestation either in another part of the same landholding, or further within the agricultural frontier

(Wood 1983; Delson and Dickenson 1984; Sawyer 1984; Ozorio de Almeida and Campari 1995; Browder, Wynne et al. 2004). While certainly not universal, both of these strategies have been observed within the Amazon, most notably in the state of Pará, where the margins of the agricultural frontier are typically the location for the spin-off of new smallholder plots (Sawyer 1984; Alston et al. 1993; Pichón 1997; Walker 1999; McCracken, Siqueira et al. 2002; Simmons et al. 2002; Arima 2005) and in the state of Rondônia, where property division tends to be the rule (Browder, Pedlowski et al. 2004). The difference in these strategies is mostly a result of the available land in these states; in Pará there are still vast, though rapidly shrinking, areas of *terra devoluta* free for the taking (Lima 2002; Caldas 2008), while in Rondônia, massive colonization projects have left little land available for frontier expansion (Browder 1997).

Regardless of which strategy is subscribed to, both property fragmentation and frontier expansion lead to an effective re-initialization of the household lifecycle, though obviously to different degrees. In both cases, the original colonists in the old lot (or the old part of the lot) begin to change their agricultural strategy due to the decrease in available labor, while colonists at the margins of the agricultural frontier (and, to a lesser extent, subdivided areas of old lots) begin the cycle anew. In the old lots, if their more market-oriented production has provided them with the available capital, original colonists will either hire temporary labor, or adjust to their decreased available labor by adopting less labor-intensive land-uses, often cattle ranching (Edelman 1985; Hecht 1993; Mattos and Uhl 1994; Faminow 1998; Walker et al. 2000; Porro 2002; Rudel 2002). This cycle describes a process through which the population and age of household members can be seen as significantly influencing the land-cover and land-use of

smallholdings within the Amazon basin (Perz and Walker 2002; Walker 2003).

Regardless of how a landholding ends up at the end of the cycle, property-level land-cover and land-use change occurs within a logical progression of iterative events according to the household lifecycle theory: (1) colonization, (2) deforestation, (3) cultivation and/or ranching, (4) resettlement, and (5) start again at step 2.

Explaining land-use and land-cover changes through the use of a household lifecycle model is, in essence, an explanation of these changes through the application of the principles of the peasant economy. Though smallholder households in a settlement, indeed, even the entire region surrounding a town, have a collective impact on the environment, these often drastic environmental impacts are actually the result of each household operating as an independent entity. In some respects, the resulting landscape is emergent (Bak 1998; Flake 1998). Each smallholder household in any given part of the Amazonian agricultural frontier is constantly in a process of transition, earning its subsistence through a nearly complete reliance on household labor and its close connection to the land (Ellis 1993). Though there are certainly some significant shortfalls in using the household lifecycle as an explanatory device, such as the fact that it does not incorporate to any significant degree the multiple scales at which each action by a smallholder colonist can have an impact, it is powerful in explaining local smallholder deforestation events.

2.2b. Largeholder Deforestation

Deforestation caused by largeholders, in most instances those who control more than 3,000 hectares, has not been particularly well studied in Amazonia. The story of largeholder land-use and the impact of cattle ranching changed significantly between

1984 and 2008, even if the actual environmental effects and reasons for doing so did not (i.e., to sum it up, it is now clear that cattle ranching is an environmental negative, but an economic positive). Early on, in the mid-1980s, attention to largeholder deforestation reached an early peak, with the focus being on ranching as *the* driving force behind the contributions of largeholders to deforestation throughout the basin (and the rest of Latin America's tropics). Before the mid-1980s, conventional wisdom held that ranching was actually *beneficial* to the Amazonian environment (Falesi 1976), with cattle improving soils and being one of the few forms of economic production which was economically rational and profit-producing (Falesi 1976; Fearnside 1979; Hecht 1984; Hecht 1985; Browder 1988b, 1988a; Serrão 1990; Hecht 1992; Arima and Uhl 1997; Faminow 1998). By the mid-1980s the efforts of Susanna Hecht (1984; 1985) severely undermined the view that largeholder ranching was economically rational for largeholders in the minds of most researchers, as she showed that, through the late 1980s, the primary profitable aspect of cattle ranching in the Amazon was supposedly the subsidies disbursed by government agencies promoting development in the region, such as SUDAM.

From around 1984 until the early 1990s, research addressed the environmental degradation wrought by cattle and disparaged the idea that it was an appropriate agricultural strategy in the Amazon, especially at large scales (Denevan 1981; Hecht 1984; Hecht 1985; Fearnside 1987; Browder 1988b, 1988a; Allegretti 1990; Hecht and Cockburn 1990; Serrão 1990; Hecht 1992). However, beginning around 1990, the universal declaration that cattle ranching in the Amazon was always bad, no matter who practiced it, began to disappear as researchers recognized that even smallholders had a number of reasons for ranching cattle on parts of their properties (among these are the

fact that cattle bring themselves to market, act as a savings account in absence of banks or reliable financial infrastructure, and they reproduce themselves, as Hecht 1993, among many others, discuss; Faminow 1998). However, the suitability of the Amazon for largeholder ranching was still mostly rejected, albeit to greater or lesser degrees (e.g., Mattos and Uhl 1994; Toniolo and Uhl 1995; Arima and Uhl 1997; Schneider et al. 2000; Walker et al. 2000; Mertens et al. 2002).

The relative contributions of largeholder ranching to deforestation in some parts of the Amazon are indeed impressive. By 1985, some 10 million hectares of standing forest fell for the creation of cattle pastures, much of which was in the South of Pará (Hecht 1985). Despite this significant deforestation in the Eastern Amazon, other parts of the basin have seen much greater deforestation by smallholder agriculturalists (Rudel and Horowitz 1993; Vance and Geoghegan 2002; Brown et al. 2004; Pan et al. 2004; Browder et al. 2005; Pacheco Balanza 2005; Aldrich et al. 2006). Indeed, ongoing settlement projects in the states of Rondônia and Pará have contributed, and continue to contribute, to deforestation at sometimes quite impressive levels. While largeholders and smallholders often coexist in the same landscape (at varying levels of peace with one another), their relative contributions to deforestation, and especially their contributions to rates of deforestation, can on occasion be more or less equal (Aldrich et al. 2006). Along the Transamazon highway (BR-230) in Pará this equal contribution to deforestation in the Uruará area has a temporal component, however, with largeholder deforestation taking place more substantially before the mid-1980s and smallholder deforestation taking place thereafter (Aldrich et al. 2006; Salisbury and Schmink 2007 also find this to be the case elsewhere in the Amazon).

Though certainly an environmental negative, on the whole cattle ranching is not the economic disaster it was once portrayed as. Since the 1980s, it has become clear that cattle were not such a bad development strategy; Walker et al. (2008) show in recent research shows that Amazonian cattle are among the most profitable in Brazil. Furthermore, for largeholder and smallholder alike there are some potential benefits to ranching cattle that, while not immediately monetary, do aid in economic accumulation. Specifically, cattle have the advantage of self-reproduction, bringing themselves to market if need be (important in a region with poor road access), and cattle serve as a living bank account (Hecht 1993; Arima and Uhl 1997; Faminow 1998; Muchagata and Brown 2003; Arima et al. 2006). Walker et al. (2008) show that, when productivity and land prices are taken into account, there are serious financial incentives to ranching in the Amazon. Ranchers in the South of Pará are aware of this, and make it clear when speaking of their efforts to produce fine “*boi verde*” (green cattle), free range cattle, which are sold in Brazil and abroad (Jimi 2007).

Despite a focus in much of the literature on the contributions of largeholders to deforestation through cattle ranching, there are other largeholder activities which have contributed to deforestation. Though many mining and forestry activities fit under the largeholder moniker in a somewhat different way than a rancher would, despite state involvement and the presence of private companies (especially in the case of mining operations), they are more reasonably categorized as industry (though see above for mining and related infrastructure). Furthermore, recent concern about the effects of soybean expansion in the Amazon basin has led many to fear that a second deforestation boom is now underway (Fearnside 2001b; Brown et al. 2004; Barrionuevo 2007). Despite

these concerns, however, largeholder miners are more or less nonexistent and largeholder soybean growers are a rarity in the Amazon outside of the state of Mato Grosso. The majority of largeholders in the Amazon basin tend to focus on ranching, which means that, in contrast to smallholder household life-cycles, the driving force behind much of their land-use and land-cover changes tends to be market effects which drive investment in farm-system expansion due to a focus on market production. However, there are other mechanisms which may lead largeholders to deforest and which involve their interactions with smallholders.

2.2c. Linking Smallholder and Largeholder Deforestation

The household lifecycle and the story of dominant largeholder interests connect to form another powerful and somewhat regularly cited deforestation phenomenon, the so-called “hollow frontier.” Initially, statements about a hollow frontier in Brazil began with early descriptions of the historical São Paulo coffee frontier by James (1969), Taylor (1973), and Cassetti and Gauthier (1977). The hollow frontier concept was one in which the frontier, being based on smallholder agricultural production, slowly advanced further into the wilds as the newly domesticated lands of the smallholders were slowly consolidated into largeholdings with few inhabitants. This concept was first applied in the Amazon by early studies on frontier deforestation, with some modification, including being sourced in the juxtaposition of peasant and capitalist production (Wood 1983), and as stemming from speculative land markets (Sawyer 1984).²⁰

²⁰ Sawyer’s (1984) hollow frontier is actually discussed as a “speculative frontier,” but shares the same characteristics as the typical “hollow” variety. In particular, his speculative frontier shares extensive land uses and larger landholdings in an area that is demographically “hollow” (i.e., has low population densities).

More recently, a process much like the hollow frontier has been observed in the Ecuadorian Amazon (Messina and Walsh 2001; Rudel 2002), but no research has empirically described this as occurring in the Brazilian Amazon in particular. Indeed, the process itself has been discounted in more recent descriptions of smallholder-driven deforestation, at least in the central part of the Brazilian Legal Amazon (Aldrich et al. 2006).²¹

If it were commonly observed in the Amazon, the hollow frontier may take on slightly different characteristics than its operation on the São Paulo coffee frontier. Two separate trajectories are imaginable, each of which would result in similar landscapes which could be described as demographically “hollow.” The first potential trajectory would be that the household lifecycle process could run its course, but with older smallholder properties being left behind (as in when children move to the fringe of the frontier to stake their own land claims) or subdivided (as in when a property is divided and multiple families live on what was once a larger smallholding). As the level of agricultural fertility steadily drops as is generally the case, and the available labor takes flight to its own smallholdings or subdivisions, aging households may find they have few options other than selling their property to speculative or largeholder interests. This would be a true demographic frontier progression, as demographic change would lead to a cycle by which frontier families replicated themselves into a moving frontier. The second trajectory could be similar to the São Paulo coffee frontier, where smallholders

²¹ The Legal Amazon is an administrative unit consisting of the Brazilian states of Roraima, Rondônia, Pará, Acre, Amazonas, Mato Grosso, Tocantins, and (generally) part of Maranhão. The Amazon basin, by contrast, is much larger, and includes much of Brazil (including most of the “Legal Amazon”), and parts of Colombia, Ecuador, Bolivia, Peru, and Venezuela. Brazilians often include the Tocantins River basin in their definition of the Amazon basin, though many others do not, as the river Tocantins flows into the Atlantic Ocean instead of into the Amazon itself.

provide the land clearing service and largeholders buy them out or, in a more disturbing trend, force them off the land and deeper into the forest (Wood 1983; Ozorio de Almeida and Campari 1995).

Hollow frontiers can actually be considered a manifestation of social and economic forces, spanning the distribution of scales and types, on the landscape. Because a hollow frontier as I have described it comes about due to tensions between large landholders (who are frequently cattle ranchers), and smallholder farmers, a complex interrelationship drives this process forward. In a hollow frontier progression, each class of landholder influences the actions of their counterpart, affecting the landscape across a number of different spatial and temporal scales (Wood 1983). For example, a hollowing frontier may initially display increased secondary forest growth as labor takes flight to new frontier areas, only to be deforested anew when largeholders buy out the aged smallholders who remain behind. Over time, a frontier such as this could become nearly devoid of forest cover, much as certain parts of the Eastern Amazon currently are.

The potential for a hollow frontier process in some areas has contributed to the popular notion that agriculture in the Amazon basin is universally extractive in nature, no matter if the crops being planted are perennial or annual, or if the agricultural strategy is ranching (Hecht and Anderson 1988; Allegretti 1990; Ehrlich and Ehrlich 1990; Brown and Rosendo 2000; McCracken, Boucek et al. 2002). While the hollow frontier is mentioned frequently in literature detailing the development and passing of agricultural frontiers in tropical forest zones throughout Latin America (e.g., Foweraker 1981b; Wood 1983; Delson and Dickenson 1984; Sawyer 1984; Angelsen and Kaimowitz 1999; Rudel 2002; Lambin and Geist 2003; Redwood III 2003; Aldrich et al. 2006), it is often

mentioned only in passing, partially because few authors have actually empirically showed this process occurs.

While the hollow frontier is a fairly common trope in tropical land-cover and land-use change studies throughout Latin America's humid tropics, this dissertation addresses another process by which land-cover change occurs through the interactions of largeholders and smallholders or would-be smallholders – namely that of the impact of increasingly strong and varied social movements focused on agrarian reform and their potential impacts on largeholder land-use strategies. As social movements have developed into strong national political forces, and have amassed significant bases of support, sources of movement members, and strong regional presence throughout Brazil, their impact on agricultural strategies in some parts of Brazil is difficult to understate. In particular, new research is beginning to point to social movements as a potentially significant driver of Amazonian deforestation in years to come (Simmons, Walker et al. 2007). This problem is of particular concern as global capital and agribusiness begin to further consolidate agriculture throughout the country of Brazil, and in the Amazon region in particular.

The process by which the actions of social movements may encourage deforestation is complex, involving constitutional law, historical context, the discourses of development and property, and even the trajectory of Amazonian development itself. In order to retain some sense of order in this discussion, I will step briefly through the history of land law in Brazil, followed by a description of the complexities of land tenure in Brazilian Amazonia in the modern (i.e., modernist development) period. Though the

interplay between landed elites and the landless poor is presently ongoing, its antecedents are not new phenomena and stretch back to the colonial period.

2.3. Land law in Brazil

The current property structure in Brazil has as its indirect foundation a colonial institution established directly by the Portuguese crown known as “*sesmarias*” used in Brazil expressly to regularize settlement in the new colony while eliminating the need of the crown to directly administrate colonization efforts (Motta 2005). Other authors have given a much more detailed and thorough account of the *sesmaria* system in both English (Motta 2005; Caldas 2008 writes an entire chapter on the matter) and Portuguese (da Costa Porto 1978), but in summary the *sesmarias* were block land grants to Portuguese nobility. These nobles were charged with colonizing and developing their *sesmarias* in the name of the Portuguese crown, and had to do so using their own resources (Caldas 2008). Nevertheless, despite multiple difficulties including financial burden, hostile indigenous groups, and unruly settlers, today’s property system is to a large extent based on similar principles, especially the idea of usufruct property rights – that property rights can be established through the use of property – which was accepted as early as 1785 (Alvarenga 1985).

In particular, given the statutes of the Brazilian constitution of 1988 which cover agricultural land and agrarian reform, any property that is not small or medium sized²²

²² Property size classification is defined by the number of “fiscal modules,” the size of which depends on the state (“federal unit”), and sometimes the municipality, within which the property is located, as defined by the 1964 Land Statute (Branco 1964). Small properties are between one and four fiscal modules in size, while medium properties are between four and 15 rural modules. Largeholdings exceed 15 rural modules (Barbosa 1993). The size of these fiscal modules varies in Brazil and can be as little as five hectares and as much as 100 hectares or more. For the South of Pará, fiscal modules vary between 25 and 50 hectares for newer properties.

(Article 185²³) which meets the limits of social function, meaning continued rational and adequate use of the property and its natural resources without violating environmental regulations, labor guidelines, or the human-wellbeing of those working or owning the property (Article 186²⁴), cannot be expropriated. At first glance, such statutes appear to indicate that a typical ranch meeting the conditions of social function as outlined in Article 186 of the 1988 constitution is ineligible for expropriation and that a property owner would be ill-advised to remove forest from their property if such an activity would violate environmental standards. However, related statutes governing the longstanding legal principle of usucaption (*usucapião*) call this simple interpretation of Article 186 into question. Specifically, Article 191²⁵ states that any individual of family occupying a portion of less than fifty hectares of privately held property for five years without opposition can, if they have improved it using their own labor, lay claim to that piece of property. In other words, in some cases, despite perfectly acceptable use of a property of “large” size, a landowner still must ensure that no person or family occupies it for five years lest a portion of the property be claimed under usucaption. Though Article 5 of the 1988 constitution guarantees the right to private property (Brasil 1988), the document is also quite clear about some cases which may lead to a suspension of that right. Though

²³ The Portuguese text of the article reads: “São insuscetíveis de desapropriação para fins de reforma agrária: I - a pequena e média propriedade rural, assim definida em lei, desde que seu proprietário não possua outra; II - a propriedade produtiva.” (Brasil 1988: Article 185)

²⁴ The Portuguese text of the article reads: “A função social é cumprida quando a propriedade rural atende, simultaneamente, segundo critérios e graus de exigência estabelecidos em lei, aos seguintes requisitos: I - aproveitamento racional e adequado; II - utilização adequada dos recursos naturais disponíveis e preservação do meio ambiente; III - observância das disposições que regulam as relações de trabalho; IV - exploração que favoreça o bem-estar dos proprietários e dos trabalhadores.” (Brasil 1988: Article 186)

²⁵ The Portuguese text of the article reads: “Aquele que, não sendo proprietário de imóvel rural ou urbano, possua como seu, por cinco anos ininterruptos, sem oposição, área de terra, em zona rural, não superior a cinquenta hectares, tornando-a produtiva por seu trabalho ou de sua família, tendo nela sua moradia, adquirir-lhe-á a propriedade.” (Brasil 1988: Article 191)

Articles 185, 186, and 191 are all clear about the consequences of “unproductivity” and of not meeting some “social benefit,” Article 5 of the constitution actually simultaneously allows the expropriation of property for necessity, public utility, or where “immediate public hazards” are involved (Brasil 1988)²⁶. Not only can land be taken away from an owner (with appropriate compensation) for “social benefit” or a lack of productivity, but in cases where social unrest and “public danger” may result from inaction the government could be justified in expropriating private property regardless of its status.

In combination, a history of usucaption²⁷ and current constitutional law has evolved to allow both the unsanctioned occupation of landholdings and the hope, sometimes realized, of redistribution in the Eastern Amazon. However, the conflict over land resources has not evolved independently of other social changes and histories in the region. Bringing these together and outlining their relevance to deforestation is the subject of Chapter 3.

²⁶ The Portuguese text of Article 5 reads: “Todos são iguais perante a lei, sem distinção de qualquer natureza, garantindo-se aos brasileiros e aos estrangeiros residentes no País a inviolabilidade do direito à vida, à liberdade, à igualdade, à segurança e à propriedade, nos termos seguintes: ... XXII: é garantido o direito de propriedade; XXIII: a propriedade atenderá a sua função social; XXIV: a lei estabelecerá o procedimento para desapropriação por necessidade ou utilidade pública, ou por interesse social, mediante justa e prévia indenização em dinheiro, ressalvados os casos previstos nesta Constituição; XXV: no caso de iminente perigo público, a autoridade competente poderá usar de propriedade particular, assegurada ao proprietário indenização ulterior, se houver dano...”

²⁷ A Latin term for the legal precedent established under Roman civil law which allowed for the transfer of ownership to people who used land for an uninterrupted period of time (OED 2009).

CHAPTER 3 - A POLITICAL ECOLOGY OF LAND CONFLICT-DRIVEN DEFORESTATION IN THE BRAZILIAN AMAZON

In this chapter I briefly describe the roots of political ecology, concepts from a body of literature known as “contentious politics,” and a framework for the study of land-use and land-cover change known as “land-change science”²⁸ in order to provide the foundation of a conceptual framework for explaining environmental change stemming from social conflict. Drawing heavily from a versatile conceptual frame first developed by Cynthia Simmons (2005), and then expanded in a collaborative explanation of land conflict in the South of Pará (Simmons, Walker et al. 2007), I will explicitly extend this frame to include land-change science. In arriving at this “fusionist” perspective (see Turner and Robbins 2008), I will also present some of the more influential conceptualizations of the conflict-environment connection. Similar to Simmons (2005), I locate the conceptual frame I use here within the context of other work in conflict and resource scarcity, including work by in edited volumes by Peluso and Watts (2001) and Peet and Watts (2004), and influential and controversial work by Homer-Dixon (1999). The chapter concludes with an overview of a political ecology designed to integrate the ideas of contentious politics (Tarrow 1998; McAdam et al. 2001; Tilly and Tarrow 2007), the rich perspective of place as developed by geographers such as Massey (1979; 2005)

²⁸ Land-Change science is arguably part of, or equivalent to (depending on your perspective), a perspective often referred to as “Global Change.” Actually, Land-Change Science’s frames and subject matter are similar to those of Sustainability Science, the Human Dimensions of Global Change, Land Use and Land Cover Change, and others. Here I will use the term “Land-Change Science” with the caveat that I actually draw from perspective with different monikers that, at least in my estimation, are essentially a struggle to solve the same problem: how humans impact their environment and how these impacts will in turn influence human society and behavior.

and Agnew (1987, 2005), and organizing concepts from the framework of land-change science (Lambin et al. 1999; Geist and Lambin 2001, 2002; Lambin et al. 2003; Gutman et al. 2004), to address the linkage between conflict and deforestation in the Eastern Amazon.

3.1. The Roots of Political Ecology

Integrating the complex processes behind human-environment change is a complicated and often frustrating task. Taking into account the environmental processes alone in research on any theme is daunting; explaining these changes in terms of the human actions and the ideas which drive them is complicated enough to feel almost impossible. Since the early investigations of our natural world by crude “natural philosophers” at the end of the European Dark Ages, and subsequent inquiry by natural scientists, people have been interested in how the world functions. As human impact on the earth has grown, and grown significantly, those with an academic interest in earth systems began to recognize the impact which humans were having upon the environments in which they lived. Though the realization that humans were not a benign force in nature came relatively early (e.g., Marsh 1864; though Williams 2002 provides many examples of this realization from the Ancient Agean and European Middle Ages), it was not until the middle-third of the 20th century that this area of inquiry became a serious focus.

Political ecology springs from deep roots in these early investigations of how man changed the nature around him²⁹, and not only for the better. The important and somewhat crippling role that objectionable ideas known collectively as “environmental determinism” had in the promotion of the concept that humans could not remake nature in an image they benefitted from is hard to underestimate. In its strongest period, environmental determinism was used as a justification for the underdevelopment of tropical, non-white people due to the “fact” that nature provided nearly everything they needed for daily reproduction (Semple 1911). The argument was, that in mid-latitude climates where harsh winters and unpredictably severe weather challenged human cultures to adapt and plan for the future, while tropical cultures reaped the benefits of a friendlier environment (McGregor 2004). Of course, this meant that the mid-latitude (white, European) human was more hardy and industrious. As this is not a document about environmental determinism, a perspective that sometimes appears even today, though in a much less racist fashion (Diamond 2005), I shall leave the discussion of this point of view at that. As environmental determinism was recognized as an academic justification for racist views as early as the 1920s, it came under strong scrutiny and lost favor among those working at the interface of human and environmental systems; in some respects the fall from grace that environmental determinism experienced gave rise to the precursors of political ecology, particularly cultural ecology.

Developed during this heady time in human-environment research, cultural ecology became one framework for research addressing the connection between societies

²⁹ Here I deliberately use the terms “man” and “nature” despite the contested significance of these terms. However, at the time, “man” was commonly used to refer to humankind in general, and “nature” was certainly seen to be an unproblematic term signifying those things outside of the human realm.

and their environments without relying on the deterministic power of the environment as its primary explanatory mechanism. Spurred onward through the genius of the cultural anthropologist Julian Steward (1955) and the geographer Carl O. Sauer (1956), cultural ecology was among the first perspectives to truly present the impacts of human and natural systems on a somewhat equal footing. At the time, cultural ecology was an advance; instead of brown, tropical people being bullied around by their environment, it became acceptable to view those in the tropics as being subtly influenced by their natural environment while constantly reshaping it.

Though cultural ecology was an incredible advance in human-environment research, as a conceptual framework, it was applied mostly to remote groups, particularly indigenous and/or rural and agricultural peoples, and focused more on how “unmodern” or “primitive” people related to their natural environment. Cultural ecology was rarely applied to societies which were integrated in a significant (even if ultimately superficial) way with the global economy, or even national economies. That is, cultural ecology tended to be used to describe how indigenous peoples interacted with their natural environments, and typically neglected urban or integrated peoples as a topic of study (Robbins 2004: 34 & 35). This shortcoming became more glaring as globalization and economic integration took off during the 1960s, 1970s, and 1980s, leading many human-environment researchers left with somewhat out-dated, or at least inadequate, tools to address the subject matter they were most interested in.

In part due to these shortcomings, during the mid-1970s researchers in geography and cognate disciplines who undertook human-environment research became increasingly disillusioned with cultural ecology. The solution, which took over a decade to develop,

was a conceptual framework which integrated Marxist political economy with ecology in a very broad fashion. At first, few researchers termed it what it is today – political ecology – but by 1974 John Cole and Eric Wolf (1974) had coined the term which has led to significant advances in both how we conceptualize our relationships with the natural environment and also how we think of the environment itself.

Though political ecology was first developed in the early 1970s, it was not until 1987 that the seminal text (at least for geographers) on this human-environment perspective was penned. In their book, *Land Degradation and Society*, Blaikie and Brookfield (1987) provided a definition of political ecology which has perhaps become closer to definitive than any other. Many authors have used their definition, “the concerns of ecology and a broadly defined political economy”(Blaikie and Brookfield 1987: 17), to describe political ecology, nearly bringing the definition of the framework to the status of other memorized and commonly applied passages of text, at least for those undertaking human-environment research through a political ecology frame.

This is not to say, however, that political ecology has been stagnant, or limited only to its roots in development studies. Many advances and trends in geography and other disciplines have quickly become advances and trends amongst political ecologists, with the result being that political ecology has changed significantly since 1987’s Blaikie and Brookfield definition. Though categorizing a large literature is perhaps unfair to the authors, political ecology has moved from a development-centered focus on underdeveloped nations (Schmink and Wood 1987; Bryant 1991; Campbell and Olson 1991; Bryant 1992; Thrupp 1993; Bryant and Bailey 1997; Bryant 2001), to post-modern themes (Yapa 1996; Escobar 1998; Blaikie 2000; Braun and Wainwright 2001;

McCusker and Weiner 2003; Neumann 2003), and onwards to consider issues of political and ecological importance in the global north, especially related to urban areas (Robbins et al. 2001; Walker and Fortmann 2003; Robbins et al. 2006). Other foci include the tensions between environmental conservation and our daily lives (Pelling 2003; Schwartz 2006), and even the practice of knowledge building through the institution of science itself (i.e., Science and Technology Studies). Political ecologists have used their conceptual framework to explore the strengths of mixed-method research as well as new conceptual foundations such as Actor-Network Theory (ANT) and the social construction of false dichotomies (particularly the dichotomy of “nature” and “society”).

Another major focus of political ecology has been the role of power relations in the creation and amelioration of socio-environmental problems. The role of power, be it political, economic, or cultural, can have a significant impact on the capability of marginal people to respond to environmental and social problems (Bryant 1998; Blaikie 2000; Gregory 2001; Forsyth 2003; Paulson et al. 2003; Robbins 2004; Walker 2007). Though the argument that wealthy elites often became that way through the exploitation of labor and the environment is commonly employed (Foweraker 1981b; Foster 1999; Storper 2001), the linkage between unequal power and environmental change is a useful and significant contribution of the political ecology literature.

To comprehend the role of power relations in environmental and social change one only has to be observant; political ecological explorations of unequal power relations in the Amazon have been important in determining the outcomes of development policy (Ciccantell 1999), capitalist economic penetration (Whitesell 1993), frontier speculation (Pacheco Balanza 2005), and even the representation of nature (Hecht 2004b). Beyond

Amazonia, power relations have been the focus of political ecologies dealing with conflicts over access to certain landscapes (Le Billion 2001; Kull 2002), public services (Swyngedouw 1997; Budds 2004), and have even helped determine what counts as “forest” in India (Robbins 2001, 2003). Of course, it is not difficult to imagine the applicability of the “power relations” perspective to the connection between land conflict and deforestation in Amazonia, a topic which I will address more directly toward the end of this chapter.

The breadth of political ecology has expanded greatly, leading some to question the conceptual frame’s ability to address important issues with the strength and focus necessary to adequately explore them. In other words, some have questioned the ability of the multitude of political ecologies to concisely describe real-world problems or their focus on actual environmental problems (Vayda and Walters 1999). Though some may see this plurality as a weakness, a sign of a lack of focus or concerted effort, many political ecologists (including Peet and Watts 2004) see this very multitude of characteristics as a sign of strength and versatility (Walker 2005, 2006, 2007).

To date, political ecology has become a strong and pervasive conceptual framework, and perhaps the preeminent framework, from which to address concerns of ecological importance wherever human actions and politics come into play. The framework of political ecology is employed by geographers, anthropologists, political scientists, ecologists, and others in order to investigate environmental change and social problems simultaneously. The strength of political ecology for this particular study lies in its perhaps unique ability to simultaneously provide the frame in which to explore rapid environmental change *and* the conflictive and unequal relationships between wealthy

largeholders and the impoverished landless. Rather than treat political economy or ecology as more important, political ecology allows the researcher to consider both. In this dissertation, I develop a political ecology framework in which to place both land conflict and the environmental change that stems from it. However, to describe this process I rely on political ecology as an organizing tool with which I put together a diverse set of concepts to describe how social conflict and environmental disaster merge to define the landscape in a part of the Eastern Brazilian Amazon.

3.2. Explaining Social Conflict through Contentious Politics

Though environmental change frequently accompanies social conflict, it is not a prerequisite; often environmental change is a tertiary outcome of conflict or occurs only after the conflict itself has passed by and those marginalized by it are forced to overuse marginal environments (Simpson 1998; Castree and Braun 2001; Pelling 2003).

However, in some cases, albeit at this stage only rare ones, environmental problems result directly from conflict. In many instances, this direct connection is not difficult to envision, such as in the case of war-torn areas where activities such as bombing and bombardment by explosive munitions (Hupy 2005; Bohle and Fünfgeld 2007) and spontaneous engineering (e.g., bridge building, road construction) are common (Institute and Westing 1976; Sadiq and McCain 1993). In others, however, the linkages between social conflict (as opposed to armed, inter-state conflict) and environmental problems are more difficult to imagine. For example, it is not straightforward to draw the connections between genocide in Darfur and environmental change there, despite the fact that such impacts are now becoming apparent; massive numbers of refugees have transformed nearby landscapes through their need for a place to live without danger of death (Myers

1986; Kalma and Camps 2004). Similarly, social movements based on indigenous identity and reacting to injustice in the remote Mexican state of Chiapas have resulted in environmental transformation in the Lacandon forests nearby, especially as impoverished rebels take refuge there (Stephen 2002; Hecht 2004a).

Despite these tenuous linkages between conflict and environmental problems, a number of researchers have begun to attempt to describe stronger links between them. One of these attempts, which I will term the “resource scarcity” view, focuses on decreased access to natural resources and ecosystem services, such as clean water, food, or air, as coming from enclosure caused by war, lawlessness, or the dominance of a militant social group. The word which much of this debate revolves around is “scarcity,” which is seen by some researchers as a driving force behind conflict, because conflict is generally a physical manifestation of a struggle for power. According to those who subscribe to the “resource scarcity” view, this power, in conditions of scarcity, comes from the control of a crucial resource, which can be anything from access to forest stands to access to water or grazing areas (Homer-Dixon 1999). According to this view, even ethnic conflicts such as the Darfur genocide mentioned above can be seen as stemming from some resource scarcity, most often due to environmental degradation or the failure of ecosystem services (Homer-Dixon 1999; Diamond 2005).

The power of the “resource scarcity” explanation of the conflict and environment linkage is not insignificant in terms of national political discussion in some countries; if resource scarcity can be seen as a national security concern, as it currently is in the United States, then much political capital can be gathered by paying attention to this potential problem (Levy 1995; Liverman 1999; Busby 2007; Finger 2008). Indeed,

concern over nonrenewable resources has led the United State Department of Defense to list environmental change, and specifically climate change, as a threat to national security specifically because of its impact on access to resources (Busby 2007; Fingar 2008). In Brazil, to offer another example, environmental change in the form of deforestation (and the fire and environmental degradation which can accompany it) has been seen as both positive and negative to national security. Early in the colonization of the Amazon region, as mentioned earlier, the deforestation which accompanied human settlement was viewed by the Brazilian military as a way to ensure territorial claims on the vast and sparsely populated region (Foweraker 1981b; Sawyer 1984; Hecht and Cockburn 1990; Schmink and Wood 1992). More recently, the smoke from large forest-fires has been viewed as antithetical to some military operations in the Amazon, and problems associated with human settlement (and particularly land speculation) led to insurgency in the region during the 1970s (Nepstad et al. 2001; Morais and Silva 2005).

A quite contrary view to that of the “resource scarcity” perspective comes from what I will label the “inequality” view. Those who subscribe to this narrative claim that conflict is an outcome of unequal power relations, rarely driven by a scarcity of natural resources or even ecosystem services. Instead, the “inequality” view insists that access to resources is generally limited by social institutions and wealthy elites who wield control, fostering resentment and eventually, should tensions run high, social conflict. In the end, environmental problems come from this conflict, but most often in the form of marginalization; socially and economically marginalized people are forced to live and tend crops on ecologically marginal lands. Supporters of this hypothesis generally point to the fact that some of the most intense “resource-based” conflicts are actually taking

place in locations where those resources are the most common (Peet and Watts 2004). The current conflict in the Middle East is a frequently offered example of this, but the same could be said to be true of land conflict in Amazonia.

These competing perspectives are hotly debated in the exchange between Thomas Homer-Dixon, the preeminent “resource scarcity” advocate, and Nancy Peluso and Michael Watts, strong supporters of the “inequality” view. Though portions of this discussion veer into the territory of thinly veiled personal attack, both perspectives do have strengths in that they explain some of the pathways whereby conflict can have an impact on the environment (and the opposite). This work draws from both of them; resource enclosure and contrived scarcity are problems in the South of Pará, which are both important causes of conflict according to Homer-Dixon (1999), but neglecting the power relations, context, and reactions these enclosures and scarcity issues create are detrimental to understanding the conflict and its environmental impacts, as Peluso and Watts (2001) and Peet and Watts (2004) indicate. Therefore, as Cynthia Simmons and her collaborators have established in previous work in the Eastern Amazon (2004; 2005; 2007), I use the idea that enclosure and scarcity can lead to conflict, but I do not leave the generation of conflict as stemming only from them (Simmons, Walker et al. 2007) – conflict arises in a place due to the complex arrangements of history, social institutions, social structure, and environmental resources which (among other things) constitute the region as a “place” (Agnew 1987; Massey 1999; Massey 2005), or “locale” (Giddens 1984).

To begin with, however, the rise of conflict in the study area merits some attention. In all actuality, conflict and environmental change stem from some of the same

processes in the South of Pará, though I will attempt to separate them wherever possible in this review. In the South of Pará, I find concepts from the literature on contentious politics, as adapted by Simmons (2005) and Simmons et al. (2007), particularly helpful in organizing my conceptual framework of how conflict arises.

3.2a. Repertoires of Contention

Contentious politics is an organizing conceptual framework which helps to describe how conflict arises in certain times and in certain locations while similar problems do not lead to conflict in others (McAdam et al. 2001). For instance, contentious politics may be employed in describing why violent clashes between Vietnam war protesters, yippies³⁰, members of Students for a Democratic Society³¹, and the police (and eventually the national guard) broke out during the 1968 Democratic National Convention, while comparable conditions during the 2004 Republican National Convention yielded arrests and some misconduct, but not all-out revolt. Similarly, in Brazil, there are many areas with analogous social, environmental, and economic conditions to the South of Pará which have not experienced the same levels of conflict (Simmons 2004; Simmons 2005; Simmons, Caldas et al. 2007). More explicitly linking conflict and environment, Simmons et al. (2007) use contentious politics to explain why violent clashes over land resources are more common in the South of Pará than elsewhere in Brazil.

³⁰ “Yippies” were members of the Youth International Party, which was an anti-authoritarian political party which had some organizing strength in the 1960s and early 1970s.

³¹ Students for a Democratic Society was a strong, though quickly organized, political action group lasting from the mid-1960s until 1969 when internal divisions brought about its collapse. It has been revived today on a somewhat less radical platform.

As McAdam, Tarrow, and Tilly (2001) outline contentious politics, a number of mechanisms combine to explain conflict “episodes” in certain times and places.

Mechanisms are simply similar events or constraints which shape or define the capacity of people to act, or, as Merton (1968) indicates, are sets of processes³² which have consequences for social structures. Essentially, then, mechanisms can be anything that leads to modifications of political action, including institutional changes like democratization, but also dynamic social changes such as the rise of protests or even the grassroots origins of a widespread labor movement. In sum, mechanisms, in the parlance of contentious politics, both stem from and help bring about meaningful change; these are not the mechanisms of more or less static institutional redefinitions, but instead are dynamic and driven by the desire of, typically less-powerful, social groups to affect change.

Mechanisms in contentious politics rarely function in isolation – they operate in conjunction with one another, concatenating into sequences or chains which lead to political outcomes. However, the linking of mechanisms into processes is not a formulaic one; the combinations of mechanisms are not linear or stable, and each episode of contention (described below) can stem from the combination of mechanisms in a different way, even if the process driving change is similar (McAdam et al. 2001: 30). Furthermore, mechanisms can combine in order to define larger-order processes, or those by which more significant change occurs. In other words, mechanisms can drive forward

³² Here, the typical reading of Merton (1968) is that “processes” start with a little “p” and are little more than a series of events or a stepwise progression that must be iterated through to affect a change or bring about an impact of some kind.

the development of a new social change process, which is exactly what contentious politics helps us to describe.

In the struggle for land in the South of Pará, Simmons (2005) and Simmons et al. (2007) apply a set of mechanisms borrowed from contentious politics to explain why conflict emerges there. I summarize these environmental, cognitive, and relational mechanisms below.

Environmental mechanisms are legion; relative land scarcity (Simmons 2005; Simmons, Caldas et al. 2007) is the product of rampant speculation and supposedly agriculturally deficient soils³³ in Amazonia (Foweraker 1981b; Sawyer 1984; Hecht and Cockburn 1990; Schmink and Wood 1992), ambiguous Brazilian land law (Simmons, Walker et al. 2007) which makes securing title, and therefore credit, virtually impossible (Foweraker 1981b; Santos 1984; Schmink and Wood 1992; Redwood III 2003), and bureaucratic loopholes and dead ends in dealing with conflicts before they are episodic (Foweraker 1981b). Of unknown importance are environmental mechanisms which may be forthcoming; climate change may create drought, leading already marginalized people to be exposed to severe disaster (Yohe and Schlesinger 2002; Busby 2007; Fingar 2008).

Cognitive Mechanisms are also at work in shaping the conflict over land in Amazonia. Simmons et al. (2007) point to a number of these, discussing the inherent awareness of the violent history of the region, and especially of the areas currently

³³ Though a substantial proportion of the Amazon basin's soils are of low agricultural potential, primarily Oxisols and Ultisols, there are portions of the basin where soils are actually quite fertile. Of obvious potential are floodplain soils of the *varzea* which are repeatedly replenished through annual flooding which deposits new soil (Denevan 1970; Bunker 1981; Denevan 1996; WinklerPrins 1997; Denevan 2001; WinklerPrins 2001; Wittmann et al. 2004). Beyond this, soil knowledge of the Amazon is actually quite rudimentary, especially with regards to the geographic distribution of "good" and "poor" soils for agriculture (Falcão 2009). However, some local pockets of soils can be quite fertile, including, but not limited to (Walker et al. 2008), Amazonian dark earth soils (Woods and McCann 1999; Schneider et al. 2000; German 2003; Browder, Pedlowski et al. 2004; Pan et al. 2004).

undergoing extensive conflict. Also at work across most of the Brazilian part of the basin is a deep-seated government fear of rebellion (Foweraker 1981b; Schmink and Wood 1992). In the eastern part of the basin this fear comes from the fairly recent (1970s) war against a small group of communist guerillas which was violently quashed in the South of Pará (Morais and Silva 2005). In the Western Amazon this fear was expressed in the programs undertaken during the long military regime in an effort to solidify and fortify Brazil's national border in the more remote parts of the Amazon (Foweraker 1981b; Ramos 1984; Moran 1989; Schmink and Wood 1992). Both of these fears have probably led to widespread fear of the military, even now under an elected civilian government (Brandford and Glock 1985; Welch 1999; Simmons 2005; Simmons, Caldas et al. 2007).

Finally, relational mechanisms are also part of the fight for land in the Amazon. One of the historical factors greatly impacting relations between groups are the customary labor relations in the region, stretching back to the very early days of colonization, which have always focused on extraction of surplus value from the land by exploiting labor, often within conditions of slavery or debt peonage (Hemming 1978; Foweraker 1981b; Wood 1983; Hecht and Anderson 1988; Hecht and Cockburn 1990; Smith et al. 1995; Brown and Rosendo 2000; Le Breton 2003). These relations still hold when smallholders or the landless interact with highly powerful landed interests, and have significantly impacted the way that the groups view each other; the history and structural inequality which defines each group's identity (landless and rancher) significantly impacts their interactions (Simmons, Walker et al. 2007). Also at work is the rise of anti-land reform movements such as the União Democrática Ruralista (UDR) who organize counter-demonstrations and potentially incite violence as well (Hecht and

Cockburn 1990; Sader and Silverstein 1991). Relational mechanisms have also been responsible for the formation of the MST (Movimento Sem Terra, Rural Landless Worker's Movement) and the Catholic Church's involvement through the CPT (Pastoral Land Commission) (Mendes and Gross 1992; Simmons et al. 2002; Wright and Wolford 2003; Wolford 2004; MST 2005b; Simmons 2005; Wolford 2005; Simmons, Walker et al. 2007). Finally, the collapse of the military government in the 1980s had significant impact bringing people together (Sader and Silverstein 1991; Welch 1999).

The above mechanisms combine to form episodes, which in the definition of contentious politics excludes things like scheduled votes or normal political action. Instead, episodes describe the pathway by which contention and change rise and fall in intensity depending on how mechanisms are shaping people's activities (McAdam et al. 2001: 5). Episodes, though, are not neatly delineable events, and are subject to some observer bias; indeed, an episode is defined by the observer, but is actually a test of a hypothesis rather than a story the observer seeks to tell through an ideological or theoretical lens (McAdam et al. 2001: 29 & 30). In essence, an episode is a case where mechanisms temporarily combine to form processes of change that may or may not be durable, and contentious political actions are the driving force.

To be clear, contentious politics is not a framework that is to be used to describe political activity within existing social norms and institutions. Contentious politics focuses on extraordinary cases of political upheaval, those which challenge the normal rules of order in dealing with a desire for political change. Protests, while often a part of contentious interactions, are not typically the focus of contentious politics as, should they remain peaceful and within the boundaries of accepted activity, they are part of the

“normal” political process. Instead, contentious politics helps describe the more extra-systemic political activity associated with uprisings, revolutions, or protest which carries with it the weight of operating outside of “acceptable” and approved channels. In other words, contentious politics focuses on those instances where either the political system is not functioning for enough of those involved that it can be discarded by a vast number of citizens (e.g., the fall of the Berlin wall), or a particular aspect of the political system is not functioning for a subset of the population, so extreme actions are warranted to address the problem (e.g., land occupations in Latin America, the subject of this dissertation).

In application, contentious politics is a useful organizational and conceptual framework for describing what Simmons et al. (2005) have called *direct action land reform* (DALR), which is most certainly a contentious political act. Essentially, in Brazil, the official political institutions meant to address the concentration of land and wealth through agrarian reform programs have not met the needs of Brazil’s impoverished populous. This has set the stage for severe political upheaval and extra-systemic political activity meant to force stagnant and unproductive official bureaucratic entities to enact some meaningful land reform. The strategy to force these land reform actions is not formulaic; in some regions would-be colonists practice what many have called “spontaneous” settlement (Bunker 1984, 1985; de Almeida 1990; Simmons et al. 2002; Simmons 2005; Simmons et al. 2005; Simmons, Walker et al. 2007; Caldas 2008) where new settlement projects are established by settlers who, sick of delays by colonization agencies, set up their own settlements and mark their own properties on unowned public land (*terra devoluta*)(Caldas 2008). This “spontaneous” settlement is DALR because it is

land reform outside of the officially sanctioned government channels, and it eventually forces the official land reform entities of the Brazilian state to recognize settlements they had no hand in establishing.

Another form of DALR which is important in Brazil is direct action land reform undertaken with the organizational direction of social movement organizations (SMOs). This form of DALR is more likely to take place in areas where no unowned public lands exist, or where they are inaccessible. In other words, SMO-driven DALR is more common in places where the land resource base has already been enclosed through the establishment of private property, which, in Brazil's past, often occurred under conditions of *latifúndio*. This variety of DALR is the more directly contentious one, frequently involving protests in cities and along major roadways (including long marches to administrative centers), the occupation of administrative buildings (particularly those agencies focusing on agrarian reform), and, perhaps most notably, the occupation of private property. Part of the responsibility for this comes from the constitutional and statute-law situation of Brazil's current land regulations, which allow the occupation of private property under certain conditions. This, in many respects, provides hope to members of social movement organizations which have taken this strategy to heart. As described above, one particularly important section of the constitution for the highly contentious political act of property occupation is article 184 of the current constitution, which states that properties not meeting their social function (*função social*) can be expropriated for agrarian reform purposes (Brasil 1988: Section III, Articles 184 & 185).

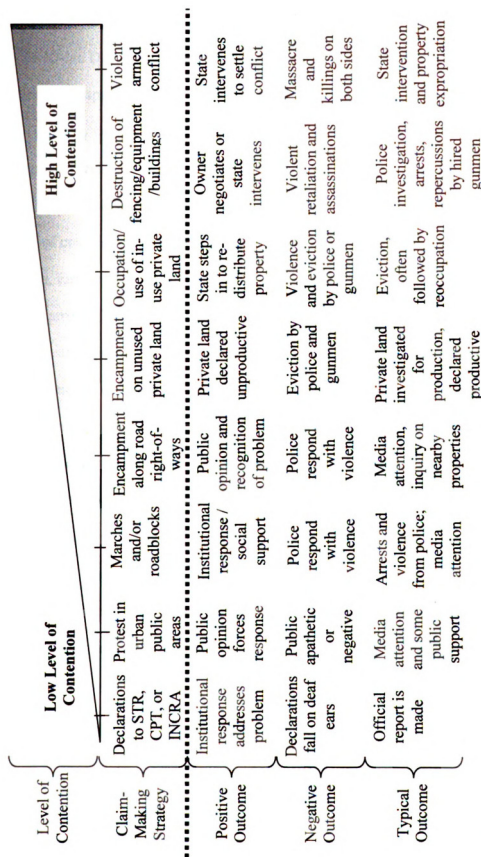


Figure 3.1. An example of elements from the repertoire of contention used by social movements in the South of Pará, Brazil.
Claim making strategies are linked to levels of contention and paired with outcomes.

3.2a1. Contentious Strategies in the South of Pará

SMO-led DALR strategies run along a continuum of contention which starts at protest in public spaces and becomes more contentious through strategies such as peaceful property occupations and even, in some rare cases, outright land war in which SMO members and authorities (or hired gunmen) enter into direct, and sometimes deadly, conflict (Simmons 2004). Figure 3.1 outlines this continuum and summarizes the repertoire of contentious acts at work in SMO-led DALR in the South of Pará, and in some cases, further afield in Brazil (Tarrow 1998: 20-21; McAdam et al. 2001: 48-50; Tilly and Tarrow 2007: 16-23). The figure displays a subset of the wide variety of contentious strategies at work in the study area addressed in this dissertation, and outlines their scope and the common outcomes for both movement members and authorities. Though strategies on the left side of the figure are less contentious than those on the right, all are contentious in that they rely on means of claim-making strategies which are outside of established political channels in the South of Pará.

3.2a1a. Declarations to NGOs, Unions, and Government Agencies

Some of the least contentious claim-making strategies employed in the South of Pará are declarations to non-governmental organizations (NGOs), trade unions, and even the government's land-reform administration (INCRA), which are represented in the left-most extreme of Figure 3.1. Announcing unjust working conditions to an NGO such as the Pastoral Land Commission (*Comissão Pastoral da Terra*, CPT), or declaring to INCRA that a certain piece of private property is not being productively used can lead, in the best case, to an institutional response to the problem. In the case of the former (unjust labor conditions) this can mean a police response or an investigation by government

officials, while in the case of the latter (unproductive private property) government officials may visit the land and even expropriate it for agrarian reform purposes.

However, these declarations are fairly common – with over 101 labor problems being reported by workers on farms in the region between 1980 and 2003 – meaning these complaints made primarily from within existing political structures often fall on the mostly-deaf ears of reluctant bureaucrats. In many cases, complaints such as these merit true and critical attention, but are instead addressed in some sort of official report, occasionally supported by cursory investigation into the matter. Some accounts of raids meant to punish those using slave labor practices are met with strong criticism in local newspapers, as in the case of one particularly impressive series of raids by Ministry of Labor enforcers which a state representative named Asdrúbal Bentes (Câmara dos Deputados, PMDB-PA) took issue with:

“In the State of Para we are experiencing the difficult consequences of blatant interference, which continues unhindered under the guise of the demarcation and extensification of reserves for environmental, indigenous, extractive, and so many other purposes,” says Asdrúbal. The Paraense deputy [deputy from the State of Pará] made this declaration to denounce a subject he considers shameful: the persecution of largeholders of the south and southeast of Pará who are accused of promoting slave labor. For Asdrúbal, this type of labor arrangement no longer exists, and makes up a contrived campaign to prejudice opinion against one of the proudest sectors contributing to growth in the state of Pará.

“They (largeholders) help us develop the region and establish the best cattle herd in the state of Pará, one of the biggest in Brazil. We will not accept this injustice. It appears that in Pará there are only bandits,” says Asdrúbal, defending the productive sector while commenting that slave labor must be eliminated but that a large proportion of largeholders have already accomplished this. The biggest problem will be the “industry of accusations,” in which workers are incited to say they have been victims of slave labor conditions, a situation which has seriously affected many largeholders who were actually the recipients of abuse. “I believe, really, that when worker infractions have occurred in the past, they should have

been processed and judged according to labor law and not through force,” concluded Asdrúbal³⁴ (Tocantins 2003)

Statements such as these are not uncommon, and show the tension created by labor relations, which often go hand-in-hand with land reform activities. On the one hand, Brazilians generally feel that slave labor conditions are atrocious and a shameful blemish on society, but on the other hand, denunciations of such conditions of labor have been co-opted by landless movements and are now prejudicial of the very forces which are responsible for the development of the region. In sum, both sides in this case frequently employ the claim-making strategy of public denouncements of labor problems, but rarely move beyond this strategy when solely labor relations are the issue.

3.2a/b. Protests in Public Spaces

However, in some cases severe injustices warrant protests in urban environments, often completely filling public areas such as town squares and public parks, spilling over into government buildings and even the streets themselves (second position from left, Figure 3.1). In one instance, the city of Marabá, a regional market and administrative center, was the site of a mass protest which completely shut down the city for more than a day (Brasil 2001a). Claim-making through protest is slightly more contentious than

³⁴ Translation by S. Aldrich, May 26, 2008. Original Portuguese text: “Estamos pagando no Estado do Pará as duras consequências de uma intervenção branca, que continua correndo pelo viés da demarcação e ampliação de reservas ambientais, indígenas, extrativistas, e tantos outros meios de interferir”, disse. O deputado paraense fez essa afirmação para denunciar um tema que considera vergonhoso: a perseguição aos proprietários rurais do sul e sudeste do Pará, acusados de promoverem o trabalho escravo. Para ele, isso não passa de ficção e uma campanha inventada para prejudicar um dos setores que mais orgulho e contribui para o crescimento do Pará. “Eles (os produtores) nos ajudaram a desenvolver a região e a construir o melhor rebanho do Estado do Pará, um dos maiores do Brasil. Não podemos aceitar essa pecha. Parece que no Pará só existem bandidos”, defendeu Asdrúbal ao comentar que o trabalho escravo deve ser combatido e que grande maioria dos produtores já está atenta para isso. O maior problema estaria na “indústria das indenizações”, uma vez que os trabalhadores são incitados a se disseram vítimas do trabalho escravo, situação que prejudica em muito aos produtores sérios próprios trabalhadores que realmente tenham sido vítimas do abuso. “Eu acredito, isto sim, que estejam ocorrendo infrações trabalhistas, que devem ser processadas e julgadas na forma da lei e não da força”, finalizou. (Tocantins 2003).

simple declarations and complaints, and is often meant to encourage the court of public opinion to find for those protesting – and sometimes is successful at forcing a response of some kind to the problem (in this case, land reform). However, the public in the South of Pará has as short an attention span (as does the public in any other place), and often the outcome is less than enthusiastic support; protests may invite the apathy of the public, or even negative opinion. Frequently, though, public protests do lead to significant media attention and some public support, if only because the rural poor are suddenly on the doorsteps (often literally) of their more wealthy urban neighbors who are able to see the conditions under which the landless live.

3.2a1c. Marches, Roadblocks, and Roadway Encampments

Marches, often over great distances, and roadblocks are somewhat more contentious claim-making strategies in the South of Pará (third position from left, Figure 3.1). Essentially, marches serve a similar purpose as public protest except that they bring the message of the social movement to many communities along the way. In contrast, roadblocks, much like the Western Amazonian strategy of *empate*³⁵ developed by rubber-tappers in Acre, are meant to stifle activity of the productive sector in order to force institutional response to address the problem (for a description of the *empate* by Chico Mendes, the man who arguably helped perfect the strategy, see: Mendes and Gross 1992). The most negative outcome of the marches is typically that people ignore them, or the police bother them and ask them to disperse and move along. The roadblock, however, is a different matter altogether. In some cases, such as the April 17, 1996 massacre of 19

³⁵ *Empate*, or stand-off, is a form of protest used extensively by protestors in the Brazilian state of Acre during the late 1980s and early 1990s (Mendes and Gross 1992). Much like a roadblock, the goal of the *empate* is to raise awareness of a struggle and the resolve of those struggling within the region and beyond.

landless protesters near Eldorado do Carajás, the police react violently and can even kill people blocking roads. Some of this violence is inevitable, especially as those blocking roads begin sacking passing vehicles in order eat, or as the police and military test their mettle. Despite violence and shootings being more common during contentious roadblocks (roadblocks are, after all, much more contentious than some other claim-making strategies), the typical outcome of an organized roadblock is certainly media attention, but also arrest and sometimes violence in the form of beatings and tear-gas attacks by police (Correio Editors 1996l, 1996w).

Further along the continuum of contention, encampment along roadways, especially in drainage ditches and road right-of-ways is another strategy that is somewhat commonly employed (fourth position from left, Figure 3.1), though perhaps more so in the South of Brazil than in the South of Pará (Wright and Wolford 2003: 27-37). Though police violence is not uncommon with this strategy, social movements, and especially the MST, have had some success in gaining media attention and increasing awareness of the plight of the landless. However, the real success has been in moving attention toward properties near roadside encampments, many of which have been expropriated and redistributed to movement members (Correio Editors 1995e; Correio Editors-a 1996d, 1996c; Correio Editors 1996t, 1996s; Opinião! Editors 1996e, 1996g; Pompeu 2000; Santos 2000f; Opinião! Editors 2001d; Wright and Wolford 2003: 72-76; RepórterBrasil 2007).

3.2a1d. Encampments

A related, though substantially more contentious, claim-making strategy is to set up an encampment on unused private land (fifth position from left, Figure 3.1), which can

be observed throughout the South of Pará. These encampments typically begin near roadways, which provide access and visibility, an important concern due to the potential for violence but also necessary as people living in encampments are reliant on food and other supplies brought in from town or from relatives nearby. The desired outcome of this claim-making strategy is that government surveyors and agronomists associated with INCRA will declare the private property unproductive, and therefore expropriatable, leading to an eventual victory for the landless through the establishment of a new settlement project. However, the far more common, and much more negative, result is that police and/or gunmen intimidate, harass, and evict the landless, often without the legal authority to do so. Though violent eviction is not uncommon, with over 145 cases in the South of Pará between 1980 and 2003, the most common result when INCRA technicians evaluate a property is that they declare it productive and a judicial order mandating eviction follows shortly thereafter. In fact, due to corruption, the power of political connections, and a climate of impunity in the region, a property declared unproductive may suddenly be declared productive again, or a judge may mandate eviction of an encampment without a survey of the property to evaluate its productivity. In general, encampments, even on unproductive land, lead to eviction and then other claim-making strategies – either of the less contentious variety (e.g., those mentioned above) or, on occasion, more contentious ones (some of which are discussed in detail in the narratives at the beginning of Chapter 5).

3.2a1e. Occupations

Further along the continuum of contention, occupation and use of currently used private land is a very frequently employed claim-making strategy in the South of Pará,

especially once declarations, protests, and marches/roadblocks have failed. In particular, the occupation of in-use properties is meant to be highly confrontational, and even evoke some of the fears of communist insurgency the wealthy of Brazil have held for quite some time (Schmink and Wood 1992: 4, 81; Welch 1999: 136). Specifically, a large group (frequently numbering in excess of 500 people) occupies a property in a coordinated fashion, often laying claim to the farm headquarters and any buildings and equipment they happen upon. The hope is that the state will intervene and redistribute the property in an effort to eliminate conflict or head-off violence and murder, which are all-too-common during occupations. Social movement members who occupy in-use properties are often unprepared for the violence they are likely to face, even if the occupation is, over the long-run, successful. For instance, some properties have been occupied, evicted, and reoccupied numerous times before a solution is arranged, most often through more or less heavy-handed state intervention (see section . Case Study: Fazenda Cabaceiras).

Even more contentious is the claim-making strategy that could be described as vandalism, or perhaps “the sack” (seventh from left, Figure 3.1). Interestingly, this strategy occasionally elicits more public uproar and direct and immediate repercussions than property occupations or roadblocks, which renders it a more contentious strategy. Frequently, the destruction of farm buildings, equipment, and even fence-lines, combined with the setting of fires, and the theft or killing of farm animals (especially cattle, pigs, and chickens) renders the farm useless should the landless be evicted. The goal of this strategy tends to be to either to force the intervention of the state, or force the property owner to the negotiation table. The sack is a common strategy on larger farms which have

more infrastructure (often one of the most valuable parts of the farm). As one would expect, assassinations and violent retaliation are not uncommon when this strategy is employed, as farm owners are quick to respond to violence against their property with violence against the landless, most often through a proxy, the *gato* (boss) or *jagunço/pistoleiro* (gunman). The most common outcome of this strategy is police investigation, arrests, and violence against vandals by gunmen employed by a rancher. However, in some cases eviction, reoccupation, and eventually expropriation of the property occur, especially if vandalism means the resources on the farm have been removed or its infrastructure utterly destroyed. The outcome is similar to property occupations outlined above because “the sack” is often an escalation of the occupation to include currently in-use areas. One of many such incidents would have been much more violent had the group not been in a hurry to leave:

The group action was so audacious that they [the MST] picked the animals and then put them in a corral where they were killed [13 calves]. The group then grabbed a number of bottles of alcohol, which they had left at the side of PA-150 at the entrance to the property. The farm manager [João Cardoso, Fazenda Cabaceiras] believes that the group intended to burn the farm headquarters, but did not have time to carry through with the action because they were in a hurry to leave.³⁶ (Santos 2002b)

Setting fire to farm headquarters is part of this claim-making strategy in a number of cases, as is burning pasture and other important farm infrastructure.

³⁶ Translation by Stephen Aldrich, April 11, 2008. The “bottles of alcohol” referred to in the quote may actually be sugar-cane ethanol used as a motor vehicle fuel. The original Portuguese text is: “A ação do grupo foi tão audaciosa, que eles escolheram os animais e depois os tocaram para o curral, onde foram mortos. O bando ainda levou várias garrafas de álcool, que foram deixadas na entrada da propriedade, jogadas na beira da pista da PA-150. O funcionário da fazenda acredita que eles pretendiam incendiar a sede, mas não tiveram tempo de concretizar a ação na pressa de fugir do local” (Santos 2002b).

3.2a1f. Violent Conflict

Though very uncommon, on occasion the contention between landowners and other elites, and the landless and their supporters becomes so intense that violent armed conflict is the result (right-most position, Figure 3.1). Though armed conflict is rarely, if ever, an initial strategy, the contentious situations stemming from other claim-making strategies has, on occasion, led to all-out armed conflict between gunmen and the landless or between the police and landless property occupiers. In one specific event on Fazenda Tupa-Ciretã in the município of Conceição do Araguaia, an eight-day continuous conflict left five dead, including landless people trying to set up an encampment on the ranch and two gunmen sent to remove them (Barata 1995: 113). Other incidents include a week long string of armed confrontations between property occupiers and police, leaving five landless people and one farm worker dead, and a number of police officers badly wounded on Castanhal Pau Ferrado in the município of Xinguara in January 1984. In this case, a landless agitator by the name of “Dimas de Jesus” appears to have been the instigator and leader of an outright rebellion; he was subsequently killed by his colleagues who dropped a tree on him, thereby ending the conflict and bloodshed (Barata 1995: 216-219). Generally, injury and death affect both sides of the conflict, and the state must step in to address the problem, often expropriating the property over which fighting has occurred, or making other land available to the landless in the hope that the conflict can be diffused. Conflicts can become quite intense at times, and there are frequent claims that a more powerful external power is actually directing the conflict, as can be seen in the following newspaper excerpt about land-related conflicts in the município of Xinguara:

“I have no doubt that a military group, of an ideological character, is behind it all,” affirms Cornel Raimundo Nonato Correa de Azevedo, commander of the 17th battalion of the Federal Police in Xinguara, the município with the most conflicts in the South of Pará. “There is a war afoot, because the actions [the landless] take are pre-planned and the objectives are always achieved,” claimed judge João Batista do Nascimento. “It is an armed gang, financed by a very wealthy group,” affirms Ademar Torres, the sole lawyer in the município. “They are ideological terrorists” claims rancher Eurélio Piazza... All four of these men had the same response when asked who the guerrillas coordinate with: “I don’t know.” The Coronel is the only one who would elaborate: “I cannot confirm who is in the command [of this group] – but it is without a doubt that the [Catholic] Church lends support to the members of this group.”³⁷ (Carvalho 1994: 8, translation by S. Aldrich)

Indeed, the general sentiment among largeholders is that financial help and planning for landless groups comes from some ideologically unfriendly, and (though mostly left unsaid) communist, source. In earlier periods, group members of the communist uprising which took place in the region in the 1970s were assumed to be part of the problem, despite the fact that their role in agitation in the region was quickly (and violently) addressed (Morais and Silva 2005). During the 1980s, there were frequent whispers of the involvement of foreigners in the struggle for land, with Sandinistas and FARC (The Revolutionary Armed Forces of Colombia – People’s Army) being mentioned to me in key-informant interviews (Gil 2007). The Catholic Church is another reoccurring theme in the protests of landed elites against the ongoing land war, and clergy members have

³⁷ Translation by Stephen Aldrich, April 11, 2008. Original Portuguese text is: “Não tenho dúvida de que um grupo guerrilheiro, de caráter ideológico, está em plena atuação,” afirma, por exemplo, o coronel Raimundo Nonato Correa de Azevedo, comandante do 17th Batalhão da PM de Xinguara, o município com mais conflitos do sul do Pará. “Existe uma guerrilha em andamento, porque as ações são preparadas previamente e os objetivos sempre alcançados”, endossa a juiz João Batista do Nascimento. “É um grupo armado, financiado por um grupo financeiramente forte”, afirma o advogado Ademar Torres, dono do único cartório do município. “São terroristas ideológicos”, acrescenta o fazendeiro Eurélio Piazza... Os quatro têm uma resposta única quando se pergunta de que guerrilha se trata: “Não sei”. O coronel é o único que vai mais longe: “Não posso afirmar quem está no comando – mas é fora de dúvida que a igreja dá apoio a integrantes do grupo”, afirma.

long been targeted for assassination and persecution for their support of the landless (Brandford and Glock 1985; Hecht and Cockburn 1990; Schmink and Wood 1992; Welch 1999; Wolford 2004).

3.2a2. Brokerage and the MST

Simmons et al. (2007) point out that how conflict occurs is not the only concept of utility in contentious politics for approaching the struggle for land in the South of Pará. In addition, the idea of brokerage is helpful in describing how landless movements have connected with each other and banded together in their struggle against *latifúndia*. Brokerage refers to the establishment of connections between previously “unconnected,” or disparate and geographically distant, social movements, locations, or political causes, and can lead to the use of new mechanisms and the rise of entirely new episodes of contention using new and innovative repertoires (Tilly and Tarrow 2007: 31 & 32). In the model of contentious politics, brokerage often leads to the utilization of the mechanisms of diffusion, whereby new ideas and contentious acts move through new political organizations, and coordinated action, linking two or more separate actors (or movements) making similar political claims (e.g., two different social movements may decide to protest against the same perceived wrong). Obviously, the connections created through brokerage have the potential to shape new social movements and reshape already established ones, and are frequently enabled through new relational mechanisms (McAdam et al. 2001).

In Brazil, since the 1964 advent of twenty years of successive and repressive military governments, brokerage has helped connect movements and acts of political contention which were more or less considered separate issues in the past. For instance,

with the rise of the Worker's Party (the Partido dos Trabalhadores, or PT) during the final death-throws of the military government through the late-1970s and early-1980s, brokerage led to the connection of the struggle for political representation and better working conditions by urban workers, and the need for land shared by most of Brazil's rural poor. From a very early stage the PT promoted a widespread need for land reform in Brazil, a commitment which continues to this day (Sader and Silverstein 1991; Anonymous 2003; CPT 2003; Associated Press 2005), though not without ongoing pressure by affiliated social movements seeking to promote land reform (Scolese 2005).

One of the features of brokerage over time is that connections are not necessarily permanent, and reconfigurations are common. Still, in Brazil, SMO-led DALR strategies are strongly allied with leftist political ideology and national political parties, such as the PT, who take seriously the goals of the landless. Though this dissertation focuses on the mobilization of DALR in the Amazon region, contentious political mobilization in the form of DALR also takes place in the South of the country where agroindustrial farming has displaced traditional agricultural workers. By way of contrast, in the North region impoverished smallholders have been kicked off their land and are looking for a small piece of property to work. Though the struggles of social movements in the South of Brazil have been significant – indeed, the region is the seat of one particularly strong and famous social movement's genesis, the *Movimento dos Trabalhadores Rurais Sem Terra* (MST) (Fernandes 2000; Wright and Wolford 2003; Wolford 2004) – their mobilization in the Eastern Amazon has been among the most contentious, violent, and impressive examples of brokerage in Latin America today.

Specifically, landless social movements in Brazil have taken advantage of the re-democratization of the nation and began to aggressively link their struggles with others with similar goals. At the regional level, the MST (and surely other social movement organizations) have linked the struggles of the landless with rural worker unions which, surprisingly, survived the military government period relatively intact (Welch 1999). These negotiated linkages provide a strong connection between the landless and the currently powerful PT, and have led to serious gains for both the party and the landless (Sader and Silverstein 1991; Anonymous 2003; Éboli 2008). Brokerage has been incredibly advantageous for both the broader landless movement and the rise of the left-of-center PT, and President Lula da Silva's success in office.

Simmons (2005) has addressed these changes at the international scale, where the landless movement in Brazil has been able to link itself to other important struggles, in particular the Via Campesina, of which the MST is a prominent member movement (Via Campesina 2008). In a sense, the new accessibility afforded by the internet and other improved communication methods (especially cellular telephones) has enabled those pitted in a struggle for agrarian reform to keep their distant brethren fighting the same fight informed of their activities. Beyond just knowing about the struggles of others, the solidarity that this new communication, and the brokered linkage to the international peasant movement affords, has given the MST a further method of enforcing the accountability of the Brazilian state. Illegal activities by the police are not likely to go unreported, or to be left ignored once reported, given the fact that brokerage has provided further leverage in claim making; if a wrong is not righted, international pressure may only be a mouse-click or text-message away.

More locally, in the South of Pará, brokerage has transformed the broader landless movement, and the SMOs to which the landless belong, substantially. During the 1970s and through the mid-1980s the poor smallholder farmers of the South of Pará were on their own should representatives of a largeholder from the South of Brazil show up and evict them (Foweraker 1981b; Brandford and Glock 1985). Over the course of about twelve years a significant number of poor farmers were thrown off the land their families may have been quietly farming for decades, all because wealthy and politically-connected elites were able to gain land grants from the government to begin agro-industrial investments in the region (see the previous chapter) (Foweraker 1981b; Schmink 1982; Brandford and Glock 1985; de Almeida 1990; de Souza Martins 1990; Simmons 2005). The period known as the *luta posseira*³⁸ marked dark days for the poor of the region. Brokerage rapidly transformed the struggle over land, however, and by the early days of MST organization in the South of Pará the connections between smaller groups of like-minded and outraged former-farmers were able to concatenate into a relatively powerful social movement. By the late 1990s, the MST, FETAGRI (Federação dos Trabalhadores na Agricultura, the Federation of Agricultural Workers), the MLT (Movimento de Liberação da Terra, the Movement for the Liberation of Land), and other social movement organizations had become powerful enough that largeholders began to complain to me that the balance of power had shifted entirely from largeholder ranchers to the landless “hooligans” involved in SMO DALR in the region (Pereira 2006).

³⁸ The *luta posseira* was a period shortly after the opening of the South of Pará to capitalist investment with the completion of road infrastructure, roughly during the early-to-mid 1970s (Simmons, Walker et al. 2007). Literally translating to the “fight to possess” these years were characterized by often violent clashes between capitalist enterprises and private landholders who had been granted title by state and federal governments, and the thousands of smallholder colonists operating under *de facto* property rights (i.e., farming on “unowned” federal land, *terra devoluta*, without official title).

In summary, brokerage (and new relational mechanisms) has enabled SMOs such as the MST to assemble a broad and powerful regional movement, which directly links to a national-level one with strong ties to the international struggle for agrarian reform. When the mechanisms triggering contentious episodes arise in the South of Pará, social movements there begin using their diverse repertoire of contentious activities in order to affect the desired change, often land reform, but occasionally other items such as credit or food assistance as well.

While contentious politics helps explain conflict, and has been used to great success in previous studies in the region (Simmons 2004; Simmons 2005; Simmons, Caldas et al. 2007; Simmons, Walker et al. 2007), the linkage between conflict and the environment is perhaps less immediately clear. However, through the use of another organizing framework, that of land-change science, the process by which social conflict becomes environmental change is more clear.

3.3. Land-Change Science and the Human-Environment Link

Land-change science, also referred to as “sustainability science,” “global change science,” and the “human-dimensions of global change,” is a framework designed to understand broad-scale biophysical modifications, sometimes aggregated to “global environmental change.” This interdisciplinary cluster includes research on climate-change, atmospheric systems, and ocean systems (Gutman et al. 2004), but probably had its formal beginnings in a combination of land-cover and land-use change and climate change research (Meyer and Turner II 1992; Brown and Pearce 1994; Lambin 1997; Lambin et al. 1999; Geist and Lambin 2001). Since successful early efforts to develop a formal conceptualization of how human activity shapes links with environmental change,

the interdisciplinary field of land-change science has shifted from one focused primarily on identifying how drivers lead to actual change, to one where new drivers of change are frequently identified and their implications for policy are explored (Kates et al. 2000; Parris and Kates 2003).

The land-change science framework has been specified in a number of different ways, but the basic premise is that human-caused environmental change typically comes about through proximate causes (mentioned in Chapter 2) which are “human activities (land-uses) that directly affect the environment” (Geist and Lambin 2001: 5). The proximate causes are propelled by underlying drivers, the “driving forces (or social processes)... fundamental forces that underpin” the proximate causes of land-use and land-cover change (Geist and Lambin 2001: 8). These underlying drivers are often explained as economic, political, institutional, technological, cultural, or demographic factors which lead people living in an area to undertake an activity (proximate cause) which changes environmental conditions (e.g., logging or road-building) and leads to land-cover and/or land-use change (Geist and Lambin 2001, 2002). Some formulations of the process are couched in terms of structure and agency, with “structures” being roughly equivalent to the “underlying drivers” of Geist and Lambin’s (2001) conceptualization, and agents being those people or institutions (e.g., companies) actually undertaking some “proximate cause” activity (Geist and Lambin 2001). Whatever the terms of the framework, the basic idea is similar; whether described as structures driving agents to undertake land-change activities or as proximate causes being driven by underlying drivers, both explanations describe human activity as being influenced to a large degree by wider social and economic pressures (Leach and Fairhead 2000; Geist and Lambin

2001; Lambin et al. 2001; Lambin et al. 2003; Gutman et al. 2004; Roy Chowdhury and Turner 2006).

Land-change science perspectives and political ecology tend to be applied to similar problems, but use different methods of framing problems and explaining them, occasionally to the consternation of those using the other approach (i.e., political ecologists are sometimes at odds with land-change science practitioners, and vice-verse). Turner and Robbins (2008) feel that, although land-change science focuses on the processes which bring about global change, and political ecology focuses on processes which can inform better development, there is some common ground between the two perspectives. Turner and Robbins (2008) go on to propose that research questions might move toward a synthesis of political ecological and land-change science approaches to human-environment change, especially based on the common issues of complexity, the importance of place-specificity and historical contingency, and the influence of multi-scalar processes. The case of land conflict and deforestation in the Amazon is one in which the strength of both perspectives can be used in a convergent approach to more fully address the problem at hand.

More specifically, in the South of Pará, land conflict may be conceptualized as an underlying-driver of deforestation, itself brought about by the proximate causes of pasture formation or, more generally, agricultural expansion. Taking the framework of contentious politics as a description of the political and cultural force driving the struggle over land, there are multiple incentives for deforestation. Beyond only the need to produce for profit, the largeholders of the South of Pará find it in their best interests to deforest their properties in order to prove the utility of their holdings and avoid

expropriation; this attempt to prove utility is often expressed as a conversion of forest to pasture. On the other hand, landless occupiers find that, in the struggle to meet basic needs for food, fuel-wood, and a shack to live in, deforestation for food production and shelter is a general necessity. Both largeholders and the landless find themselves in different, but similarly tenuous, situations in the region, leading to a need to undertake activities that can only be labeled proximate causes of deforestation.

However, both the contentious process generative of land conflict (an underlying driver of environmental change), and the deforestation events which take place through various proximate causes, can both be further illuminated through the application of some of the basic tenets of political ecology. As Turner and Robbins (2008) point out, the “inherited focus” of political ecology tends to be study to inform development policy; by applying a political ecology that integrates the land-change science frame in the South of Pará, we can see how former policies regarding development have generated conflict and environmental destruction.

3.4. A Political Ecology of Land-Conflict Driven Deforestation

There are a number of highly sophisticated formulations of political ecology in the literature on social and environmental change, ranging from those that integrate gender-relations with environmental problems (Rocheleau et al. 1996; Rocheleau and Edmunds 1997; Hovorka 2006), to those which investigate identity and how it shapes environmental conservation (Brú-Bistuer 1996; Schwartz 2006). Rather than focus on the arrangement and linkages amongst the complex frames of contentious politics and land-change science, I argue that contentious politics can be used to explain why land conflict arises in the South of Pará, and that the conflict itself can be conceived of as an

underlying driver of the proximate cause of deforestation most common in the region – agricultural expansion.

As already outlined, the conceptual frame implemented in this dissertation is an extension of that outlined in Simmons et al. (2007), which deploys contentious politics in developing a political ecological explanation of deforestation (among other things) in the South of Pará. This work, however, involves an extension of that frame by explicitly joining it with the land-change science frame commonly employed in studies of land-use and land-cover change. The frame here employed is a political ecological one in the sense that contentious politics, and a rich concept of place, are employed with the idea that they cover the political parts of the explanation, and land change science helps explain how the politics link to ecological change.

Any discussion of the political ecology of land conflict-related deforestation cannot ignore power relations, which, as described earlier, are quite important in the rise of contention and the struggle for land resources. However, environmental decisions are framed within these power relations as well. Largeholders have the implicit, and sometimes explicit, support of the state in their capitalist enterprise, even when the law has to be broken (as in the case of investment in pastures, the establishment of which often voids environmental law) or bent (such as the legal requirement for ranch hands to be registered employees). Officials look the other way when forests fall by largeholders, but often become incensed when deforestation associated with property occupation is uncovered, even though the areas involved are often *much* smaller.

Cultural power is at work in the region as well. Throughout Amazonia a culture of grudging respect for the wealthy, a remnant of political patronage (which is still alive and

well in certain places) and exploitative labor systems such as *aviamento*, persists, and leads even the lay person to quietly endure the brazen attempts of the elite classes to thwart the law for their own gain. Some social movement members whom I spoke with admitted that they were hesitant to occupy largeholder properties because, despite social movement rhetoric, the land was already spoken for. Furthermore, a “cowboy” culture persists in Amazonia, at least in the sense that many entertain the ambition of being a rancher (Faminow 1998). Smallholders on new agrarian reform settlements and the urban commercialists they sometimes sell their plots to both want to be ranchers (Gil 2007). If much of the deforestation to date in Amazonia has been undertaken to establish cattle pastures, the power of the cowboy culture is partially to blame.

The combination-frame I have proposed here, whereby contentious politics explains the emergence of a new underlying driver of deforestation, is not a conventional political ecology in the sense that much of the “political” and the “ecological” are examined through different frames (contentious politics and land-change science, respectively). However, the mechanisms by which conflict arises in the South of Pará are multi-scalar, and involve international, national, and regional power relations. Furthermore, the environmental changes wrought by this political, social, and economically based conflict are both based upon, and have the potential to reshape, development policy (a touchstone of political ecology in geography).

This conceptualization of political ecology of course takes into account changes in the arrangement of the Brazilian state, which have been instrumental in the establishment of unequal power relationships at all levels of society. Taken together with substantial modifications to Brazilian civil society following *abertura* and the dissolution

of military government, the social scene in the South of Pará was primed for DALR. Despite the fact that there are vast areas of unclaimed land, the history of Amazonian development has set up a situation where a sort of artificial land scarcity is evident (Simmons 2004). The three-quarters of a century history of large-scale development projects focused on the integration of the Amazon with the rest of Brazil has been one where increased accessibility and the opportunity to acquire land has led to the migration of many landless poor colonists from the South and Northeast and the arrival of largeholders. The resulting rapid influx of colonists and largeholder capital led to confusing title situations, land speculation, and eventually artificial land scarcity. In many areas there is plenty of unused land, but little of it remains unclaimed.

The outcome of the changes in the Brazilian state, Brazilian civil society, and the trajectory of Amazonian development give rise, through the mechanisms of contentious politics described earlier, to episodes of land conflict which evidence a repertoire of contentious activities, including land occupations by a critical mass of landless people who feel their chance at acquiring land lays in DALR.

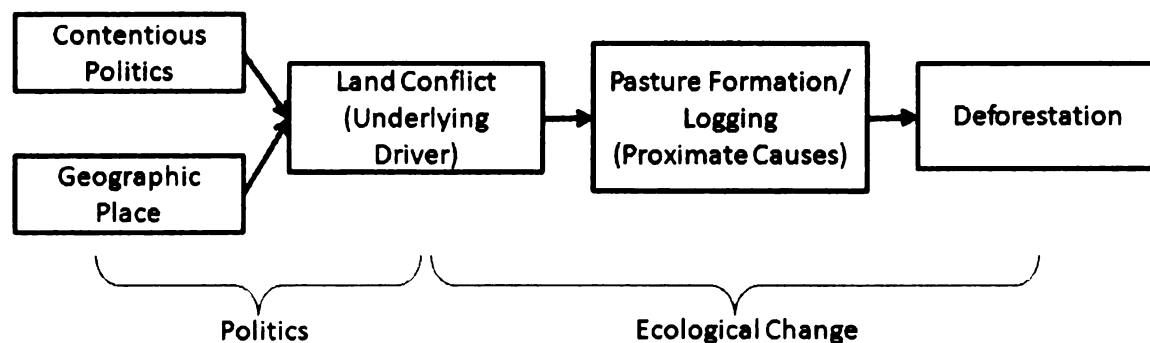


Figure 3.2. The political ecology of land conflict-related deforestation in the South of Pará

In sum, in the South of Pará the contention over inequitable distributions of power and land resources by SMOs and landless peasants has resulted in extensive conflict. These conflicts have been enabled by institutional arrangements (and political power) allowing the rich to lock-up land resources in large properties, while leaving the poor and landless with few options other than DALR. DALR has the potential to lead to significant and rapid deforestation, particularly by largeholders seeking to protect their holdings from expropriation. Here, drawing from Simmons et al. (2007) I have outlined how contentious politics helps to conceptualize how land conflict arises in the South of Pará, providing the “political” of this political ecology. To conceptualize how the “ecological” changes, I extend the Simmons et al. (2007) frame by joining it with a commonly used explanatory chain drawn from land-change science (Geist and Lambin 2001, 2002). The linkages between these many frames are shown in Figure 3.2.

The overarching goal of developing a “political ecology” to describe the connection between land cover change and land conflict in the South of Pará is to maintain a connection to what I consider the touchstone ideas of political ecology to date; that human-environment interaction is constrained (or enabled) through multi-scalar processes, steeped in power relations, and developed through historical and geographical contexts which change over time. Though the political ecology I have described in this chapter differs from the “classic” political ecology works, it is an attempt at the “fusionist” perspective that many recent explorations of human-environment theory have called for (Zimmerer and Bassett 2003; Turner II et al. 2004; Walker 2005; Roy Chowdhury and Turner 2006; Walker 2006; Turner II et al. 2007; Walker 2007; Turner and Robbins 2008).

At this juncture I leave behind the conceptual frames and focus on the analysis which each (and the overarching idea of political ecology) help organize. I return to the implications of these frames for future work, as informed by the analysis of the next two chapters, in Chapter 6.

CHAPTER 4 - GETTING MIXED UP IN CONFLICT: HOW SOCIAL MOVEMENTS SELECT PROPERTIES FOR OCCUPATION

Despite the chaotic nature of land conflict throughout Brazil, landless movements do not select properties in a completely disorganized fashion, even if outward appearances are that they do. Indeed, a review of the literature covering land conflict in Amazônia, and Brazil in general, indicates that social movement members and leaders, government officials, and largeholders all recognize property occupations occur with specific goals and criteria. Though practical considerations such as travel time and current demand for land often play a significant role in more spontaneous property occupations (Caldas 2008), there are a substantial number of characteristics indicated in academic literature on the topic, ranging from land values to properties with absentee landlords, which predispose properties to occupation by the landless. Furthermore, my interviews in 2006 and 2007 with key-informants³⁹ on both sides of the land issue (landless occupier and largeholder) as well as government officials appear to indicate that many of the characteristics predisposing a landholding to occupation may be more complex and varied than treatments in the literature indicate.

What is the value of understanding the factors which lead organized groups, typically established social movements, to select certain properties for occupation? For one, the number of property occupations within the South of Pará is surprising; between

³⁹ These key-informant interviews with open-ended and began with the question “what are the difficulties ranchers (or colonists) face in the region?” As land conflict was mentioned I further explored the theme with key informants by asking them “what contributes to land conflict?” and “what do you think makes a property more attractive for occupation?”

1980⁴⁰ and 2003 over three-hundred properties in the region were occupied ($n=318$), with exactly 116 occupations occurring on sixty-four of the 180 ranches in the region immediately to the south of the city of Marabá, an area known as the *polígono dos castanhais* (see Figure 1.2). Occupations are a noteworthy phenomena given that in the most accessible area of the region (the *polígono dos castanhais*) thirty-five percent of the properties experienced occupations, all but four of which ended with eventual expropriation and redistribution for agrarian reform purposes ($n=60$)⁴¹. As one key-informant, “Sebastião” (2007), the president of a local producer’s union, said in an interview, “large properties will be finished because of land reform around here,” echoing the helplessness some largeholders I spoke with. Of the forces driving the rapid change in the region, the impact of social movement organizations practicing land occupations was the second most cited difficulty largeholders mentioned in my interviews with them (12 of 19 listed occupations second, with environmental regulations being the “most severe” difficulty⁴²).

Beyond the number of occupations occurring in the South of Pará, understanding which characteristics may predispose a tract of land to occupation will help agronomists

⁴⁰ According to one informant, “Carlos,” a largeholder with longstanding ties to the region and a good friend of one of the region’s patriarchs, Evandro Mutran, before 1980 there were “no occupations” in the region. News records indicate nine instances of occupations in the late 1970s (none in the *polígono dos castanhais*), all of which were small and resolved relatively quickly through unsanctioned police eviction of occupiers, a common occurrence at the time.

⁴¹ Data comes from a tabulation of news records described below.

⁴² Environmental regulations are among the most intractable difficulties for landholders of all varieties throughout Amazônia (where individuals are aware of them), though they are certainly more difficult for largeholders who rely on vast areas of deforested land (typically ranchers and soy farmers). Since the early 1980s the legally required proportion of forest on large properties within the Legal Amazon has flip-flopped from 20% forest in 1986 to 50% forest in 1989, and now 80% as of 2001 (see . Measuring Forest Cover). Nearly every largeholder ($n=18$ of 19 total) I spoke with in the South of Pará indicated environmental regulations were the most burdensome issue they had to address (one informant stated that the biggest difficulty he faced was the inflation of durable goods prices, fuel, and equipment parts). Many largeholders were exasperated when environmental regulations came up; “how can we be expected to have a productive farm if we can only use 20 percent of it?” asked one largeholder.

and other researchers evaluate to what degree social movements are abiding by their own claims. For instance, in interviews with social movement leaders undertaken as part of another project (Simmons et al. 2005), many key-informants stressed that occupations only take place on (a) properties which are unproductive, (b) have legal title issues, (c) have slave-labor problems, or (d) are genuinely *latifúndia* (i.e., large properties with low productivity and often pre-capitalist, or wage-slave, labor arrangements). These claims mirror others in the literature covering the struggle of the landless in Brazil, particularly with reference to the MST (Brandford and Glock 1985; Sader and Silverstein 1991; Fernandes 2000; Branford and Rocha 2002; Wright and Wolford 2003; Wolford 2004, 2005), and supported by statements on “Friends of the MST” websites in various languages (all of which can be accessed at the MST's official website, MST 2005a). However, some authors have implied that these claims may be more flexible; Alston et al. (2000) discuss their reservations that the constitutional justification for land occupations relies on a highly subjective definition of “beneficial use” (i.e., articles 189 and 191 of the 1988 constitution). Furthermore, Alston et al. (2000: 169) even state that occupiers garner political support from “an influential urban constituency in Brazil that supports land reform.” Of course largeholders seriously doubt the claims of landless social movements, insisting that productive properties with large clearings (which may be violations of environmental regulations) and a prime resource-base are likely targets. Finally, in the literature there are insinuations that largeholders occasionally collude with landless movements in order to get a better price for their land through expropriation than they would receive on the open market (Foweraker 1981b; Alston et al. 2000; Fearnside 2001a; including an actual example of this in the South of Pará: J.B. 2003).

Knowing which characteristics actually drive the selection of a property for occupation efforts by the landless has the potential to help inform any of the policy changes which many researchers have recommended (e.g., de Almeida 1990; Alston et al. 1996; Alston et al. 2000; Simmons et al. 2002). Indeed, until recently many land reform policy recommendations were critical of the current state of things in Brazil, but their recommendations have lacked detail or the support of more than anecdotes (e.g., Schmink 1982; Hecht and Cockburn 1990; Schmink and Wood 1992; Smith et al. 1995, though this was more due to a lack of concrete information and data dealing with the issue than a reluctance by researchers to address the issue empirically; Alston et al. 1996; Fearnside 2001a). If certain characteristics have a strong tendency to promote property occupation, such as accessibility or title problems, current policies and standard practice throughout Brazil may be called into question. For example, if title problems are indeed one of the most apparent conditions predisposing a property to occupation, the frequent calls by researchers in geography, sociology, and political science, as well as admonitions by economists and some politicians, to address title confusion in Amazônia would be significantly reinforced. Similarly, if a greater degree of accessibility (i.e., proximity to roads) encourages occupation, then ongoing efforts to improve transportation infrastructure might need to be reevaluated or refocused to improve transportation in areas where smallholder settlements already exist.

Before exploring the measurement of characteristics which impact the likelihood of property occupation (i.e., variable specifications) and logistic regression models to uncover their explanatory power, it is important to emphasize the historical context within which the strategy of property occupation came to be used in the South of Pará.

While the strategy itself was revitalized *en mass* in the South of Brazil with the MST's rise in the late 1970s and early 1980s, in the South of Pará conflict over land has had a long history. Much of this history was described in Chapters 1 and 2, but in summary, during the past thirty years the region has experienced simultaneous communist uprising (the "Little War of Araguaia") and widespread struggle associated with the opening of the region to development projects (the *luta posseiro*). During this period, occupations were an infrequent strategy, but they did occur, especially in response to evictions which were legally dubious at best (Barata 1995 describes incidents at the end of the *luta posseiro* period). As the redemocratization of Brazil led to the political opening necessary for land reform-focused social movements to emerge from their clandestine activities, the MST and other SMOs began to organize their fight for agrarian reform around the tactic of property occupation. This period, roughly extending from 1984 until the current day, has been defined by DALR – a struggle known as direct action land reform (Simmons 2005) – and has contributed to the establishment of many agrarian reform settlements in the South of Pará and the rest of Brazil.

To address the factors important to social movements and their members in determining which properties to occupy, I have developed a series of models which are meant to determine which of a wide variety of often contradictory and historically contingent characteristics influence property occupation significantly. From key-informant interviews with former and current landless residents of the region, ranchers, and government agents, as well as statements in the literature, I have uncovered a number of characteristics and will describe each condition named as promoting property

occupation in the next section. At the end of this chapter, I evaluate these characteristics through a series of logistic regression models.

4.1. Property Occupations (The Dependent Variable)

As the event the models presented here evaluate is occupation of a property, the very basic variable necessary is one indicating whether a property has been occupied or not. Unfortunately, though non-governmental organizations have been recording and cataloging land conflict throughout Brazil since the early 1980s, there are some gaps, especially when direct action land reform activities are not violent, or do not involve INCRA, the police, or military. In other words, accounts collected by the Pastoral Land Commission (CPT), though an impressive and a valuable service, may not include the wide range of contentious activities which make up the struggle for land (see section 3.2a1); the record assembled by the CPT tends to focus on the most contentious parts of the spectrum of activities which may be considered contentious. In other words, while violence and land occupations certainly make it into the CPT's accounts, other activities such as protests and denunciations may not be reliably included, or included at all. Furthermore, on occasion, property occupations in the South of Pará have gone unrecorded.

To get around this particular limitation, especially in reference to the *poligono dos castanhais* for which largeholder property boundaries are available (a rarity in the Amazon), I used newspaper accounts collected from the archive at the Municipality's Culture House (*Casa da Cultura*) in the city of Marabá, Pará. This archive has a continuous collection of three local newspapers which serve (or served, in the case of one newspaper) the region extending north to Tucumã and south to Redenção. The journal *O*

Marabá began printing in the late 1960s on a monthly basis, and, by 1984, had begun weekly printings. By 1987, *O Marabá* was eclipsed by the more popular and more frequently published *Correio do Tocantins* which was joined shortly afterwards by the *Correio*'s rival paper, *Opinião!*. These two papers, *Correio do Tocantins* and *Opinião!*, have been covering news, including instances of land conflict, since their inception.

Working over a period of nearly two months in the summer of 2007, with the part-time help of two colleagues and the gracious help of the head archivist and her assistant, I photographed every article covering land conflict in these two papers (and the earlier journal, *O Marabá*) from 1980 until 2003⁴³. Though an arduous task in Marabá's heat and humidity, the more difficult stage came later – reading each and every account in order to acquire dates of land conflict incidents and other information, including occupations, to assemble a database of conflict from which I developed the dependent variable (among others) for this analysis. The source of the paper property-boundary map and the data-processing steps are explained in the sections below.

⁴³ The photographs of articles in my possession actually extends to July 2007, though for the purposes of this analysis I limit data collection until 2003 due to land cover data availability; Landsat images were not available at low cost for the entire region after Landsat 7's scan-line corrector stopped functioning on May 31st, 2003 during the time of analysis (USGS 2008).

Characteristic	SMO Members	Key-informants: SMO's	Key-informants: Ranchers	Academic Literature	Government Agents
Proximity to major road	✓		2/9	✓	✓
Proximity to town	✓	✓			
Large forest reserve	✓	✓	15/19	✓	
Open land (pasture, etc.)		✓	6/19	✓	✓
Environmental violations		✓	13/19	✓	
Title/Legal problems	✓	✓	9/19	✓	
Better soil	✓		5/19	✓	✓
Accessible water	✓			✓	✓
Labor violations (slave-labor)	✓	✓	12/19		
Vacant landlords			7/19	✓	
Large size		✓		✓	
Landlord encourages an occupation				✓	

"SMO members" are settled colonists who were interviewed about what characteristics were important when selecting their land ($n=62$ who did not purchase or who were not simply assigned to their property). "Key-informants: SMO's" are SMO leaders who were interviewed about the characteristics important for settlement formation ($n=11$). "Key-informants: Ranchers" are ranchers in the region (primarily from the *poligono dos castanheais*) ($n=19$). "Academic Literature" indicates an author named this characteristic as important, see table in Appendix 1. "Government Agents" were INCRA officials ($n=3$).

Table 4.1. Property characteristics predisposing largeholdings to occupation by the landless according to various sources.

For the dependent variable in a binary logistic regression model a “successful” trial is typically represented with a value of “1.” In the case of the dependent variable for this model, each property ($n=180$) which was occupied in any given year is assigned a value of 1, and all others a value of 0. I have developed four dependent variables, each representing the property occupations occurring over all years, and in 1986, 1987, and 1999. Because of the availability of some of the independent variables, I have limited my single-year logistic regression models to these years because (a) they are three of the most active in terms of property occupations, and (b) the proportion forest independent variable is available for properties for these time periods.

For each logistic regression model specification, the dependent variable contains only those cases where an occupation occurred for the first time on a property in that year. When this occurs the property is counted a “success” and is assigned a value of “1.” All other properties are assigned a value of “0.” Therefore, by way of example, the dependent variable in 1986 equals “1” in each of the eleven cases where a property was occupied and a “0” in the remaining 169 cases where the property was either occupied (a) before 1986, (b) after 1986, or (c) never occupied at all (116 properties in the region have never been occupied according to newspaper accounts of conflict).

4.2. Explaining Property Occupations (Model Development)

No regression analysis is complete without explanatory variables. In the following sections, for nearly every characteristic listed in Table 4.1, I include a description of why each group of agents listed a characteristic as important for occupations, as well as a description of how I developed variables meant to measure their impacts. Therefore, the next few sections are primarily a discussion of different perspectives on the

characteristics which those in the region feel lead social movements to occupy properties, but also a definition of model inputs.

If only because agents⁴⁴ at work in the South of Pará are engaged in other struggles, there is, oddly, little debate among those living there over which characteristics may encourage the occupation of a property by the landless; generally, researchers and residents of the region think most characteristics encourage occupation in one way or another. Keeping with this perspective, many characteristics have been named, spanning various categories including physical characteristics of the land itself, land title or other legal issues, or even market access. Table 4.1 lists the general characteristics and which group of agents mentioned each as being important. It is clear that most agent groups feel a multitude of characteristics drive property occupation.

Gathering data to test which of these characteristics most strongly influences a property's likelihood to be occupied involved a number of data sources and different measurements. In some cases, information from a number of sources had to be combined to make one measurement of the phenomena of interest, while for others reliable data are simply not available. Aside from presenting selection characteristics, in this section the variables with which I intend to measure them are described and the process steps for developing them are also outlined. Though members of opposing groups often "agree" on the characteristics driving property occupations, their reasons for naming them vary significantly. This section is also an exploration of why such disparate groups may feel the same characteristics are important in the *poligono dos castanhais*.

⁴⁴ In using the word "agents" here I refer to the admittedly artificial groupings in the headings for columns in Table 4.1.

4.2a. Market Access (Proximity to Road, Proximity to Town)

In most studies of agrarian issues market access is an important explanatory variable. While collecting this sort of information is difficult short of inquiring of producers (in this case largeholders *and* property occupiers) on a repetitive basis, academic research focusing on land issues often emphasizes market effects through proxies such as distance to major roads and towns nearby (e.g., Alston et al. 2000; Fearnside 2001a; Simmons et al. 2002; Wright and Wolford 2003). Obviously, road access is more of an issue in the remote Amazon than in the southern reaches of Brazil, which have a somewhat more established and year-round transportation infrastructure, but proximity to roads is important to anyone who seeks to produce for market sale; von Thünen market-distance and transportation cost effects are alive and well in Amazonia (Anderson 1990; Coomes and Burt 1997; Angelsen and Kaimowitz 1999; Imbernon 1999; Walker et al. 2000; Chomitz and Thomas 2001; Walker et al. 2002; Moran et al. 2003; Walker et al. 2004; Walker et al. 2008). Indeed, many land-use and land-cover change researchers have recognized the strength of this variable in their models of change (Dale et al. 1994; Reis and Guzmán 1994; Chomitz and Gray 1996; Walker and Homma 1996; Messina and Walsh 2001; Browder 2002; Vance and Geoghegan 2002; Moran et al. 2003; Walker 2003; Pan et al. 2004; Walker et al. 2004; Arima 2005; Arima et al. 2005; Messina and Walsh 2005; Caldas et al. 2007). The strength of this characteristic in all things agricultural, thus theoretically indicates its importance for social movements to identify properties for occupation.

Developing explanatory variables accounting for market access through distance to roads and distance to towns and cities, therefore, might seem straightforward. However, because these models are meant to capture the reasons properties are occupied,

it is worthwhile to discuss *why* the different agent groups name similar characteristics. The reason for selecting properties close to highways and roads is not something those who mentioned it as important can agree upon. Among the three government officials at INCRA I spoke with in 2006 about the importance of road proximity, the consensus was that social movements selected properties, and areas of those properties, visible from major thoroughfares (especially PA-150 and BR-230, the two paved highways in the region) in order to raise awareness of their cause through high visibility. A secondary benefit, one INCRA official allowed, is that occupied areas closer to major roads make it easier for officials to survey the property for productivity (a necessary step in the property expropriation process) and allows for the easier delivery of *cestas básicas* and other state aid. One government official also indicated that maximizing the visibility of occupations can have the important benefit of preventing extreme violence; since gunmen have been terrifying the landless and smallholders in the region since time immemorial, social movement organizers likely appreciate the protection which comes with visibility.

Government officials are not the only agents in the region who consider proximity to road an important driver of selection for occupation; some landless movement members themselves indicate its importance. Settlers who successfully acquired property through land reform indicate that at least some of the time (10.4 percent of those asked how their property was selected in the Simmons et al. 2005 study) road access is important to them.

Finally, some ranchers tend to believe that proximity to roads predispose their properties to occupation, though for very different reasons. In fact, ranchers tended to disagree with government officials and the landless about the reasons why proximity to

road might encourage occupation (except in the case of increasing awareness of the landless movements' cause, where government officials agreed). Specifically, two of the ranchers I interviewed said that being close to roads was important because the property was of higher value and therefore could be sold for a higher price once the land had been expropriated and redistributed. Cynically, they believe that property occupiers wish to sell the land they win through agrarian reform for profit, even going so far as claiming an entire industry revolves around the process. Whether or not this is true, and some anecdotal evidence supports the claim, picking high value land, which tends to be located near better roads, would be a shrewd strategy to say the least. Some ranchers suspect a less selfish motive, as "Palmiro," a rancher in Eldorado dos Carajás said "most of the land on ranches is pretty poor and degraded, so the movements might as well pick land near the road" (Palmiro 2007).

Going hand-in-hand with proximity to roads, being close to towns can make a property more attractive for occupation by social movements. In addition to market access, towns provide other services such as health care, better education opportunities, a larger service sector, telephone and electrical service (which tends to be extended to agricultural settlements close to town, as in the case of the *Palmeiras II* settlement near Parauapebas), and equipment and car repair services.

Though it follows that, similar to road proximity, a property close to town may be more attractive for occupation, only social movement members and key-informants mentioned it. Apparently, for some agents in the region, other factors appear more important. Indeed, social movement members who successfully acquired a farm through land reform indicated that they prefer locations closer to town (almost 19 percent of those

surveyed in the Simmons et al. 2005 dataset), a statement mirrored by one social movement member who was a key-informant in the *Alegria* settlement located near the city of Marabá.

4.2a1. Social Movements and Social Movement Members

However, reflecting upon the goals of social movements and how they may compare, but also contrast, with their members, it is clear that some variables cater more clearly to social movement *members* while others cater more clearly to social movement *organizations*. In fact, of all of the variables to be explained in this section (Explaining Property Occupations (Model Development)) proximity to towns is the only one which appears to meet the goals of both social movements and movement members.

The goal of the social movements active in the South of Pará, broadly defined, is the successful execution of meaningful agrarian reform. A secondary goal, however, is to bring more members into the fold. Some researchers and activists would inevitably take issue with such a statement, as it tends to downplay the concern a social movement might have for the welfare of its members. While movement doctrine may present an argument that SMOs and their members exist in perfect synergy, reality is much more messy; movement members are, first-and-foremost, interested in gaining a piece of land, while movements are interested in achieving their political goals.

Consider what a successful occupation might look like for a social movement; the political fight of social movements is explicitly one against *latifúndio*, and therefore a “successful” occupation would likely draw attention to such a property (i.e., a large property with questionable title arrangements). Furthermore, especially over the past 10-15 years, the concept of *latifúndio* has been explicitly expanded in the literature of social

movements to include properties maintaining slave and wage-slave labor arrangements, as well as those properties displaying gross environmental violations. Finally, in order to draw media and lay attention to the struggle (a crucial recruitment strategy) a “successful” occupation is likely to take place close to town, or on a major thoroughfare.

Compare the definition of “success” for a social movement (i.e., media attention, targeting of *latifúndio* and its misbehaving *donos*) to those of its members; social movement members are primarily looking for a piece of property which they can use to provide for their family’s needs and perhaps sell some production for cash.⁴⁵ Therefore, a “successful” occupation for a member of a social movement in the South of Pará will take place on a property which is not degraded (typically indicated by good soils and the presence of a significant forest reserve), with access to water and markets where goods produced on their land can be sold for cash.

“Success” therefore, may be defined differently for social movements than for their members. One explanatory variable (i.e., characteristic of a property which may increase the odds of occupation) is common between these two allied, but differently motivated agents: proximity to town. For social movements, proximity to towns is a proxy for exposure; the closer one is to town the more likely people in the town, and hence the media and perhaps even those outside the immediate region, will know about the struggle for land. For social movement *members*, on the other hand, proximity to town is a proxy for access to markets where their excess production and cash-crops can be sold.

⁴⁵ Leaving aside the potential for land speculation and other less-than-noble motivations which inevitably do occur.

4.2a2. Measuring Market Access

Measuring access to markets is not as straightforward a process as one might imagine, particularly given the large property sizes in the region. In many parts of the Amazon, market access has been proxied by simple Euclidian distance from a regional market center to the property of interest (Walker 1996, 1999; Walker et al. 2004; Caldas et al. 2007; Caldas 2008). Being unsure of the relative importance of towns (which typically have basic markets and urban services) in comparison to cities (which typically have a wide range of services and more specialized market demand), I have developed multiple variables to account for their influence. However, access to roads may be more important than the actual distance to the cities they connect, especially as road quality in this part of the Amazon, while still atrocious, is passable for most of the year. Finally, a combination of road access and distance is also considered through cost-distance measurements which account for road access. I have developed and included two measurements of road access, and three measurements of proximity to town in the models presented below, (and further explored in Appendix II).

4.2a2a. Market Access: Highway Binary

This binary variable indicates either (a) that a major highway runs through (i.e., intersects) the property, or (b) that a major highway forms the border (i.e., abuts or “touches the boundary”) of the property. If the aforementioned conditions are met, the observation for the property is given a value of “1,” otherwise its value is “0.” The variable was developed in a Geographic Information System environment (ArcGIS 9.3) by performing a spatial query comparing largeholder property boundaries digitized from a paper map and roads data from the Brazilian Institute for Geography and Statistics

(IBGE, Instituto Brasileiro de Geografia e Estatística).⁴⁶ I downloaded the roads data, projected them to match the projection, datum, and coordinate system of largeholder property boundaries, and performed the spatial query. Only road segments representing major roads were considered due to the fact that (a) secondary roads are of highly variable quality in the region, and (b) other roadways remain unmapped in many cases. The major roads considered were the federal highways BR-230 (the so-called Transamazon highway) and BR-222 (a road connecting the city of Marabá to BR-010) and the state highways PA-150 (running through the study area) and PA-257 (linking PA-150 to the Carajás mine).

Over the entire study area, forty-one of the 180 properties are either intersected by a road or have at least one property-boundary formed by a road segment.

4.2a2b. Market Access: 10 Kilometer Highway Binary

Because the impact of roads can be important for many processes even if a property has no direct or reliable connection to the major road network (Anderson et al. 2002; Batistella et al. 2003; Arima 2005; Caldas et al. 2007), I developed this variable to consider that properties close, but not immediately proximate, to major roads may have an impact on the odds they may be occupied. This variable was developed in a manner similar to the Highway Binary variable, above, but with the added specification of a ten kilometer buffer of the major roadways. In other words, all properties coming into contact with the ten kilometer buffer of any of the listed major roadways were assigned a

⁴⁶ Geographic data are often of poor quality for the Amazon. However, in the case of roads data the positional error appeared, upon visual inspection throughout the entire study area, to be low enough for the data to be used as described. In other words, road location was within three pixels of its location on orthorectified landsat imagery for the majority of sampled road segments ($n=55$). Agreement is not perfect, however, but given the phenomena this data is used to measure I deemed it suitable for use.

value of “1” in a spatial query, while those outside of the zone were assigned a value of “0.”

Over the entire study area, ninety-two of the 180 properties are either intersected by a road or have at least one property-boundary formed by a road segment

4.2a2c. Market Access: Distance to Major City

Within the *poligono dos castanhais* there are two towns which stand out beyond their neighboring urban nuclei; the city of Marabá and the large town of Eldorado do Carajás are far larger than the other towns in the region. In order to capture the impact of these urban centers on property occupations, I calculated simple straight-line (Euclidian) distance to these locations. In order to calculate these distance values for every property centroid, I had to first calculate property centroid locations within a GIS. Town and city locations are available from IBGE, but required projection so that geospatial reference would agree between town and city locations and the location of property centroids. Once these two data items were adequately prepared, I was able to generate a distance grid (with the same projection and coordinate system as the other data layers in the GIS) where each cell contained its distance from the closest of either Marabá or Eldorado do Carajás. I then extracted the value corresponding to the property centroid and assigned it to each property.

There are limitations to this variable and others like it which are based on the extraction of a value from a raster grid to a property centroid location. The foremost limitation is the assumption that the centroid of largeholder properties is in some way important. In fact, many property headquarters, and therefore most of the market-oriented activities, are not located near the property centroid, but instead are located near the edge

of the property (often the edge closest to roads), or near water features (particularly rivers). However, since property headquarters locations are not available for each and every property, I have assumed property centroid locations an appropriate location from which to calculate distance to various features in the landscape.

A further limitation is that people do not tend to travel in straight lines; the landscape does not often permit direct, point-to-point, trips, and the Amazon is no exception. Because fine-scale geographic transportation data are not available for this region, I addressed this issue by using cost-distance functions, as described below (see section 4.2a2e)

Over the entire study area, the average distance to the city of Marabá or the town of Eldorado do Carajás is 39.82 kilometers, with a standard deviation of 18.58 kilometers and a maximum distance of 79.38 kilometers.

4.2a2d. Market Access: Distance to Closest Town

Though larger towns in the region are likely to be more important in terms of measuring market access and access to services, smaller towns play an important role as well. In particular, while largeholder ranchers may be more interested in the services a big city can provide, such as advanced veterinary care and slaughterhouse facilities, the would-be colonists occupying their properties often do not need such services as frequently (if at all). Indeed, occupiers are more likely to make do with the more limited opportunity for markets and services in smaller towns given the amount of production they bring to market, which in the South of Pará often does not amount to much.⁴⁷

⁴⁷ Total average perennial plantings on agricultural settlements in the region amounts to an average of 6.15 hectares, with a standard deviation of 19.13, according to data collected by Simmons et al. (2005).

To develop a variable representing distance to the closest town (including the aforementioned cities of Marabá and Eldorado do Carajás), I used a geospatial point database of municipality seats, combined with another piece of geographic data representing other small towns of consequence as denoted by IBGE (both municipality seats and other small towns came from the agency). These data were projected so that spatial references matched other data in my possession for the study area, and then were clipped so that towns far outside of the study area would not slow processing. I then input the towns layer into a GIS function calculating Euclidian (straight-line) distance. The resulting raster grid where each grain is comprised of observations whose value is the number of cells to the nearest town. Using the property-centroid layer developed above (described in section . Market Access: Distance to Major City) I extracted grid cell values for each property centroid to develop a variable indicating kilometer straight-line distance to the nearest town.

Over the entire study area, the average distance to the nearest town is 28.87 kilometers, with a standard deviation of 12.86 kilometers and a maximum distance of 62.33 kilometers.

4.2a2e. Market Access: Cost-Distance to Closest Town

Because road access has a significant impact on the ability of residents in the region (both largeholder and landless) to travel to town, I also created a measure of distance which took into account the travel cost associated with first gaining access to a major road (via straight-line distance from property centroid to major roadways), and then travelling to town.

Using the cost-weighted distance function built into many GIS software packages (in this case I used those functions included in ArcMap 9.3 Spatial Analyst extension) I input the towns layer described above (in section 4.2a2) as the “distance to” layer and a raster grid (a “cost” grid) where each cell contained the straight-line distance (in kilometers) to the nearest major highway (as described in section 4.2a2e). The resulting raster grid is comprised of cells whose values contain the relative travel distance to the nearest town. Of course, because distance to major highways was included as a “cost” surface in this calculation, those properties immediately next to roadways display much shorter relative travel distances than those further away.

Over the entire study area, the average cost-adjusted distance to the nearest town is only 3.39 kilometer equivalents, with a standard deviation of 4.74 kilometers and a maximum distance of 19.55 kilometers.

4.2b. Legal Status (Title Problems, Labor Violations, Environmental Violations)

Though the initial impetus for the development of social movement organizations focused on agrarian reform was actually due to a literal violation of longstanding land law in Brazil, as an occupation strategy, legal issues are increasingly being used to justify land in the South of Pará. Title problems have long been a major driver of land occupations, but more recently the strategy of social movements has been to target properties which have been the site of other serious legal problems, namely labor and environmental violations. The argument, most recently put forward by social movements and their leaders (and very infrequently by the rank-and-file movement members) is that landholdings which have played host to these illegal activities have been used to commit a crime, and therefore should be expropriated for agrarian reform purposes.

For their part, ranchers are afraid of being raided for legal problems, especially labor and environmental violations. Title problems are a different matter, however. As mentioned previously, many properties in the South of Pará, and throughout Brazil, suffer from extreme confusion over legal title. Though somewhat of a truism, a full, properly documented, and legitimate land title is very rare in the Brazilian Amazon. Many other types of authorizations (often dubious state-level grant papers and tax receipts), leases, and falsified documents are presented as legal documentation of ownership, but the fact remains that many of these documents are not definitive title. In the South of Pará, and especially in the region immediately around Marabá (the *poligono dos castanhais*), the majority of large ranches were leased to their owners under a system known as *aforamento perpétuo*, whereby the state of Pará (and not the federal government) issued long-term leases (in many cases perpetual leases, though some were leased to the landholders who control them for 99 years) for Brazil-nut and/or rubber extraction only. As mentioned above, the argument of landless groups in the South of Pará is that these long-term leases only allowed for extractive use of the properties in question, not deforestation and then ongoing cattle ranching. Regardless, only government officials did not indicate that questionable title status was a variable in determining a property's suitability for occupation.

The reasons for the impact of title status, beyond the fact that the apparent land owner may have no more legitimate claim to a property than the occupier who is trying to get it expropriated, are varied. Pessimistically, ranchers say that occupying properties with title problems is popular because any damage done to property infrastructure does not legally need to be repaid by occupiers (9 of 19). In other words, because the person

who built a fence, barn, or home on the property has no greater legal status than a long-term and well-endowed squatter, any damage done to these improvements, or even to crops and cattle, may not require compensation. This applies to occupations, though rare, where occupiers over-graze their own animals (horses, mules, cattle) and cause pasture degradation, which can cost over \$1,500 per hectare to remedy (Fearnside 2001a: 1369). Ranchers also insist that title issues open a property to occupation due to the fact that the occupation of such a property dovetails well with social movement rhetoric; land grabbers and *latifundiaristas* are the number one enemy of the landless, and a rancher with title problems is either one or the other to social movement members and leaders.

More than likely, however, social movements target properties with questionable title arrangements because they have learned over the years that the state, which is under pressure to enact land reform measures written into the constitution, finds it easier to justify expropriations of properties without them. Essentially, rather than find property to purchase from a legitimate owner, the state can legally justify the expropriation of property from illegitimate owners in order to redistribute it in a land reform program. Of course, ranchers are quick to point out that their belief as to why this is the case is that government agencies, and particularly INCRA, are faced with immense pressure to enact land reform and when an opportunity to expropriate a property with questionable legal title arises, they are afraid to anger social movements by denying them what they want. Though this is may or may not be the case, social movements *have* undertaken a significant number of occupations of government agencies themselves (especially the autonomous office of INCRA in Marabá) when promised or desired expropriations fail to materialize. This is often a shock to the status quo of the region; for many people this

unrepentant stand against powerful interests, be they largeholders or government agents, is unheard of an incredibly dangerous. No matter the reason, occupation of properties with title problems is among the most commonly mentioned characteristics, and some anecdotal evidence supports it; one social movement leader insisted legal issues on the property that eventually became the *Primeiro do Março* settlement were important in selecting it for occupation.

Beyond title problems, environmental violations are a near-universal concern for ranchers in the region; they frequently mentioned it as a likely characteristic encouraging land occupation (13 of 19). One rancher mentioned that if a property is discovered to have less than the minimum mandated forest cover (see Table 4.2) it is often mentioned in newspapers once IBAMA fines (or attempts to fine) the property holder.⁴⁸ This, of course, indicates the property is in poor legal standing and may be eligible for expropriation. “Raul,” a rancher near Marabá, indicated that if ranchers want to avoid property occupations they should, among other things, be sure to follow environmental laws because they are frequently used as a pretext for “invasion” (Raul 2008).

As would be expected, the majority of informants who believed environmental law violations were a criterion for occupation were ranchers, nearly all of whom stated that landless social movements sought out properties with environmental violations. Despite this fear, only one social movement member mentioned environmental violations as having an impact on the selection of a property for occupation (in the case of the Canudos settlement, near Eldorado do Carajás). Fearnside (2001a: 1364) mentions

⁴⁸ Landholders can be fined for every hectare deforested above the legal limit (now 20 percent of the property, see Table 4.2) of cleared area as well as for every hectare of burned land (the use of fire, though widespread, is illegal). Apparently, both of these conditions hold regardless of who set the fire or deforested the land (Leno 2007).

environmental violations as a possible point of argument between one social movement, the MST, and ranchers in the region, stating “the MST claims these concessions [ranches which were originally leased as extractive zones, a significant number of establishments in the region] allow only the harvest of Brazil nuts, not deforestation or logging.” By this measure, most ranches in the entire South of Pará, and certainly nearly every ranch in the *poligono dos castanhais*, is in violation of the law, even beyond the requirement of maintaining a required minimum forest reserve.

A more recent issue which may increase the likelihood of property occupation is labor relations. Over the past decade a number of proposals for a constitutional amendment requiring the expropriation, for agrarian reform purposes, of any property found employing slave labor, or any labor arrangement like slavery, have been proposed in Brazil, some garnering widespread support (e.g., Projeto de Emenda Constitucional nº 90/99, Projeto de Emenda Constitucional nº 90/01, and most recently Projeto de Emenda Constitucional nº 90/07). Though conservative politicians and many large property owners claim this is yet another assault on the sanctity of private property (and hold many claims of slave labor as false, see below), there is some legal precedent for the seizure of property hosting slave laborers in the current Brazilian Penal Code (2003). Though there is not currently a constitutional requirement for seizure, a number of ranches in the South of Pará have experienced expropriation after being cited for slave labor issues.

Social movement leaders specifically mentioned labor problems being a driving factor behind the occupation of the ranches that have since become the settlements of *Primeiro do Março*, near Marabá, and *Canudos* just outside of Eldorado do Carajás.

Underlining this point, all of the six ranches in the *poligono dos castanhais* which were raided for employing slave labor between 1980 and 2003 are now, in whole or in part, agrarian reform settlements. Ranchers are aware of this fact and plainly state that anyone wishing to retain their land would best avoid exploitative labor arrangements, or any appearance of slave labor, on their properties.

The issue of slave labor is highly contentious, and has a long history. Some authors have gone as far as to state that the opening of the Amazon to most forms of human exploitation occurred through slave labor arrangements (Foweraker 1981b; Allegretti 1990; Schmink and Wood 1992; Whitesell 1993; Brondízio 1997). Though Brazil fully abolished slavery in 1888, slavery did not altogether disappear in Brazil; various forms of labor exploitation continued to thrive, and many are still ongoing. Of particular historical importance in the South of Pará was the *aviamento* system, an arrangement whereby laborers in remote areas (typically collecting rubber latex, Brazil-nuts, and cultivating jute) were kept in perpetual indebtedness due to their reliance on the supplies sold to them at high prices by their employers (Foweraker 1981b; Hecht and Cockburn 1990; Schmink and Wood 1992; Brondízio 1997; WinklerPrins 2006). These sorts of labor arrangements persist today, though they are explicitly illegal and are prosecuted, masquerading as contract labor agreements (Le Breton 2003). The typical narrative of modern-day slavery begins in impoverished urban and rural areas; a surplus of untapped laborers willing to travel for work means that labor wranglers, called *gatos*, can easily convince workers to sign up and travel great distances (frequently piled into the back of a truck) for work. Typically, the work offered is clearing forest to make way for pasture, though other types of work may be offered as well. Once laborers arrive in

the remote forested area they are contracted to clear, they quickly realize that should they disagree with their employer, find the work unsuitable, or express displeasure in their living arrangements they will face violence and sometimes even death (Brandford and Glock 1985; Correio Editors 1999i; Branford and Rocha 2002; Sakamoto 2004a, 2004b; RepórterBrasil 2007). To make matters worse, contracted workers frequently arrive without tools and have to buy them from their employers – it should come as no surprise that these tools are sold to laborers at a massively inflated price (Brandford and Glock 1985; Branford and Rocha 2002). Due to the remote nature of the work, it is difficult to estimate how many people have been, or currently are, employed in this sort of arrangement, but the practice still continues today (Folhapress 2006). In cases where this labor practice is exposed, it is only thanks to intrepid workers who, after becoming fed up with violent exploitation, flee at great personal risk through miles of dense forest to denounce the practice at the nearest police station or Church (e.g., Barata 1995: 281, 315, 342, 460, 536, 621, 673, 696). When *gatos* (hired in order to defray the responsibility of largeholders for slave-labor on their properties; a landholder can argue that he just contracted with a labor-services company and had “no idea” about the slave-labor arrangement) and their employers are busted for this practice the number of people involved can be staggering. In November of 1987, one very large ranch in the *poligono dos castanhais* (Fazenda Bamerindus) was raided by the Federal Police for slave labor and poor working conditions and 400 laborers were liberated (Barata 1995: 621).

Despite the long history of modern slavery in the region, and the fact that as of 2006 there were sixty-seven largeholder ranchers and loggers on the *dirty list* of slave-labor violators in Pará alone (Folhapress 2006), ranchers insist that most claims are

spurious (12 of 19); according to largeholders slave labor does not exist except in very rare cases. One rancher stated that most claims are actually trumped-up out of poor living conditions (which are typically “above average” for laborers in the region). In his description, a largeholder hires a family to work on his farm, providing them the customary house to live in and helping them to meet basic needs in addition to earning a wage (Pereira 2006). In many cases, the house the landlord provides is “far superior” to the urban slums or rural shacks that the hired laborer would likely live in should they be unemployed. However, living conditions are Spartan, as many laborer’s homes do not have easy access to water and have poor home sanitation arrangements, which leads labor officials to declare the workers “slaves” when the farm is inspected (Pereira 2006). Though this description is surely accurate in rare cases, it is more likely that labor disputes involving a failure to pay for labor rendered are the true cause of many slave-labor busts.

Slave-labor raids generally involve a team of police officers and ministry of labor officials who survey living and working conditions of farm employees. Furthermore, they often conduct interviews with workers. Initial violations are generally punished by public humiliation of the landholder through newspaper reports of slave labor, fines, and generally increased oversight (Sousa 2002; RepórterBrasil 2004; Sakamoto 2004a, 2004b). The reaction by largeholders is generally denial, and a legal battle to avoid paying fees (Tocantins 2003). Further (i.e., second and third) violations may entail the expropriation of a property on which slave-labor was discovered (Câmara 2008).

A final word regarding the importance of these characteristics in influencing the likelihood of occupation by social movements is necessary here. While social movement

members are certainly concerned with labor violations, the title status of properties, and environmental violations, none of these variables is strictly necessary for an occupation to be a “success” in the view of a typical would-be smallholder. Therefore, these variables are considered to be of importance to social movements in divided model results presented later in this chapter.

4.2b1. Measuring Legal Status

If developing measurements for market access/media exposure was difficult in the case of proximity to town and proximity to road variables, entering the realm of legal violations is even more so. Because title, labor, and environmental problems all indicate some violation of the law in cases where they are discovered, and are likely a problem on a large number of properties in the region even when left undiscovered, one cannot simply start asking about these issues without being at risk for potentially violent repercussions. Therefore, I have used secondary data to develop the following measurements:

4.2b1a. Title or Legal Problems

Given the ambiguities and difficulties associated with figuring out exactly who owns what in the Amazon region, which was discussed at some length earlier in this chapter, developing a variable signifying those properties with title problems is a difficult prospect. Fortunately, in an effort to overview the largeholder ownership situation in the heyday of the Carajás project, the state agencies of SUDAM, IDESP (the state of Pará’s institute of social and economic development, Instituto do Desenvolvimento Econômico-Social do Pará), DRN (the federal natural resources department, Departamento de Recursos Naturais), MIRAD (the ministry of agrarian reform and development,

Ministério da Reforma e do Desenvolvimento do Agrário), INCRA, and ITERPA collaborated to publish a map titled “Profile of the occupation of land and subsoil in Pará: Polígono dos Castanhais, ownership situation, forest cover, and transportation” which includes, as of 1990, the legal land-tenure situation for each largeholding in the region of interest in this study (SUDAM 1990).

The map includes a number of different legal categories for land tenure status, but for the purposes of this analysis, all properties which were not accorded “definitive title” in some manner (either from the state or various land reform agencies) were assigned a value of “1,” thereby indicating their status as having “title problems.” A select number of properties (eleven) did not have information about their legal status, and were assigned a value of “1” as well, given that if the state does not know their status it is likely that an occupation would be at least as likely to succeed on a property without legal status information as one on which title was not assigned. All told, 143 properties have shaky, or no, legal documentation.

4.2b1b. Environmental Violations Variables

Due to the importance of environmental law violations according to social movement organization members, ranchers, and researchers, I developed two variables indicating cases of environmental law violations, both coming from different sources. First, I created a binary variable where those properties which were reported in the news-media (in *O Marabá*, *Correio do Tocantins*, or *Opinião!*) between 1980 and 2003 as having environmental violations of some kind (typically illegal logging, logging beyond forest-reserve law limits, logging along rivers or streams, or out of control fires were the offences listed) are assigned a value of “1.” In this variable a value of “1” can indicate

more than one environmental law violation. According to newspaper accounts, eight properties had environmental violations between 1984 and 2003.

Because newspaper accounts tend only to list those environmental violations which are either extremely egregious or which have caught the eye of somewhat “visually impaired” authorities,⁴⁹ I developed a second environmental law violation variable using classified remotely sensed data. The idea to do so stems from the fact is that local folks involved in SMOs might know of actual environmental law infractions before the authorities, and therefore might pass this information on to SMO leaders. This variable is also binary, where each property which has a forest-reserve law violation (see Table 4.2) as measured by remote sensing for the period before occupation is assigned a value of “1.” While there is some overlap between these two variables, which is to be expected given that they measure the same phenomenon, there is only a fifty percent agreement. Satellite image analysis indicates that, for the forest-reserve law in the year before occupation, ten properties had environmental violations between 1984 and 2003.

Finally, I created a combination variable (also binary) indicating those properties listed as having either a news-media reported environmental violation or a remote sensing detected environmental violation. Fourteen properties had an environmental violation of either (or both) varieties.

4.2b1c. Labor Violations

As already mentioned, labor relations are a serious problem in Amazônia, and particularly in the South of Pará. Between 1980 and 2003 eleven of 180 properties in the

⁴⁹ Environmental violations generally go unnoticed and/or unpunished. Between 1980 and 2003 there were only 8 environmental violations reported in newspapers on the 180 large properties in the analysis sample. Remote sensing evaluation yielded another six. However, as of 2003, 162 of the 180 properties in the analysis sample had proportional forest cover *below* the 20% mark required by the law at the time.

poligono dos castanhais were raided for conditions of slavery, whether outright slavery or wage peonage, and another six were fined for poor working conditions. Labor violations are obviously a sensitive topic among largeholders in the region, for reasons covered previously, so, rather than approaching key informants directly about slavery and other labor problems, I again turned to newspaper records. The variable accounting for labor violations is binary, indicating which properties have experienced some sort of raid or repercussion for poor or illegal labor conditions with a “1.”

4.2c. Quality of the Resource Base (Large Forest Reserve/Open Land, Better Soils, Water Access)

Among the most intuitive characteristics encouraging “successful” occupation of properties by social movement organizations focusing on agrarian reform is, at first glance, likely to be that the occupied land be able to support would-be smallholder colonists. Indeed, ranchers, government officials, and SMO leaders and members all mention one or more resource quality variables as important in Table 4.6. However, in terms of achieving goals, the landless movement members themselves likely care more about these characteristics as they determine the agricultural success new colonists may have. Therefore, in the divided models presented later in this chapter, these variables are considered in the “resource quality” models rather than the SMO-focused “exposure” models.

One of the most common assertions about property characteristics which may encourage property occupation is the presence of a large forest reserve, which is actually mandated by current environmental law (a reserve eighty percent of the size of the property is the current legal requirement for large properties in the Legal Amazon, see Table 4.2, below). Despite this, the vast majority of properties in my sample exceeded the

twenty percent limit on deforestation long ago. Though much, if not all, of this deforestation was undertaken in order to expand areas under agricultural production, paradoxically there may be legal benefits to the violation of environmental law. In the current national constitution, a series of articles (articles 189, 191, and 196 in Brasil 1988) allow for the expropriation of property which is not meeting its “social function,” but the language is not at all clear on what “social function” may be and how a property could be evaluated for meeting it. In Amazonia, given a plethora of ownership pitfalls and constitutional license for the occupation of private or public property (when the owner does not evict the occupier), one way to assert land rights is to deforest, as most forested areas are considered “unused” and therefore, perhaps, not meeting their social function.

Year	Required Forest Reserve Size	Applicable Legal Statute
1986*	20%	Law no. 7.511, July 7, 1986*
1989	50%	Law no. 7.803, July 18 1989
2001	80%	Medida provisória no. 2.166-67, August 24, 2001

* Law 7.511, July 7, 1986 slightly altered law 4.771, of September 16, 1965 (which itself was reaffirmed through law 6.535, June 15, 1978) and established a national forestry code.

Table 4.2. Legally mandated forest reserve for properties in forested regions of the legal Amazon, according to federal law.

Perhaps not surprisingly, the only group of actors in the region to neglect mentioning the impact of forest reserves on property selection was government officials. Otherwise, social movement members, key-informants, and ranchers all indicate that a large forest reserve may encourage occupation. Furthermore, it is the most common claim in the academic literature, most likely because it is a glaring policy contradiction which

can, and has, led to significant deforestation (Bunker 1981; Foweraker 1981a; Schmink and Wood 1992; Simmons 2002; Simmons et al. 2002). However, each of these groups disagree on the reasons for the tendency, though literature dealing with land conflict and land reform tends to mention some or all of these reasons in its treatment of them.

The most common reason among all informants for the perceived predisposition of social movements for the occupation of properties with forest reserves is that they tend to indicate a property is “unproductive” and not meeting its “social function,” making it eligible for expropriation in the eyes of social movement leaders. Nearly every rancher I spoke with (15 of 19) indicated that forest reserves are interpreted as “unproductive,” despite being legally required; the majority of those that remained in the region have been cut down to avoid expropriation (Raul 2008). Even the landless movements and their members are not coy about this part of their strategy; forest resources were mentioned as influencing selection of lots by 6 percent of social movement members surveyed by the Simmons et al. (2005) study on agricultural settlements in the region ($n=93$), and key-informants involved in social movements (mainly the MST) on three settlements indicated that targeting properties with forest reserves was part of their strategy to acquire land through occupation.

As frequent as statements about forest reserves being viewed as unproductive were, other reasons for occupying properties with large forest areas were mentioned by nearly every agent group (with the exception of government officials) and in the academic literature on the topic. For instance, ranchers and landless movement members both agree that forest areas are attractive to occupiers because they have wood which can be sold to meet their short-term needs. Essentially, once a property occupation is

underway the occupier removes valuable timber and sells it, illegally, to loggers who will pick up the cut trees and bring them to sawmills. While social movement members in the settlement of *Santa Maria do Pontal*, located thirty kilometers to the northwest of Eldorado do Carajás, mentioned why the land which was once a large ranch was occupied, they responded by saying one of the attractive components of the farm was its large stand of trees which might be useful to occupiers. The practice of occupiers selling timber from their land raises the ire of many ranchers in the region; one rancher, “José” insisted that “[occupiers] only invade forest reserves because they can sell the wood.” A number of authors have mentioned this practice as well, which is unsurprising given it is a common tactic among smallholder farmers in the Amazon who have not won their land through occupation and direct action land reform (Foweraker 1981b; Pace 1992; Fearnside 2001a; Simmons et al. 2002).

A few ranchers (3 of 19) also feel that occupiers might target properties with forest reserves because landholders can be fined for illegal deforestation on their property, even when the landholder is not the responsible party. In other words, if property occupiers remove forest cover, which qualifies as illegal deforestation, the rancher can be held responsible for it. One rancher balked at the incredulity of the legal situation that ranchers in this case would be put in, and was quite adamant about his belief that the landless enact the strategy of occupying properties with forest in order to encourage just this sort of retribution.

The remaining reasons for occupying properties with large forest reserves were mentioned only in the literature; apparently the landless are content to exploit the popular belief that forested areas are “unproductive” and to target properties in order to remove

the occasional tree from their reserve to meet a medical cost or to pay for something needed (of course, there may be instances of substantial deforestation by occupiers). Similarly, ranchers feel the only reasons for occupying properties with forest are the above two, plus the “fact” that occupiers want to get them into trouble with IBAMA, the national environmental protection agency. Researchers, however, feel otherwise, and point to a number of other reasons why the landless might target properties with significant forest cover (Foweraker 1981b; Fearnside 1987; Hall 1989; de Almeida 1990; Pace 1992; Alston et al. 2000; Fearnside 2001a; Branford and Rocha 2002; Simmons et al. 2002; Simmons, Walker et al. 2007). One idea is that property occupiers might want to deforest reserves in order to either clear the land for future sale, or to be reimbursed for the “improvements” they have made in the case that they are evicted, as required by law. Though this legal requirement would appear to encourage deforestation by occupiers, as well as an “industry of occupation” (which some authors have described, e.g., Fearnside 2001a) functioning primarily to be paid for work done to “improve” occupied properties, in practice there does not appear to be a significant number of cases which could be described as falling into this category, at least in the South of Pará. In fact, in a search of over 5,000 articles from two regional newspapers (*Correio do Tocantins*, and *Opinião!*) between January 1980 and July 2007 not a single case of a rancher reimbursing an evicted occupier for clearing appears to exist.

Simmons et al. (2002) and Fearnside (2001a) both describe forest reserves as being a handy hiding place for occupiers as well. Indeed, as most of the ranches in the South of Pará are large (those in the *poligono dos castanhais* have an average size of seventeen square miles, with the largest being over half the size of Cape Cod,

Massachusetts), it is understandable that within a substantial forest reserve, even one of less than the legal requirement, it would be difficult to happen upon occupiers. Another reason which both of the aforementioned authors mention as potentially important for occupiers is that landholders are not as keen to use forested areas, so these reserves are less likely to attract reprisals and violence as an occupation in the middle of an active pasture. Finally, Simmons et al. (2002) and Fearnside (2001a) point out that land under primary forest cover has a much lower likelihood of fertility problems, soil compaction, and other symptoms of degradation which are common on current or former pastureland.

Forest cover changes over time due to agricultural expansion, logging, fire, and other activities and hazards in the region, but this change is not necessarily unidirectional; as older agricultural areas fall out of production due to fertility declines, forest cover on select properties may actually appear to *increase*. Though some researchers have worked under the assumption that forest, once cut down, will not regenerate (e.g., Skole and Tucker 1993; Moran and Brondizio 1998; Wood and Skole 1998; McCracken et al. 1999; Lambin et al. 2003), this relies on a relatively precise ability to separate secondary-growth forests from primary forests. Because I have only limited ground-truth verification data, I have decided to leave satellite image classifications of forest cover remain unmanipulated (and therefore, a very few select properties show increases in forest cover in certain time periods). The overall trend, however, is a decrease in forest cover over time.

In contrast to the notion that forested areas predispose properties to occupation, some key-informants, and a few researchers, indicate that properties with significant amounts of open land (i.e., already deforested land) may be more attractive to social

movements. In particular, one INCRA official stated that social movements are attracted to areas which have recently been in agricultural production because they provide a more direct path to use; logging in the forests of the region is not an easy task, especially for an occupier who very likely does not own a chainsaw. Alston et al. (2000) mention this strategy explicitly, stating that cleared land has higher value and is therefore more attractive to occupiers. The downside to selecting properties with open land is that they are harder to get the federal government to expropriate, given their status as deforested and hence more likely to be seen as “productive” and therefore ineligible for expropriation.

Despite these drawbacks, and the fact that deforested areas in the region typically have problems with soil fertility, erosion, soil compaction, weeds, and pests, ranchers are somewhat concerned about this strategy (6 of 19). Because so many ranchers feel that occupiers are on a quest to “steal,” and then sell, property on ranches in the region, they feel that the landless select high-value land that can be exploited (e.g., ranches at higher-than-capacity stocking levels) and then sold or abandoned once fertility problems arise. One rancher even stated that he felt most of the pasture degradation in the region was due to the overuse of pastures by the current and former landless (Gil 2007). Wright and Wolford (2003) mention this strategy but indicate its purpose is to gain land for occupiers which can be used without expensive and time-consuming (not to mention illegal) logging. Finally, one social movement leader indicated that cleared land was an important characteristic driving the occupation of the ranch which eventually became the *Palmares II* settlement. Being the obverse of forest cover, as least in the conceptualization of land-cover which this analysis is based upon, no specific variable for the amount of open land

was developed for this analysis. This is to avoid double-counting the impacts of forest cover (or its absence).

Beyond land cover, if the goal of a property occupation (especially for would-be colonists who are SMO members) is to bring about the expropriation of private property for the establishment of agrarian reform settlements, then it follows that land with agricultural potential would be a prerequisite. Indeed, Fearnside (2001a) claims that soil quality is an important consideration among property occupiers. One in ten⁵⁰ social movement members currently living on lots in agrarian reform settlements claim that, in selecting their individual properties, good soil and water access (see below) were important.

What is interesting, however, is that ranchers (5 of 19) and researchers tend to emphasize soil quality more than social movements, a fact one INCRA agronomist emphasized with some consternation, stating that the MST rejected his team's suggested location for a new agrarian reform settlement in favor of a ranch with poor soils. Ranchers are among the most emphatic proponents of soil quality being a criterion for occupation; one rancher stated that SMOs did not "mess around" with fertilizer because it was expensive, so better soils are more attractive (José 2006).

Large portions of the Amazon basin are known for their highly weathered Oxisols and Ultisols, which are of very poor to moderate suitability for agriculture of various types (Gourou 1949; Sombroek 1966; Falesi 1974; Smith 1980; Furley 1990; Meggers 1996; Cleary 2001b; Denevan 2001). Obviously, impoverished property occupiers typically do not have the resources available to purchase large amounts of fertilizer

⁵⁰ Ten percent of social movement members who were not assigned their lots by SMOs or INCRA. Ten of 96 respondents in the Simmons et al. (2005).

inputs, and therefore would prefer soils that are of higher natural fertility for smallholder agriculture.

In addition to suitable soils, a pronounced dry season makes water access important for agriculture, a characteristic mentioned by one government official, and Brandford and Rocha (2002), as likely to encourage occupation. Would-be colonists are hesitant to live in a place without water for household needs and rudimentary irrigation activities. However, as in the case of soils, the same INCRA agronomist indicated that water access, while important, falls by the wayside in favor of land which may be more in-line with a social movement's political goals.

Though the eastern Amazon, where the *poligono dos castanhais* is located, is by no means an arid environment, with an average rainfall of just over 2,000 millimeters (2081.62 mm, or 81.95 inches), there is pronounced dry season in this part of the basin where monthly rainfall can dip below 20 mm (0.79 inches). Because of this marked dry season, water access for irrigation and household needs can be a nontrivial concern; those who cannot afford wells are often forced to rely on surface water, which can be hard to come by during the dry season (which extends from June through September). Therefore, water access is important, a fact well represented in key informant responses.

4.2c1. Measuring Forest Cover

To develop the sole variable measuring the size of forest reserves in these logistic regression models, proportion forest in the time period before the first occupation of a property, I had to undertake extensive pre-processing, classification, and post-processing of Landsat MSS, TM, and ETM imagery for nine years between 1984 and 2003. The images are all for path 223, row 64 of the second World Reference System (WRS-2).

Table 4.3 provides a summary of the year, date, sensor involved, root mean squared error (RMSE) resulting from georectification, and calculated percent cloud cover for each scene used.

Year	Sensor	Date Acquired	Overall RMSE ¹	Percent Cloud Cover ²
1984	Indicated as Landsat TM	July 11th	0.913	0 %
1986	Landsat MSS	August 2nd	0.903	0 %
1988	Landsat 5 TM	July 22nd	0.888	< 1 %
1996	Landsat 5 TM	June 10th	0.524	0 %
1999	Landsat 7 ETM	July 13th	0.523	0 %
2000	Landsat 7 ETM	July 31st	Orthorectified	< 1 %
2001	Landsat 7 ETM	July 18th	0.763	1.2 %
2002	Landsat 7 ETM	August 22nd	0.683	< 1 %
2003	Landsat 7 ETM	May 21st	0.412	1.3 %

Notes: ¹RMSE calculated from 30 control points matched in each image to the July 31, 2001 Landsat ETM+ image which was provided in an orthorectified state. ²Percent cloud cover for the entire scene (clouds and cloud-shadows) as calculated from land-cover classifications.

Table 4.3. Landsat imagery for Path 223, Row 64 used to calculate land-cover measurements on properties in the South of Pará.

The first step of the land-cover classifications was to acquire the imagery from various low-cost or free-of-charge sources. Though the Landsat imagery archive is beginning to offer all imagery in the archive free of charge, at the time of data processing the necessary images were not available through these channels. Instead, I made use of the Global Land Cover Facility at the University of Maryland and Landsat.org at Michigan State University in order to acquire the imagery listed in Table 4.3. Once I downloaded the imagery I had to assemble and import them into remote sensing software, in this case Erdas Imagine 9.1.

Preprocessing involved making sure spatial reference information was included, and in agreement, between each satellite image. All images were made available to me in

the Universal Transverse Mercator (UTM) projection for UTM Zone 16, units in meters, and in the World Geodetic Survey of 1984 (WGS84) datum. Due to a number of slightly different processing lineages and spatial “float” in the sensor itself, the satellite image data were not in complete spatial agreement. Therefore, I made use of an orthorectified image acquired on July 31st, 2000 and processed in order to remove terrain and sensor-based spatial and geometric inaccuracies. Using this image, I matched between thirty-one and thirty-eight control-points between each image and the July 31st, 2000 Landsat ETM image which had been orthorectified. After matching landscape features (typically human-created features such as bridges and significant landmarks like town-squares and landing strips) I removed the single most erroneous control point and completed a geometric correction using bilinear interpolation. RMSE values reported in Table 4.3 indicate the spatial error associated with this transformation. All images have a 28.5 meter cell size and are projected in UTM Zone 16, South with the WGS1984 datum. Finally, in order to keep land-cover scene extent constant, I windowed each image to be equal to the largest area overlapping all bands of all of the Landsat images listed in Table 4.3.

Many remote sensing applications for land cover involve the development of spectral signatures for various land cover classes of significance (e.g., forest cover or urban areas) and derive land-cover maps from them. In these signature-development methods the researcher or technician uses a large amount of ground-collected data with which to “train” a supervised classifier (Lillisand et al. 2008). The idea is to provide the supervised classifier with enough, in this case cross-spectral, information that the classifier is able to assign each and every pixel in a satellite image to a land-cover

category based on its spectral characteristics. Because of the amount of reference data necessary to use supervised classification methods for land-cover mapping, I opted to use a hybrid approach; to make up for my inability to collect reference signature data, which was beyond the temporal and financial means of this study, I have employed unsupervised, statistical, classification routines, followed by statistical class elimination and finally class assignment using visual inspection. These methods have been used in other studies in the Amazon, notably by Messina et al. (2000, 2001; 2005) in Ecuador, but also in the Brazilian Amazon as well (Aldrich et al. 2006; Simmons, Walker et al. 2007).

The first classification step involved using Erdas Imagine's "Unsupervised Classification" routine (using the ISodata algorithm). Unsupervised classification routines divide images into spectrally related groups using statistical comparison. ISodata (Iterative Self-Organizing Data Analysis Techniques), one of two commonly employed, and highly similar, unsupervised statistical classifiers (the other being *k*-means), operates by using an arbitrarily set number of clusters which the user provides. The algorithm assigns each pixel to a cluster based upon its values. All clusters are then evaluated by the algorithm in order to drop pixels from clusters if they do not meet some selection criteria (often simply percentage of pixels with membership, or perhaps distance from means). The algorithm then recalculates cluster membership, splitting and combining clusters based upon input conditions until convergence or a threshold value is met (Jensen 1996). In the case of multi-spectral satellite imagery, such as Landsat MSS, TM, and ETM scenes, ISodata iterates on the multi-spectral values of the images (i.e., ISodata iterates on each spectral band in the layer-stacked image).

For the Landsat image classifications used in this dissertation I set initial values for the ISodata algorithm to cluster the image into 255 classes by iterating as many times as necessary to meet a convergence criteria of 0.980 (98 percent). Data processing for this step of the classification process was computationally intensive. In no case was I able to cluster more than two images in a day.

While unsupervised classification routines are very effective at parceling out the landscape into statistically dissimilar categories without user intervention (and therefore, perhaps, the addition of bias in land-cover classes), their output is generally not immediately useful. Significant post-processing is necessary to make sense of algorithm outputs. In the case of the ISodata clustering I performed for this analysis, with each output being a single-layer raster grid with 255 statistically dissimilar categories, the 255 categories needed to be collapsed into a more manageable subset of meaningful land-cover classes.

In order to evaluate which of the 255 land-cover classes are different (separable) from one another, I employed a transformed divergence matrix to evaluate which classes were more likely to be confused, and eliminated them. Specifically, by manually iterating through the 255 classes ten at a time, I evaluated classes based upon their transformed divergence matrix values. Because the images had a wide variety of different land-cover characteristics including sand dunes, rivers and other water bodies, forests, urban areas, exposed soils, burn scars, electric transmission lines, and roads, I compared each class having a matrix value of less than 1940 (with transformed divergence measures a value of 2000 indicates perfect divergence, or separation, and a value of 0 indicates perfect convergence – values closer to 2000 are desirable) with other classes and eliminated

those classes which were most confused. This labor-intensive process resulted in between 25 and 42 remaining classes, depending on the individual image. These classes constitute a statistically (instead of manually or assembled from field-data) derived spectral signature for various land-covers, and therefore were used as an input in a “Supervised Classification” in Erdas Imagine.

For every image I used a combination of visual inspection and, for early images, 1:250,000 topographic maps, to name the land-cover classes which resulted from the supervised classification routine. I named five level-one land-cover classes: forest, not-forest, water, clouds, and cloud-shadow. No post processing was performed in order force those areas classified as not-forest to remain that way over time (i.e., not-forest areas were allowed to change, over time, back into forest) in order to allow for the occasional case of areas in the region which are secondary growth nearing maturity.

Once these five-category raster land-cover maps were complete, I processed them to remove very small isolated instances of certain land-covers, assigning these pixels to a nearby class. For example, if a two-pixel area (i.e., any cluster less than 3-pixels in size) of forest was classified in the middle of an expansive not-forest area it was reassigned to the not-forest class. This is to avoid a “salt-and-pepper” landscape in locations where this is likely not the case. I note, however, that this was a common problem in one medium-sized rocky outcrop outside of the analysis area, and in this case some information was lost. Since this rocky outcrop is not part of the primary analysis area, I deemed it an unimportant change.

Accuracy assessment of land-cover maps created from remotely sensed imagery is one of the most important steps of any application of these technologies, and is perhaps

the most difficult and costly to perform in any environment. The task becomes even more difficult in the remote Amazon, where access is difficult and expensive and repeat visits are nearly impossible, especially over the decades covered by this land-cover analysis. Therefore, a significant limitation of this study is that land-cover data, with the exception of that for 2003, is presented without accuracy assessment. However, as can be seen from the 94,911.87 hectares for which I collected ground cover data in the summer of 2007 (two categories only, forest and not-forest, Table 4.4), the classification method has done a fairly acceptable job of classifying the gross, level-one land-cover classes important to this study, especially considering the four years between the last land-cover classification and the collection of field data. Because I classified each Landsat scene using the same methods, using none of my input until the very last stage, my assumption is that land-cover for each year is reasonably accurate.

		2007 Field Data	
		Forest	Not-Forest
2003 Land-Cover Classification	Forest	82.81%	10.23%
	Not-Forest	17.19%	89.77%

Table 4.4. Cross tabulation of 2007 Field Data and those same areas according to 2003 Landast ETM image classification. Forest/Not-Forest categories only.

Over time, forest cover on largeholdings in the region shows a precipitous decline, as can be seen in average proportion forest calculations for each year for which land-cover data were created (Table 4.5). In 1984, forest cover is quite high, at an average of just over eighty-six percent, but within twelve years average forest cover dropped to just under forty-six percent. The average proportion of forest cover would again drop by nearly half by 2003, to just under twenty-five percent (Table 4.5). One

interesting point is that the minimum percent forest cover on properties was already quite low in 1984, representing properties near the city of Marabá which had already been almost completely deforested. In contrast, the maximum forest cover observations for 1984 indicate at least one property, and upon visual inspection a handful of others can be picked out, where nearly no deforestation has taken place. Even in 2003 there we still five properties where over half of the forest cover remains.

Proportion Forest (<i>n</i> =180)	Mean	Deforestation Rate	Standard Deviation	Minimum	Maximum
1984	86.01%	–	17.57%	3.00%	99.96%
1986	77.58%	4.5%	21.72%	0.03%	99.86%
1988	70.26%	3.5%	23.05%	1.33%	98.44%
1996	45.85%	3.1%	23.03%	0.07%	96.57%
1999	37.63%	2.7%	21.90%	0.11%	91.49%
2000	35.20%	2.4%	20.83%	0.35%	88.04%
2001	30.32%	4.8%	18.67%	0.58%	88.12%
2002	26.37%	4.0%	17.98%	0.00%	89.49%
2003	24.81%	1.6%	12.91%	0.58%	73.46%

Table 4.5. Summary of proportion forest on properties (*n*=180) in the South of Pará.

Deforestation rates have changed significantly over time, with strong deforestation in the mid-1980s which persisted, though declined, through the mid-1990s. Between 1996 and 2000, the rate dipped under three percent deforestation per year, but the dip was not long lived; by 2001 the rate surged to nearly five percent, and stayed high until 2003 when a significant decline to less than two percent per year is evident (Table 4.5). Since 2003, however, there has been a significant uptick in deforestation in Amazonia, though much of it is focused in the state of Mato Grosso, which is predisposed to mechanized agriculture for a variety of reasons (Lentini et al. 2005; Brasil 2008a; Brasil 2008b; Globo 2008; Sant'Anna 2008).

To measure the impact of forest cover on property occupations, given that it is listed by every category of informant besides government officials, and of apparent importance to ranchers in the region (15 of 19 mentioned large forest reserves as important), I developed a variable indicating the proportion (thereby limiting the need to control for property size) of forest on each property during the time period before occupation. For example, in the logistic regression model covering the predisposing factors for occupations of largeholdings in 1986, the observations for the proportion forest variable are the proportion forest measured on each property in 1984, the time step before the occupation.

4.2c2. Measuring Soil Quality

To develop a variable indicating soil suitability I made use of a soil map for the State of Pará developed by the Brazilian national agricultural extension service, EMBRAPA (Empresa Brasileira de Pesquisa Agropecuária) and a few other sources (see Table 4.6), to develop a binary variable indicating those properties which had some soil of at least moderate suitability for smallholder agriculture.⁵¹ I note that smallholder agriculture in the region can be executed on soils in locations which are less suitable for ranching, such as seasonally flooded soils along riparian zones which tend to have very high suitability for subsistence agriculture but are completely unusable during high-water periods (and therefore not prime grazing lands for large cattle operations). Table 4.6 lists the soils found in the region and their assigned suitability, as indicated by sources in the right-most column, for smallholder agriculture. Seventy-nine properties of the 180

⁵¹ In this research I *do not* evaluate soil suitability for largeholder production systems (i.e., ranching and mechanized soy), nor do I evaluate what reasonable agricultural practice may be on these soils.

properties in this analysis have at least ten percent of the property with moderate to very high suitability for smallholder agriculture.

Brazilian Soil Name (English)	Assigned Suitability	Source
Areias Quartzosas (Quartzose Sands)	Low	(RADAM-BRASIL 2004; Gomes de Sousa and Lobato 2007)
Brunizem Avermelhado (Purple Brunizem)	Very High	(RADAM-BRASIL 2004)
Cambissolo (Cambisol)	Low	(RADAM-BRASIL 2004)
Gleissolo	Low	(Gomes de Sousa and Lobato 2007)
Latossolo Amarelo (Yellow Latisol)	Moderate	(RADAM-BRASIL 2004)
Latossolo Vermelho-Amarelo (Red-Yellow Latisol)	Moderate	(RADAM-BRASIL 2004)
Latossolo Vermelho-Escuro (Dark Red Latisol)	Moderate	(RADAM-BRASIL 2004)
Podzolico Vermelho-Amarelo (Red-Yellow Podisol)	Moderate	(RADAM-BRASIL 2004)
Podzolico Vermelho-Escuro (Dark Red Podisol)	Moderate	(RADAM-BRASIL 2004)
Solos Aluviais (Aluvial Soils, often seasonally flooded)	High	(Goulding et al. 1996)
Solos Litolicos (Histosols/Aquents)	Low	(Eswaran et al. 2003: 138)

Table 4.6. Soils found in the study area, with assigned suitability (low to very high) and the source for the classification. Note that named suitability classes denote suitability for smallholder agriculture and not largeholder ranching.

4.2c3. Measuring Water Accessibility

In order to assess the impact of water access on occupation likelihood I developed a variable where each observation is the straight-line distance from the centroid of the property to the nearest river or stream.⁵² River or stream location data for the region come

⁵² Topography plays a role in water accessibility as well, though for the area covered by the properties of focus in this analysis the range of elevation is slight, ranging from approximately 70 to 380 meters. While

from a highly detailed dataset developed through the Carbon in the Amazon River Experiment, which is part of the Large-Scale Biosphere-Atmosphere Experiment in Amazonia, and were clipped to the study area (Mayorga et al. 2006). The average distance from property centers to the nearest river or stream is just less than a kilometer: 776 meters, with the maximum distance being 4.53 kilometers.

4.2d. Latifúndia and Latifúndiaristas

One of the basic tenets of the ideology of landless social movements throughout Latin America is the fight against *latifúndio* – large, mostly unproductive, properties often controlled by a malignant oligarch. In Brazil, SMOs focusing on land reform are no exception, and in some sense they have reinvented the fight against *latifúndio* through contentious tactics. In the discourse of social movements, large property size more or less equates to unproductive *latifúndio*, which means the larger the property, the greater the likelihood of occupation (a fact many researchers have mentioned, e.g., Hall 1989; Branford and Rocha 2002; Simmons et al. 2002; Simmons, Walker et al. 2007).

In the case of the 17 de Abril settlement, near Eldorado do Carajás, property size was explicitly mentioned by social movement members and leaders and being one reason why the property was selected for DALR (though the property never experienced a sustained occupation the way many others in the region have). Furthermore, one of the premiere social movements in the region, the MST, states the fight against *latifúndio* in

there are some areas where local topography is severe, these are outside of the properties considered here. Further work may be enriched by the consideration of topography.

Brazil is one of its constant political goals: “The MST has always stated that its principal enemy in its political fight is *latifúndio*” (MST 2004)⁵³.

The assumption here is that larger properties are more likely to be found unproductive if evaluated by the government, and therefore will be eligible for expropriation. In other words, if the ultimate goal is, as the MST states, to acquire land locked up by the wealthy, the odds that an occupation will result in expropriation may be better if the property itself is large. Largeholders are aware of this strategy and speak of splitting up large properties and putting them in the name of children, spouses, fathers, and other relatives in order to hide their true size (Raul 2008). Still, when a property is large enough, or if a memory of it being one management unit is strong enough (as in the cases of Fazenda Bamerindus and Fazenda Macaxeira, both of which property which were nominally split into multiple smaller properties to no effect), this strategy is not likely to work in the largeholder’s favor, even if the property is “productive.”

Because the fight against large properties forms a significant part of the ideological basis of many social movement organizations, it is a potentially powerful explanatory variable. It comes as no surprise that social movement organizations bent on ending *latifúndia* in Brazil are apt to target large properties when deciding which to occupy. Furthermore, given the relative success of these social movements in occupying and eventually acquiring property in this manner, it is no shock that even those would-be settlers who take it upon themselves to occupy a property may also target larger examples in the region.

⁵³ Portuguese text reads: “O MST sempre colocou em sua luta política que nosso inimigo principal é o latifúndio.” Translation by S. Aldrich, September 4th, 2008.

A further possible indicator of the struggle for land is that SMOs in the region have, over years of violent clashes with largeholders in the region, developed a set of enemies. Cast in less polarizing terms, there are a set of largeholders, indicated in accounts of conflict from newspaper articles and books on the struggle for land in the region, who are more active in their response to threats to their property. Essentially, social movements can be said to target particularly notorious largeholders for direct action, perhaps knowing that such activities would be more likely to garner media attention. The motivation to act against these largeholders likely stems from the desire for media exposure, but also from the fact that many well-known ranching families are indeed the declared enemies of the landless movements in the region.

Some methods of measuring the impact of *latifúndia* on property occupations are straightforward; property size is an intuitive and easily measurable phenomenon. For the targeting of specific largeholder *latifúndiaristas*, or notorious largeholders, the method is less obvious. To address property size, I developed two variables. Another variable attempts to measure the influence of conflict between SMOs and particular largeholder enterprises or families (*latifúndiaristas*).

4.2d1. Measuring Property Size

Though measuring a large property is as simple as acquiring its boundary and then calculating area using commonly available geographic information systems functions, I chose to measure property size (or, more accurately, large property size) in two different manners.

4.2d1a. Property Size in Hectares

Though somewhat obvious, one way to measure property size is through the aforementioned simple area measurement technique. In particular, I include the area of each largeholding in hectares in some of the models presented below. The idea is that larger properties may increase a property's odds of occupation.

Mean property size for the 180 properties in the region which are considered in this analysis is 4,886.27 hectares (standard deviation of 4,666.413), with the smallest being 564.729 hectares and the largest being 56,035.24 hectares.

4.2d1b. Latifúndio Binary

Because the goal of including a property size variable in these models is to account for the targeting of larger properties (what SMOs would refer to as *latifúndio*), I also developed a variable where each property larger than the regional average (i.e., those properties larger than 4,886.27 hectares) were assigned a value of "1." In other words, a value of "1" in this variable indicates the property is larger than average, and therefore may be considered *latifúndio* by would-be occupiers and hence may be more likely to be occupied.

In all, fifty of the 180 properties in the region are larger than the average size. This means approximately twenty-eight percent of the properties in the region are potential *latifúndio*. Half of these fifty properties were occupied at least once between 1980 and 2003.

4.2d1c. Measuring SMO Targeting of Latifúndiaristas

Admittedly, getting at sometimes secret, or at least concealed, animosities can be difficult when talking with SMO leaders. Therefore, I relied on text (i.e., newspaper and

book) accounts of conflict where particular largeholder families or enterprises were named as “notorious” or were named more frequently than others. Another cue that a largeholder group was, or could be, singled out for direct action land reform activities was if they were named as *grileiros*, land-grabbers. Specifically, two companies and eight largeholder families were so-named (either as *grileiros* or as “notorious”) in accounts of land conflict. Using this information I developed a binary variable where properties controlled by these families or enterprises were indicated with a “1,” while properties controlled by others were indicated with a “0.” Overall, 54 of the 180 properties in the region are or were controlled by *latifundiarias*.

4.3. Unconsidered Factors

Certain characteristics named by the groups in Table 4.1 as influencing occupations are not measurable given the resources available for this study or the social climate and security concerns which come from working in a contentious region. Nevertheless, I include a description of why these characteristics may be important for the sake of completeness.

4.3a1. Vacant Landlords

Among the less commonly described factors predisposing properties to occupation by social movement organizations is whether a landholder lives on their property or is absentee. Though social movement members and key-informants did not mention targeting properties with absent landholders as a strategy, both ranchers (7 of 19) and academic treatments of land conflict do (see Table 4.1). In fact, seven of the ranchers I interviewed stated that one way a property holder can make their property less attractive to occupiers is to live on it. The idea is that social movements would prefer to avoid

confrontation with landholders, and therefore target properties where the landholder is not likely to notice immediately; absentee landholders are not immediately aware of occupations on their property and therefore the probability of quick reprisals and eviction are lower (Fearnside 2001a; Simmons, Walker et al. 2007).

Though ranchers seem to accord some importance to landholder's absentia (over one-third of those interviewed believe absenteeism an important factor in land occupations), this may be due to the fact that the vast majority of largeholdings in the South of Pará, and even in the *poligono dos castanhais*, are controlled by absentee landlords. Even those largeholders who live in the region tend to live in cities and commute to their properties, when they visit them at all. The typical largeholder mixes their ranching business with many others, meaning cattle-rearing is not their only, and sometimes not their primary, mode of economic production. The majority of ranchers I spoke with owned and operated other businesses (18 of 19), including logging and milling enterprises (2 of 19), car dealerships (3 of 19), agricultural equipment distributors (1 of 19), fuel supply (1 of 19), and even public office (2 of 19). In fact, only one rancher I interviewed worked exclusively in ranching, making a good living in cattle breeding.

Despite the importance accorded to absenteeism by largeholders, as an explanatory variable it is both difficult to measure and likely of dubious explanatory value. As a large number of ranchers do not live full-time on their property, there is not much variation; most properties have an absentee owner. Furthermore, given the importance ranchers accord to absenteeism in contributing to occupations, asking which properties are controlled by landholders who are not around is inappropriate given the contentious climate in the region. In other words, getting reliable information on which

properties have absentee landholders is not possible at this time. In the interest of completeness, however, I include it here.

4.3a2. Landlord Encourages an Occupation

One of the commonly cited pathways to occupation stresses the corruption of Brazil's land resource "industry," and is sometimes cynically called the "industry of possession" (Fearnside 2001a). In essence, authors accuse largeholders who, having mined the fertility from their landholding through years of poorly managed ranching, want a quick and financially viable exit plan; some largeholders stand accused of encouraging occupation to turn a profit from unusable degraded land (Foweraker 1981b; Alston et al. 2000; Fearnside 2001a). Researchers hint that largeholders and the landless work together in cases where the largeholder believes they are able to receive a higher price for their property through government expropriation rather than selling it on the open market.

Indeed, there are a number of anecdotal cases where this is said to have happened in the South of Pará, though in most cases it is unclear whether the property owner negotiated with INCRA and landless would-be occupiers in order to avoid costly and sometimes deadly confrontation (something largeholder key-informants tended to believe) or because they can see a better financial return if they allow the state to expropriate it from them (something researchers tend to indicate). Curiously, when social movement members informally discussed collusion between occupiers and landholders, they were dismissive of cooperation being a common occurrence. Similarly, the two ranchers who I asked responded by shaking their heads and stating that "nobody would

work with those social movements.” Apparently, enemies do not become business partners in the South of Pará.

In sum, though in occasional cases this pathway to occupation may be in evidence, it is difficult to prove and may actually involve a different process of occupation. In the one case of landholder-encouraged occupation I am aware of in the South of Pará, on *Fazenda Jacaré Grande* in Curionópolis, the property “occupiers” were actually current and former employees of the property holder, and the occupation was quickly resolved through private arrangements (i.e., the division of the farm did not directly involve the federal government, J.B. 2003). What this means for an analysis of property occupation in the region is that this particular process of occupation is not likely to be significant, especially considering that in a thorough reading of accounts of conflict and land occupation in the region there was no indication of this occurring within the *poligono dos castanhais*. Furthermore, reliable information on this pathway to occupation is not available; aside from newspaper accounts, which do not indicate it is common (only one instance in the region over a twenty-three year period), there is no clear source of data such as this. Given this limitation, I do not include a variable for this in model runs.

4.4. Results and Discussion

In total, 58 properties were occupied during the period for which land-cover data in the form of Landsat scenes was available (1984-2003) for the *poligono dos castanhais* (Table 4.7)⁵⁴. Though the lack of land-cover data in the early-to-mid 1990s (1990-1995) is unfortunate, there is a distinct downturn in the number of occupations in the region

⁵⁴ A total of sixty-five properties were occupied, meaning seven were occupied between 1978 and 1984.

over this time period (a total of ten over six years). Land-cover analysis of any type is frequently limited by data availability, and this analysis is, unfortunately, no exception to that trend.

Though the goal here is to investigate the contribution of a number of factors to property occupations overall, the dependent variable (property occupation) and most of the independent variables vary over time. Therefore, in this section I present four models, the first of which covers the years 1980 to 2003, and the remaining three correspond to a year where there were a large number of occupations *and* land-cover information is available. In other words, each of the three models for specific years presented in this section was selected based on two criteria: (1) if there were a large number of occupations in the selected year relative to others, and (2) if land-cover information is available for that year.

I make a further division in each model as well; because property occupations take place to satisfy the goals of social movements and, one would imagine, their members, I have separated the independent variables according to which characteristics are more important for each group (SMOs and SMO members) according to my survey of the literature and key-informant interviews. For the overall model and for the year-by-year models I first present the combined model, and then present a pair of models with different variables indicated for SMOs (“exposure model”) and SMO members (“resource quality model”). Only one variable is replicated between these divided models; distance to cities or towns are important to both SMOs and their members, though for different reasons (as discussed in section 4.2a1).

As 1986 and 1987 are the years with the highest number of first-occupations, they are the focus of two logistic regression analyses. Nineteen eighty-four is left out because variables accounting for land cover in the time period before occupation, meant to uncover the significance of forest reserves in occupation selection, are not available for this time period. Further model specifications are presented in Appendix II; only the best performing or most interesting models are presented and summarized in this section of the dissertation.

Year of First Occupation	Number of Occupations	Land-Cover Data Available
1984	8	Yes
1985	6	–
1986	10	Yes
1987	8	–
1988	–	Yes
1989	4	–
1990	1	–
1991	1	–
1992	1	–
1993	1	–
1994	–	–
1995	2	–
1996	5	Yes
1997	3	–
1998	1	–
1999	3	Yes
2000	–	Yes
2001	–	Yes
2002	1	Yes
2003	3	Yes

Table 4.7. Number of first occupations in the *poligono dos castanhais* for each year, along with land-cover data availability. Each year with an accompanying logistic regression analysis is displayed in boldface.

4.4a. Logistic Regression Method

Though logistic regression functions in a somewhat similar manner to ordinary least squares regression, the method is necessary to address dichotomous dependent variables. In a logistic regression, we seek to understand the expected value of a variable, Y , given a value of another variable, x , and assume the relationship between the two is linear in variable x . Such a relationship is generally expressed as:

$$E(Y|x) = \beta_0 + \beta_1 x$$

indicating that it is possible for the expected value of variable Y to be any value as the values of x range from negative to positive infinity (Hosmer and Lemeshow 2000).

Because the dependent variable in this case is binary, the expected values of Y must be greater than or equal to zero and less than or equal to 1, in other words, values of Y must adhere to the range:

$$0 \leq E(Y|x) \leq 1$$

The curve generally described by this specification takes on the form of an “s”, “resembling a plot of the cumulative distribution of a random variable” (Hosmer and Lemeshow 2000). Fortunately, the logistic distribution accounts for this type of relationship, taking the form of:

$$E(Y|x) = \frac{e^{\beta_0 + \beta_1 x}}{1 + e^{\beta_0 + \beta_1 x}}$$

However, in order to retain the linear, continuous, and range characteristics imposed by the aforementioned conditions imposed on the response of the dichotomous variable, Y , given a certain value of x , a logit transformation may be imposed (Hosmer and Lemeshow 2000), defined by:

$$g(x) = \ln \left[\frac{E(Y | x)}{1 - E(Y | x)} \right] = \beta_0 + \beta_1 x$$

which, if solved, provides estimated logit coefficients (Hosmer and Lemeshow 2000).

These coefficient values can be converted into odds ratios to aid in interpretation through exponentiation, following Hosmer and Lemeshow (2000).

One of the problems I encountered in these model runs was separation. This occurs when a dichotomous independent variable completely agrees with, or completely mirrors, the dependent variable over some large number of observations (or, in some cases, all of the observations). Separation is handled differently by statistical analysis software packages, and there are a number of different approaches to addressing it (Heinze and Schemper 2002). The solution taken here was to insert an artificial observation where the issue causing separation was addressed, hence the $n+1$ count of observations, following a method suggested by Agresti (1990). Dichotomous variables (e.g., suitable soils binary; title problems binary; labor violations; environmental violations; highway binary variables; and *Latifundiarista*) for the single artificial observation were switched from the majority state (e.g., if most observations were “1” the artificial observation was assigned a value of “0”). Continuous variables (e.g., proportion

forest, property area, and distance variables) were assigned a value corresponding to the mean of all observations.

Interpreting logistic regression model results is not always completely straightforward. Because the dependent variable is dichotomous (i.e., either an occupation occurs, and the dependent variable equals “1,” or an occupation does not, and the dependent variable equals “0”) a change in any independent variable, whether dichotomous or continuous, does not contribute to a linear change in the dependent variable. In other words, if, as is the case in the model presented in Table 4.11, the area of a property (as measured in hectares) is a statistically significant variable, each increase in unit of the independent variable will not lead to a increase in the unit of the dependent variable; an increment of 2 in the independent variable cannot lead to more than one occupation represented in the dependent variable. Because of this issue, it is common practice to interpret logistic regression models in terms of odds ratios, reflecting the fact that changes in independent variables change the likelihood that a property will be occupied. However, for the overall logistic regression model, which considers property occupations over the entire 19-year period of this study, odds ratios are not reported due to their very high or low nature (i.e., scientific notation would have to be used in many cases).

Model specifications vary slightly from year-to-year, which at first may be alarming to the reader. However, because the strategies of property occupiers are likely to have evolved over the years spanning the end of *abertura* (political opening) in Brazil, and the following new democratic period, this slight change in the model, and the change of significance for certain variables, seems justified. With the exception of the 1999

model, and the variable “Distance to Major City,” model runs are identically presented in Appendix II to aid interpretation for those interested.

4.4b. Overall Model

To address hypothesis 1, that SMOs target properties with certain characteristics for occupation, I address the impact the explanatory variables outlined above have on land occupations over the entire nineteen-year period this research addresses. In order to assess both the total contribution of these variables to the odds of property occupation, as well as the contribution of occupations in individual years, I specified a model where each year is replicated, creating a much larger dataset. The rationale for including a replicated model is to attempt to understand the factors which, over the entire DALR period, have contributed most significantly to property occupations. A secondary rationale is to account for the fact that certain periods are likely to be more contentious, in terms of land occupations, than others. Developing a replicated dataset allowed for an investigation as to which years contributed more significantly to the explanatory power of the overall model.

Rather than limiting the model to occupations in a certain year, and specifying separate models for each year, the replicated dataset is one in which, for each year, the observations for all properties are replicated and properties which were occupied in previous years are excluded. In other words, starting with 180 properties in the first time step (1985) I then replicated all observations aside from those properties occupied for the first time in 1985 to represent data for 1986. To control for the passage of time, and the contribution of any single year, I created a dichotomous variable indicating all properties occupied in that year. Separation was again a problem and was resolved through the

creation of one artificial observation for each year-control variable as before (Agresti 1990). The model is presented, without odds ratios due to their very low (in the case of average proportion of forest) and very high (in the case of most other variables, especially the year control) values, in Table 4.8. With regards to independent variables, the model specification presented here is one of many tested but not presented in the text of this dissertation (see Appendix I); significant variables remain robust, and in models where other variables are significant (but much lower measures of goodness-of-fit) the direction of the coefficient remains robust and odds ratios are similar.

Overall, it appears that in nearly every year, occupations contribute significantly to the odds a property will be occupied (Table 4.8). Odds ratios (see footnote 55) for some variables, holding all others constant, indicate a substantial increase or decrease in the odds that a property will be occupied, and the only variables that are not of significance are a few of the annual year control variables in the 1990s and for 2002 (Table 4.8). Of note is the near universal significance of the explanatory variables, particularly the strong influence of proportion of forest, environmental reserve violations, and distance to towns (Table 4.8).

Distance to towns, a commonly significant variable in many studies of human behavior throughout the world, is significant at the five percent level, and indicates that being further from town actually increases the likelihood of occupation over the years between 1984 and 2003 (Table 4.8). This is a perverse result to the one conceptualized in the first chapter. Suitable soils, title problems, labor violations, distance to rivers, and notorious property owners all display this perverse result. Other models displayed in Appendix II display slightly different trends, though generally the impacts of different

measurements of distance to town are significant but do not decrease or increase the odds of property occupation to any great degree. Some of the potential reasons for these perverse results will be explored in Chapter 6, but they are perhaps less surprising than they could be given that social movement strategies in occupations have changed substantially over the 19-year time period which this study focuses on.

Overall <i>n</i> : 2268	Dependent Variable: Occupation (<i>n</i> =50)		
Independent Variables:	Coefficient ¹	Standard Error	P > Z
Average Proportion Forest ²	3.882641	0.6155811	0.000
Suitable Soils Binary ³	-0.9805558	0.2143867	0.000
Title Problem Binary ⁴	-0.4374593	0.2221178	0.049
Labor Violations	-0.6122581	0.3710842	0.099
Area of Property in Hectares	0.000977	0.0000363	0.007
Environmental Reserve Violations ⁵	4.481304	0.3243675	0.000
Distance to Town ⁶	-0.0182526	0.0087189	0.036
Distance to River	-0.1904877	0.0612836	0.002
Highway Binary ⁷	0.5419579	0.2248878	0.016
<i>Latifundiarista</i> ⁸	-0.361319	0.1902793	0.058
Occupied in 1985 ⁹	4.787524	1.217038	0.000
Occupied in 1986	4.548146	1.098872	0.000
Occupied in 1987	5.008192	1.148927	0.000
Occupied in 1989	3.142149	1.149251	0.006
Occupied in 1990	2.56649	1.539153	0.095
Occupied in 1991	2.916454	1.836502	0.112
Occupied in 1992	2.571857	1.439144	0.074
Occupied in 1993	2.622225	1.619274	0.105
Occupied in 1995	3..043444	1.25799	0.016
Occupied in 1996	1.283616	1.650856	0.437
Occupied in 1997	1.33831	1.582474	0.398
Occupied in 1998	1.940538	1.986	0.329
Occupied in 1999	3.154203	1.34459	0.019
Occupied in 2002	0.7373521	3.137888	0.814
Occupied in 2003 ¹⁰	3.394691	1.346894	0.012
Constant	-3.685797	0.4651629	0.000
<i>Log Likelihood</i>	-543.23127		
<i>Pseudo R</i> ²	0.3908		

Notes: ¹Coefficients are displayed here because odds are so high as to exceed the precision capabilities of most software ²Proportion forest averaged over all years.

³Suitable soils are those rated as moderate to highly suitable for smallholder agriculture by soil scientists at EMBRAPA. ⁴Properties without definitive title as indicated by SUDAM. ⁵Forest reserve violations as measured by remote sensing.

⁶Distance to local towns in the region. ⁷Highways in this case are the major paved roads in the study area, including BR-230, BR-222, PA-150, and PA-257. ⁸A binary variable where known land grabbers or other violent property owners are indicated.

⁹To address separation, artificial observations were inserted for each dichotomous year variable. ¹⁰No properties were occupied in 1988, 1994, 2000, or 2001.

Table 4.8. Logistic regression results for replicated dataset covering all years. Statistically significant variables are displayed in boldface.

One limitation of the overall model is its conflation of the objective of those groups who are actually undertaking the occupations themselves. Arguably, SMOs seek to occupy properties which are likely to be expropriated and, perhaps less importantly, contribute to overall awareness of SMO struggle. Success for a SMO is expropriation of *latifúndio* and the formation of new agricultural settlements. I refer to these goals as the “exposure model” of success due to the fact that successful expropriations often lead to media attention and an increased awareness of the struggle for agrarian reform. In the “exposure model,” I include on those variables which measure the stated goals of social movements: (a) the struggle against unproductive largeholdings (title problem binary, area of property in hectares, *latifúndiarista*), and (b) making the struggle for land visible to people throughout Brazil (labor violations, environmental violations, distance to town) (Table 4.9). Taking this into account, I have separated out variables which more closely capture the quality of the resource base, and therefore, I assume, would-be colonists’ desires for viable agricultural land. Only one variable is shared between the “exposure model” and this, the “resource quality model”; distance to towns. The rationale for including distance to towns is quite different in the resource quality model, however, as the variable is included to measure the desirable status of properties closer to the markets at which excess agricultural production may be sold for cash (Table 4.10).

	Dependent Variable: Occupation (n=50)		
Independent Variables:	Coefficient ¹	Standard Error	P > Z
Title Problem Binary ²	-0.6673173	0.1814808	0.000
Labor Violations	-0.2104529	0.3460041	0.543
Area of Property in Hectares	0.0000816	0.0000335	0.015
Environmental Violations ³	3.790187	0.2729385	0.000
Distance to Town ⁴	-0.0258054	0.0066747	0.000
<i>Latifundiarista</i> ⁵	-0.1102281	0.1780375	0.536
Occupied in 1985 ⁶	4.474436	1.128281	0.000
Occupied in 1986	4.686617	1.072256	0.000
Occupied in 1987	4.516524	1.091326	0.000
Occupied in 1989	3.754781	1.136854	0.001
Occupied in 1990	2.379236	1.464624	0.104
Occupied in 1991	2.566856	1.562126	0.100
Occupied in 1992	2.875939	1.422029	0.043
Occupied in 1993	2.858235	1.431232	0.046
Occupied in 1995	3.109863	1.259454	0.014
Occupied in 1996	1.040078	1.35368	0.442
Occupied in 1997	0.911243	1.456858	0.532
Occupied in 1998	0.893892	2.07364	0.666
Occupied in 1999	3.062327	1.241646	0.014
Occupied in 2002	1.102317	2.090807	0.598
Occupied in 2003 ⁷	3.379311	1.203559	0.005
Constant	-1.71715	0.258798	0.000
<i>n</i>	2268		
<i>Log Likelihood</i>	-592.57846		
<i>Pseudo R²</i>	0.3355		

Notes: ¹Coefficients are displayed here because odds are so high as to exceed the precision capabilities of most software. ²Properties without definitive title as indicated by SUDAM. ³Forest reserve violations as measured by remote sensing and indicated by newspaper accounts. ⁴Straight-line distance to local towns in the region. ⁵A binary variable where known land grabbers or other violent property owners are indicated. ⁶To address separation, artificial observations were inserted for each dichotomous year variable. ⁷No properties were occupied in 1988, 1994, 2000, or 2001.

Table 4.9. Logistic Regression of replicated dataset for the Exposure Model of occupations, meant to weigh the importance of social movement organization desires for political and news media attention.

Title problems are significant in the exposure model, though it appears that if a property has shaky title arrangements it is actually *less* likely to be occupied (Table 4.9). Though this would appear counterintuitive – why not target properties where the struggle has a higher chance of being successful because of a property’s legal situation? – in fact the direction of this relationship (no title leads to a decreased chance of occupation) fits with the desire of social movements for struggles to lead to exposure of their cause to regional and national news media. In other words, by picking a contentious fight, SMOs are more likely to meet some of their goals. Property size is significant, and very slightly increases the odds of occupation (Table 4.9). Environmental violations appear to be a strong and highly significant motivator of property occupation; properties with environmental violations are some 97 times more likely to be occupied all other variables held equal. Distance to towns displays a perverse result, though other models presented in Appendix II do not; this will be addressed more directly in Chapter 6.

Though the power of the resource quality model is somewhat weaker than the exposure model (above, Table 4.9) it is interesting to note that the proportion of forest, distance to town, and highway access variables are significant. These likely reflect the desire to be close to transportation corridors where excess production can be sold (properties with a highway running through them are nearly 5 times more likely to be occupied, all other variables held constant). However, distance from town displays a perverse result, indicating that properties closest town are significantly less likely to be occupied; I will explore this more in Chapter 6. Proportion forest over all years contributes in a highly significant manner to the occupation of properties; as mentioned earlier in this Chapter, forested areas have a number of characteristics which make them

attractive to would-be smallholders, including the fact that they are perceived as less likely to be degraded.

Beyond variables regarding the physical characteristics of the land base, it is clear that the variables in the resource quality model are significant (and increase the odds of occupation) in the early stages of the struggle for land, and during the period 1996-1999. These results are likely due to the fact that for the years 1990-1995 the number of occupations was much lower than for the periods 1985-1989 and 1996-1999. However, it may also indicate that SMO members are more likely to drive SMO property selection strategies during times when the movement is highly active than when it is not.

Independent Variables:	Dependent Variable: Occupation (n=50)		
	Coefficient ¹	Standard Error	P > Z
Average Proportion Forest ²	3.77653	0.536288	0.000
Suitable Soils Binary ³	0.0202	0.152526	0.895
Distance to Town ⁴	-0.03745	0.006781	0.000
Distance to River	-0.01837	0.051497	0.721
Highway Binary ⁵	1.538073	0.162427	0.000
Occupied in 1985 ⁶	4.156762	1.160208	0.000
Occupied in 1986	4.376923	1.078738	0.000
Occupied in 1987	4.564567	1.089315	0.000
Occupied in 1989	3.018448	1.211415	0.013
Occupied in 1990	1.57016	1.419594	0.269
Occupied in 1991	1.523951	1.666206	0.360
Occupied in 1992	2.11523	1.468625	0.150
Occupied in 1993	1.717858	1.433064	0.231
Occupied in 1995	2.338967	1.277209	0.067
Occupied in 1996	2.863249	1.13118	0.011
Occupied in 1997	2.832814	1.261492	0.025
Occupied in 1998	3.266321	1.456273	0.025
Occupied in 1999	2.470883	1.225399	0.044
Occupied in 2002	2.435022	1.566491	0.120
Occupied in 2003 ⁷	2.76575	1.281712	0.031
Constant	-3.3434	0.36994	0.000
<i>N</i>	2268		
<i>Log Likelihood</i>	-700.47429		
<i>Pseudo R²</i>	0.2145		

Notes: ¹Coefficients are displayed here because odds are so high as to exceed the precision capabilities of most software ²Proportion forest averaged over all years. ³Suitable soils are those rated as moderate to highly suitable for smallholder agriculture by soil scientists at EMBRAPA. ⁶To address separation, artificial observations were inserted for each dichotomous year variable. ⁷No properties were occupied in 1988, 1994, 2000, or 2001.

Table 4.10. Logistic Regression of replicated dataset for the Resource Quality Model of occupations, meant to weigh the importance of social movement members and their needs for agriculturally viable property.

The overall models provide a strong indication that the process of land occupations is temporally dependent; the characteristics which encourage land occupations are neither static, nor are the goals of SMOs and their members identical. The models presented above (Table 4.8, Table 4.9, Table 4.10) hint at the dynamic nature of property occupation strategies, or at least the changing state of which characteristics significantly influence occupation and which do not. To more fully explore these temporal differences, I split the models off by year, considering occupations taking place in 1986, 1987, and 1989, as constrained by data availability.

4.4b1. Occupations in 1986

The first model specification I present in this section investigates the impact of a number of variables specified as described in previous sections on property occupations in only 1986 (Table 4.11).

1986 Occupations (<i>n</i> =11)	Specification 3, 1986 Occupations, Appendix II			
Independent Variables:	Odds Ratio	Coefficient	Standard Error	P > Z
Proportion Forest ¹	9.951288	2.297702	3.42569	0.502
Suitable Soils Binary ²	1.426219	0.355027	0.839932	0.673
Title Problem Binary ³	5.997858	1.791402	1.36036	0.188
Labor Violations	3.031117	1.108931	1.09894	0.313
Area of Property in Hectares	1.000264	0.0002641	0.000096	0.006
Environmental Violations ⁴	0.2723385	-1.30071	1.56680	0.406
Distance to Major City ⁵	0.9599908	-0.040832	0.29857	0.171
Distance to River	1.511246	0.4129346	0.457359	0.367
Highway Binary ⁶	1.071677	0.0692245	1.10923	0.950
<i>Latifundiarista</i> ⁷	2.123529	0.7530793	0.758108	0.321
Constant		-7.255021	3.89167	0.062
<i>n</i>	181			
<i>Log Likelihood</i>	-30.721138			
<i>Pseudo R</i> ²	0.2591			

Notes: ¹Proportion forest in time period before occupation listed in column heading. ²Suitable soils are those rated as moderate to highly suitable for smallholder agriculture by soil scientists at EMBRAPA. ³Properties without definitive title as indicated by SUDAM. ⁴Environmental violations as named in regional newspapers or through remote sensing measurement in time period before occupation. ⁵Euclidian distance to the cities of Marabá and Eldorado do Carajás, the two largest cities in the *poligono do castanhais*. ⁶Highways in this case are the major paved roads in the study area, including BR-230, BR-222, PA-150, and PA-257. ⁷A binary variable where known land grabbers or other violent property owners, as indicated by newspaper reports, are indicated.

Table 4.11. Combined logistic regression results for property occupations in 1986. Statistically significant variables are displayed in boldface.

In the model presented in Table 4.11, for occupations in 1986, we see that only property size significantly increases odds that a property will be occupied, and then only weekly (barely above even odds). As mentioned before, interpreting logistic regression results can be difficult. For instance, in the above model (Table 4.11), for each percent forest cover increase, the odds that a property will be occupied increases by nearly ten to one (9.951288 to 1), holding all other variables constant; a property with two percent

greater forest cover would be 99 times more likely to be occupied.⁵⁵ For this model, however, proportion forest is not a statistically significant contributor to the odds of occupation. In 1986, only property size is significant in increasing the likelihood of occupation in the *poligono dos castanhais*, and then only at a very low level. For example, for each 100 hectare increase in property size, odds are only slightly better than even that the property will be occupied. However, perhaps an adjustment to the odds ratio on the order of 1,000 hectare increases in property size is more consistent with the goals of social movement organizations; 1,000 hectare increments only increase the odds of occupation by thirty percent (i.e., a property which is 1,000 hectares larger is 1.3 times as likely to be occupied).

For 1986, some of the variables display a perverse result to that described by key informants; properties with environmental violations are actually 3.7 times *less* likely to be occupied than those without (though not in a statistically significant way). Similarly, as distance to river increases, the likelihood for occupation increases. These trends will be addressed in Chapter 6, but are interesting as they are not robust results across this multi-temporal analysis.

However, as discussed in previous sections, there may be a difference between SMO goals and SMO member's goals in occupying a property. Therefore, I divided 1986 occupations into an exposure model and a resource quality model. In general, these

⁵⁵ In order to understand the impact of unit changes of more than one in continuous independent variables, one must take the coefficient value and multiply it by the number of independent variable unit steps and then exponentiate the result. For example, to develop an odds ratio for a property 10 kilometers from a major city in 1986, one would solve $\exp(10 \times -0.040832)$ (where "10" is the number of kilometers and "-0.040832" is the coefficient value for the variable), resulting in an odds ratio of 0.67. To put it another way, the property is 1.49 times *less* likely to be occupied, all other variables held constant, for each 10 kilometer distance interval from a river. For a more thorough explanation see Hosmer & Lemeshow (2000).

results are confirmatory of the combined model presented in Table 4.11; only the area of the property is significant, and only increases odds of occupation slightly. The constant term is significant and its coefficient value indicates a strong influence; this model is missing explanatory variables which may influence the process of property occupation (Table 4.12).

1986 Occupations (<i>n</i> =11)	1986 Occupations, Exposure (SMO) Model			
Independent Variables:	Odds Ratio	Coefficient	Standard Error	P > Z
Title Problem Binary ¹	1.550357	0.4384853	0.9224495	0.635
Labor Violations	3.992179	1.384337	1.04426	0.185
Area of Property in Hectares	1.00025	0.00025	0.0000877	0.004
Environmental Violations ²	0.3275988	-1.115966	1.412697	0.430
Distance to Major City ³	0.9789622	-0.021262	0.0223639	0.342
<i>Latifundiarista</i> ⁴	1.793743	0.5843048	0.717402	0.415
Constant		-4.126053	1.289061	0.001
<i>n</i>	181			
<i>Log Likelihood</i>	-32.664098			
<i>Pseudo R²</i>	0.2123			

Notes: ¹Properties without definitive title as indicated by SUDAM.

²Environmental violations as named in regional newspapers or through remote sensing measurement in time period before occupation. ³Euclidian distance to the cities of Marabá and Eldorado do Carajás, the two largest cities in the

poligono do castanhais. ⁴A binary variable where known land grabbers or other violent property owners, as indicated by newspaper reports, are indicated.

Table 4.12. Logistic Regression for the Exposure Model for 1986 occupations, meant to weigh the importance of social movement organization desires for political and news media attention.

The resource quality model (Table 4.13) also confirms the combined model (Table 4.11) in 1986; it appears that the desires of SMO members were not a deciding factor in occupations in 1986 (Table 4.13).

1986 Occupations (<i>n</i> =11)	1986 Occupations, Resource Quality (SMO Member) Model			
Independent Variables:	Odds Ratio	Coefficient	Standard Error	P > Z
Proportion Forest ¹	8.804259	2.175236	2.459675	0.377
Suitable Soils Binary ²	0.9368339	-0.065249	0.6985988	0.926
Distance to Major City ³	0.9704288	-0.030017	0.0228729	0.189
Distance to River	1.066028	0.0639394	0.3219528	0.843
Highway Binary ⁴	0.9757283	-0.024571	0.8570675	0.977
Constant		-3.535623	2.554252	0.166
<i>n</i>	181			
<i>Log Likelihood</i>	-39.423506			
<i>Pseudo R</i> ²	0.0492			

Notes: ¹Proportion forest in time period before occupation listed in column heading. ²Suitable soils are those rated as moderate to highly suitable for smallholder agriculture by soil scientists at EMBRAPA. ³Euclidian distance to the cities of Marabá and Eldorado do Carajás, the two largest cities in the *poligono do castanhais*. ⁴Highways in this case are the major paved roads in the study area, including BR-230, BR-222, PA-150, and PA-257.

Table 4.13. Logistic Regression for the Resource Quality Model for 1986 occupations, meant to weigh the importance of social movement members and their needs for agriculturally viable property.

Considering the results from the 1986 models, it is clear that for that year the most important characteristic in property occupations considered here is property size, which is consistent with SMO goals. Specifically, large properties are the stated target of most land-reform related SMOs, and it appears that in 1986 they are abiding by those statements. In 1987, however, the story is different, with other variables being more significant in modifying the likelihood of property occupation.

4.4b2. Occupations in 1987

While in 1986 only property size (as reported in hectares) was significant (aside from the constant, indicating unaccounted for effects are important in increasing the odds of property occupation), the picture changes in 1987 (Table 4.14). In the combined model, those properties with title problems are significant in their contribution to property occupations, albeit in a perverse way; similar to the results of the overall combined model (Table 4.8), a property with title issues is nine times *less* likely to be occupied than one without title problems. Of note is that properties of above average size are 5.4 times more likely to be occupied in 1987 than those of smaller than average size (meaning that property size, and particularly a property being larger, is a robust contributor to the odds of occupation). Another variable of interest is the dichotomous variable indicating if a property is within ten kilometers of a highway. Proximity to a major highway is consistent with the relationship described in earlier sections; being within ten kilometers of a major highway actually decreases the odds that a property will be occupied substantially (and significantly) by nearly 13 to 1.

1987 Occupations (n=9)	Specification 2, 1987 Occupations, Appendix II			
Independent Variables:	Odds Ratio	Coefficient	Standard Error	P > Z
Proportion Forest ¹	2.409984	0.8796199	2.305046	0.703
Suitable Soils Binary ²	1.094992	0.0907474	0.9101429	0.921
Title Problem Binary ³	0.1087752	-2.218472	1.149826	0.054
Labor Violations	1.595121	0.4669494	1.391557	0.737
<i>Latifúndio Binary</i> ⁴	5.424556	1.690936	0.8120373	0.037
Env. Violations from News ⁵	2.109728	0.7465591	1.534768	0.627
Distance to Towns ⁶	1.00045	0.0004503	0.0372176	0.990
Distance to River	0.7096821	-0.342938	0.3162893	0.278
Highway 10km Buffer Binary ⁷	0.0772863	-2.560238	1.256696	0.042
<i>Latifundiarista</i> ⁸	1.318434	0.2764446	0.768585	0.719
Constant		-1.628626	2.394044	0.496
n	181			
Log Likelihood	-30.084701			
Pseudo R ²	0.1593			

Notes: ¹Proportion forest in time period before occupation listed in column heading. ²Suitable soils are those rated as moderate to highly suitable for smallholder agriculture by soil scientists at EMBRAPA. ³Properties without definitive title as indicated by SUDAM. ⁴Properties exceeding the regional average. ⁵Environmental violations reported in regional newspapers. ⁶Distance to local towns in the region. ⁷Properties within ten kilometers of the aforementioned major highways. ⁸A binary variable where known land grabbers or other violent property owners, as indicated by newspaper reports, are indicated.

Table 4.14. Logistic regression results for property occupations in 1987. Statistically significant variables are displayed in boldface.

Splitting the model, however, indicates that these variables are not robust when only those meeting SMO goals or SMO member's goals are considered. The exposure model (Table 4.15) shows only the constant, an expression of the influence of missing variables, as being significant in modifying the likelihood of property occupations. All other variables are not significant, though the *Latifúndio Binary* variable is nearly so at the 0.1 level.

1987 Occupations (<i>n</i> =9)	1987 Occupations, Exposure (SMO) Model			
Independent Variables:	Odds Ratio	Coefficient	Standard Error	P > Z
Title Problem Binary ¹	0.5265823	-0.641348	0.7986887	0.422
Labor Violations	1.111552	0.1057574	1.227513	0.931
<i>Latifundio</i> Binary ²	3.264527	1.183115	0.7261547	0.103
Environmental Violations ³	1.295739	0.2590812	1.291154	0.841
Distance to Towns ⁴	1.010791	0.0107331	0.292212	0.713
<i>Latifundiarista</i> ⁵	1.681468	0.5196671	0.7147931	0.467
Constant		-3.480307	1.096722	0.002
<i>n</i>	181			
<i>Log Likelihood</i>	-33.480834			
<i>Pseudo R</i> ²	0.0644			

Notes: ¹Properties without definitive title as indicated by SUDAM. ²Properties exceeding the regional average. ³Environmental violations reported in regional newspapers. ⁴Distance to local towns in the region. ⁵A binary variable where known land grabbers or other violent property owners, as indicated by newspaper reports, are indicated.

Table 4.15. Logistic Regression for the Exposure Model for 1987 occupations, meant to weigh the importance of social movement organization desires for political and news media attention.

The resource quality model (Table 4.16) similarly has little explanatory power, and even the constant is insignificant. This is perhaps a bit surprising given the significance of the Highway 10km Buffer Binary variable in the combined model, but its influence there was a weak decrease in the likelihood of occupation at a fairly low level of significance (though still significant at the 0.05 level).

1987 Occupations (<i>n</i> =9)	1987 Occupations, Resource Quality (SMO Member) Model			
Independent Variables:	Odds Ratio	Coefficient	Standard Error	P > Z
Proportion Forest ¹	3.073069	1.122677	1.938242	0.562
Suitable Soils Binary ²	1.290171	0.2547749	0.7752539	0.742
Distance to Towns ³	0.9903392	-0.009708	0.03308	0.769
Distance to River	0.8985672	-0.106952	0.2611413	0.682
Highway 10km Buffer Binary ⁴	0.4699826	-0.755060	0.8002575	0.345
Constant		-3.238772	2.054473	0.115
<i>n</i>	181			
<i>Log Likelihood</i>	-34.844268			
<i>Pseudo R²</i>	0.0263			

Notes: ¹Proportion forest in time period before occupation listed in column heading. ²Suitable soils are those rated as moderate to highly suitable for smallholder agriculture by soil scientists at EMBRAPA. ³Distance to local towns in the region. ⁴Properties within ten kilometers of the aforementioned major highways.

Table 4.16. Logistic Regression for the Resource Quality Model for 1987 occupations, meant to weigh the importance of social movement members and their needs for agriculturally viable property.

Models for 1987 indicate that in occupations were not driven by SMO member's needs as much as by the goals of SMOs. However, these results have low explanatory power, suggesting that perhaps other factors came into play. Indeed, the significance of the constant in the exposure model indicates that a missing variable is likely to have contributed to the occupation of properties in that year.

4.4b3. Occupations in 1999

Moving forward in time from what Simmons et al. (2007) have called the *luta posseiro* (the fight for possession) to the new era of direct action land reform (DALR) there are further changes in significance and the relative contribution of independent

variables. In particular, in the combined model for 1999 occupations (Table 4.17), proportion forest substantially, and significantly, increases the odds of property occupation; for each percent increase in forest cover on a property, the odds of occupation increases by 18,556. In other words, increase proportion of forest is a significant (at the ten percent level) and substantial contributor to occupations in the *poligono dos castanhais* in the late 1990s. Title problems retain the same perverse relationship in 1999 as they did in 1997 (though the strength of their contribution has increased considerably – properties with title problems are nearly 168 times *less* likely to be occupied). In 1999, however, labor problems are a significant new contributor to the odds of occupation; properties with labor violations of some kind are 90.6 times more likely to be occupied. The size of properties is no longer a significant contributor to occupation, but environmental violations do significantly contribute to the odds of occupation, and do so substantially (properties with environmental violations are 105 times more likely to be occupied). Furthermore, the fit of the model is much higher for 1999, indicating that the variables which social movement members, government officials, ranchers, and academic researchers suggested in 2006 fit the land conflict of the late 1990s better than the land conflict present during the *luta posseira* of the 1980s.

1999 Occupations (<i>n</i> =4)	Specification 3, 1999 Occupations, Appendix II			
Independent Variables:	Odds Ratio	Coefficient	Standard Error	P > Z
Proportion Forest ¹	18556.32	9.828566	5.82436	0.092
Suitable Soils Binary ²	12.95526	2.561502	2.13458	0.231
Title Problem Binary ³	0.0059556	-5.123417	2.41675	0.034
Labor Violations	90.63067	4.505689	2.44499	0.065
Area of Property in Hectares	0.9994787	-0.000522	0.000549	0.342
Environmental Violations ⁴	105.0123	4.654078	2.77478	0.093
Cost-Distance to Town ⁵	1.026167	0.0258302	0.435108	0.953
Distance to River	0.4159096	-0.877288	0.715033	0.220
Highway 10km Binary ⁶	0.0474853	-3.047334	2.77472	0.272
<i>Latifundiarista</i> ⁷	0.0412118	-3.189031	2.97396	0.284
Constant		-4.63453	4.26175	0.277
<i>n</i>	181			
<i>Log Likelihood</i>	-9.1451253			
<i>Pseudo R</i> ²	0.5238			

Notes: ¹Proportion forest in time period before occupation listed in column heading. ²Suitable soils are those rated as moderate to highly suitable for smallholder agriculture by soil scientists at EMBRAPA. ³Properties without definitive title as indicated by SUDAM. ⁴Environmental violations as named in regional newspapers or through remote sensing measurement in time period before occupation. ⁵Cost-weighted distance, considering road access. ⁶Properties within ten kilometers of the aforementioned major highways. ⁷A binary variable where known land grabbers or other violent property owners, as indicated by newspaper reports, are indicated.

Table 4.17. Logistic regression results for property occupations in 1999. Statistically significant variables are displayed in boldface.

Taken separately, the exposure model indicates that in 1999 social movement organizations goals were adhered to (Table 4.18), though the variables appear to indicate that a confrontational approach was used. Specifically, it appears that properties with clear title, and those which experienced labor violations were specifically targeted for occupation at a reasonably high level of significance (0.045 and 0.057 respectively, see Table 4.18).

1999 Occupations (<i>n</i> =4)	1999 Occupations, Exposure (SMO) Model			
Independent Variables:	Odds Ratio	Coefficient	Standard Error	P > Z
Title Problem Binary ¹	0.0501829	-2.992081	1.495824	0.045
Labor Violations	33.96692	3.525387	1.852972	0.057
Area of Property in Hectares	0.999676	-0.000342	0.00038	0.394
Environmental Violations ²	9.029237	2.200468	1.928726	0.254
Cost-Distance to Town ³	1.033262	0.0327207	0.211806	0.877
<i>Latifundiarista</i> ⁴	0.1774533	-1.729048	1.941088	0.373
Constant		-1.713788	1.562107	0.273
<i>n</i>	181			
<i>Log Likelihood</i>	-11.733816			
<i>Pseudo R</i> ²	0.3890			

Notes: ¹Properties without definitive title as indicated by SUDAM.

²Environmental violations as named in regional newspapers or through remote sensing measurement in time period before occupation. ³Cost-weighted distance, considering road access. ⁴A binary variable where known land grabbers or other violent property owners, as indicated by newspaper reports, are indicated.

Table 4.18. Logistic Regression for the Exposure Model for 1999 occupations, meant to weigh the importance of social movement organization desires for political and news media attention.

The resource quality model, in contrast, does not indicate that SMO member's goals were well served, or at least highly influential in property occupations taking place 1999 (Table 4.19). Though the explanatory power of this model is not the lowest displayed in this chapter (with a pseudo R^2 of 0.1499, see Table 4.19), it is not particularly striking either. Only suitable soils are nearly significant, and the constant term is the only truly significant variable, displaying a strong coefficient value.

1999 Occupations (<i>n</i> =4)	1999 Occupations, Resource Quality (SMO Member) Model			
Independent Variables:	Odds Ratio	Coefficient	Standard Error	P > Z
Proportion Forest ¹	27.90913	3.328954	2.652327	0.209
Suitable Soils Binary ²	9.35622	2.236041	1.437109	0.120
Cost-Distance to Town ³	1.01949	0.0193027	0.2260556	0.932
Distance to River	1.828983	0.6037601	0.622546	0.332
Highway 10km Binary ⁴	3.366136	1.213766	1.82631	0.506
Constant		-8.19889	3.056421	0.007
<i>n</i>	181			
<i>Log Likelihood</i>	-16.32505			
<i>Pseudo R²</i>	0.1499			

Notes: ¹Proportion forest in time period before occupation listed in column heading. ²Suitable soils are those rated as moderate to highly suitable for smallholder agriculture by soil scientists at EMBRAPA. ³Cost-weighted distance, considering road access. ⁴Properties within ten kilometers of the aforementioned major highways.

Table 4.19. Logistic Regression for the Resource Quality Model for 1999 occupations, meant to weigh the importance of social movement members and their needs for agriculturally viable property.

The number of occupations in 1999 (*n*=4) likely limits the explanatory power and robustness of these models, but it is interesting that in the combined model the significant variables appear to indicate a focus on legal challenges to property status, which follows the overall trajectory of SMOs fighting for land reform in Brazil. The significance in the overall model of title problems, labor violations, and environmental violations all suggest that in the most recent period SMOs are going after largeholders who violate the law. Such a strategy provides ample opportunities for SMOs to make complaints to the news media, many of which have often resulted in regional and state-wide coverage in newspaper reports (Editors 1999d; Opinião! Editors 2000b; RepórterBrasil 2004; Câmara 2008).

4.5. Logistic Regression Results Summary

These logistic regression models point to the fact that a number of factors significantly and somewhat reliably affect the likelihood that a property in the *Poligono dos Castanhais* will experience an occupation at the hands of the region's numerous SMOs.

	Overall Occupations (1985-2003)
Combined Model	Forest, Soils, Title, Labor Problems, Property Area, Environmental Problems, Town Access, River Access, <i>Latifundiaria</i> , Constant, 1985, 1986, 1987, 1989, 1990, 1992, 1995, 1999, 2003
Exposure Model	Title, Property Area, Environmental Problems, Town Access, Constant, 1985, 1986, 1987, 1989, 1992, 1993, 1994, 1999, 2003
Resource Quality Model	Forest, Town Access, Highway Access, Constant, 1985, 1986, 1987, 1999, 1996, 1997, 1998, 1999

Table 4.20. Summary of significant variables in overall logistic regression models.

The combined model reliably indicates, both overall and during specific years, that certain factors do influence property occupations in the region. Comparing the influence of the exposure model and the resource quality model it appears that for the specific-year models the exposure model, meant to gauge SMO goals, is more robust and has more explanatory power than the resource quality model (meant to gauge the influence of SMO member interest) (Table 4.20, Table 4.21). This may lead one to suspect that, in general, the goals of SMOs trump the goals of their membership, though this may be an artifact of how SMO members are recruited and how properties are actually occupied; the act of occupation requires financial and material support, primarily in transporting a massive occupational force of SMO members to a particular property. SMO members are likely to go where their organizing movement indicates, rather than commandeer the vehicles transporting them in order to occupy a property more to their liking. Furthermore, my

discussion of these models assumes that SMO members have some agency in determining which properties are occupied; in fact, their knowledge of the relative resource quality merits of one piece of property over another is likely to be minimal at best, so their input may be nonexistent or even have a perverse effect on occupation.

	1986 Occupations	1987 Occupations	1999 Occupations
Combined Model	Property Area, Constant	Title, <i>Latifúndio</i> , Highway Access	Forest, Title, Labor Problems, Environmental Problems
Exposure Model	Property Area, Constant	Constant	Title, Labor Problems
Resource Quality Model	None	None	Constant

Table 4.21. Summary of significant variables in specific-year logistic regression models

The outcome of these logistic regression models does provide an overall finding of importance; it is clear that some characteristics of properties in the South of Pará do predispose, or discourage, their occupation by organized social movements. I will address what these results mean for the hypotheses stated in Chapter 1 in the final chapter of this dissertation, but before I do I will first address the potential for land conflict to cause land-cover change through preemptive deforestation.

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**LARGEHOLDER DEFORESTATION AND LAND CONFLICT IN THE
EASTERN BRAZILIAN AMAZON**

VOLUME II

By

Stephen Peter Aldrich

A DISSERTATION

**Submitted to
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CHAPTER 5 - REMOVING THE RISK: PREEMPTIVE DEFORESTATION AND THE FIGHT FOR LAND

Once the landless have selected a property for occupation, the landholder has a potentially dire situation on his or her hands; once occupied, the options for evicting interlopers lead down one of two paths, either a cycle of occupation, eviction, and reoccupation begins with the real possibility of expropriation, or a cycle of violence may occur. In either case the largeholder must prove that their property is productive in order to save it from being committed to agrarian reform, and the most common measure of “productivity” in the Amazon tends to be the proportion of a property dedicated to agricultural production. As stated in Hypothesis 2, this measurement would seem to indicate that largeholders might have a strong incentive to preemptively deforest their properties in order to prove their “productivity” and hence avoid losing control over the land they hold. In addition, if a property is occupied there is a good chance that deforestation will result from the efforts of occupiers to meet their basic needs. I turn to these two types of deforestation – preemptive deforestation by largeholder ranchers, occurring before occupation, and occupation-driven deforestation by property occupiers (occurring after) – in the remainder of this chapter, and include three illustrative case-studies of conflict before presenting analysis focusing on the former – preemptive deforestation.

5.1. Defining Two Types of Deforestation

In the globally important tropical moist forest environments of the South of Pará the contentious and frequently violent struggle for land resources may have a particularly

striking impact upon the physical landscape; deforestation in the Amazon is one of the most charismatic environmental changes humankind faces today, and both the scientific community and the lay public throughout the world have been impressed by the rates of deforestation which have been observed in the region. In Chapter 2, I discussed the drivers of deforestation at some length, ultimately pointing out that an important driver in the Eastern Amazon has been more or less unstudied. In particular, evidence from key-informant interviews (n=19), newspaper records of land conflict, and interviews with officials at the national agrarian reform institute (INCRA) all indicate that land conflict has had a significant impact on forest cover in the region. These triangulated accounts seem to indicate two types of deforestation which commonly stem from land conflict: (1) occupation-driven deforestation and (2) preemptive deforestation. I separate these two forest-loss pathways with the knowledge that the outcome is almost always exactly the same, but that very different processes lead the agents of change involved (largeholders, gunmen, laborers, and property occupiers) to the same endpoint – complete deforestation. I begin first by discussing the most conflictive pathway, preemptive deforestation, which is meant to remove the reasons property occupiers may have for actually occupying the property, and then I move on to discuss what I call occupation-driven deforestation which, though also contentious, involves the struggle of property occupiers to meet their needs.

5.1a. Preemptive Deforestation

In June 2001, on one formerly quiet ranch in the Município of Marabá, a thirty-man logging crew working for a local logging boss fired up their chainsaws to complete the task at hand. Evandro Mutran, the owner of the property had contracted their services

to remove a 3,500 hectare portion of mature standing forest in the back corner of Fazenda Cabaceiras, a large property (one of seven the rancher controlled) long under threat of occupation by the landless, and, at the time, actually occupied by them. Unfortunately for the logging crew, a particularly aggressive anti-logging campaign had just been started by the local director of the national environmental protection agency (IBAMA). After removing only 250 of the 3,500 hectares of forest they had been contracted to clear IBAMA shut them down, and the MST insisted that over 60 percent of the forest on the property had already fallen victim to these illegal activities.

Why would the MST, an organization involved in redressing social wrongs, not enforcing environmental regulations, chime in when a rancher was caught illegally logging his own property (rarely a problem given the rampant nature of illegal logging in Amazônia)? The case of Fazenda Cabaceiras is actually among the most complex and longest running conflicts in the region, but this particular episode is a good example of how and why a rancher would chose to deforest their property when faced with occupation and other actions by landholders.

If the case of Fazenda Cabaceiras was extraordinary, the phenomenon of preemptive deforestation would not be important, but the evidence for this trajectory of change is in fact substantial. As covered in Chapter 2, many of the current land statues (Articles 185, 186, and 191 of the 1988 Constitution) allow for the expropriation of land in the estimation of social movements. In some respects, despite perfectly acceptable use of a property of “large” size, a landowner still must ensure that no person or family occupies it for five years lest a portion of the property be claimed under usucaption.

Some authors have argued that standing forest reserves may allow for the concealment of ongoing property occupations (Foweraker 1981b; Fearnside 1987; Hall 1989; de Almeida 1990; Pace 1992; Alston et al. 2000; Fearnside 2001a; Branford and Rocha 2002; Simmons et al. 2002; Simmons, Walker et al. 2007), and some anecdotal evidence supports this view (e.g., CT 1995; CT 1997; Rodrigues 1997; Santos 1998; Filho 2001c). This would indicate that in some respects ranchers would have an incentive to remove large extents of standing forest on their properties in order to remove the opportunity for property occupiers to remain on the property unseen for the period necessary to lay claim to it. Initially, a proposal such as this appears ridiculous; does the typical wealthy rancher in the Amazon lack the ability to patrol their property for invaders? In much of the Amazon, the size of a property makes constant patrol or monitoring very difficult, and in some regions, such as the South of Pará, properties may be so large as to make the task impossible (average property sizes can exceed twenty square kilometers in some areas).

Brazilian land law has long been a point of criticism for scholars of land conflict, with analysis focusing on a variety of topics ranging from a focus on specific statutes that would appear to encourage conflict (Holloway 1980; Brannstrom 2001), or on the character of the law itself (Holston 1991). Some authors blame land law for much of the environmental devastation wrought in both the Atlantic and Amazon forests, while simultaneously leading to violent conflict in both regions (e.g., Dean 1995; Alston 1996b; Alston et al. 1999; Alston et al. 2000). While the shifting character of land law in Brazil was detailed in Chapter 2, the nature of its influence on land conflict deserves special

attention. Specifically, land law in Brazil is complicated and ambiguous enough so as to put nearly any land claim in doubt. As Holston (1991: 708) points out:

“Irresolution is also a means of rule that the legal system empowers; that is, the rule of law in Brazil systematically produces irresolution for a society in which irresolution is a means of rule. Of course, legal ambiguity need not entail administrative uncertainty. There are countries more or less efficiently governed with legal systems, such as American and British common law, that produce irresolution. Moreover, there are other means of rule in Brazil, and judicial resolution is not unheard of. But the more significant the dispute in Brazil, especially involving land, the less likely it will find such settlement. Rather, the ruling classes use law to avoid court decisions in which they have to submit to the uncertainties of justice. Instead they launch jural-bureaucratic maneuvers to keep conflicts open but bureaucratically tied up until they secure an extrajudicial, political, and politic [sic] solution. Going to court for a judgment between elites may be an act of desperation that they fear because it means that they have exhausted their networks of power and favor – that they have failed to find a *jeitinho* [emphasis in original] (a knack or way of getting around a bureaucratically or legally difficult problem), as this extralegal process is often called – and are therefore likely to lose.”

The notion here is that largeholders, in an effort to remain in control of legally ambiguous landholdings may seek to tie-up any property claim or counter-claim in a string of bureaucratic and legal fights which may prevent a property from leaving their hands. In some cases, at least in the Amazon, this strategy is further aided by the remote and contradictory nature of the social institutions which deal with these legal issues. For instance, in the South of Pará, no fewer than four state or federal level agencies (Instituto do Terras do Pará [ITERPA], the Grupo Executivo das Terras do Araguaia-Tocantins [GETAT], INCRA, and SUDAM), have been highly active (mostly at the same time) in registering property and issuing documents which can be (and are) used to justify some legal claim to a piece of land. Perhaps more significantly, many wealthy largeholders

exert undue influence over the local offices of many of these agencies (Foweraker 1981b; Hecht and Cockburn 1990; Binswanger 1991; Schmink and Wood 1992; Pfaff 1999; Treccani 2001). In Amazonia, especially in the eastern half of Pará, elites with longstanding land-claims in the region (such as those with now-cancelled perpetual or long-term leases from the state) can tap into latent networks of power established through decades of *Coronelismo*, a power relationship so nicknamed (after the rank of Coronel) because of the authoritarian tactics and impunity that those in power can wield (Emmi 1999; Sakamoto 2004b; Almeida 2006).



Figure 5.1. Typical cattle pasture near Marabá, moderately degraded. Note short palms throughout, indicating common burning most likely in order to temporarily increase pasture productivity. Photo by S. Aldrich, 2007.

Another facet to preemptive deforestation is that, due to cultural and legal norms, forested areas in Amazonia tend to be viewed as “unproductive” (Bunker 1981;

Foweraker 1981b; Eden et al. 1990; Alston et al. 2000; Hall 2000; Brown 2001; Arima et al. 2006; Leno 2007). When this norm is coupled with the fact that a substantial number of large and small properties alike are held and farmed under various levels of illegal possession, the incentive to show productive use, and hopefully the legal claim to a tract of land, leads many to deforest their holdings. Indeed, in discussing the *sesmaria* system which serves as the basis for many of the tenets of modern land law in Brazil, Holston (1991: 710) makes it clear that “because the [imperial Portuguese] Crown’s central initiative was to link land occupation to productive agricultural use” many current land statutes are interpreted to indicate only agricultural land as being “productive” and therefore ineligible for expropriation. When the historical antecedents are treated this way by government officials in Amazônia, and combined with contemporary views of the region as a harsh “green hell,” the results are often prejudicial to forests (Cleary 2001a). This is arguably what turned the South of Pará from a mostly closed-canopy tropical forest into what is today primarily cattle pasture, much of it of poor quality (see Figure 5.1 and Figure 5.2).



Figure 5.2. Overgrazed pasture, somewhat recovered. This pasture was once part of a large and successful farm in the region and is now within an agricultural settlement. Ranchers claim settlers overgraze their pasture and are responsible for a “large proportion of the degradation” evident in the region (Gil 2007). Photo by S. Aldrich, 2006.

In the end, this tripartite combination (land law and notions of land “productivity,” overlapping bureaucratically-supported land claims, and an aversion to forest) provides a very significant incentive for largeholders to deforest their holdings. Not only are the social conditions such that the loss of the forest will likely not be mourned (or even noticed) by anyone but some distant environmentalist (mourning the loss) or low-level technician in a government agency (noticing the loss), legal conditions are such that, should the property be threatened with occupation, the reward by

establishing “productive use” is high in comparison with the threat posed by fines stemming from the violation of environmental laws as outlined in Table 4.2.

Not only do anecdotes and academic treatments of the problem seem to indicate a high potential for preemptive deforestation, but ranchers themselves acknowledge that some of their colleagues have taken exactly that approach. In fact, fifteen of nineteen ranchers (79%) I interviewed mentioned removing forest reserves as a good method to discourage occupation and one explicitly said so (Raul 2008). When I asked one rancher and his colleague what could be done by ranchers seeking to discourage property occupations one of their responses was “limit the size of forest reserves,” immediately followed by the caveat that environmental laws should be followed (note that both of these are named risk factors for property occupation from Table 4.1).

The importance of preemptive deforestation, or the removal of forest cover before occupations occur (or in order to discourage them) plays out in newspaper accounts of land conflict on largeholdings throughout the region. In one case, in the municipality of Xinguara, property occupiers were ejected from *Fazenda Marajoara*, a large property controlled by an infamous *grileiro* named Manoel de Sá. What makes this case stand out is that newspaper coverage of the event (involving the expulsion and arbitrary imprisonment of three landless rural workers) states that 2,500 hectares of 4,500 total hectares on the farm were slated to be deforested “for the implantation of pasture in order to avoid the qualification ‘unproductive *latifúndio*,’ and therefore avoid expropriation” (Liberal 1986)⁵⁶.

⁵⁶ Original Portuguese text reads: “Segundo a agente pastoral Marilza Santos Lopes e a assessora do STR de Xinguara, Benvinda de Assis, a Fazenda Marajoara, de propriedade de Manoel de Sá, tinha cerca de 1.800 alqueires e naquela ocasião, sua proprietário estava planejando desmatar uma área de mil alqueires

In another more violent case, property occupiers on *Fazenda Curral de Pedra*, a ranch in the Municipality of Conceição do Araguaia, were threatened by gunmen who were attempting to intimidate them to get them to leave the property. This, in and of itself, is not an uncommon event in the South of Pará, which experienced more than 700 cases of violence, intimidation, threats, and sometimes killings between 1980 and 2003. What makes this event stand out from the 699 others over the years is the fact that the gunmen actually showed up with the purpose of clearing the forested area of the property which occupiers were inhabiting. Upon finding the landless occupiers there the gunmen's purpose changed; the thugs began intimidating the occupiers by threatening four of them with death.

These two cases are clear anecdotes showing a tendency by largeholders in the region to remove forest cover, perhaps in the hopes that it will eliminate the threat of expropriation by showing some "productivity," and avoid falling afoul of the so-called "beneficial use" clause of the 1988 Brazilian Constitution (Brasil 1988, articles 189 and 191). A further 84 instances gleaned from newspaper accounts between 1980 and 2003 are indicative of this strategy of preemptive deforestation, or involve claims that preemptive deforestation occurred. Of those eighty-four instances, nineteen occurred in the *poligono dos castanhais* on twelve of the 180 properties there. Over the years many more instances of preemptive deforestation may have occurred on the largeholdings in this area and in the region in general, but escaped detection.

In the following section, I track land conflict on the two of the largest and most active sites of conflict in the region of the *poligono dos castanhais* (Fazenda Cabaceiras

para implantação de pasto, para fugir à qualificação de latifúndio improdutivo e, assim, evitar a sua desapropriação" (Barata 1995: 417 & 418).

and Fazenda Macaxeira), and a smaller conflict on a ranch key-informants universally lauded as being among the most technologically advanced (Fazenda Peruana), showing through accounts from local newspapers and satellite imagery the changes in land-cover which have accompanied incidents of land conflict and direct action land reform activity (Figure 5.3).

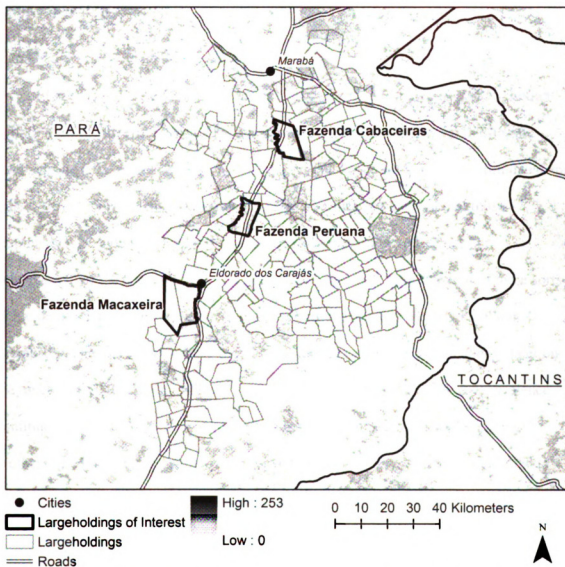


Figure 5.3. The location of Fazendas Cabaceiras, Peruana, and Macaxeira within the Polígono dos Castanhais.

Though it is difficult to directly connect these two phenomena, I will bracket major conflict events with classified Landsat imagery in order to quantify the land cover change which occurs immediately after land conflict events, but before occupation. Through this narrative history, and illustration of the changes wrought on these properties, I set the stage for an investigation of the factors which influence forest cover in the region through a spatial regression model.

5.1a1. Case Study: Fazenda Cabaceiras

Fazenda Cabaceiras has been the object of intense conflict since 1985. Though agitation for the property did not start in earnest until the late 1990s, the mid-to-late 1980s through the mid-1990s saw a stage of conflict where workers were intimidated and killed. Despite the violence, newspaper reports are quick to point out that those responsible for such activities were unknown, or suspected to be “friends” or “coworkers” of the deceased who had some argument with them. The first of these sorts of incidents occurred in June of 1985, when a farm worker was abducted while in Marabá, and he and his wife were found dead (and severely burned) a few days later on the ranch, where they both lived and worked (Barata 1995: 357)(Figure 5.4). Violence continued a few years later, in May 1987, when a pair of infamous land-grabbing brothers hired police and gunmen to expel and harass some *posseiros* who had tried to settle on Fazenda Cabaceiras after Fazenda Surubim was cleared of occupiers (Barata 1995: 571).

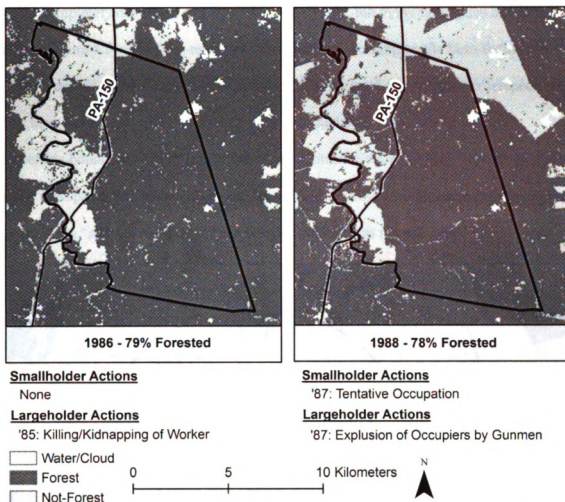


Figure 5.4. Land-cover and conflict events on Fazenda Cabaceiras for 1986 and 1988.

After these episodes, violence and conflict on Cabaceiras calmed down, and no further incident took place until May of 1994, when a farm worker was found dead in an area he was hired to clear. The property holder, still one of the two land-grabbers mentioned above, told newspapers that the man must have been killed in a dispute with a fellow worker, who probably fled the scene (Correio Editors 1994).

By 1996, the farm had been purchased or otherwise taken over by Délio Mutran, of the wealthy and powerful (and now somewhat infamous) Mutran family. Délio's farm did not stay peaceful for long, however, and in August of that year a farm worker arrived in a part of the property he was to clear only to find the Caterpillar D6 bulldozer he was

to use completely destroyed and burned. Not only this, but many farm gates had been stolen (Figure 5.5). The farm manager, who had been working on the farm for at least three years, noted that “occupiers or invaders” (“*posseiros*” and “*invasores*” respectively) may have been responsible, and that “occupiers” had been encroaching upon the property’s boundaries over the past few years (Correio Editors 1996y). Though the title of the newspaper article describing the burned and destroyed bulldozer makes the event sound like a “sinister mystery” of vandalism, accident was not ruled out.

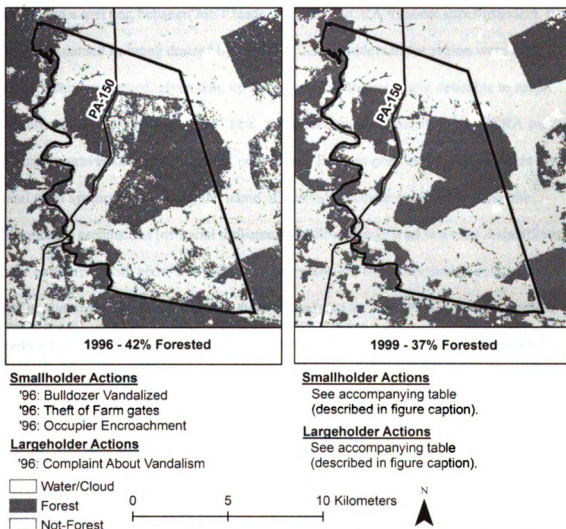


Figure 5.5. Land-cover and conflict events on Fazenda Cabaceiras for 1996 through 1999. See Table 5.1 for a description of the conflict events in 1999.

In 1998 the property was finally explicitly threatened with occupation by the MST, which the owner, Délio Mutran, was surprised to hear (Correio Editors 1998c). Before the occupation took place, Mutran explained that he was not concerned, claiming “the farm is something you would find in the first-world. It involves high costs to maintain. If it were not for the fact that this was declared productive land [by INCRA], it would make no sense to be occupied by the landless, as they would never have the ability to maintain it.”⁵⁷ After an ongoing occupation of the INCRA headquarters in Marabá resulted in a meeting between MST leaders and the INCRA regional superintendent, the farm was named as being desired by the MST. Largeholders in the region were not immediately concerned, given that, up to this point (although being desirable to social movements due to status as “good” land) a declaration of productivity by INCRA was enough to prevent a serious threat of occupation. Perhaps presciently, the president of the local rural syndicate (a man by the name of Carivaldo Ribeiro) proclaimed that the “despicable pretensions [of social movements] will certainly lead to a total instability of rural enterprise, with economic and social repercussions of unimaginable proportions”⁵⁸ adding that invasions would turn the state of Pará into an area of violence and conflict, leading to loss of life and the complete undermining of Brazil’s international credibility (Correio Editors 1998c).

Despite the threat of occupation, Cabaceiras also continued to be the location of killings stemming from work conditions. In one incident, in early 1999, a farm worker

⁵⁷ Original Portuguese text reads: “A fazenda é coisa de primeiro mundo. Envolve custos altos para mantê-la. Se não fosse pelo fato de ser uma terra produtiva, também não haveria bom-senso na ocupação pelos sem terra, uma vez que estes jamais teriam condições de mantê-la.” (Correio Editors 1998c)

⁵⁸ Original Portuguese text reads: “...pretensões descabidas certamente conduzirão a total instabilidade de empreendimentos rurais, com repercussões econômicas e sociais de proporções inimagináveis” (Correio Editors 1998c)

responsible for managing other workers set at clearing part of the farm was killed by his underlings and thrown in a river (Correio Editors 1999i) (Figure 5.5, Table 5.1). The fact that clearing had been ongoing may be due to nervousness on the part of Délio Mutran that his “productive” property might suddenly be declared “unproductive” in the eyes of INCRA.

1999	
Smallholder Actions	Largeholder Actions
- Farm Workers Kill Boss - MST Occupation - Sacking of Fish-Farm - Declarations by MST - Infrastructure for Encampment - Killing of Calves - Imprisonment of Workers by MST - Threats of Cattle Raids - 10ha of Deforestation - Withdrawal of MST from Ranch - Further Killing of Calves - Reoccupation - Blockades Against Police - Clandestine Cemetery Discovered - Negotiation with INCRA & Owner - Voluntary Eviction - Occupation of INCRA by MST - Reoccupation of Ranch - Demand for Surveys of Productivity - Planting of Crops on Ranch - Roadblocks - Intimidation of Ranch Hands	- Clearing of Property by Workers - Negotiation with Police Assistance - Police Eviction of Occupiers - Arrest of 15 MST Leaders - Release of 15 MST Leaders - Legal Declarations - Public Statement/Denunciation - Criticisms of Legal System - Eviction of Occupiers by Police - Ranch Security Attempts to Stop Reoccupation - Illegal Logging of Valuable Trees

Table 5.1. Conflict events on Fazenda Cabaceiras in 1999 for both Largeholders and Smallholders

Still, the MST had not turned its gaze from Fazenda Cabaceiras, and on March 26th, 1999 the movement organized a surprise occupation of the property, starting a long and drawn out process of conflict, occupation, expulsion, and reoccupation which was

not solved until October 2004. Assembling at the INCRA headquarters in Marabá beginning at 8am (ostensibly for a 3pm protest on the other side of the city), the MST movement members loaded into busses. As the three o'clock hour came, the busses started across the city, but did not stop at the plaza (*praça Osório Pinheiro* in *Novo Marabá*, on the eastern side of the Rio Itacaiunas) as they had announced they would, and instead drove directly to two properties nearby – one of which was Fazenda Cabaceiras (Correio Editors 1999f). Along the way the Police, who had heard that MST militants and organizers were preparing for occupations, attempted to blockade the road, but perhaps due to the all-to-fresh memories of the massacre only 85 kilometers down the road they only succeeded in taking the tools of the MST members (Correio Editors 1999f). Members of the Mutran family immediately filed a legal complaint against the occupiers who established themselves in the 1,200 hectare forest reserve on the property (Correio Editors 1999f; de Souza 1999a). Though INCRA had made threats that those who occupied properties would not receive a spot at any negotiation table, that decision was quickly reversed, though the topic of Cabaceiras was not discussed (de Souza 1999a). Some of the occupiers quickly experienced difficulties when it became clear the encampment was low on food. One would-be colonist said that the food they brought was likely not enough, and would only last them for around four days (de Souza 1999a). For a landless group who had already spent countless months occupying INCRA while petitioning for land, this lack of food and constant worry over security was demoralizing, especially given the large number of “young people, children and men and women who

dream about a piece of earth to cultivate and plant legumes and other crops to sustain their families”⁵⁹.

The hunger and desperate conditions of the occupiers led to some illegal activities on the farm over the weeks immediately following the occupation. Only six days after occupying the property, a group of MST movement members decided to attack a fish-farming operation on the property, stealing fish to eat (Correio Editors 1999l). By April 15, 1999, only twenty days after the occupation, landless movement members were declaring they would not leave the farm even if a judicial order demanded the MST vacate the area (de Souza 1999b). Furthermore, reporters noted that the infrastructure they had established to handle the occupation of more than 1,200 people, including 300 huts and a health post, appeared designed to support an occupation of more than a year (de Souza 1999b). Security in the encampment was handled by gatekeepers at the entrance of the occupied area, but movement members were quick to point out that, while they had machetes and other knives to handle the tasks of setting up the encampment, they are “a movement of peaceful rural workers; [who] want some land to work, but though [they] are without fear of the police, [they] are not thieves”⁶⁰ (de Souza 1999b).

Lawless behavior, and outright conflict, continued with a hostile incident reportedly involving between fifty and one-hundred armed (with revolvers, shotguns, and machetes and tools) landless movement members. On the 19th of April the group began killing calves in a corral near the farm headquarters, successfully taking eight calves

⁵⁹ Original Portuguese text: “...há um grande número de jovens, crianças, senhoras e senhores que sonham com um pedaço de chão para cultivar o plantio de legumes e pequenas criações para sustentar as suas famílias”(de Souza 1999a).

⁶⁰ Original Portuguese text: “Somos um movimento de trabalhadores sem-terra pacíficos; queremos apenas a terra para trabalhar; não temos que temer a polícia, pois não somos ladrões” (de Souza 1999b).

(Correio Editors 1999j), probably for food (Opinião! Editors 1999k; Souza 1999).

However, when farm cattle workers intervened before more livestock could be killed they quickly found themselves in the custody of armed and angry landless people (Correio Editors 1999j), who used them as human shields against potential police retaliation (Souza 1999). The police were called, and though negotiations failed as the landless fled into the forest, nobody was injured in the incident. Later, the farm manager was contacted by the MST via cellular phone and told to deliver the slain cattle to the encampment lest he face another raid (Correio Editors 1999j). One child (of a ranch-hand) who was present during the raid claimed that the “landless wanted to shoot us and humiliate my mom and dad. I was afraid when they stuck a gun to my head and I cried”⁶¹ (Correio Editors 1999j). This raid stands in stark contrast to the claims of movement members that they were a “peaceful movement.” In addition to this incident of lawlessness, the occupiers had by this time removed at least ten hectares of the forest reserve as well (de Souza 1999b).

If the ranch itself was a highly developed and expensive farm to run, and INCRA had already declared it productive, why was the MST interested in it? Until April 21st, most largeholders in the region wondered the same thing, but then the MST proclaimed that it had evidence that the farm did not have definitive title. Indeed, the property was revealed to be possessed under a perpetual lease arrangement for the exploitation of brazil nuts – not ranching and other production (Correio Editors 1999e).

Despite the movement’s desperate struggle to make it clear that Fazenda Cabaceiras was not private property, and declarations which made the MST’s intent to

⁶¹ Original Portuguese text: “Os sem-terra queriam atirar em nós e humilharam a minha mãe e meu pai. Eu fiquei com medo quando colocaram a arma na minha cabeça e chorei” (Correio Editors 1999j)

stay on the property clear, on April 23rd a 400-strong contingent of military police officers arrived in Marabá to evict the landless living on the ranch (Correio Editors 1999h). 100 of this troop were elite special police (*choque*) from Belém (Correio Editors 1999g; Opinião! Editors 1999m). The operation was set up to be as “peaceful as possible” and the police were instructed to “use the minimum armaments possible” and to avoid conflict (Correio Editors 1999g). This was the first operation of its size by the police since the massacre of 19 landless protesters, all MST members, at the “*curva do S*” outside of Eldorado do Carajás. On the 24th, after negotiating to withdraw to a location eight kilometers away, the operation was deemed a success for the police, and a setback for the MST; a peaceful solution was negotiated and the over 1,200 people occupying the property withdrew after their demands for new plastic sheeting (for hut roofing in their new encampment), *cestas básicas*, healthcare and medications, and a new evaluation of the productivity of Fazenda Cabaceiras within the next month were all promised (Correio Editors 1999d; Santos 1999h).

Only a few months later 850 families, roughly corresponding to those involved in the first occupation of Fazenda Cabaceiras, reoccupied the property because INCRA did not live up to its promises from the April 23rd agreement (Opinião! Editors 1999d). During the occupation, 15 to 18 MST leaders (numbers vary in newspaper accounts) were arrested for possessing illegal firearms and for forming a “violent gang” (Opinião! Editors 1999l). The occupation took place in the middle of the night of June 11th, exactly 48 days after the accord between INCRA and the MST took place (Santos 1999e). Though the occupation was completely peaceful, there were some fears of violence against farm workers. In order to calm these fears, the MST again made public statements

about “only wanting a bit of land to work” and that no action would be taken against cattle workers or the animals in their care (Santos 1999e). However, the presence of “heavily armed” MST militants perhaps belies that fact, even though the MST claimed the police were attempting to incite violence and, in fact, fabricated the charges of illegal weapons possession amongst a few occupation leaders (Santos 1999e). Among the families participating in the reoccupation, there was some disagreement for the reasons behind it; some, like the MST leadership, insisted that the occupation was because INCRA broke its promise, while others mentioned that their encampment (which had been set up after the April 23rd eviction) had “inexplicably” caught on fire, necessitating a move (Santos 1999e). After a substantial amount of public and social movement agitation, the charges of illegal weapons possession and “being in a gang” were dropped against 15 of the 18 MST leaders arrested on June 11th, due to lack of evidence (Filho 1999c, 1999b; Opinião! Editors 1999i, 1999e).

Because the initial “reintegration of possession” order from April was still valid (Editors 1999e), after the occupation, the MST wasted no time in stating that it would not leave the property under any circumstance, and did not rule out direct confrontation with the police if they entered the property to evict them (Correio Editors 1999a, 1999b). The movement quickly lived up to its promise; on the 12th of June a group of civil police officers sent to pick up 150 steers for a county fair were barred entrance to the property (Correio Editors 1999a, 1999b). At this point the “reason” for INCRA breaking their promise was announced by the Superintendent. Because the MST occupied the INCRA headquarters in Marabá, INCRA had decided that it would not honor its pledge from April 23rd (Correio Editors 1999a, 1999c).

By all observations, the conflict over Fazenda Cabaceiras began to look intractable, and the potential for violence was real. In a passionate missive targeting the Mutran clan, a Catholic priest in the region asked a local paper to publish an open letter, pleading with the largeholder family to avoid violent retribution. “It is easy to see that you are not treating with assailants and revolutionaries – these are simply mothers looking to put together a better life for their children” claimed Father Luiz Muraro (1999). He pointed out that “they [the MST] live in small shacks, in the midst of dust and smoke, drinking questionable water, and survive only due to divine providence” (Muraro 1999). The open letter slowly worked to a crescendo where Father Muraro reminds Délio Mutran that “you do not need the ranch to thrive (you have other resources)... but they [the MST] need it to survive” finishing with the admonition that Mutran “has one family” but the MST “has hundreds of families,” pointing out that if the owner does not believe in the struggle of the occupiers, he should visit his own ranch and see, in the middle of their shacks, how the landless live for their struggle (Muraro 1999).

On July 9th, 1999 a gruesome discovery was made by MST members working on the ranch – four badly decomposed bodies were found, three adults and one child, assumed to be the remains of workers who passed away on the property during its years as a “*Castanhal*,” or Brazil-nut reserve (Opinião! Editors 1999c). The MST quickly jumped to the conclusion that these bodies were the remains of four people summarily executed by gunmen hired by the Fazenda, likely because they complained about not receiving their pay (Santos 1999d). However, government investigators claimed no such story could be told, and that the bodies have been interred for at least 30 years, though admittedly it would be easy to think the remains were not that old as they were somewhat

preserved in a nylon tarp (Editors 1999c; Santos 1999d). The MST believed the bodies had only been buried for a period of five years, allowing their claims to be taken seriously (Santos 1999d). Furthermore, the movement controlled access to the grave site, allowing only federal investigators to view the locations, and making a point of turning away the news media (Editors 1999f; Opinião! Editors 1999f). A few days later, even more bodies were found, amounting to over thirty, and the federal investigators proclaimed the site a common cemetery, albeit one not widely known (Editors 1999f; Santos 1999g). A lawyer for Délio Mutran pointed out that if the authorities had bothered to ask, the rancher would have been able to tell them that the cemetery on his property had been established more than 30 years ago when transporting the dead to Marabá was difficult due to poor road conditions (Santos 1999g). The MST rejected this story, and investigative journalism later that year by the magazine "*Caros Amigos*" supported the alternative explanation that the area was a grave-site for those murdered by gunmen in the employ of the region's ranchers (Almeida 1999).

A further controversy was mentioned at this time as well; after the reoccupation of Fazenda Cabaceiras on June 11th ten calves were killed or had gone missing (Opinião! Editors 1999c). MST members claimed they died due to sickness, but ranch-hands claimed the landless had been killing them for food (Opinião! Editors 1999c). After one young man was expelled from the MST encampment (for "displaying no interest in the philosophy of the movement" and for leaving and entering the encampment whenever it struck his fancy) he disclosed to the police that the MST had been killing cattle for food, and that they had a hidden cache of heavy arms in case the police attempted to evict them (Editors 1999d; Santos 1999g). Despite these declarations, the MST insisted that cattle

were dying and disappearing due to illness, and that the denunciations of the youth were “revenge for being expelled” (Editors 1999d; Santos 1999g).

In mid-July, the state land institute (ITERPA) attempted to visit Fazenda Cabaceiras to evaluate its productivity, but claimed the MST’s reoccupation prevented it from doing so (Pompeu 1999). Further negotiations with INCRA soured when INCRA, too, insisted the reoccupation prohibited any further progress (Pompeu 1999). The MST responded that the movement was facing “great persecution” by the federal government and its agencies, and repeated its claim that it would not, under any circumstances, quit Fazenda Cabaceiras (Pompeu 1999).

Though it may appear that the Mutran family, the ranch owners, sat by the wayside while the MST attempted to get their property expropriated, they and their largeholder colleagues waged a struggle of their own. “This is an aggression, a robbery, a thing which will prove to be a disincentive for any producer in the region to invest in their property” said Evandro Mutran in a public statement (Editors 1999b). Evandro took the opportunity to blame the state, saying that judges took too long to rule in cases of land occupations, and that this trend “cannot continue” (Editors 1999b). When asked about the legal situation of his family’s properties (including Fazenda Cabaceiras), he emphasized that they were some of the “oldest near Marabá” and they had “perfect documentation, and if they had not they already would have been expropriated” (Editors 1999b). Mutran also claimed that “we will not negotiate with anyone, we will exploit [Fazenda Cabaceiras], rationally, for as long as we are able”⁶² (Editors 1999b). The Mutran family certainly felt they were a prime target of the landless: “Our properties are all completely

⁶² Original Portuguese text: “Essa Fazenda aí nós não vamos negociar com ninguém. Vamos explorar, racionalmente, até quanto tivermos forças.” (Editors 1999b)

delimited. They have been for a long time. In the GETAT period, they were completely delimited. [GETAT] already determined who was the owner of this property, and who was the owner of that property. The MST knows that there is no space for it here”⁶³ (Editors 1999b).

Indeed, shortly after Evandro Mutran made these claims, the governor of the State of Pará signed an order of eviction for the occupiers of Fazenda Cabaceiras. On July 14th, the commander of the 4th battalion of the federal military police in Marabá received orders to remove the landless from Fazenda Cabaceiras, an order he planned to act on “in the next few days.” The operation was likely to involve more than 400 officers, some of whom were members of the special police forces (*choque*) (Santos 1999f, 1999a). The commander, Coronel Jaime de Jesus, said that “it would be good sense for the leadership of the MST to advise their families to leave the area without police intervention” and that “in the case they don’t have this good sense, we will have to act” (Santos 1999f). When reporters working for the newspaper *Opinião!* asked the MST what they planned to do should the police attempt to evict them, their response was that they would stay no matter what actions the police took (Santos 1999f).

Negotiations for the MST to quit Fazenda Cabaceiras began in earnest on July 16th, but were completely unproductive. The leadership of the movement would not accept any outcome that resulted in the occupiers leaving the ranch (Opinião! Editors 1999j). The MST’s main objection to INCRA’s proposals was that the locations offered to the MST were over 160 kilometers from Marabá, and “did not offer even the minimum

⁶³ Original Portuguese text: “As nossas terras são todas discriminadas. Foram discriminadas há muito tempo. Na época do GETAT. Estão organizadíssimas nos seus limites. Está discriminado quem é dono disso, quem é dono daquilo. O MST sabe que não tem espaço para ele” (Editors 1999b).

conditions to guarantee a settlement's survival" (Opinião! Editors 1999j). As one movement member said, "you [INCRA] have a lot of nerve asking use to leave Fazenda Cabaceiras. Everyone knows that the ranch was purchased illegally, and that recently a clandestine cemetery was found there, established due to the death of workers who lost their lives trying to assert their rights. You've got a lot of nerve"⁶⁴ (Opinião! Editors 1999j).

The issue of the cemetery of Fazenda Cabaceiras, despite being declared a legitimate burial ground by federal investigators (Editors 1999f; Santos 1999g), would not go away. The MST insisted that the cemetery was clandestine in an announcement released on July 16th, 1999, providing a relatively detailed history of the cemetery which bolstered their portrayal of the Mutran family as villains, and the property as being won and improved through the blood of innocent rural workers (Opinião! Editors 1999b). According to the MST, in the 1970s and 1980s a band of notorious gunmen, led by one of the worst of all, a man by the name of João Passos, used the area to dispose of the bodies of the men, women, and children they had been hired to kill (Opinião! Editors 1999b). The history was met with some skepticism by those in the media, however, and the newspaper *Opinião!*, generally friendly toward the cause of the MST, claimed little evidence existed for such claims (Opinião! Editors 1999b).

Despite the best efforts of INCRA to negotiate some form of settlement or agreement with the MST to clear Fazenda Cabaceiras, on July 26th a contingent of more than 600 military police officers, many of which were special forces entered the ranch to

⁶⁴ Original Portuguese text: "Vocês tem muita coragem de pedir para sairmos da Fazenda Cabaceiras. Todo mundo sabe que a área foi comprada ilegalmente, encontrado recentemente um cemitério clandestino, resultado da morte de trabalhadores que perdiam suas vidas quanto iam cobrar os seus direitos. É muita coragem" (Opinião! Editors 1999j).

remove the occupiers (Editors 1999h, 1999a; Opinião! Editors 1999a). To avoid violence, the MST placed women and children at the front lines of their defense (Editors 1999h; Santos 1999c) a common tactic in other conflicts (Simmons et al. 2002; Wright and Wolford 2003; Wolford 2004; Simmons 2005). Despite a militant stance by both the MST and the police, nobody was hurt in the peaceful clearing of the occupation, though the MST insisted on marching to the headquarters of INCRA, a move the police permitted (Editors 1999h; Opinião! Editors 1999a). The eviction on Fazenda Cabaceiras was the first of a four-stop eviction tour, a common strategy in the region (Editors 1999h; Santos 1999c). It is interesting to note, however, that the attitude of the police was peaceful going into the operation; one officer said, no matter the situation the police would “not fire upon or hit anyone, but we will accomplish our mission”⁶⁵ (Editors 1999a).

The MST occupation of the area surrounding INCRA, known as “mahogany plaza,” in response to their eviction from ranches in the region (especially Fazenda Cabaceiras), began immediately (Correio Editors 1999k). INCRA’s response was to guarantee land, transportation, and food aid for those who were evicted, but specified that land provided would be selected by INCRA, and not the MST (the area mentioned was already rejected by the MST in earlier negotiations) (Correio Editors 1999k). Despite these declarations, INCRA did not schedule a meeting with the MST until July 28th, likely because the outcome was more or less predetermined; while waiting the MST quickly began to agitate for the expropriation of Fazenda Cabaceiras and claimed that

⁶⁵ Original Portuguese text: “Não vamos dar tiro nem bater em ninguém, mas vamos cumprir a nossa missão” (Editors 1999a).

unless satisfactory progress was made toward this aim they would reoccupy the property (Opinião! Editors 1999n, 1999g).

The meeting with INCRA was apparently unsuccessful; on July 30th MST members encamped outside of INCRA reoccupied Fazenda Cabaceiras at around 5:30am (Sousa 1999). In contrast to past occupations, this one met some resistance – five gun-carrying security guards, likely professional gunmen, confronted MST leaders, threatening them with violence and death unless they left (Sousa 1999). Despite the threats, the MST successfully invaded the property, intending to stay until ITERPA performed a complete reevaluation of the farm's productivity (Sousa 1999). Occupiers soon started producing on their own farm areas, leading to a relatively significant fire exceeding 75 hectares shortly after their reoccupation of the ranch (C.F. 1999), an unfortunate event one expert who visited the area claims did very serious damage to the pastures on the farm (Filho 1999d).

In early November 1999, MST movement members began using a new tactic in this particular conflict – the roadblock. On November 10th, a group of approximately 400 landless workers occupying Fazenda Cabaceiras completely blocked vehicle traffic on PA-150, the state highway running by the ranch, for a period of two hours during the middle of the day (Opinião! Editors 1999h). Apparently, at least according to MST leaders, the roadblock was not much of a bother to motorists who “gave us support, including their passengers as well” (Opinião! Editors 1999h). The goal of the action was explicitly to garner support and make the plight of the occupiers of Fazenda Cabaceiras more known (Opinião! Editors 1999h). Over the next month the MST blocked both the Transamazon (BR-230) and PA-150 two more times in order to keep the pressure on

INCRA and the state and federal governments to take some action on Fazenda Cabaceiras and other properties in the region (Editors 1999g; Santos 1999b).

Beyond roadblocks, the MST and its members kept pressure on the Mutran family and the state by acting out on the property itself, in open defiance of the judicial order requiring them to quit the area (Filho 1999a). At the time, accounts of robberies, vandalism, and threatening confrontations between occupiers and farm workers were common (Filho 1999a). The MST defended its ongoing, and quite illegal, occupation, claiming that “there have already been denunciations of slave labor, a clandestine cemetery, and other exploitations of workers on the ranch, none of which were ever investigated in the least...” (Filho 1999a). Frustration at INCRA’s inaction eventually got the best of MST leaders, and by the 10th of January, 2000 they began another campaign of intimidation against ranch hands on Fazenda Cabaceiras (Filho 1999a, 2000b)(Figure 5.6, Table 5.2). A group of armed men, supposedly “MST militants,” attacked the farm headquarters in the middle of the night, shooting (though nobody was shot) the buildings, beating farm workers, and holding them prisoner for over an hour (Filho 1999a). When contacted, however, the MST claimed that the denunciation is “irrational and absurd” and that “those who support this type of violence, beating and killing, are the *latifundiários* of the region”⁶⁶ (Filho 1999a, 2000b).

⁶⁶ Original Portuguese text: “...é irracional e absurdo... Quem age dessa forma violenta, espancando e matando, são os latifundiários da região” (Filho 1999a).

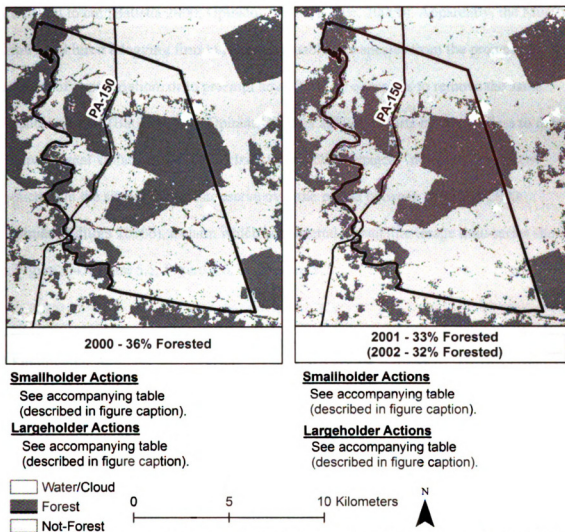


Figure 5.6. Land-cover change on Fazenda Cabaceiras for 2000 through 2002. For a list of conflict events please refer to Table 5.2.

For the next four months, the occupation of Fazenda Cabaceiras proceeded without major incident. However, in mid-June, a team of thirty workers was discovered removing trees from a 250 hectare clearing within the forest reserve on the ranch (Opinião! Editors 2000c, 2000b), an act which can be observed in the northwestern quadrant of the farm between Figure 5.4 and Figure 5.5. While clearing on properties is not uncommon, this particular deforestation event was noted in the press because 100 of the trees taken were of the so called “*madeira nobre*” (noble hardwood) species, which

are illegal to cut (Batistia 2000; Opinião! Editors 2000c, 2000b). Apparently, the Mutran family had hired a logging firm to remove valuable tree species from the property in advance of expropriation, or to preempt any efforts by occupiers to remove the same valuable species (Batistia 2000; Opinião! Editors 2000c). Efforts by the landless to report environmental violations led to the claim that satellite imagery indicate a 60 percent reduction in the size of the forest reserve over the period between 1996 and 2000 (Opinião! Editors 2000b), a claim which is bolstered by satellite image time-series shown in Figure 5.4, Figure 5.5, Figure 5.6, and Figure 5.7.

2000-2002	
Smallholder Actions	Largeholder Actions
'00: Violence/Intimidation of Ranch Hands	'00: Protests
'00: Cattle Theft	'00: Accusations of Land Sales by MST
'00: Complaints about INCRA & Ranch Security	'00: Proclamations of Ranch Productivity
'00: Negotiation & Agreement to Leave Ranch	'00: Legal Threats
'00: Roadblocks and Sacking Vehicles	'01: Police Removal of Roadblocks
'00: Reoccupation	'01: Complaints of Theft and Vandalism
'00: Vandalism	'01: Police Announce Forthcoming Evictions
'00: Expropriation of Ranch Announced (Dec.)	'01: Negotiations (Failed)
'01: Roadblocks	
'01: Intimidation Raids	
'01: Burning of Buildings & Equipment	
'01: Agreement to Limit Encampment	
'02: Raid & Cattle Killing	
'02: Slave Labor Fines	
'02: Cattle Raid	

Table 5.2. Conflict events on Fazenda Cabaceiras between 2000 and 2002 for both Largeholders and Smallholders.

Given over a year of illegal occupation, it is perhaps unsurprising that the Mutrans began to more vocally protest the occupation, and more strenuously petition the

government and the police for intervention. The agitation by the largeholders led the MST to take action, most likely to remind the police that any attempt at eviction would be taken very seriously by the movement, by harassing farm management and threatening them with violence should they not leave within 24 hours (Filho 2000a). Ranch hands claim the altercation began with a simple soccer match that the MST held “on a football pitch constructed in the middle of the forest reserve” (Filho 2000a). Once the game was over, the MST “decided to have a barbeque... and to do this invaded pasture ‘10’ and killed five head of cattle by shooting them” (Filho 2000a). The next day, the farm managers, in an attempt to assess the damage, were confronted by nearly 100 armed men, holding them at gunpoint for nearly two hours, giving them one day to “pack their bags and leave the ranch” (Filho 2000a), making sure to leave behind all the cattle (Opinião! Editors 2000f). In response, the military police commander for the state of Pará, Coronel Mauro Calandrini, stated that, should the governor issue the order, the ranch may be “subject to police invasion” to kick the occupiers off, but that he preferred a negotiated solution (Filho 2000a). The MST responded to this by saying the incident was partially due to the way that INCRA was treating the process that could lead to the expropriation of the property (Opinião! Editors 2000f). The movement also claimed the “managers” of the farm they commanded to leave were really gunmen who had been constantly threatening the families occupying the property (Opinião! Editors 2000f). Simultaneously, Bené Mutran, one of the wealthiest of the Mutran family, claimed that the landless wanted the land in order to sell it at a profit (justifying his claim by citing the case of Fazenda Bamerindus), and claiming the conflict over land “is a war and nobody

with good sense in this country will ever agree with anything to do with it”⁶⁷ (Editors 2000g). The order for the re-eviction of the MST came on July 6th, 2000 (Opinião! Editors 2000f).

A negotiated solution was soon forthcoming, and on July 7th, 2000 the MST made a surprise announcement indicating they would begin striking their encampment on July 11th, moving approximately 1,800 families that were on Fazenda Cabaceiras (Opinião! Editors 2000e; Santos 2000e). The move was ostensibly to allow INCRA to more easily survey the property for productivity, but many in the news media pointed to a simultaneous desire by the MST to avoid outright conflict between occupiers and the military police, who were assembling a contingent of special forces officers to evict occupiers in the region (Santos 2000e). The occupiers did not move far, however, and set up multiple encampments near the ranch in order to monitor the crops they had planted there (Opinião! Editors 2000e), ominously declaring that the MST would occupy the ranch as many times as would be necessary to receive a positive verdict in the evaluation of the productivity of the ranch (Santos 2000b). Shortly after the voluntary evacuation of the ranch, INCRA made the announcement that the evaluation of the property would be released to the public in 35 days (Editors 2000h, 2000e).

In the meantime, the living conditions of those in the new encampments on lands nearby were inadequate, leading some to stop and rob passing cars (Editors 2000k; Santos 2000b). The strategy of roadblocks which the MST claimed it would continue to use even after the police put an end to the multiple interdictions of PA-150 (one of which took place by Cabaceiras), spread to other locations as well (Editors 2000f). By the 16th

⁶⁷ Original Portuguese text: “Isso é uma guerra e ninguém de bom senso neste País pode concordar com uma coisa dessa” (Editors 2000g).

of July, the roadblock-strategy, complete with blockades made of timber and burning tires, was put into widespread use on PA-150, causing traffic jams and leading motorists to fear violent repercussions should they attempt to circumnavigate them (Santos 2000f). Blocking PA-150 was partially a strategy to push INCRA to more rapidly assess Fazenda Cabaceiras, but also was an agitation to release imprisoned MST leaders (Santos 2000f).

The MST was awarded a small victory on the 25th of July, 2000, when a team of surveyors from the federal environmental ministry (Ministério do Meio Ambiente) arrived on the property to assess the damage done to the forest reserve on Fazenda Cabaceiras (Opinião! Editors 2000d). News reports indicated that the team “did not like what it saw” meaning that the property could be expropriated for environmental violations independently of any evaluation performed by INCRA (Opinião! Editors 2000d). The survey team arrived after months of hounding by MST movement leaders in Brasília, who had pointed out numerous environmental law violations on Cabaceiras. The team decided that claims of 60 percent deforestation in the reserve were not exaggerations quickly after arriving on the property (Cardoso 2000; Editors 2000l). A further mark against the Mutran family was that the reserve was “considered one of the last reserves of Brazil-nut trees left in the municipality [of Marabá]” (Editors 2000l). The evaluation team pronounced the property eligible for expropriation after their visit, primarily because the entire farm was only leased to the Mutran family for the extraction of Brazil-nuts, not cattle production (Editors 2000l). The environmental ministry assessors also began discussing new self-sustaining forms of agrarian reform settlements with those encamped nearby (Cardoso 2000).

Within a few weeks INCRA began speaking openly about its plans to visit Fazenda Cabaceiras, making it clear that the institute does not break its promises, yet is forbidden by federal law from negotiating or meeting with any group which uses the strategy of land-occupation to meet its goals (Editors 2000b) – apparently explaining the ultimate reason for the length of the process in the case of Fazenda Cabaceiras (Editors 2000b). Supposedly, in a meeting which took place on the 8th of August, 2000, INCRA made it clear to social movement leaders that expropriations of properties to solve the agrarian reform crisis in the South of Pará would be forthcoming “in a minimum of 60 and a maximum of 90 days” (Editors 2000b). However, Fazenda Cabaceiras was not mentioned as a property likely to be expropriated (Editors 2000b).

Though not covered in the press, it appears that by October the MST had reoccupied at least part of Fazenda Cabaceiras, and rapidly stepped up their campaign for its expropriation. In particular, on the morning of October 23rd, 2000 the farm manager made a complaint to a local judge that landless occupiers living on the farm were continuing to kill cattle, taking more than 100 animals during 2000-2001 (Santos 2000c). In the majority of cases, the animals were stripped of meat and their carcasses were left, though the farm manager claimed sometimes the cattle were killed and left intact, indicating an act of vandalism (Santos 2000a). Conflict continued a few weeks later when, early November 2nd, 2000, a group of attackers invaded Fazenda Cabaceiras, stole diesel fuel, killed two dogs, and threatened farm workers with firearms (Filho 2000b). Those threatened insisted that the aggressors were all residents of the MST encampment, but the MST insisted that they were not, or if they were those who participated in the violent act were operatives sent to infiltrate the MST in order to distort the movement's

philosophy and goals (Filho 2000b). Alternatively, the MST allowed that one man who may have been involved may have done so out of revenge for being beaten and humiliated in public by two farm workers the previous day (Filho 2000b). The more conservative regional paper, *Correio do Tocantins*, blamed the violence and intimidation wholly on the MST, claiming that the two dogs, robbery of farm goods, and violence was orchestrated by 8 armed MST “militants” who beat the farm workers and discharged their weapons repeatedly (Editors 2000i, 2000j). The farm manager denounced the attacks as “part of the strategy of the MST, to intimidate ranch workers so that they will abandon their posts”⁶⁸ (Santos 2000a).

Despite ongoing violence, and, it would appear, the reoccupation of, Fazenda Cabaceiras, on December 15th, 2000 INCRA superintendent Darwin Boerner Júnior announced that the expropriation of the ranch would occur in the coming year, and would be the only peaceful solution to ongoing conflict (Editors 2000d, 2000a; Pompeu 2000). The announcement of the expropriation was accompanied by 28 similar announcements, all of which would occur because the properties involved were “considered unproductive, [and are therefore] destined for social ends”⁶⁹ (Editors 2000a; Santos 2000d). Furthermore, Boerner stated that part of the evaluation had included surveying the areas for the likelihood that settlements created there would be successful, and verified the legitimacy of potential expropriations with agencies in Brasília (Pompeu 2000).

The announcement that Fazenda Cabaceiras would be expropriated led Délio Mutran to quickly step up his (and his family’s) campaign to prove the farm productive

⁶⁸ Original Portuguese text: “a ação foi parte de uma estratégia do MST, para intimidar os trabalhadores da fazenda e eles abandonem seus afazeres”(Santos 2000a).

⁶⁹ Original Portuguese text: “as propriedades que foram consideradas improdutivas, foram destinadas para fins sociais” (Santos 2000d).

and take last-ditch efforts to prevent its expropriation. In early December, Délio proclaimed his farm productive, and that any expropriation of it would be illegal and result in a lawsuit against INCRA and the federal government (Editors 2000c; Opinião! Editors 2000a). Délio went further to claim the expropriation “represents a stimulation of agrarian conflict in the South and Southeast of Pará”⁷⁰ (Editors 2000d; Ribeiro 2000). For Mutran, the announcement was verification of a largeholder suspicion that INCRA operated outside the law, citing federal statutes limiting the evaluation, not to mention expropriation, of a property which has been occupied until the occupiers have left for two years (Editors 2000d). Mutran, and his farm manager, a man named Genêncio Chimoka, insisted that the farm was not only productive, but had been registered properly as a private property with ITERPA, and therefore could not be expropriated by INCRA (Editors 2000d). In angry letters sent to both major newspapers, Délio underlines the fact that “the ranch is non-negotiable”⁷¹ (Ribeiro 2000).

By early January, the case of Cabaceiras was in the hands of the president of Brazil, Fernando Henrique Cardoso, who would announce the ultimate decision about the property by signing the paperwork authorizing its expropriation (Filho 2001b). Apparently, according to a high-level INCRA official, the decision would come after “all technical, agronomic, and social aspects” of the expropriation have been taken into consideration (Filho 2001b). Furthermore, he explained why INCRA included Cabaceiras in the list of properties to be expropriated; while highly productive, the property

⁷⁰ Original Portuguese text: “...representa um estímulo ao conflito agrário no sul e sudeste do Pará” (Editors 2000d).

⁷¹ Original Portuguese text: “A fazenda é inegociável” (Ribeiro 2000).

apparently did not meet a rule for 80 percent utilization⁷² (Filho 2001b). Despite this, subsequent accounts indicate that INCRA had been approaching the property as if it were productive.

The MST again began roadblocks, continuing off-and-on in July, with all-day blockades of PA-150, a major regional highway, resulting in the deployment of police special forces to remove the road “occupiers” (Opinião! Editors 2001d). The protests and roadblocks were set up immediately outside of Fazenda Cabaceiras, and were part agitation for expropriation and part protest of the ongoing imprisonment of MST leaders (Opinião! Editors 2001d; Santos 2001b). Of course, such protest and police action immediately brought up comparisons to the 19 of April, 1996 massacre of landless protesters by the police (Santos 2001b). Immediately before the police arrived to remove the roadblock, the MST abandoned its 32-hour long action in order to avoid violent repercussions, though not without leaving the roadway an impassable mess (Santos 2001a).

Roadblocks were not the only ongoing strategy by the landless to agitate for action on Cabaceiras; another 60 to 100-strong group of armed “MST militants” made an early morning raid on the farm headquarters, beating farm workers, robbing and burning vehicles (Brasil 2001b; Editors 2001b), burning pasture, and setting fire to outbuildings (Opinião! Editors 2001c). The 4am raid occurred on August 16th, 2001, with the MST claiming, again, that the altercation was meant only to eject gunmen from the ranch who had been constantly abusing and threatening MST members occupying the property

⁷² To date I have not been able to find mention of this standard in any legal code or agency policy in Brazil. However, it is certainly possible that such a rule exists in the region surrounding Marabá, as it is subject to different federal rules, or in the state of Pará. The legal landscape surrounding land-use policies in Brazil is quite complex, and even many lawyers in Brazil have trouble reliably deciphering it.

(Brasil 2001b; Filho 2001d). Those beaten claimed that the militants who invaded the building they were sleeping in were “not messing around” and that the workers “had nothing to defend ourselves with because we do not use firearms in our work”⁷³ (Filho 2001d). Farm manager Genêncio Chimoka claimed that the early-morning raid was solely an act of vandalism (Brasil 2001b; Opinião! Editors 2001c). Over 500 sacks of mineral salts (used to fertilize and treat pasture), diesel fuel, wood, and pesticides were lost in the raid, and a number of buildings were burned to the ground (Souza 2001). Those assaulted also claimed that the MST militants stole R\$650 from them (Souza 2001). The MST responded that the burning of buildings and supposed theft of money took place after the movement finished its raid, and were reported to police only to incriminate the MST (Souza 2001). Less than a week later, on August 21st, 2001, another group of 120 MST militants invaded the headquarters of Fazenda Cabaceiras in the middle of the night (Brasil 2001c). The farm headquarters was again burned, along with a vehicle and a generator, and ranch hands and security guards were told to quit the property (Brasil 2001c). The farm manager, Genêncio Chimoka, angrily denounced the attack, and the entire occupation of the ranch:

“The losses on the ranch are huge, they [the MST] have burned more than 1000 hectares of pasture, cut the wires of our fences and destroyed the ecosystem of the ranch, [by] burning the forest. I believe that the actions of the MST are meant to characterize the property as abandoned and to encourage the evaluation of the farm as unproductive. But we are trying to work with the authorities to resolve this situation in a legal manner”⁷⁴ (Brasil 2001c).

⁷³ Original Portuguese text: “Nós não pudemos nem nos defender, pois não usamos armas em nosso trabalho”(Filho 2001d).

⁷⁴ Original Portuguese text: “Os prejuízos são enormes, eles atearam fogo em mais de 400 alqueires de pasto, cortaram os arames das cercas e destruíram o ecossistema da fazenda, incendiando a mata. Acredito que estas ações do MST são para caracterizar o abandono da propriedade e favorecer o laudo da fazenda

Apparently the MST achieved their goals, because after their raid ranch hands and security workers claimed they would no longer work on the property because they feared for their lives (Brasil 2001c). A meeting a few weeks later between the MST, INCRA, and federal and municipal police led to an agreement for the MST to turn in all firearms within the Fazenda Cabaceiras encampment in exchange for a pledge by INCRA to move forward more rapidly with the expropriation process (Filho 2001a).

The MST did not have to wait long for movement on the expropriation of Fazenda Cabaceiras, although the news was probably not to their liking; on August 24th, 2001, the state military police commander sent notification to social movement groups and human rights NGOs in the region indicating that fifteen ranches would be cleared of occupants under order of the governor of the State of Pará, among them Fazenda Cabaceiras (Opinião! Editors 2001a). INCRA superintendent Darwin Boerner Junior was frustrated by the announcement, saying:

“these meetings [between the MST, INCRA, and police authorities] have been worthless, and the representatives don’t have any power to make a decision. One meeting we decide one thing, and the next we receive a communiqué stating that police special forces are going to be evicting people from properties in the region. Meetings don’t mean a thing”⁷⁵ (Opinião! Editors 2001a).

Government officials and MST leaders apparently felt that no matter what action they took to resolve the ongoing land conflict on Fazenda Cabaceiras, someone higher up

como improdutiva. Mas nós estamos buscando junto às autoridades uma providência para resolver esta situação de forma legal” (Brasil 2001c).

⁷⁵ Original Portuguese text: “Estas reuniões de nada valerem, os representantes não tem poder de decisão. Num dia eles resolvem uma coisa e no outro recebemos um comunicado que a Batalhão de Choque da PM vai despejar os acampados. Reuniões não valem” (Opinião! Editors 2001a).

would undo their efforts. Reactions to the announcement by INCRA officials, the Pastoral Land Commission (CPT), and the MST led the governor to put any eviction order on hold for 120 days (Opinião! Editors 2001b), which was then quickly rescinded. A contingent of 130 troops arrived in Marabá on the 27th of August to evict people from 12 ranches in the region (Editors 2001a).

In an effort to keep violence and conflict at a minimum on Fazenda Cabaceiras, on the eve of police action, leaders from the MST, CPT, INCRA, and the Mutran family's commercial front-end, *Jorge Mutran Exportadora e Importadora Ltda.*, met to sign an accord agreeing to a peaceful negotiation involving the ranch (Santos 2001c). However, the MST refused to sign any document after it became clear that the expropriation of the property would not be guaranteed in the agreement (Santos 2001c). The MST did, however, agree to help the Mutrans round up cattle released in raids by MST militants, and that their encampment on the property would not be enlarged in any way for a period of 120 days while INCRA further evaluated the property (Santos 2001c). In return, the MST would be allowed to stay on the property, unmolested by police or gunmen, for the same period (Filho 2001e). This peace treaty would last for the agreed-upon length, though, as in the past, the MST would not tolerate delays.

On April 4th, 2002, the MST again made a late-night raid on the headquarters of Fazenda Cabaceiras, killing 13 calves, approximately 40 cattle, and imprisoning and beating one farm worker for a few hours (Santos 2002a). Three other farm workers were unharmed as they successfully fled the scene (Santos 2002a). Apparently, the militants had intended to burn the farm headquarters, but in haste did not carry out their plan (Santos 2002a). The MST made no statements as to its supposed invasion and

intimidation (Santos 2002a). The 6-month cease-fire in the battle for Fazenda Cabaceiras was officially over.

After a relatively calm summer, at least according to newspaper reports, a visit and evaluation of Fazenda Cabaceiras by the Ministry of Labor (MT, Ministério do Trabalho), found that 22 workers there were living in “sub-human” conditions, without work authorizations (“cartorio”), and had been without pay for four months (Sousa 2002). For Cabaceiras this was the second such finding in five years (Sousa 2002). At this stage, speculation began whether, aside from the question of productivity, the ranch could be expropriated and redistributed due to repeated violations of labor laws (Sousa 2002).

A Christmas day raid ended conflict events on the property in 2002, with nearly 20 cattle killed, and some meat taken by unknown criminals (Editors Correio do Tocantins). The police indicated that the cattle-killers fled to the forest reserve on Fazenda Cabaceiras when they arrived, indicating the MST may have been involved. However, the farm manager neglected to notify the police of the problem (their investigation took place when, while driving by on PA-150, the police noticed suspicious behavior by people in a pasture), indicating that perhaps farm workers were the aggressors (Editors Correio do Tocantins). This was likely to be the case, noted one police officer, because the ranch had a problem with labor violations and misbehavior by workers was not likely to be reported to the police in order to limit trouble with the Ministry of Labor (Editors Correio do Tocantins). However, nearly three weeks later, Fazenda Cabaceiras manager Genêncio Chimoka complained that “200 heavily armed men killed 25 cows and stole their meat for Christmas” while reporting another sacking and vandalism of the ranch headquarters (Opinião! Editors 2003) (Table 5.3, Figure 5.7).

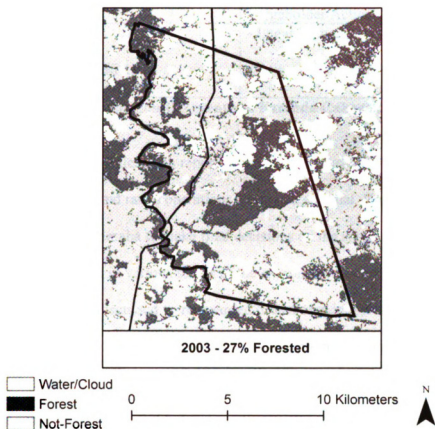


Figure 5.7. Land-cover on Fazenda Cabaceiras in 2003. For a list of conflict events see Table 5.3.

In mid-January a group of landless “militants” attacked and vandalized a brand-new corral deep within Fazenda Cabaceiras, making off with four animals and scattering the rest (Opinião! Editors 2003). Workers in the area were told to flee or risk being “executed” by over 100 armed and masked “MST militants” (Santos 2003). The MST remained silent about the motivation for the attacks, or even if the movement was involved (Santos 2003).

2003	
Smallholder Actions	Largeholder Actions
- Vandalism - Intimidation - Ambush of Farm Vehicle - Final Expropriation in 2004	- Legal Demands for Eviction

Table 5.3. Land conflict events on Fazenda Cabaceiras in 2003.

For two months little worth reporting occurred on Fazenda Cabaceiras – the MST encampment persisted and ranch operations continued as usual. However, on March 12th, 2003, officials met in Marabá to make final decisions on the status of many properties which were occupied or in various stages of the expropriation process (Editors 2003a). Most of the properties discussed were awarded orders of eviction of the occupiers, with Fazenda Cabaceiras the one standout; a decision to expropriate Cabaceiras would await a ruling by the president, and so the council of agrarian reform officials would suspend a ruling for sixty days (Editors 2003a).

On the 22nd of April, 2003, the MST's campaign of ranch worker intimidation again became front-page news when a group of 30 "militants" attacked and tried to set fire to a truck transporting ranch hands in Fazenda Cabaceiras (Editors 2003b, 2003d).

While the order to expropriate Fazenda Cabaceiras continued to languish on President Cardoso's desk (having been nearly two years since INCRA announced Cabaceiras as a property eligible for expropriation), ranchers in the *poligono dos castanhais* revolted, demanding that judges in the region issue eviction orders for properties currently experiencing occupations (Editors 2003c). Their ultimatum carried a threat of wholesale roadblocks of every state road running through the region (Editors 2003c).

Eventually, the Mutran family resigned their holdings and began to “completely pull out” of the South of Pará, as one rancher I spoke with stated (Gil 2007). By the time the final order for the expropriation of Fazenda Cabaceiras was signed by President Lula in October, 2004, the Mutran family had sold nearly all the land they held in the *poligono dos castanhais*, either to other private parties, or through negotiation with INCRA and social movements like the MST (Raul 2008).

While the struggle for Fazenda Cabaceiras began relatively early in the region, with the first land conflict incident occurring in 1985 and initial *posseiro* encroachment in 1987, the most involved struggle actually began relatively late, and occurred once the property had been over 50 percent deforested. However, as Figure 5.5 displays, the onset of earnest land conflict with the 1999 occupation and multiple evictions of the property, deforestation continued, including the removal of trees within the forest reserve of the property. While the MST continued to agitate and lobby for the expropriation of the property, and the order for its expropriation sat on the President’s desk, it would appear that the Mutran family began to remove as much forest cover as possible. Though there is some indication in newspaper accounts that the MST removed forest during repeated occupations, the area cleared is never reported to exceed more than 100 hectares – far less than the removal observable in Figure 5.5. Despite this, it is somewhat surprising that, by 2003, 27 percent of the property was still forested. Another farm in the region, Fazenda Macaxeira, does not display the same trend.

5.1a2. Case Study: Fazenda Macaxeira

One of the most notorious land conflicts in the history of the struggle for agrarian reform in Brazil took place on a large farm complex known as Fazenda Macaxeira⁷⁶. The ranch, literally called “sweet manioc,” was owned by the Pinheiro family and was subjected to the same repetitive struggle which took place on Fazenda Cabaceiras. The difference, however, is that at least 20 people lost their lives in the struggle for Macaxeira, and that the struggle itself shocked Brazil into a national realization that land reform may be necessary.

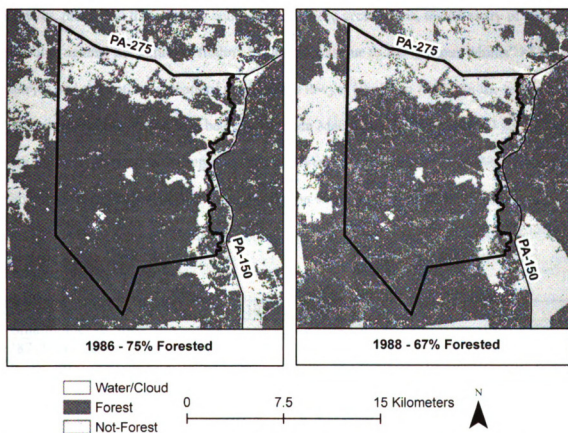


Figure 5.8. Land-cover on Fazenda Macaxeira from 1986 to 1988. For a summary of land conflict events see Table 5.4.

⁷⁶ In the print media the ranch is referred to as “Fazenda Macaxeira” and “Fazenda Macacheira.” For this dissertation I will use the more recent convention in the print media, “Fazenda Macaxeira.”

The first indication that things might be awry on Fazenda Macaxeira came in early 1987 when local newspaper accounts reported that contract laborers denounced slave labor on the property (Pinheiro 1987). After some petition by the Pinheiro family, the federal Ministry of Labor sent investigators who did not uncover any instances or evidence of slave labor on the ranch (Pinheiro 1987). At the time, the family patriarch, Osório Francisco Martins Pinheiro, wrote a public “letter of clarification” claiming that, as he and his family suspected, his ranch had been cleared as a site of labor violations (Pinheiro 1987). In his letter, Pinheiro discussed the outcome of judicial hearings, however, and noted that, despite being cleared of the accusations, the Ministry of Labor still ruled against his family, a finding he claims was due to the “jealous whims” of his enemies and the untimely death of the family’s lawyer (Pinheiro 1987). In the letter, Pinheiro claims his family “has been on Fazenda Macaxeira for more than 40 years... we were the first to arrive in the region... it was the establishment of Fazenda Macaxeira that allowed for the penetration of the Carajás region which is now so highly developed... here we developed the agriculture, ranching, and the Brazil-nut extraction industry”⁷⁷ (Pinheiro 1987).

1986 to 1988	
Smallholder Actions	Largeholder Actions
'87: Slave Labor Denunciation	'87: Claims that Slave Labor Has Never Been Practiced on Macaxeira '87: Complaints that Ranching Legacy is Threatened in the Region

Table 5.4. Land conflict events on Fazenda Macaxeira between 1986 and 1988.

⁷⁷ The original Portuguese text of the full passage reads: “Gostaria de informar que estamos na Fazenda Macacheira há mais de 40 anos. Fomos os primeiros a chegar naquela região. Foi através da Fazenda Macacheira que se deu início à penetração da área hoje tão desenvolvida de Carajás. Ali desenvolvemos agricultura, pecuária e indústria extrativa de castanha” (Pinheiro 1987).

For the next seven and a half years little of note occurred on Fazenda Macaxeira, at least according to newspaper accounts. The next item of interest occurred in March, 1995, when a group of officials from ITERPA, INCRA, and the MST surveyed three farms in the region (Fazenda Macaxeira, Fazenda Primavera, and Fazenda Rio Branco, all three of which were expropriated and redistributed to the landless by 2002) in the search for a place to settle 1,500 families who had invaded and occupied the *Cinturão Verde* biological reserve which surrounds the Carajás mine (owned by CVRD, *Compania Vale do Rio Doce*) (Correio Editors 1995b). In the discussion between the governor of the state of Pará, Almir Gabriel, and officials from ITERPA and INCRA, the size of agricultural lots on settlements was raised, with the governor thinking 50 hectares was much too large for a single family (Correio Editors 1995b). Furthermore, Governor Gabriel made it clear that “Pará is not able to solve land problems for all of Brazil... given that 72 percent of all of the territory of Pará is under federal jurisdiction”⁷⁸ (Correio Editors 1995b). In order to get the governor to order a search for alternative settlement areas, the MST had to send a contingent of 430 members to set up camp in Belém, the state capital (Correio Editors 1995b). Interestingly, there was no indication that the MST had their eye on Fazenda Macaxeira until after it is visited by government officials. The attention of the movement quickly turned toward the ranch thereafter, with disastrous consequences.

⁷⁸ Original Portuguese text: “Almir Gabriel também observou que o Pará não pode dar solução para os problemas de terra de todo o Brasil... disse que 72% das terras do Pará estão hoje concentradas em poder do governo federal” (Correio Editors 1995b).

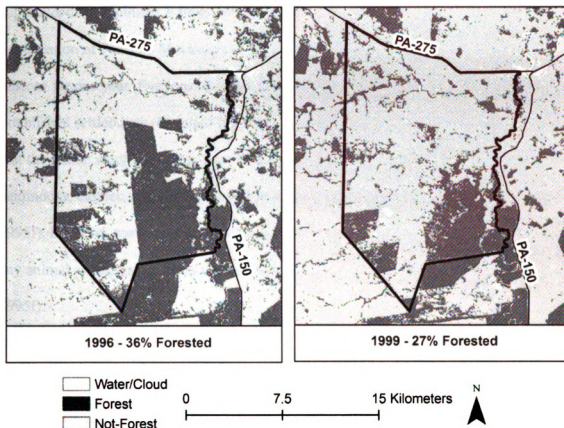


Figure 5.9. Land-cover on Fazenda Macaxeira for 1996 and 1999. For land conflict events see Table 5.5.

On October 10th, 1995 the MST began a march from the *Cinturão Verde* forest reserve and Fazenda Rio Branco, both near Parauapebas, to Belém (Opinião! Editors 1995f). Before departing, however, they requested that the mayor of Parauapebas, Francisco Alves de Sousa, provide busses for the women and children who made up a significant part of the movement (Opinião! Editors 1995f). After reinforcing city hall with 30 military police officers, de Souza spoke with MST leaders on the phone, but was unable to provide the requested busses because the municipality of Parauapebas was running in deficit (Opinião! Editors 1995f). The approximately 1,500 movement members, women and children in tow, pressed onward by foot, hoping to cover the 710 kilometers to Belém in order to meet with Governor Gabriel and the state INCRA

superintendent (Opinião! Editors 1995f). Their demands were for the expropriation and demarcation of Fazenda Macaxeira and Fazenda Rio Branco, a guarantee of *cestas básicas* for one year, five tons of seeds, and the construction of state schools on already established settlements (Opinião! Editors 1995f). The news media predicted at the time that the march would last more than 40 days, noting that the landless carried only hammocks, clothes, and small personal items with them on their march (Opinião! Editors 1995f). For food, movement leaders hoped to encounter it along the way – they promised any animal attempting to cross the road would likely be their lunch (Opinião! Editors 1995f).

1986 to 1988	
Smallholder Actions	Largeholder Actions
'95: Ranch Surveyed by ITERPA, INCRA, MST '95: March to Parauapebas '95: Protest for Cestas Básicas '95: March to Curionópolis '95: Encampment in Protest for Expropriation of Macaxeira '95: March to Curionópolis '95: Food Aid Received '95: Demands for Expropriation of Macaxeira '95: Meeting with INCRA President '95: Promise to Reevaluate Macaxeira's Productivity '95: MST Threatens to Occupy Macaxeira '95: MST Meeting Proclaims Macaxeira a Target '95: Roadblock for Cestas Básicas '96: March to Macaxeira '96: Occupation of Macaxeira '96: Deforestation for Rice Production on Macaxeira '96: MST Quits Macaxeira in Exchange for Food and Reevaluation of the Property '96: March to Belém '96: Roadblock of PA-275 '96: Encampment on PA-150 at the "Curva do S" '96: Demands for Food Aid & Bus Transportation to Belém '96: Allegations of Largeholder Funding of Massacre '96: Inquiry into Police Misbehavior and Bribes Related to Massacre '96: INCRA Expropriates Macaxeira '96: Promises to Settle More Landless Families in the Region '96: Cestas Básicas Distributed, Palmeiras Settlement Founded, Credit Distributed '96: INCRA Creates Settlement at Macaxeira	'95: INCRA Refuses to Expropriate Macaxeira '95: Macaxeira Declared Productive by INCRA '95: Largeholders Syndicate Protests MST Interest in Macaxeira '96: 100 Private Guards Threaten MST Occupiers '96: Ranchers Complain about State Inaction Against Occupiers '96: Public Denunciations of Occupations '96: Pinheiro Family Refuses to Sell Macaxeira '96: Police Massacre of 19 MST Members at "Curva do S" '96: Public Statements by Largeholders that the MST "deserved" to be Massacred '96: Complaints that Land Conflict was Inhibiting Development and Investment '96: Proclamations of Innocence in Massacre by Largeholders '96: Claims that Constitution Allows for Violence in Response to Property Occupations '96: Pinheiro Family Complains it has yet to Receive Money from INCRA

Table 5.5. Land conflict events on Fazenda Macaxeira between 1988 and 1999.

The movement's strategy of catching their food along the way resulted in some hunger, and by the end of a week of walking they had to stop to rest in the city of Curionópolis, along PA-275, after marching only 52 kilometers (Opinião! Editors 1995a). INCRA sent relief, however, in the form of rice, beans, and meat, though only half of the promised amount arrived, providing enough food for only four days (Opinião! Editors 1995a). During an interview with some would-be colonists, *Opinião!* disclosed that movement members planned to demand the expropriation of both Fazenda Rio Branco and Fazenda Macaxeira (Opinião! Editors 1995a).

In early November, 1995 INCRA president, Francisco Graziano, under the authorization of President Cardoso, announced he would meet with the 1,500 MST members on their march to Belém (Opinião! Editors 1995e). Ahead of the meeting, the MST claimed that if the offer that was likely to be made by INCRA was not unanimously accepted by its members they would organize a new property occupation (Opinião! Editors 1995e). Given their location in their march – between Curionópolis and Eldorado do Carajás – their likely target would be Fazenda Macaxeira. The MST and INCRA president Graziano met on November 6th, 1995, and the expropriation of Fazenda Rio Branco was the outcome (Opinião! Editors 1995g), supposedly the first INCRA action in a campaign to settle 280,000 families throughout Brazil (Correio Editors 1995c; Opinião! Editors 1995b). When the topic of the occupation of Fazenda Macaxeira came up, INCRA president Graziano asked for an end to occupations and discounted the possibility that the Pinheiro ranch (Macaxeira) would be expropriated because it was productive (Correio Editors 1995d, 1995c; Opinião! Editors 1995b). However, in order to avoid inflaming an already tense situation, Graziano formed a cooperative commission with the

MST whereby six landless movement members and INCRA officials would visit Fazenda Macaxeira in order to gauge its productivity (Correio Editors 1995c; Opinião! Editors 1995b). MST leaders were less dismissive of the potential for occupation and expropriation of Macaxeira, however, and stated that if INCRA did not issue a decision on the ranch within 30 days, the movement might occupy it as “it is the only tactic available to accelerate the formation of an agricultural settlement” (Opinião! Editors 1995b, 1995g). These claims were reiterated a few weeks later when MST leaders claimed that they would certainly occupy Fazenda Macaxeira before the end of the year if they did not agree with the result of the MST/INCRA evaluation of the property, due by mid-December (Correio Editors 1995e).

During the weekend of December 16th, 1995, approximately 200 MST leaders from all over the South of Pará met in Marabá in order to strategize for the coming year and summarize their progress over 1995 (Opinião! Editors 1995c). According to Joaquim Ribeiro, an MST leader from Parauapebas, the expropriation of Fazenda Rio Branco was the only “victory” the movement could claim in 1995 (Opinião! Editors 1995c). Apparently, the conclusion of the meeting was an overall disappointment in progress by official organizations; Ribeiro stated that the “movement does not believe that the federal and state governments have any interest in realizing the dream of agrarian reform, and fault the commitment of INCRA [for the disinterest], which has as of today failed to visit any of the 13 areas considered adequate for expropriation [by the MST], among which is Fazenda Macaxeira...”⁷⁹ (Opinião! Editors 1995c). One result of the meeting was to win

⁷⁹ Original Portuguese text: “Ele [Ribeiro] afirma que o movimento não acredita que o governo federal ou meso estadual tenham interesse em realizar a tão sonhada Reforma Agrária e redamam da falta de empenho

land for the 3,500 families which had been encamped in Curionópolis since September (Opinião! Editors 1995c), some in desperate hunger and relying entirely on *cestas básicas* for their survival (Correio Editors 1995e). Coverage in the more conservative *Correio do Tocantins* emphasized the “tense climate” between largeholders and the landless (Correio Editors 1995a). Apparently, though the other newspaper, *Opinioao!*, made no mention of this, INCRA president Graziano guaranteed that “if the landless do not invade Fazenda Macaxeira, within ten days it will be expropriated”⁸⁰, a claim the federal government quickly announced had never been made (Correio Editors 1995a). Apparently, at least according to *Correio do Tocantins*, the MST members encamped throughout the municipality of Curionópolis had threatened to occupy no fewer than 14 properties, with Fazenda Macaxeira likely to be the first given its proximity (Correio Editors 1995a).

In one statement by Geraldo Minton Soares, the president of the largeholder’s union (*Sindicato dos Produtores Rurais*) in Parauapebas, the equation of the MST’s tactics with militant socialism is unabashed:

The most impressive thing is the clear identification of a line of conduct conceived under a socialist ideology, under command of a national leadership, concerned with fundamental question about the fight against “capitalism” and “significant and radical agrarian reform”⁸¹ (Correio Editors 1995a).

do INCRA, que até hoje não fez a vistoria nas 13 áreas consideradas adequadas para a desapropriação, entre elas a Fazenda Macaxeira, da qual não abrem mão” (Opinião! Editors 1995c).

⁸⁰ Original Portuguese text: “...foi garantido que se os trabalhadores rurais não invadissem a Fazenda Macaxeira, dentro dez dias ela seria desapropriada...” (Correio Editors 1995a).

⁸¹ Original Portuguese text: “E o que mais impressiona é a clara identificação de uma linha de conduta concebida na ideologia socialista que, sob a liderança de um comando nacional, prega como questões fundamentais a luta contra o ‘capitalismo’ e a ‘reforma agrária ampla e radical’” (Correio Editors 1995a).

In my conversations with Largeholders in the region, they repeatedly made claims of socialism, communism, and radical militancy when discussing the ideology of the landless and their tactics.

On December 29th, 1995, over 1,200 MST members occupied PA-275 between Curionópolis and Parauapebas in protest of the long wait for action by INCRA in the region (Opinião! Editors 1995d). Again, their demands were accompanied by a request for more food-aid in the form of *cestas básicas* (Opinião! Editors 1995d). Conditions for the nearly 3,500 people encamped in Curionópolis continued to be atrocious (Correio Editors 1996c), and reached the point of crisis early in 1996. By February, 1996 the movement had been encamped throughout the municipality of Curionópolis for over two years, and the rumor of occupation continued to cascade through the movement and the press (Correio Editors 1996t). Despite the constant grumbling by the MST that a new agricultural settlement should be created on Fazenda Macaxeira, standing evaluations by INCRA indicated the ranch's productivity, and therefore its ineligibility for expropriation (Correio Editors 1996b). The ongoing complaint of many INCRA officials was that INCRA had "already demonstrated to the landless that the area is productive, making it impossible to expropriate"⁸² (Correio Editors 1996b).

In the middle of the night on March 4th, 1996 the impasse was broken; approximately 3,000 families from the municipalities of Curionópolis and Parauapebas invaded a farm linked to Fazenda Macaxeira and began to set up huts and to deforest a 20 hectare area for rice cultivation (Correio Editors 1996r; Opinião! Editors 1996e). The occupation of the ranch was peaceful, however, despite the potential for armed conflict

⁸² Original Portuguese text: "...o INCRA já demonstrou aos sem-terra que a área é produtiva, daí a impossibilidade de desapropriá-la" (Correio Editors 1996b).

between MST occupiers and 100 security guards who stationed themselves in the farm's forest reserve (Correio Editors 1996u, 1996r). The initial reaction in the press was one of a reasonable resignation to the fact that this may have been the only reasonable option for the MST. In a very diplomatic discussion of who was responsible for the occupation of Fazenda Macaxeira and what the solution should be, the editor of the newspaper *Opinião!* claimed:

However, the lack of political will on the part of the Federal Government led INCRA to put property owners and the landless "in the belly," perhaps in the hope that the hunger the landless would experience would lead them to think more with their stomachs and give up. Big mistake. The position INCRA took, whether deliberate or through incompetence, only further provided the fuel (or food, since we speak here of stomachs) to further radicalize conflict. In reality, Fazenda Macaxeira is a small piece of land. It is more a symbol for the landless than an opportunity to meet the needs of even half of the families camped out in Curionópolis.

Meanwhile, huge and completely unproductive *latifúndia* are added to the veritable continent of land that the Companhia Vale do Rio Doce and the state possess in the region. Land capable of being used for agrarian reform is not used due to lack of political will, stimulating the conflict between productive ranchers, small and large farmers, the poor agriculturalists, the landless, and politicians. At most, the authorities bring in the police to deal with these occupations ("though always too late," claim ranchers). The land issue is not resolvable by the police. The problem is political. Brazil is the only Latin American country which has not produced meaningful agrarian reform.

As for "public servants" who do not move so much as a straw to address this serious social problem, either due to a lack of will or incompetence, they are a case for the police⁸³ (Neto 1996).

⁸³ Original Portuguese text: "No entanto, a falta de vontade política do Governo Federal fez o INCRA levar proprietários e sem terra "na barriga," talvez à espera que a fome fizessem com que os trabalhadores pensassem mais na sua barriga e desistissem. Ledo engano. Essa atitude do INCRA, deliberada ou por incompetência, só forneceu mais elemento (ou alimentos já que falamos de estômago) para a radicalização do conflito. Na realidade, a fazenda Macaxeira é uma pequena área de terra. É mais um símbolo para os sem terra do que uma possibilidade de atender pelo menos a metade das famílias acampadas em Curionópolis. Enquanto isso, latifúndios gigantesco e totalmente improdutivo somam-se ao verdadeiro continente de terras que a Companhia Vale do Rio Doce e o Próprio Estado possuem na região. Terra passíveis de uma reforma agrária, que não é executada por falta de vontade política, estimulando o conflito entre propriedades produtivas, pequenos e médios fazendeiros, camponeses, sem terra e políticos da região.

This measured approach was not universally popular, however, and largeholders were quite upset at the MST's brazen invasion of an obviously productive property (Opinião! Editors 1996j). Though ranchers also blamed the inaction of the state and federal government (and harbor no kind feelings towards INCRA, either) for the intractable situation involving land reform in the region, their contention was that the stance of the federal government led to a situation where "these invasions are a violence against the right to property, especially when they take place on land which is considered productive"⁸⁴ (Opinião! Editors 1996j).

The symbolic nature of Fazenda Macaxeira to the MST became apparent only two days after the occupation of the ranch began; the president of ITERPA, Ronaldo Barata (incidentally, the same Barata who compiled the text *Inventário da Violência: Crime e Impunidade no Campo Paraense – 1980-1989*) offered the MST a guarantee of food and medical aid, along with lumber and 20 wells for a new encampment, should they agree to quit the ranch for 30 days while the government negotiated, with the cooperation of INCRA, for an area where a settlement could be established (Opinião! Editors 1996k). The MST refused.

In fact, as soon as the occupation of Macaxeira began, the federal police were put on alert, and the governor of the state, Almir Gabriel, began the search for a suitable area

No máximo, as autoridades acionam a polícia para tratar dessas ocupações ("mesmo assim com atraso," reclamam os fazendeiros). O problema fundiário não se resolve com polícia. O problema é político. O Brasil é o único país da América Latina que não realizou uma verdadeira reforma agrária. Quanto aos "homens públicos" que não mexam uma palha para enfrentar esse grave problema social, por falta de vontade ou incompetência, esses sim, são um caso de polícia" (Neto 1996).

⁸⁴ Original Portuguese text: "...as invasões são uma violência contra o direito de propriedade, notadamente quando estas invasões são realizadas em terras consideradas produtivas" (Opinião! Editors 1996j).

for expropriation or purchase, noting that one area had already been offered to the state to solve the problem (Correio Editors 1996r). Despite this, as one newspaper report stated, “there is potential for bloodshed at any moment” (Correio Editors 1996r), and the president of the largeholder producer’s union went on record saying he “wouldn’t rule out independent action [on the part of “security guards”] by some largeholders in occupied areas”⁸⁵ (Correio Editors 1996r). A tense situation prevailed, and the Pinheiro family’s lawyer (himself a Pinheiro) stated that the family would not even have a conversation about selling or trading the property (Correio Editors 1996{}).

During the week of the 12th of April, 1996, the approximately 2,000 MST members encamped on and around Fazenda Macaxeira began a march towards Belém in order to force ITERPA and INCRA to release an area for settlement formation (Correio Editors 1996s). The march began in Curionópolis on April 10th, with a large protest which soon became a roadblock of PA-275, the road which links PA-150 to the Carajás mine (Correio Editors 1996s). On the 11th, the roadblock continued, and one truck belonging to a food company from Parauapebas was sacked (Correio Editors 1996s). When the protest march reached Curionópolis, the group again protested on major thoroughfares, claiming to be against the “petite bourgeoisie,” “corrupt government,” and “shameless politicians” (Correio Editors 1996s).

By the 13th of April, 1996, the group (somewhat diminished to 1,200 members) had made it five kilometers north of the city of Eldorado do Carajás, where they stopped for a four-day rest (Opinião! Editors 1996g). Characteristically, the MST continued to make demands, in this case requesting that the town government of Eldorado do Carajás

⁸⁵ Original Portuguese text: “...não está descartada uma ação independente de algum dos proprietários da área invadida” (Correio Editors 1996r).

provide busses for their trip to Belém, along with 10 tons of food (Opinião! Editors 1996g). When these items were not forthcoming by the 17th, the MST blocked a major roadway for the third time in two weeks; a roadblock across PA-150, the major transportation artery for the entire Southeast of Pará was a major statement (Opinião! Editors 1996g).

Shortly after the roadblock began, 150 to 200 federal military police officers arrived, flanking the protest from the north and south (Correio Editors 1996l, 1996w, 1996q; Opinião! Editors 1996g), with the contingent of troops arriving from Marabá apparently escalating the confrontation (Correio Editors 1996w). Special forces officers began shooting machine guns and rifles above the heads of the protestors in an attempt to get them to disperse (Opinião! Editors 1996g), and when this tactic did not work tear gas grenades were employed (Correio Editors 1996l, 1996w). The protesting MST responded by throwing rocks and pieces of wood (Correio Editors 1996l; Opinião! Editors 1996g). This tense and confrontational situation became much worse as the police began shooting to kill, hitting men, women and children (Correio Editors 1996w, 1996q; Opinião! Editors 1996g). One witness to the scene said that:

...what I saw was a massacre, but the police showed up shooting, first, throwing grenades and then later shooting above people's heads. However, at some point, the police lost control and the officers began shooting to kill.⁸⁶(Editors 1996b)

As soon as the massacre began the protesters scattered, attempting to take refuge in a nearby forest stand (Editors 1996b; Opinião! Editors 1996g). One protester was shot

⁸⁶ Original Portuguese text: "O que vi, foi um massacre, pois a PM chegou atirando, primeiro, bombas de efeito moral e depois atirando para o alto. Porém, num dado momento, a ação da PM ficou fora de controle e os homens passaram a atirar para matar" (Editors 1996b).

twice in the leg, but managed to get away, saying later that “they were shooting on all sides. We had many women and children shot in the middle of the forest. I think 40 of my colleagues are dead”⁸⁷ (Opinião! Editors 1996g). The shootout went on for nearly 30 minutes, with some claims of MST members firing revolvers at the police (Correio Editors 1996l), but once it was over the police did not leave; they stayed and arrested a large number of MST members who ventured back to try to gather their things (which were left in the roadside encampment) (Opinião! Editors 1996g). The dead, numbering 19, and some wounded (those who were wounded, but arrested were apparently thrown in jail without medical treatment) were brought to a crude public hospital in Curionópolis, and their family members were held outside without information on the status of their loved ones (Correio Editors 1996q; Editors 1996b; Opinião! Editors 1996g). When the rest of the protesters who had fled to the forest returned to the encampment the next day, no fewer than 30 people, the majority of them children, were missing (Correio Editors 1996l; Opinião! Editors 1996g). After a thorough search of the area known as the “S curve” (“*Curva do S*”), local police officers released a casualty count of 23 dead and between 50 and 70 wounded in the altercation (Correio Editors 1996l; Opinião! Editors 1996g), six of which were police officers (Correio Editors 1996l).

Reaction to the massacre was both swift and very different amongst the government, ranchers, and the MST. The MST immediately blamed the governor of the state of Pará, Almir Gabriel, saying he “authorized the general command of the military police to use force to clear the highway, even though a truce had already been signed with the workers who were demanding that the two farms which make up the Macaxeira

⁸⁷ Original Portuguese text: “Eles atiravam para todos os lados. Tem muita mulher e criança ferida no meio do mato. Eu acho que 40 companheiros estão mortos” (Opinião! Editors 1996g).

complex be purchased [for agrarian reform]”⁸⁸ and that “it is necessary that the government put aside the propaganda and begin taking concrete steps to resolve the problems in the countryside”⁸⁹ (Opinião! Editors 1996f). The president of the largeholder producer’s union, Geraldo Capota barely stopped short of stating that those killed “deserved it” by condemning the violence but then adding “this climate of civil disobedience must come to an end, where property rights and the daily operations on them are limited by the landless”⁹⁰ and complaining that “this episode will harm the region, inhibiting investment and devaluing the land market”⁹¹ (Opinião! Editors 1996b). Capota went on to say “the landless also use violence” because the sales of revolvers increased dramatically in Parauapebas when a large sum of financial aid was distributed to the MST for the purchase of seeds and farm equipment (Opinião! Editors 1996b). Capota, and very likely the ranchers he represented, clearly believed that the MST and their political sympathizers were looking for an event like the massacre to occur because leaders of the left were “delirious with this bloodshed, as if they have been looking for a corpse of some poor worker to continue promoting their ideology that the problem is grave, but the situation will only be resolved through negotiation, not violence by either side”⁹² (Opinião! Editors 1996b). For his part, Governor Almir Gabriel stated that “the

⁸⁸ Original Portuguese text: “determinou ao comando maior da Polícia Militar usar de for a para desobstruir a rodovia, quando já havia sido firmada uma trégua com os trabalhadores que pedem a compra de duas áreas que ficam no complexo Macaxeira” (Opinião! Editors 1996f).

⁸⁹ Original Portuguese text: “É preciso que o governo deixe de fazer propaganda e tome medidas concretas para resolver o problema no campo” (Opinião! Editors 1996f).

⁹⁰ Original Portuguese text: “é preciso acabar com o clima de desobediência civil, onde os direitos de propriedade e de ir e vir são transgredidos pelos sem terra” (Opinião! Editors 1996b).

⁹¹ Original Portuguese text: “o episódio trará danos para a região, inibindo investimentos e desvalorizando o preço das terras” (Opinião! Editors 1996b).

⁹² Original Portuguese text: “estão delirando com esse sangue como se estivessem em busca de um cadáver de um pobre trabalhador para continuar ideologizando esse problema que é grave, mas o será resolvido com negociações e jamais com violência, seja de que lado for” (Opinião! Editors 1996b).

government does not support or practice any act of violence, whether undertaken by soldiers, paramilitary forces, or civil police,” and guaranteed that the methods used on the 17th of April would be investigated by an internal inquiry within the federal police, and also a civil tribunal (Opinião! Editors 1996a). In an interview on national television, Gabriel placed the blame firmly on the MST’s leadership, saying:

The negotiation that was ongoing was for the expropriation of Fazenda Macaxeira and the expropriation of Fazenda Três Curvas [Fazenda Fundos do Macaxeira]. From the standpoint of the government, every possible effort to solve the problem was being made. What delayed a solution somewhat was the issue of possession or ownership of land. The leaders of the MST were warned, knew of the negotiations ... it is necessary to see through the intolerance, radicalism, and sectarianism of the leadership of this movement... The problem of land can take years [to solve]. The actions that have been undertaken by the government over the past 15 months were all made to avoid this confrontation, so much so that the Military Police on several occasions, along with ITERPA, provided food, medical supplies, and medical assistance, and has always given the landless information about what was being done to resolve the problem... Therefore, in the opinion of the State and Federal government, there have been good will efforts to solve the problems. Finally, the leaders of the MST behaved in an incomprehensible manner and sectarianized [sic] the movement ... the action of the Military Police has always been to avoid, in every way, this type of violence⁹³ (Opinião! Editors 1996a).

The outcome of the massacre is viewed by many in the region as raising awareness of the dire state of development, with even local union presidents informing me, in the summer

⁹³ Original Portuguese text: “A negociação que estava sendo feita era de desapropriação da fazenda Macaxeira e da desapropriação da fazenda Três Curvas [Fazenda Volta do Rio]. Do ponto de vista do Governo, todas as medidas estavam sendo feitas. O que atrasou um pouco foi a questão da posse ou domínio da terra. E as lideranças dos Sem terra foram avisadas, sabiam das negociações... é preciso ter claro a intolerância, a radicalização, a sectarização da liderança desse movimento... O problema fundiário é de anos. As ações que desenvolvemos dentro desses 15 meses de governo foram no sentido de evitar esse confronto, tanto que a Polícia Militar, em várias ocasiões, junto com o ITERPA, forneceu alimentos, forneceu medicamentos, deu assistência médica e deu sempre a informação daquilo que estava sendo procedido... Portanto, do ponto de vista do Governo do Estado e do Governo federal, tem havido boa vontade para a solução dos problemas. Lastimavelmente, as lideranças não comportaram de maneira compreensiva e sectarizaram [sic] o movimento... a ação da Polícia Militar de evitar, de toda forma, essa violência” (Opinião! Editors 1996a).

of 1996, that, aside from being a tragic loss of life, the net outcome of the massacre had been positive for the region; “we are now in the eye of the federal government” said Pereira, which meant better roads and more federal support for agriculture and other investment in the region (2006).

After a period of shock, during which the 19 landless who lost their lives were interred (Correio Editors 1996e), discussion of the ongoing agrarian problem was launched to the forefront of concern in the region. By the first week of May, 1996, INCRA and ITERPA had apparently successfully negotiated with the Pinheiro family for both Fazenda Macaxeira and Fazenda Três Voltas (also known as Fazenda Fundos do Macaxeira) (Correio Editors 1996d). More than 300 families were scheduled to be settled on the farms, which together made up the Macaxeira ranch complex, according to the national INCRA president Raul Vale Júnior (Correio Editors 1996d). Vale also indicated that, because of the ongoing problems in the South of Pará, the government would increase the number of families settled in the region by 8,000 by the end of the year, simultaneously reminding people that over 2,400 families were settled in the region in 1995 (Correio Editors 1996d). The most stunning part of Vale’s announcement was that Macaxeira, despite being productive, would be expropriated⁹⁴, possibly even by the end of the week (Correio Editors 1996d).

Despite the appearance of an amiable solution whereby largeholder and landless movement members would be compensated for their loss, and a large number of families would be granted land to work, dire accusations were immediately forthcoming. On May 9, 1996, only a few days after the statement by INCRA chief Raul Vale Júnior, the news

⁹⁴ At a price of 1.1 million reais, or about \$1,398,250 2006 U.S. dollars, with the Pinheiro family agreeing to the expropriation (Correio Editors 1996d).

program *Journal Nacional* (a TV program which was part of the *Globo* network) broadcast an interview with an unnamed gunman-turned-whistleblower who claimed that Osório Plinheiro's lawyer (and nephew), Plínio Pinheiro Neto, has been in a meeting with 20 largeholders in the region (Opinião! Editors 1996h). Apparently, according to the whistleblower, he had been hired by Plínio Pinheiro and instructed to pay a bribe of R\$100,000 (approximately \$128,380 2006 U.S. dollars) to a police commander in order to evict the occupiers, and a further R\$5,000 (approximately \$6,315 2006 U.S. dollars) to buy the officers firearms to provide the "conditions to be able to evict" the occupiers (Opinião! Editors 1996h). However, when the gunman-turned-whistleblower got up to accomplish this, he was apparently stopped by Pinheiro and the conversation changed; ten people had been marked to die, all of which were MST leaders (Opinião! Editors 1996h). The whistleblower was certain that the money he was given to bring to the police was actually a bribe to arrange the murder of these landless leaders, by providing the fiscal incentive for the police to furnish weapons to gunmen, and to turn a blind-eye to the operation (Opinião! Editors 1996h). In an interview with Plínio Pinheiro, the local newspaper *Opinião!* showed that the rancher and lawyer had no worries of being connected to the massacre at the infamous "*Curva do S*," saying "look, I have plenty of documents showing I was in a consultation that day"⁹⁵ and "I have a clear conscience, my faith and convictions prohibit me from participating in anything like this [accusation indicates]"⁹⁶ (Opinião! Editors 1996h). Plínio Pinheiro does make it clear that he had nothing but contempt for the accusation, saying "Why would I get mixed up in this if I

⁹⁵ Original Portuguese text: "Vejam só, estou cheio de documentos que provam que neste dia eu estava no fórum" (Opinião! Editors 1996h).

⁹⁶ Original Portuguese text: "Tenho a consciência tranqüila, minha fé e convicções me impedem de participar de uma coisa dessas" (Opinião! Editors 1996h).

offered the area in question [Fazenda Macaxeira] to INCRA in February? The evaluation process had already been completed, it was only a matter of time [before the property was expropriated]”⁹⁷ (Opinião! Editors 1996h). In the meantime, with wild accusations common in the press, the landless suffered hunger and health problems while awaiting a solution on Fazenda Macaxeira (Correio Editors 1996i; Opinião! Editors 1996d). Despite Pinheiro’s calm, only two months later, three more accusers, one a farm manager from a nearby ranch, confirmed the initial accusations, saying that R\$100,000 was paid to the police, and the money was collected and disbursed by Plínio Pinheiro (Correio Editors 1996z). Even with the confirmation, some were not convinced, including the president of a largeholders union, Geraldo Capota, who stated that the accusation is a “creation of the MST and radical leftist groups”⁹⁸ (Correio Editors 1996h, 1996n, 1996k).

By May 9th, 1996 the expropriation of a part of Fazenda Macaxeira was confirmed; 5,521 hectares, 13 percent of the ranch and enough land to settled 200 families, was purchased by INCRA (Correio Editors 1996v). However, this small part of the over 41,000 hectares of land on the property was not nearly enough to meet the MST’s demands, and the “solution” INCRA proposed was to settle a group on a piece of land over 300 kilometers distant which had already rejected by the MST four times (Correio Editors 1996v). Apparently, at least according to the MST, the property, Gleba Tuerê, was unworkable, infested with pest plants, Hansen’s disease, and leishmaniasis, and was so far from cities that access was precarious (Correio Editors 1996v). To further

⁹⁷ Original Portuguese text: “Então pra que eu iria querer mexer com isso, se desde fevereiro eu ofereci a área ao INCRA? Já tinha avaliação e o processo já tramitava, era só uma questão de tempo” (Opinião! Editors 1996h).

⁹⁸ Original Portuguese text: “criação do MST e desses grupos radicais de esquerda” (Correio Editors 1996h).

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worsen matters, due to a long and hard struggle, and injuries sustained in the 17th of April massacre, many MST movement members were actually in various states convalescence, meaning sending them into the middle of the forest to make a living would be nothing but cruel (Correio Editors 1996v).

Protests throughout Pará indicated the MST would not take these (to the movement) objectionable propositions lightly. A 350-member protest in Belém, marking the end of the initial march which led to the massacre, combined with a public mass in honor of the fallen landless marked the two-month anniversary of the massacre on June 19th, 1996 (Correio Editors 1996a; Opinião! Editors 1996c). On the same day, an INCRA agro-economist indicated that at least 2,500 hectares of the Macaxeira complex was productive, and that “most of the rest of it could be considered that way as well” (Editors 1996a). Ten of the group of 350 that protested in Belém on the 17th of June stayed encamped in front of the state INCRA office, beginning a hunger-strike that lasted until at least the end of the month .(Correio Editors 1996x).

The delay of INCRA in making any headway in either establishing a settlement on the expropriated areas of Fazenda Macaxeira, or in expropriating further parts of it, led a band MST members to occupy the farm headquarters over the weekend of July 28th, 1996 (Correio Editors 1996g). INCRA’s response was to plead that the MST be patient because negotiating for expropriation “takes time” (Correio Editors 1996g). Going hand-in-hand with difficulties surrounding ongoing negotiations, the federal government was not releasing the funds necessary to begin establishing the settlement in a timely fashion, frustrating the attempts of INCRA to make progress in a tense situation (Correio Editors 1996g). Fanning the flames, politicians began using the massacre and the

mismanagement of the ongoing investigation into it to further their political goals.

Current president Lula da Silva visited families encamped on Fazenda Macaxeira only three months after the massacre, stating he was “shocked with the level of poverty those people deal with” and that he suspected that food donated to those in the encampment might have been contaminated (Correio Editors 1996j).

An international group consisting of Catholic priests, protestant ministers, professors, and NGO officials made a trip to the region in late July, 1996 in order to visit the encampment at Macaxeira and evaluate the possibility for some resolution to the ongoing conflict (Correio Editors 1996m). In a statement released after the visit, the “mission” of foreigners stated, through the Ecumenical Service Coordinator, Enilson Rocha Souza,

We know that these people and institutions will not be able to promote the changes they dream of alone. The Brazilian state must take a practical and concrete political position, making the necessary resources available to the Executive and Judicial branches of government... We feel that people in the region do not believe that the perpetrators of the massacre of Eldorado do Carajás will be punished, making Brazil known internationally as the country of impunity⁹⁹ (Correio Editors 1996m).

Most of the landless in the region despaired of ever receiving justice for the suffering they had experienced, let alone the object of their struggle, a piece of land to raise crops on. Despite a general climate for support of the landless, however, largeholders decided that the time was right to remind people of the “actual situation” of

⁹⁹ Original Portuguese text: “nós não sabemos que essas pessoas ou instituições não vão promover as mudanças sozinhas. É preciso que o Estado brasileiro tome uma posição política prática e concreta, colocando recursos a disposição do Executivo e Judiciário... Nós estamos sentindo nas pessoas que elas não acreditam que os culpados do massacre de Eldorado do Carajás vão ser punidos, fazendo com que cada vez mais o Brasil finque conhecido internacionalmente como o país da impunidade” (Correio Editors 1996m).

occupied properties by staging a 1,000-strong public protest in Marabá and Curionópolis on the 23rd of August (Correio Editors 1996p, 1996o). The goal was to persuade those in the South of Pará that the MST “would like to turn the region into a new Chiapas, based on a mass invasion of properties in a guerrilla-war fashion, just like what happened recently in Mexico” simultaneously reminding authorities that “largeholders are disposed to use any possible manner to defend their land”¹⁰⁰ (Correio Editors 1996p). The complaints of largeholders ranged from the trauma of occupation to acts of vandalism by occupiers (Correio Editors 1996p). Rather than the calm and respectful people the general public assumed the MST and related social movements were, according to ranchers, the landless were “in reality, bandits, repugnant individuals who kill our herds, destroy our pastures and fields, and try to bring true chaos to our region”¹⁰¹ (Correio Editors 1996p). The story largeholders have to tell is one of impunity, not by gunmen and their employers, but one where a violent, obstinate, and powerful landless movement is holding the region and its government hostage through threats and actual acts of invasion of productive private property (Correio Editors 1996p). An ominous statement accompanied news coverage of the protest, as Geraldo Capota, president of the largeholder producer’s union, stated “we will defend our property to the last, using

¹⁰⁰ Original Portuguese text: “...querer desenvolver nesta região um novo Chiapas, que se baseia na invasão em massa de propriedades através de guerrilhas, como aconteceu recentemente no México... os ruralistas estão dispostos a usar de todos os meios possíveis para defender suas terras” (Correio Editors 1996p).

¹⁰¹ Original Portuguese text: “que na realidade são [the MST] bandidos, indivíduos repugnantes, que estão aí matando nosso rebanhos, destruindo o campo e tentando implantar um verdadeiro caos em nossa região” (Correio Editors 1996p).

violence if needed, as protected by article 502 of the constitution, which establishes the right to defend ones property through the use of weapons”¹⁰² (Correio Editors 1996p).

A separate declaration occurring right around the same time (August 16th), emphasizes that, although INCRA had expropriated some of Fazenda Macaxeira through negotiation, the owners, the Pinheiro family, had yet to receive any of the money from the sale (Opinião! Editors 1996i). Plínio Pinheiro claimed that because of the delay, many ranchers in the region who would be interested in selling their property to INCRA for agrarian reform might avoid doing so (Opinião! Editors 1996i).

Ranchers were not the only group fed up with INCRA’s delays; on September 18th a group of 500 landless movement members occupied INCRA’s headquarters in Marabá (Correio Editors-a 1996g). The occupation was prompted by yet another “broken promise” that INCRA made the MST in June, stating that (a) the Palmares settlement in Parauapebas would be demarcated, (b) the expropriation of the entirety of Fazenda Macaxeira would occur, (c) 1,200 *cestas básicas* would be provided, (d) roads would be opened and maintained on the Rio Branco and Palmares settlements, and (e) credit would be made available for food and building homes (Correio Editors-a 1996g). As usual, INCRA held that it had not broken its promise, that the MST was being impatient, that some progress has been made in the expropriation of property, and that demarcation of lots within established settlements had already occurred (Correio Editors-a 1996g). When negotiations broke down, the MST began using one of their strongest incentives to force further negotiations – the hunger strike – which led INCRA to negotiate and provide

¹⁰² Original Portuguese text: “Nós vamos defender nossa terra até a última instância, nem que seja com violência, amparados no artigo 502 da Constituição, que estabelece o direito de defender a propriedade usando as próprias armas” (Correio Editors 1996p).

concessions amounting to further *cestas básicas* for families in encampments in return for the MST quitting INCRA headquarters (Correio Editors-a 1996f). Another outcome of the negotiation is that a group of negotiators from Brasília would come to Marabá to aid in the expropriation of Fazenda Macaxeira (Correio Editors-a 1996e). As time went on, other hints that the expropriation of Fazenda Macaxeira was close at hand were common, including statements made by INCRA in early November, 1996 (Correio Editors-a 1996b), and another attempt at negotiation between INCRA, the MST, and the Pinheiro family on November 22nd, 1996 (Correio Editors-a 1996a).

These negotiations paid off for INCRA and the MST (and, likely, the Pinheiro family as well), and on November 18th, the national superintendent of INCRA, Raul Jungmann, announced that the two primary properties of Fazenda Macaxeira were officially expropriated and would be used to settle 700 of the nearly 1,200 families still encamped on the ranch (M.C/W.S. 1996). This provided the MST a great deal of satisfaction, having struggled so long for the property. However, it turns out that some of those involved in the 17th of April massacre were not included in the allotment of property on Fazenda Macaxeira, so the MST again occupied INCRA headquarters on December 17th (Correio Editors-a 1996h). After a few months of further negotiations, INCRA announced the acquisition of three more portions of the Fazenda Macaxeira complex on the 24th of March, 1997 (Correio Editors-a 1996c), and completed the expropriation of the entire area by mid-April, just in time for the first anniversary of the horrible massacre (Correio Editors-a 1996d). Though the MST made many efforts to speed the process, despite its ongoing disappointment with how long the expropriation took, the conversion of Fazenda Macaxeira to the 17th of April settlement was among the

most rapid in the region. Even more surprising, the struggle of the MST led to one of the most rapid decision of how demarcations of lots in an agrarian reform settlement should be arranged; in negotiations on December 3rd, 1997, the MST and INCRA finally agreed that 50 hectare lots would be distributed to everyone living on what once was Fazenda Macaxeira (Correio Editors-a 1996i).

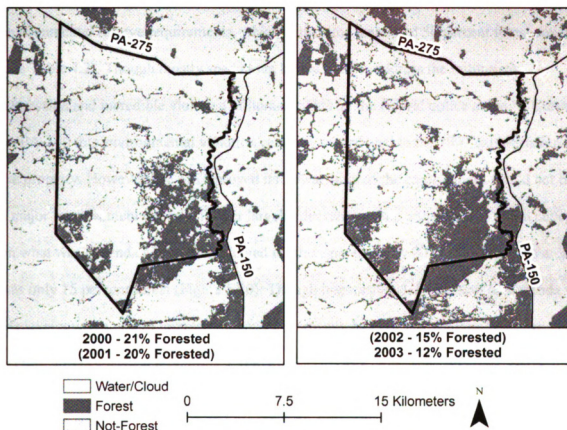


Figure 5.10. Land-cover change on Fazenda Macaxeira after it was expropriated and converted into an agricultural settlement. No significant land conflict was recorded on this property after 1996.

Though a highly conflictive place by the mid-1990s, in the mid-1980s, Fazenda Macaxeira was relatively sleepy and perhaps even could be said to be under-utilized – Figure 5.8 shows that in 1986 the ranch was still 75 percent forested, which is 3 percent over the regional average for the time! However, slave labor, which the farm was fined

for in 1987 certainly played a part in the rapid deforestation over the two years between 1986 and 1988, with an 8 percent decrease in forest cover. Still, by 1996, one year after an initial (and unprompted) visit by an ITERPA and INCRA survey team, the MST had occupied the property, and been kicked off. Shortly after the tragic 17 of April massacre of MST members, the property had been so heavily deforested that only 36 percent of its original forest cover remained. This, in and of itself, represents a gross violation of environmental reserve requirements, which at the time mandated 50 percent forest cover (see Table 4.2). Though mostly sped along by the need to address the militaristic aggression and incredible violation of human rights by the federal police at the “S Curve” on PA-150 this environmental violation certainly contributed to the 1997 expropriation of the property. However, the MST proved its stewardship of the environment would not be a major improvement over the former largeholder rancher; the proportion of forest cover, on what was Fazenda Macaxeira changed for the worse, and by 2002 the property’s area was only 15 percent forest (Figure 5.10). Though impressive, deforestation on Fazenda Macaxeira was no more impressive than on many ranches in the region; by 2003 the average forest cover on properties in the region was only 23 percent, and fully three-quarters of the largeholdings in the region were less than 31 percent forested.

5.1a3. Case Study: Fazenda Peruana

Fazenda Peruana may not be the largest farm in the *poligono dos castanhais* (Fazenda Bamerindus is), nor is it the most contentious (Fazenda Cabacerias holds that title, with 99 separate DALR activities), but key-informant interviews with ranchers indicate it is one of the most advanced and extensively modernized farm in the region (e.g., Gil 2007; Raul 2008). One key-informant described the farm as having the highest

level of cattle artificial insemination capability in the region, and that the family who owned it (the Mutrans, once again) were heavily invested in the ranch (José 2006). Furthermore, the farm was universally considered “productive;” even the MST acknowledged the ranch’s productivity (Correio Editors 1998b). The final difference setting Peruana apart from the conflict on other ranches covered here is that, by 2003 (and, actually, as of July 2007) the MST had not been successful in winning the expropriation of the property.

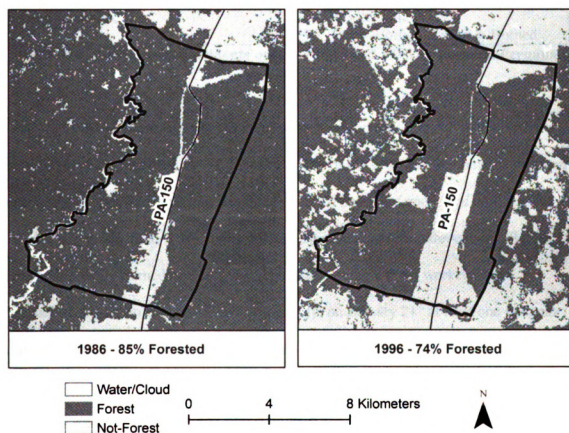


Figure 5.11. Land-cover on Fazenda Peruana in 1986 and 1996. For a summary of conflict events during this period see Table 5.6.

The first mention of conflict on Fazenda Peruana surfaced in a news retrospective for 1987, where news coverage indicated that a worker on the ranch met his end at the

hands of another, apparently over some sort of personal argument (Correio Editors). However, frequently these sorts of “worker conflicts” end up actually being the result of harsh discipline by work bosses and their thugs, hired gunmen (Le Breton 2003). Given the history of labor violations that would unfold on the property, there is a good chance that this incident falls into the category of an unfortunate farm worker asserting their rights and losing their life for their audacity.

1985 to 1996	
Smallholder Actions	Largeholder Actions
-None Recorded	'87: Worker Killed '96: Three Workers Killed & Burned

Table 5.6. Land conflict incidents between 1985 and 1996 on Fazenda Peruana.

Fazenda Peruana was not the focus of another incident covered in the media until early 1996, when, on February 2nd, the civil police of the town of Curionópolis received an anonymous phone call stating that three men had been shot and killed on Fazenda Peruana (Correio Editors 1996f). The police responded and found three men killed and their bodies badly burned, the only one identifiable being a hired worker from Pernambuco (Correio Editors 1996f). Apparently, on January 21st at least one gunman killed the three men due to a labor dispute, but also possibly in retaliation for the assault of a supermarket owner in Parauapebas by the deceased (Correio Editors 1996f). Though the deaths were potentially due to a land conflict, the land in question was actually not Fazenda Peruana, but instead a ranch owned by the aforementioned supermarket owner (Correio Editors 1996f). The man calling in the anonymous tip apparently knew many details of the deaths of the workers, leading police to believe he was one of the assassins

(Correio Editors 1996f). Though brutal, unexplainable deaths such as this are an ongoing and serious problem in the region, lending it the wild-west social climate that is at once palpable when one arrives in Marabá.

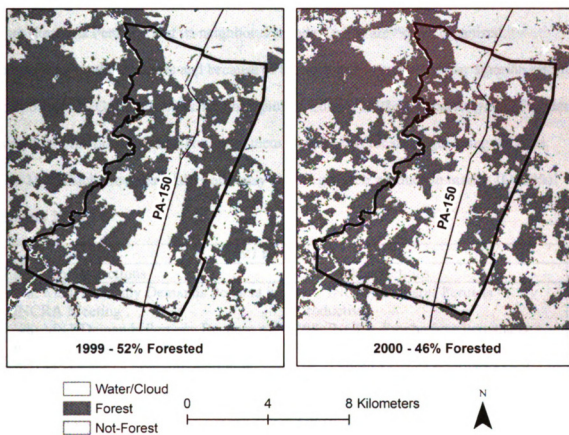


Figure 5.12. Land-cover on Fazenda Peruana in 1999 and 2000. For a summary of land conflict events on the ranch during this period see Table 5.7.

Two years later, in March 1998, the MST unexpectedly turned their gaze to Fazenda Peruana, though in a much different manner than for other properties in the region. While negotiating with INCRA, the MST unexpectedly demanded the expropriation of Fazenda Peruana (Correio Editors 1998b; Opinião! Editors 1998a, 1998e). INCRA's response was that it will not, under any circumstances, evaluate a property known without a doubt to be productive, and discounted the possibility of

expropriating a property with a status such as Peruana's (Opinião! Editors 1998e).

INCRA president Vítor Hugo da Paixão Melo goes so far as to say the demands of the MST were meant only to provoke (Correio Editors 1998b; Opinião! Editors 1998e). Vítor Hugo reminded the MST that the ranches they were targeting in their negotiations with him (Fazenda Peruana, and its neighbor, Fazenda Cedro) are "super organized, considered rural businesses and because of this will not be evaluated [for agrarian reform purposes]"¹⁰³ (Correio Editors 1998b; Opinião! Editors 1998e). Apparently, MST leaders stated that the property is important to them because it is located right along the road, PA-150, which provides settlers any easy way to get their produce to market (Opinião! Editors 1998e).

1997 through 2000	
Smallholder Actions	Largeholder Actions
'98: MST Suddenly Demands Peruana in INCRA Meeting	'98: INCRA Declares Peruana Productive
'98: MST Demands Peruana Because of its Proximity to PA-150	'98: INCRA Emphasizes Peruana is Rural Business
'98: MST Claims Legal Injunction is meant to "Valorize" Peruana	'98: Mutran Lawyer Acquires Legal Injunction Against MST
'98: MST Gives Up on Peruana Expropriation	'98: Restraining Order Against MST Leaders
	'98: MST Called "Barbarian Raiders" by Judge
	'98: Sanctity of Private Property Demanded by Mutrans
	'98: MST Will Be Fined Daily for any Occupation of Peruana
	'99: Mutrans Sell Peruana to José Batista Afonso

Table 5.7. Land conflict events on Fazenda Peruana between 1997 and 2000.

¹⁰³ Original Portuguese text: "Fazendas Cedro e Peruano, com cerca de 10 mil hectares juntas, são super organizadas, consideradas empresas rurais e que por isso não são passíveis de vistoria" (Correio Editors 1998b).

Fearing occupation, a malady all too familiar to the Mutran family from their experiences with some of their other properties such as Fazenda Volta do Rio, Fazenda Bagua, and Fazenda Boca do Cardoso (and shortly after this conflict began, Fazenda Cabaceiras), their lawyer petitioned judicial action to preemptively prohibit occupation of Fazenda Peruana (Correio Editors 1998a). On the 13th of March, 1998, a Civil Court judge in Marabá, and another in Curionópolis, issued what amounted to a restraining order against superstar MST negotiator and leader Lindomar de Jesus Cunha and two others, commanding them to avoid the property at the cost of R\$1,000 per day per occupier (Correio Editors 1998a; Opinião! Editors 1998b, 1998d). The petition for the restraining order came one week after the surprise demand by the MST for the expropriation of Fazenda Peruana, a demand which the judge ruling in the suit said

is a bold act without limits and with immeasurable consequences, as has been evident in the public attitude toward such an illegal and immoral horde of inconsequential people [the landless], to invade, plunder, and indiscriminately burn productive private property, meaning all those who look to the future see destruction, without any regard for private property ¹⁰⁴

calling the landless a “band of barbarian invaders from the middle ages”¹⁰⁵ (Correio Editors 1998a). The judge ruling in this case was an ardent supporter of private property and the duty of the state to protect it. During his final remarks in the case, he apparently saluted the “heroic” efforts of the judicial branch to respect the sanctity of private

¹⁰⁴ Original Portuguese text: “é de uma audácia sem tamanho e conseqüências imensuráveis, pois tem sido público e notório a atitude ilegal e immoral dessa horda de inconseqüentes, a invadir, saquear e incendiar indiscriminadamente imóveis rurais produtivos, e tudo que vêem pela frente destroem, sem qualquer respeito a propriedade privada” .

¹⁰⁵ Original Portuguese text: “um bando de bárbaros invasores do tempo da Idade Média” (Correio Editors 1998a).

property, and complained that the state had failed, keeping its “arms crossed” and failing to take serious action against occupations (Correio Editors 1998a). Judge Sérgio Augusto Andrade Lima made it clear that the police were complicit in this failure by “recusing themselves from the necessary police work and expediting the execution of the [MST’s] plans”¹⁰⁶ (Correio Editors 1998a). After receiving a copy of the court’s ruling and implementation of a restraining order, INCRA restated that it would not evaluate or otherwise consider any productive property for agrarian reform activity (Correio Editors 1998a; Opinião! Editors 1998d). Apparently, the cost to the MST would be enormous if the 800 families occupying INCRA at the time followed through on their threat to occupy Fazenda Peruana; 800 families ignoring the judicial restraining order would have to pay R\$800,000 per day (Opinião! Editors 1998d). One of the MST leaders cited by name in the restraining order, Gladson Barbosa Souza, stated that he believed the judicial order and statements by INCRA were meant not to prohibit the MST from occupying the property, but instead to “supervalorize” the property, increasing the benefit the Mutran family would be likely to receive from the expropriation of the property (Opinião! Editors 1998d).

The restraining order, and threat of massive fines, appeared to work in the case of Fazenda Peruana, as the MST began to modify their demands. By the last week of March, only a few days after the restraining order was issued, the MST encampment at INCRA in Marabá turned into a massive demonstration, but at no point were demands for the expropriation of Fazenda Peruana or Fazenda Cedro reiterated (Opinião! Editors 1998c). Instead, the MST protested for food and agricultural aid for the settlements which had

¹⁰⁶ Original Portuguese text: “a polícia Militar se recusa em ceder os policiais necessárias a auxiliarem na execução da medida” (Correio Editors 1998a).

already been established in the region, and for the final expropriation of land for three new settlements which had already been announced (Opinião! Editors 1998c).

For four years no news surrounding Fazenda Peruana was forthcoming, though the Mutran family apparently sold the farm to José Batista Afonso during the interim (a fact which one key-informant interview confirmed; by 1999 the Mutran family had sold nearly all of their properties in the region, Raul 2007). Whether continuing old labor practices or instituting his own, José Batista Afonso ran afoul of labor law rapidly, and by August 2002 was notified, apparently for the second time on Peruana, of serious labor-law violations which would lead to a R\$30,000 fine (E.S. 1998). The tribunal doling out fines states that “this is the way it must be; we have to penalize violators with the maximum fine so that they feel in their checkbook what they should do in the future”¹⁰⁷ (E.S. 1998). In raids against slave labor conditions in 2002 over 1,455 workers were involved in the ranches near Marabá alone (E.S. 1998).

Over a year later, in October 2003, the MST began its quest for the expropriation of Fazenda Peruana again, stating that the ranch, along with two other ranches in the region, must be expropriated due to the ongoing labor violations discovered there by ministry of labor enforcement teams (Filho 1998). Arguments such as this tend to rely on a heavily contested section of Brazil’s penal code, which states that any property, broadly defined, used to promote or enact slave labor can be taken from the owner by the state (Brazil 2003).

Despite agitation about Fazenda Peruana, the property remained unoccupied until April 17, 2004, when a commemoration of the 17th of April, 1996 massacre culminated in

¹⁰⁷ Original Portuguese text: “Esse é o caminho, tem que penalizar ao máximo possível, para eles sentirem no bolso o que deveriam fazer antes da punição” .

the occupation of the ranch (RepórterBrasil 2004). Despite the occupation, by the summer of 2007, the latest time period for which I have newspaper records, the ranch had not been expropriated, even though it had been promised to the MST by INCRA (RepórterBrasil 2007). However, the MST decried the severe degradation that the owners of the ranch had allowed to occur, stating:

A big problem on Peruana is that the land is completely degraded. We will have to do a lot to recuperate the area in order to put together a settlement that will be ecologically sustainable¹⁰⁸ (RepórterBrasil 2007).

Unfortunately, this is a common problem in the region even today, with many settlements established on former ranches experiencing severe fertility problems. Landscapes like the one shown in Figure 5.2 are common, and both sides of the conflict tend to blame one another.

¹⁰⁸ Original Portuguese text: “Um grande problema da Peruano é que a terra está totalmente degradada. teremos que recuperar grande parte dessa área para conseguir fazer um assentamento ecologicamente sustentável” (RepórterBrasil 2007).

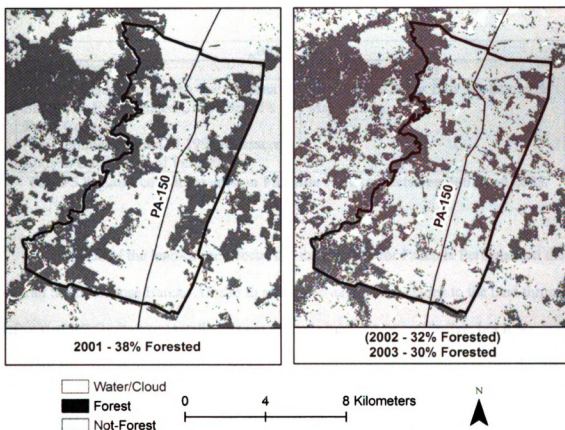


Figure 5.13. Land-cover on Fazenda Peruana during 2001 and 2003. For a summary of land conflict incidents see Table 5.8.

Despite being in the sights of the MST, Fazenda Peruana was not occupied by the landless until long after labor violations rendered the property suspect in the eyes of local and national labor officials, who passed along the information to those involved in executing agrarian reform in the region (i.e., ITERPA and INCRA). While occupations and violent conflict are often employed in the region, they are not the only strategies available to the landless, and more peaceful outcomes are not unheard of. Despite this, there can be severe environmental impacts due to land conflict even on properties which never experience an occupation, or experience it very late.

2001 to 2003	
Smallholder Actions	Largeholder Actions
'03: MST Begins Arguing that Peruana Should be Expropriated Under Brazil's Penal Code '04: Commemoration of 1996 Massacre Ends in Occupation of Peruana	'02: Serious Labor Law Violations & Major Fines

Table 5.8. Land conflict events on Fazenda Peruana between 2001 and 2003.

But what of the land-cover effects; did the struggle for Fazenda Peruana lead the Mutran family or José Batista Afonso to attempt to assert their claims to the land through deforestation? On its own, satellite image analysis may not be conclusive, but it is certainly suggestive of preemptive deforestation, especially considering the fact that the property was not occupied for the first time until 2004.

Figure 5.11, Figure 5.12, and Figure 5.13 show forest cover, in dark gray, for Fazenda Peruana, for the years 1986, 1996, and 1999-2003. In 1986 the property is highly forested, with the 15 percent of the property under agricultural production centered along the road, PA-150, which bisects the property. While some conflict took place on Peruana in the late 1980s, it was not until 1996 that workers were gunned down on the property, by which point some 11 percent further forest cover had been removed. What is interesting, and supports the case that some preemptive deforestation may have occurred, is the relatively precipitous drop in forest cover on the property between 1996 and 1999; while deforestation proceeded at a modest rate of a little over 1 percent per year between 1986 and 1996, between 1996 and 1999 the rate of deforestation on the property was over 7 percent. This is suggestive of preemptive deforestation because the first threat by the MST, in the form of a demand for expropriation of the property, was made in 1998.

Between 1999 and 2003 a further 22 percent of the forest cover on the farm was removed, meaning that between two years before the initial indications that the MST was interested in the property (in 1998) and the July before they occupied it for the first time, 44 percent of the property was deforested.

5.1b. Conflict-Driven Deforestation

Largeholders are not the only agent deforesting the landscape of the South of Pará; once a property is occupied there is significant evidence that the landless deforest properties as well. While the reasons and justifications for this activity were described in the previous chapter (see section 4.2c), it is worth reiterating that largeholders are highly suspicious of the motives of the landless in cases where forest reserves are targeted for occupation (as was the case on Fazenda Cabaceiras). Though a contributor to overall deforestation in the region, especially in recent years as ranches have been converted to agrarian reform settlements, I do not delve into the relative contributions here. However, it is arguable that deforestation due to occupation has contributed more than a small proportion to the total deforestation in the region given the significant pasture formation activities of largeholders.

5.2. Explaining Preemptive Deforestation

Many of the variables likely to increase the likelihood of properties to be deforested preemptively are similar to those suggested by key informants, researchers, and government agents as predisposing properties to occupation. However, some of the variables in the regression models presented here vary slightly, or control for different processes. In the interest of brevity, the specification of those variables listed in the tables in this chapter (and in Appendix III) which match those from the tables in Chapter 4 and

Appendix II will not be covered here as their specification is identical. I will, however, describe why these variables are likely to contribute to the likelihood of preemptive deforestation in the South of Pará.

5.2a. The Dependent Variable: Deforestation

The dependent variable here appears to be a fairly simple one; as conceptualized, the model evaluates the impacts of variables on change in forest cover on each largeholding, meaning each observation of the dependent variable includes the deforestation on a property over a period of time. However, a number of factors complicate the specification of this variable. As is often the case with land-cover variables, the observations of the dependent variable depend on data availability. As land-cover data are not available for the region with the optimal temporal resolution, there are gaps in the land-cover data (in particular during the early-to-mid 1990s, see Table 4.3). Furthermore, getting at preemptive deforestation is not as straightforward as creating a variable with the absolute (i.e., hectare) or proportional measurement of deforestation. Instead, I have created two dependent variables one where each observation contains the number of hectares of forest change in the time between the two land-cover observations (derived from Landsat image classification, see section . Measuring Forest Cover for a description of the methods used) *before* the first occupation of the property, and a second where each observation of the dependent variable is the proportional forest change in the time between two land-cover observations *before* the first occupation of the property. Figure 5.14 explains these variables visually. It is worth noting here that once a property is occupied subsequent land-cover changes are no longer considered.

The greater proportion of properties (116, or 64 percent) in the region were not occupied at some point between 1980 and 2003 according to newspaper accounts, meaning each of these properties also requires an observation in the dependent variable. For each unoccupied property, I calculated the dependent variable observation to be equal to the total forest loss over the entire period, controlling for the passage of time between the first (1984) and last (2003) land-cover observation with an independent variable (see section Independent Variable: Forest Year Control).

Average forest change on largeholdings was a loss of 2014.67 hectares, or 44 percent. However, some largeholdings were the site of impressive deforestation, with a maximum loss of 9,514.69 hectares (a loss of 99 percent). Still, some gained forest cover over the observations of the dependent variable¹⁰⁹, with one largeholding experiencing an increase of forest cover by 365.67 hectares, or almost 6 percent. Average total forest loss on unoccupied properties was 2,342.65 hectares (or 54 percent), with no property experiencing forest cover increases. Among those properties occupied at some point between 1984 and 2003 there is a decrease in forest cover of 1,420.19 hectares, or approximately 26 percent).

¹⁰⁹ This “gain” of forest is not to indicate that forests regenerated by 2003; recall that observations on occupied properties consider only the time span between land-cover observations for two years immediately before occupation. Once a property is occupied any land-cover change on it is no longer considered in the dependent variable. The total average loss over the entire 1984 to 2003 period was 2,832.58 hectares, or a loss of 57 percent. One property increased its forest cover over the entire period, a gain of 108.65 hectares, or 2 percent.

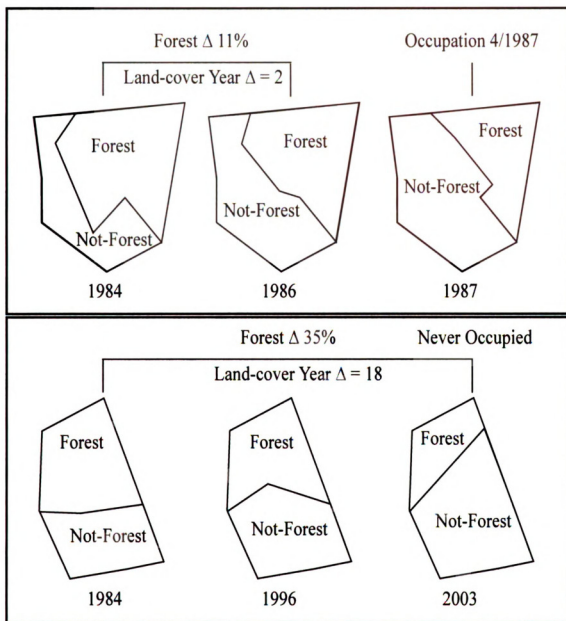


Figure 5.14. Stylized example of how dependent variables were created. In (a), above, a property occupied in 1987 is assigned a forest change value of -11 percent, and a forest year control value of 2. In (b), above, a property was never occupied so the total forest change is assigned (-35%) and the number of years between land-cover observations (i.e., “forest year control”) is 18.

5.2b. Independent Variable: Forest Year Control

Obviously land-cover changes such as deforestation occur for a variety of reasons, and are likely to change to a large degree with the passage of time. Because this analysis

spans a period of nineteen years (1984 to 2003) a variable must be included to account for these effects. As mentioned above, to control for time effects I included a variable representing the number of years between land-cover observations. In other words (see Figure 5.14), each observation of this variable includes the number of years between the two land-cover variables *before* occupation for those properties in the dataset which were occupied, or the number of years between the first (1984) and last (2003) land-cover observations for those properties which were not occupied.

The average number of years between land-cover observations is 13 (with a standard deviation of 7.40), though some land-cover observations are only separated by one year and some are separated by as many as 18. Among occupied properties the mean separation is 2.28 (with a standard deviation of 1.69). Unoccupied properties are universally separated by 18 years.

5.2c. Independent Variable: Suitable Soils Binary

Though suitable soils have been factored into the likelihood of occupation for a property, it would seem that better soils would lead the property holder to strive more strenuously to hold on to their property, perhaps through preemptive deforestation. The ultimate goal of including this variable is to assess whether this is indeed the trend. The specification of this dichotomous explanatory variable is identical to that described in section 4.2c2, indicating those properties with soils moderately to highly suitable for agriculture with a value of 1.

Among occupied properties, 38 percent have moderately to highly suitable agricultural soils (with a standard deviation of 47 percent). Half (50 percent) of unoccupied properties have some inclusion of suitable agricultural soils (with a standard

deviation of 50 percent). Suitable soils are not well represented in the study area, with only 23 percent of the 879,473 hectares in the *poligono dos castanhais* being of moderate to high suitability for agriculture.

5.2d. Independent Variable: Title Problems Binary

Because many authors have emphasized the utility of deforestation for the assertion of property rights, it follows that a variable describing those properties with shaky legal standing would be an important addition to any model addressing preemptive deforestation. The specification of this variable is identical to the variable addressing title issues in the analyses presented in Chapter 4 (see section . Title or Legal Problems).

Among occupied properties, 78 percent had title problems (with a standard deviation of 42 percent). Eighty percent of unoccupied properties had title problems (standard deviation of 40 percent), though this is not surprising given that 143 of 180 properties in the study area (79.4 percent) do not have legal title.

5.2e. Independent Variable: Labor Violations

When discussing the difficulties largeholder ranchers may face in the South of Pará, few topics get blood boiling faster than the topic of labor violations. Because these labor violations are serious, and can, conceivably, lead to the loss of a property, ranchers take these accusations very seriously. Furthermore, it appears that, at least in more recent times, labor violations may lead to higher odds of occupation. Because forest cover can be interpreted as a deficiency of legitimate “production” and therefore not “beneficial use” (recall the 1988 constitution), any property with labor violations *and* somewhat substantial forest areas may be prime for occupation by SMO landless groups. Therefore,

labor violations may be an important driver of deforestation, if only as an attempt to stave-off occupation, and is therefore included in this model.

Among occupied properties, 12.5 percent had labor violations (with a standard deviation of 33.3 percent). Only 2.6 percent of unoccupied properties experienced labor violations (standard deviation of 15.9 percent).

5.2f. Independent Variable: Property Size

Because property size is frequently discussed as an important factor in property occupations, and comprises the chief objection of many social movement organizations comprised of landless would-be colonists, it follows that larger properties may be more likely to be occupied. Indeed, for most of the logistic regression models presented in the previous chapter property size was a significant variable in explaining property occupations in the region. In these models, I include two measures of property size (similar in specification to those in section 4.2d1): size of the property in hectares and a dichotomous variable indicating which properties are larger than the regional average of 4,886.21 hectares.

5.2f1. Independent Variable: Area of the Property in Hectares

Area of each property in hectares is an obvious way to include the effects of property size on preemptive deforestation. The idea is that larger properties will deforest more when faced with the possibility of occupation. There are drawbacks to including property size in a model in the form of a variable such as this, however, as property size is incredibly variable in the *poligono dos castanhais*; properties range from a relatively small 564.73 hectares (about the size of a typical medium-sized farm in the Midwestern

United States) to an impressive 56,035.24 hectares (over half the size of Cape Cod, Massachusetts).

The average size of occupied properties is 6,052.37 hectares (with a standard deviation of 7,151.05 hectares). Among unoccupied properties the average size is 4,242.81 hectares (standard deviation of 2,212.32 hectares). It is worth noting that the average size of occupied properties is significantly larger than the regional average (4,886.21 hectares), and that the average size of unoccupied properties is slightly less. Also, the standard deviation for mean property size on occupied properties is high, most likely due to the inclusion of the largest property in the region (it is three times larger than the next largest occupied property, or over 32 percent larger).

5.2f2. Independent Variable: Latifúndio Binary

Because simple property area does not control for property size, I developed another variable to account for the fact that larger properties may be occupied more frequently and therefore be subject to preemptive deforestation by largeholders frantically trying to maintain control over their property. As mentioned above, the regional average property size within the *poligono dos castanhais* is 4,886.21 hectares, and each property larger than that ($n=49$) was assigned a value of “1” in this variable.

Thirty-seven percent (37 percent) of occupied properties were larger than the regional average (with a standard deviation of 48.8 percent), while only 21.6 percent of those unoccupied were larger than average (standard deviation of 41.3 percent).

5.2g. Independent Variable: Distance to Cities & Towns

As mentioned in chapter 4, there have been a large number of land-cover and land-use change studies which have found market access, as proxied by distance to towns

and cities, as important in the Amazon (e.g., Bunker 1981; Anderson 1990; Hecht 1993; Dale et al. 1994; Brondízio 1997; Sierra and Stallings 1998; de Souza 1999a; Mertens et al. 2002; Caldas et al. 2007) and other world regions (e.g., Angelsen and Kaimowitz 1999; Lambin et al. 2001; Lambin et al. 2003). Though largeholder ranchers are more likely to focus their marketing efforts on larger cities, the needs for equipment and other items (such as food for workers) can often be met in smaller towns. Therefore, I include three specifications of proximity to cities and towns in the models presented in this chapter. These specifications are similar to those outlined in section 4.2a2.

5.2g1. Independent Variable: Distance to City

This variable is simply the Euclidian (straight-line) distance from property centroids to the nearest of the two largest cities in the *poligono dos castanhais*, Marabá and Eldorado do Carajás. Because largeholders and SMOs alike tend to base their business in major urban areas, proximity to these locations may be an important driver of land-cover change in the face of conflict. Furthermore, the overarching land-cover change trend throughout the world is that proximity to major towns and cities tends to increase deforestation; this may be even more noticeable in the case of deforestation due to land-conflict.

Occupied properties are, on average, 7.07 kilometers closer to the two major cities in the region than unoccupied ones (35.26 kilometers, with a standard deviation of 16.76 and 42.33 kilometers with a standard deviation of 19.12, respectively).

5.2g2. Independent Variable: Distance to Towns

This variable is another Euclidian (straight-line) distance measure from property centroids to the nearest municipal seat. Some municipal seats are quite large, but most are

relatively small towns where perhaps some basic supplies services can be accessed, but more significant items are difficult to come by. Because most informants I interviewed discussed proximity to towns as being important to occupations *and* the daily business of ranching, I include this variable in some model specifications.

Among occupied properties, the average distance to the nearest town is 25.82 kilometers (with a standard deviation of 10.96 kilometers). Unoccupied properties were, on average, further from the closest town; those unoccupied properties were 30.56 kilometers away from town (standard deviation of 13.55 kilometers).

5.2g3. Independent Variable: Cost-Weighted Distance to Towns

Cost-weighted distance to towns is a more complex specification of the above variable, taking into account the fact that people, property occupier or rancher alike, do not generally cut directly through forest and field to get to the nearest town; roadways increase mobility, but some properties are further from roads than others. This variable provides distance information, but is weighted based on distance of property centroids to major roadways in the region. There are drawbacks to this variable, as some ranch headquarters are located alongside these major roadways, but as property headquarters are not universally locatable throughout the *poligono dos castanhais* I assume property centroids are a reasonable approximation.

On average, occupied properties are closer to town by this measure (2.84 kilometers, standard deviation of 3.91) than unoccupied ones (3.69 kilometers, standard deviation of 5.12).

5.2h. Independent Variable: Distance to River

Water access, as proxied by river accessibility, may be an important variable as rivers tend to be a primary source of water for ranch, household, and agricultural needs throughout the region. However, an added benefit, especially for remote properties (and most of the properties in the *poligono dos castanhais* were remote at the early part of the time period covered by this study), is the fact that river transportation is a major component of the transportation network of Amazonia. Therefore, this variable provides the Euclidian (straight-line) distance for each property centroid in the study area to the nearest river or stream, with the idea that properties closer to rivers may be more likely to experience preemptive deforestation than those further away, given their potentially greater attraction of property occupiers. While results from chapter 4's analysis do not indicate that river access is a significant driver of property occupation, many informants believe it is. As largeholder actions are driven by their beliefs, rather than the quantitatively important factors, I include this variable in the models presented here.

The power of this variable to explain preemptive deforestation is likely to be low given the region is a hydrologically rich environment. Even so, those properties occupied over the years have been slightly *further* from rivers and streams, with an average of about 930 meters (standard deviation of 828 meters) compared with an average of about 700 meters for unoccupied properties (standard deviation of 1.67 kilometers).

5.2i. Independent Variable: Proximity to Highway

Given, as with distance to towns and cities, market access has the potential to both increase the odds of occupation, and provide largeholders an incentive to deforest their property, being near a major highway may be an important driver of preemptive

deforestation. Using specifications similar to section 4.2a2, I include two different variables accounting for these potential effects.

5.2i1. Independent Variable: Highway Binary

This dichotomous variable indicates the properties which either have a highway dissecting them, or have a boundary formed by a highway. The idea here is that properties very close to a highway are more likely to be occupied (a claim that comes directly from interviews with three of the five informant types in Table 4.1), and hence ranchers will be likely to counter this predisposition through preemptive deforestation.

Twenty-eight percent of occupied properties were in this category (i.e., the value of the highway binary variable was “1,” indicating their incredibly close proximity to major highways) while only 19.8 percent of unoccupied properties were, though the standard deviation for occupied properties was higher than those left unoccupied (45.3 percent as opposed to 40 percent).

5.2i2. Independent Variable: Highway 10km Buffer Binary

Given that transportation is poor, and has been even worse over the eighteen years covered by this research, close proximity to passable all-season roads is important. However, even in relatively poor conditions, a ten kilometer distance is a reasonable distance to travel, either on foot or, perhaps, by vehicle, for most of the year. Therefore, I created a variable indicating those properties within ten kilometers of the same major highways as the variable described above (and in section 4.2a2b).

Occupied properties were less likely to be within this ten kilometer buffer; only 48 percent of the occupied properties were (with a standard deviation of 50.4 percent),

while 52.6 percent of the unoccupied properties were in this zone (standard deviation of 50.1 percent).

5.2j. Independent Variable: Latifundiarista

Identical to the variable specified in section . Latifúndio Binary, this variable indicates those properties whose owners were among the most infamous and violent largeholders and *grileiros*. This dichotomous variable indicates those properties with a value of “1,” with a total of 54 properties being owned by such people. To be an “infamous” largeholder or *grileiro*, largeholders had to be associated with a property where a large number of people were harassed or killed, newspaper articles mentioned the owner as a “*grileiro*” (land grabber), or social movement members may have named the person or entire family as an enemy of the poor.

Among those occupied properties, 39.1 percent (with a standard deviation of 49.17 percent) were owned by such unpleasant landholders. Unoccupied properties had a relatively smaller proportion of such owners, with only 25 percent being infamously awful to smallholders, would-be colonists, and others in the region (standard deviation of 43.5 percent).

5.2k. Independent Variable: Number of DALR Actions

Some properties are more likely to be targeted for occupation than others, as results in chapter 4 suggest and key informants were quick to point out. It follows that those properties with a greater likelihood of occupation would be more likely to be the subject of some sort of activity or agitation for land reform before occupation would occur. Indeed, this is the case for 79 properties in the *poligono dos castanhais*, though of

those 79 properties where SMOs enacted some form of DALR that came short of occupation 15 were never occupied.

This variable is simply the number of DALR actions (ranging from protests and declarations to the occupation of government agencies or even *other* properties in order to force the expropriation of a property) reported in newspapers where the property was mentioned as being either the sole, or one of a number, of properties about which the DALR action was taking place.

The rationale for including such a variable is to gauge SMO interest. If a SMO is very interested in a property its members are more likely to take some action calculated to increase their chances of gaining access to it, but will also encourage the property holder (largeholder rancher) to do whatever they can to hold on to it, including preemptively deforesting it to show productive or beneficial use.

Among occupied properties there were, on average, 8.22 DALR actions (not including occupation) where the property was named as being of interest to SMOs (with a standard deviation of 12.62 actions). In contrast, the average number of DALR actions on unoccupied properties was 0.31, with a standard deviation of 1.25 actions)

5.21. Independent Variable: Number of Deaths

Finally, I include a variable meant to gauge the intensity of conflict over individual properties. While this variable is morbid – being the total number of deaths occurring on or because of conflict over the property before occupation – it is meant to portray how serious social movements are in their interest in a property *and* how serious the landholder is at maintaining control over it.

All told, 203 people, whether gunmen, ranchers, police officers, occupiers, laborers, or government officials, died on properties in the *poligono dos castanhais* between 1984 and 2003. This is a tragic example of how bloody and violent this struggle for land has been, and continues to be. The actors in this conflict are serious about their control over land resources here.

The rationale for including this variable, beyond gauging interest on both sides of the conflict, is that largeholder ranchers will more strenuously attempt to hold on their properties if conflict becomes more intense. If murder and death are options for maintaining control over a property, preemptive deforestation is also on the table.

On average, 3.06 people died on properties which were eventually occupied (with a standard deviation of 5.34 deaths) in the period leading up to occupation. One occupied property had, over a period of nearly ten years, 26 people killed in conflicts. Unoccupied properties are the site of conflict-related deaths much less frequently; the average number of deaths on unoccupied properties is 0.06, with a standard deviation of 0.40. The largest number of deaths due to conflicts on unoccupied properties over the study period was four.

5.3. Results and Discussion

Given that many variables with some potential to encourage preemptive deforestation on the 180 properties in the South of Pará are measurable in a number of different ways, I present full results of models with two slightly different dependent variables in

Appendix III. In the text of this section, however, I will only describe and evaluate those models with the best goodness-of-fit.

As mentioned earlier, about 28 percent ($n=50$) of the largeholdings in the study area were eventually occupied between 1984 and 2003. However, occupation is not necessarily the outcome on properties where preemptive deforestation may have occurred. Indeed, supposing preemptive deforestation is a valid method of asserting one's control and productive/beneficial use of a piece of land, the strategy may work, meaning properties with preemptive deforestation are not invaded. Therefore, the goal of these models is to uncover which non-market driven variables contribute to deforestation in time periods before occupation, or, for unoccupied properties, over the entire period of land-cover change (i.e., 18 years between 1984 and 2003).

Ordinary least squares (OLS) regression is a statistical method that can be used to predict values in a dependent variable by optimizing an estimator, b , and using this optimal solution to fit a prediction line that minimizes the square error between a predicted values of the dependent variable and actual observations of that variable (Griffith et al.). Simply stated, the OLS equation appears as below where X is an $n \times n$ matrix of observed independent variable values, B is a $k \times 1$ matrix of estimators, and E is an $n \times n$ matrix of squared errors, expressed as:

$$Y = XB + E$$

Moran's I is a diagnostic used to assess the level of autocorrelation in a dataset, with negative values indicating "negative spatial autocorrelation" (or a checkerboard pattern) and positive values indicating "positive spatial autocorrelation" (or values being clustered around similar values). A zero value indicates no spatial autocorrelation. While values typically range between -1 and 1, they are not bound to that range (Griffith et al.).

Moran's I is calculated as follows where W_{ij} is a weights matrix, and Z_i and Z_j are observed values:

$$I = \frac{\sum_{i=1}^N \sum_{j=1}^{N, j \neq i} W_{ij} Z_i Z_j}{\left(\sum_{i=1}^N \sum_{j=1}^N W_{ij}, i \neq j \right) \sum_{i=1}^N Z_i^2}$$

Further spatial diagnostics can be developed should Moran's I indicate potential problems with spatial autocorrelation. Because errors due to spatial effects can occur in either the error term or the dependent variable itself, one should test for both kinds of error. The diagnostic of choice to date is the Lagrange Multiplier, one of which is specified for spatial lag, and the other of which is specified for spatial error. They can be expressed, respectively, as:

$$Y = XB + \rho WY + u$$

and,

$$u = \lambda Wu + e$$

Where X and B are as stated in the statements detailing OLS regression, ρ is the lagged dependent variable, Y , according to spatial weights, W , u is a specified test of error, and e is an error term.

Finally, the SEM (or spatial error) model is quite similar to the equation describing ordinary least-squares regression, above. However, the error term varies as follows,

$$Y = XB + \lambda WE + u$$

where X is a matrix of independent variables, B is a matrix of estimators, E is a matrix of errors weighted according to W , a matrix of spatial weights, λ is the spatial autocorrelation of the error, and u is a matrix of unweighted errors.

OLS regression results, spatial diagnostics, and spatial error model results are presented in the sections concluding this chapter, and detailed further in

Appendix III. Because spatial diagnostics do not indicate a spatial lag model should be used in any of these regressions, I omit the model and its specification.

5.4. Models for Deforestation in Hectares

As specified in section 5.2a, one of the two definitions of the dependent variable is the total hectares of forest change in the time period before property occupation. Average hectare forest change is a loss of 2,014.67 hectares, with a standard deviation of 1,833.32 hectares and a range going from a loss of 9,514.69 hectares to a forest *gain* of 365.67 hectares. Each of the five properties which experienced forest gains in the dependent variable were occupied, most in the mid-1980s. The average forest increase was 97.21 hectares, a relatively small increase.

Table 5.9¹¹⁰ displays results of OLS and spatial error models for the third model specification listed in the table in

¹¹⁰ Model Specification notes: Notes: ¹A control for intermediate time steps (years) between land-cover observations. For example, if, due to data availability, the two time periods before a property occupation span more than one year the value of this variable will equal the number of years between observations (e.g., for change from 1984 to 1986 the value of this variable would be “2”). ²Suitable soils are those rated as moderate to highly suitable for smallholder agriculture by soil scientists at EMBRAPA. ³Properties without definitive title as indicated by SUDAM. ⁴Properties exceeding the regional average size (4886.21

Appendix III. Significant variables are robust across model specifications, though some models show significance where this one does not (e.g., the variable “Title Problem Binary” is significant in two of three specifications of the OLS model).

Of particular interest to land-cover change studies in general is that coefficients for the variable controlling for the passage of time indicate that between 106.46 and 108.87 hectares of deforestation occur annually all other variables held constant. In other words, the march of time and the pressure to produce leads property holders to deforest upwards of 106 hectares of their forest land each and every year. Furthermore, the passage of time is a highly significant variable in modeling deforestation.

Suitable soils display a perverse result to the generally hypothesized relationship; it would be reasonable to assume that ranchers would have significant interest in exploiting parts of their properties with high quality soils in an effort to maximize productivity. Rather, properties with moderate to high quality soils (as defined in Table 4.6) experience less deforestation, though not in a statistically significant way.

Questionable title arrangements on a property tend to indicate that the property will have more deforestation, though not to a significant amount. Interestingly, however, the direction of the relationship described by the title issues variable changes in the Spatial Error model, indicating that perhaps spatial effects play a significant role. Labor

hectares). ⁵Highways in this case are the major paved roads in the study area, including BR-230, BR-222, PA-150, and PA-257. ⁶A binary variable where known land grabbers or other violent property owners, as indicated by newspaper reports, are indicated. ⁷The number of direct-action land reform (DALR) activities which have occurred either on, or about, the property. These activities include public declarations, complaints, protests, and occupations, among other things. The variable is meant to proxy for the amount of interest in a given property ⁸The number of people killed on the property, or because of their interest in the property, before occupation. This variable is meant to proxy for the intensity of conflict on a given property.

violations are not significant in either the OLS or the Spatial Error models (though their sign remains positive, indicating those properties also have higher deforestation).

Unsurprisingly, larger properties are significantly more likely to experience deforestation, as those properties larger than average typically have 1,485.246 hectares greater deforestation than those that do not (though the amount of deforestation is less in the Spatial Error model).

Hectares Deforestation* (negative coefficients indicate forest gain)	OLS 4 (n=180)		Spatial Error 4 (n=180)	
Independent Variables:	Coef. (Std.Err.)	P > Z	Coef. (Std.Err.)	P > Z
Forest Year Control ¹	106.4603 (17.2034)	0.000	108.8696 (13.5180)	0.000
Suitable Soils Binary ²	-72.0427 (231.706)	0.756	-183.709 (310.279)	0.554
Title Problem Binary ³	386.2632 (303.206)	0.204	-31.2823 (251.284)	0.901
Labor Violations	200.1264 (517.612)	0.700	313.1107 (422.427)	0.459
Area of Property in Hectares	0.077697 (0.29055)	0.008	0.097980 (0.25241)	0.000
<i>Latifundio</i> Binary ⁴	1485.246 (302.280)	0.000	1366.439 (250.681)	0.000
Distance to Conceição do Araguaia	-60.7262 (45.1591)	0.180	-23.4082 (25.3568)	0.356
Distance to River	172.7624 (94.1993)	0.069	59.1509 (84.5356)	0.484
Highway Binary ⁵	-227.351 (293.395)	0.439	-115.905 (284.610)	0.684
<i>Latifundiaria</i> ⁶	185.0831 (248.286)	0.457	-26.5330 (230.045)	0.908
Number of DALR Actions ⁷	53.92536 (17.7476)	0.003	36.51109 (14.3015)	0.011
Number of Deaths ⁸	-7.89355 (36.1664)	0.827	9.421337 (29.6218)	0.750
Constant	320.6665 (870.224)	0.713	22.36049 (123.289)	0.856
Lambda			0.11673 (0.01622)	0.000
R ² (Pseudo R ²)	0.4189		(0.392)	
Log Likelihood			-1547.0377	
Moran's I (p-value)	1.350 (0.177)			
Lagrange Multiplier - Error	29.514(0.000)			
Robust Lagrange Multiplier - Error	11.678 (0.001)			
Lagrange Multiplier - Lag	17.943 (0.000)			
Robust Lagrange Multiplier - Lag	0.107 (0.743)			

*Notes for Table 5.9 can be found in footnote 110.

Table 5.9. OLS and spatial error model results for model specification 4 (see Appendix III).

Distance to markets, as proxied by the straight-line distance to Conceição do Araguaia, a major market town and transportation gateway, is not significant in the OLS or spatial error models. Furthermore, the coefficient value decreases substantially in the Spatial Error specification. Distance to rivers, the presence of a highway, and ownership by an infamous landlord are all insignificant, though the *latifúndiarista* variable changes sign in the Spatial Regression model.

Variables considering the intensity of SMO interest in properties are significant and robust, leading to greater deforestation per event. This is an important variable as one property had as many as 90 direct action land reform incidents related to it (Fazenda Bamerindus). The intensity of conflict (as measured by the number of land-conflict related deaths on properties) is not robust in sign, and once spatial effects are removed it appears to indicate that deforestation is less likely to occur. This variable is not significant, however. Lambda is highly significant, indicating that forest cover is likely to be found near other forest cover.

5.5. Models for Percent Deforestation

The second of the dependent variable specifications controls for property size by proportionalizing forest change measurements, and therefore eliminating the need to control for property size.¹¹¹ Each observation of the dependent variable is the proportion of the property which was deforested in the time period before occupation.

¹¹¹ However, larger properties are, at least according to ranchers and SMOs, a target in the struggle for land reform. Therefore the *latifúndio* binary and property size variables remain in this model specification.

Percent Deforestation* (negative coefficients indicate forest gain)	OLS 4 (n=180)		Spatial Error 4 (n=180)	
Independent Variables:	Coef. (Std.Err.)	P > Z	Coef. (Std.Err.)	P > Z
Forest Year Control ¹	.0208949 (.003044)	0.000	.0237002 (.002045)	0.000
Suitable Soils Binary ²	-.004883 (.041006)	0.905	.0424999 (.047468)	0.37
Title Problem Binary ³	.0971469 (.053659)	0.072	.0407014 (.037968)	0.284
Labor Violations	-.089014 (0.91603)	0.333	-.067403 (.063936)	0.292
Area of Property in Hectares	-.000001 (.000005)	0.221	-.000001 (.000001)	0.631
Latifúndio Binary ⁴	.062024 (0.05350)	0.248	.013052 (.039322)	0.740
Distance to Conceição do Araguaia	-.017959 (.007992)	0.026	.0016741 (.003797)	0.659
Distance to River	.0537333 (.016671)	0.002	.0124953 (.012832)	0.330
Highway Binary ⁵	-.041105 (.051923)	0.430	-.011826 (.043620)	0.786
Latifundiaria ⁶	.0951989 (0.43940)	0.032	.0365952 (.035491)	0.296
Number of DALR Actions ⁷	.0091003 (.003141)	0.004	.0062654 (.002155)	0.004
Number of Deaths ⁸	-.005067 (.006401)	0.430	-.002601 (.004477)	0.561
Constant	.335806 (.154006)	0.031	.0000001 (.017958)	0.999
Lambda			.126735 (.009851)	0.000
R ² (Pseudo R ²)	0.3443		(0.247)	
Log Likelihood			43.51852	
Moran's I (p-value)	2.018 (0.044)			
Lagrange Multiplier - Error	95.205 (0.000)			
Robust Lagrange Multiplier - Error	66.587 (0.000)			
Lagrange Multiplier - Lag	29.395 (0.000)			
Robust Lagrange Multiplier - Lag	0.776 (0.378)			

Notes for Table 5.10 can be found in footnote 112.

Table 5.10. OLS and Spatial Error Model regression results for percent deforestation.

Like the hectares-deforested models, the proportion of deforestation on an annual basis is significant in both the OLS and Spatial Error models, with a bit over 2 percent of deforestation per year.¹¹² Good soils display the same perverse result in the hectares-deforestation OLS model, but remain an insignificant contributor to forest cover change.

Title problems in the proportion of deforestation model display a perverse result, but, as in the hectares-deforestation models the variable is not significant when spatial effects are considered (it is significant at the ten percent level in the OLS specification). Similarly, property size as measured in hectares displays a perverse result, though perhaps not surprisingly as a large area deforested on a large property will not result in as large a proportional change as a large area deforested on a small property.

Properties which are larger than average do not possess a significantly greater proportion of deforestation in either the OLS or the Spatial Error model. However, as in the case of the OLS hectares-deforestation model distance to Conceição do Araguaia is not significant in the spatial error model. Distance to river is significant in the case of the OLS proportion-deforestation model, but does not retain its significance when included in a spatial regression model. Highway access is highly insignificant in both models, and

¹¹² Model Specification Notes: ¹A control for intermediate time steps (years) between land-cover observations. For example, if, due to data availability, the two time periods before a property occupation span more than one year the value of this variable will equal the number of years between observations (e.g., for change from 1984 to 1986 the value of this variable would be “2”). ²Suitable soils are those rated as moderate to highly suitable for smallholder agriculture by soil scientists at EMBRAPA. ³Properties without definitive title as indicated by SUDAM. ⁴Properties exceeding the regional average size (4886.21 hectares). ⁵Highways in this case are the major paved roads in the study area, including BR-230, BR-222, PA-150, and PA-257. ⁶A binary variable where known land grabbers or other violent property owners, as indicated by newspaper reports, are indicated. ⁷The number of direct-action land reform (DALR) activities which have occurred either on, or about, the property. These activities include public declarations, complaints, protests, and occupations, among other things. The variable is meant to proxy for the amount of interest in a given property ⁸The number of people killed on the property, or because of their interest in the property, before occupation. This variable is meant to proxy for the intensity of conflict on a given property.

displays the same perverse result as it had in the hectares-deforestation models. However, the strength of the coefficient is weak in this case.

Known land grabbers and violent property owners do not appear to deforest more than their more peaceful and less nefarious neighbors; forest cover in the region according to all four (i.e., proportion-deforestation and hectares-deforestation OLS and Spatial Error models) models presented here show the *latifundiarista* variable as insignificant, though admittedly perverse, and in some alternative specifications of the percent-deforestation OLS model it shows up as significant and somewhat strong (coefficients indicate these properties have 10.1 percent greater forest cover).

Finally, variables meant to gauge the impact of severity of conflict indicate mixed effects. The number of DALR actions taken on or about a property increase deforestation on the property by something less than one percent per incident. Given that some properties experienced 90 incidents the potential land cover impact of this highly significant variable could be substantial. However, the number of deaths caused by conflict over the property (but taking place before occupation) is not significant. The constant is not significant and has relatively weak coefficient values, but the spatial effects, captured by Lambda, indicate highly significant and positive (i.e., greater forest cover) effects.

Proportion Deforestation	Deforestation in Hectares
- Passage of time - Number of DALR Actions	- Passage of time - Area of Property (ha) - <i>Latifundio</i> Binary - Number of DALR Actions

Table 5.11. Significant variables in the Proportion Deforestation and Hectare Deforestation spatial error regression models.

A number of variables, therefore, have a significant impact on deforestation in the region. Specifically, the passage of time and the number of land conflict events on a property appear to have a statistically significant and strong impact (at least when combined effects are considered) on the land cover of the South of Pará. Though the size of properties has a significant impact on deforestation, this is an expected result given that larger properties are more likely to have larger cleared areas than small properties. However, the results presented here strongly suggest that DALR activities strongly influence the amount of forest cover on properties before occupations occur. These themes will be more thoroughly explored in Chapter 6.

CHAPTER 6 - CONCLUSIONS

The conflict over land resources in Brazil and the ongoing environmental destruction in the Amazon will not be ameliorated overnight, nor will any one project to solve the problem be sufficient. An intractable war based upon social, economic, and political inequalities will not yield to a single, or even set of, national or regional policy shifts. Instead, we must recognize the forty-four year (or some might consider 508 year) history which has brought the region such social and ecological harm will likely not be solved instantaneously. However, in order to begin addressing such issues academics and policymakers alike must learn more about the processes by which these issues may be linked; it is my hope that this dissertation is a part of the ongoing discovery which may lead to a solution to both land conflict and the rampant deforestation stemming from it.

A number of general models of land-cover and land-use change have been developed, some specifically for the Amazon (Hecht and Cockburn 1990; Skole et al. 1994; Walker and Homma 1996; Pfaff 1999; Mesquita et al. 2001; Browder 2002; Mertens et al. 2002; Moran et al. 2003; Walker 2003; Skole et al. 2004; Arima et al. 2005; Caldas et al. 2007; Caldas 2008), and others for different world regions or even with global applicability (Committee on the Human Dimensions of Global Change 1994; Ojima et al. 1994; Vitousek 1994; Lambin 1997; Lambin et al. 1999; Dale et al. 2000; Gibson et al. 2000; Geist and Lambin 2001; Klepeis and Turner 2001; Lambin et al. 2001; Lambin and Geist 2003; Lambin et al. 2003; Turner II et al. 2004; Roy Chowdhury and Turner 2006; Stafford Smith et al. 2007). However, there are many components and

drivers of change which have yet to be described, and I have argued here that to ignore the land-cover change associated with land conflict would be perilous in the delicate Amazon. Given the stated intent of many social movement organizations to bring their struggle for land to all corners of the country, it is quite likely that the South of Pará is only the early manifestation of what may become widespread unrest over the enclosure of land in Amazonia. This would be consistent with the South of Pará's status as an early-warning case for many of the region's woes, including the collapse of the rubber economy (Foweraker 1981b; Jadão 1984; Dean 1987), the abandonment of the extractive Brazil-nut industry (Jadão 1984; Emmi 1999; Rohter 2004; Sakamoto 2004b; Almeida 2006), problems with land speculation (Sawyer 1984; Fearnside 1987; Diegues et al. 1992; Schmink and Wood 1992; Imbernon 1999), and the ongoing environmental problems associated with mechanized mining (Hall 1987, 1989; Schmink and Wood 1992; Cleary 1993).

Not only does land conflict present itself as an unexplored underlying driver of deforestation, but it has the potential to be the outcome, in some respects, from proximate drivers of change. For example, as key-informants and academic researchers have both listed land-cover as a characteristic which might encourage the occupation of a property (see Table 4.1), previous processes leading to deforestation (e.g., road building or agricultural extensification) can be seen as historic proximate causes of land-cover change which may lead, when combined with social conflict and a critical mass of the landless, to further deforestation. In other words, the analysis presented in Chapter 4 may help researchers and policymakers arrive at a better idea of what can be done to limit land conflict between social movement organizations and largeholders, and the analysis

presented in Chapter 5 may provide an understanding of what land-cover outcome will occur should a property be occupied, or if its neighbors are.

6.1. Hypothesis 1: Characteristics Influencing Property Occupation

The initial hypotheses presented in Chapter 1, which relate to the selection of properties for occupation, are important and to a large extent supported by this research. In order to better formulate regional policy which may help avert land conflict, which often turns violent, and provide meaningful agrarian reform, it would be useful to know what factors actually influence the decision to occupy a property. To be more specific, the sub-hypotheses fitting within hypothesis 1 provide some insight. For instance, hypothesis 1a, that properties targeted for DALR are likely to have larger forest stands, is supported in the overall model, and during the latest period of conflict (i.e., 1999), which Simmons et al. (2007) count within the DALR struggle. Overall, the models presented in Chapter 4, and those presented in Appendix II, support the strength of the proportion of forest on a property for predisposing it to occupation, but most significantly during more recent conflicts. Indeed, it appears that measurements of property size (i.e., larger properties) and title problems are more important in earlier periods (see Table 4.11 & Table 4.14), but that overall, most variables are significant in contributing to the odds that a property will be occupied (see Table 4.8).

The second hypothesis (1b), states that properties of higher potential for agriculture are more likely to be targeted for occupation by the landless. However, the only model where all of the variables substantially aiding agricultural production (market access, soil quality, access to water) are significant is the overall model (Table 4.8), and even then these variables display perverse results. Furthermore, the resource quality

models, which primarily consider these agricultural factors tend to be weaker than the models which do not. Both of these outcomes may not be surprising, however; given that suitable soils are highly spatially autocorrelated, and properties closer to town were occupied in early periods it is clear why perverse coefficient values are the result, and the strength of SMOs appear to trump the agricultural ambitions of would-be colonists.

The third hypothesis (1c) states that properties located near regional offices for land reform and other services are more likely to be targeted by SMOs for occupation. This hypothesis is not supported by results from any model specification included in this dissertation; in the few cases where access to towns or cities is statistically significant in determining property occupations, the sign of the logit (coefficient) is perverse, indicating that being further from a town increased the odds of occupation. This seems counterintuitive, especially given that SMO members and key-informants indicated access to urban areas as important (Table 4.1). However, this might not be as counterintuitive as it at first appears; towns in the region, especially ones large enough to have some land reform focused agency or regular visits by land reform officials, are more or less ubiquitous, even in the earlier years covered by this study. Furthermore, many properties closest to current municipal seats in the region were occupied long before the late 1980s and 1990s, meaning that the only properties available for occupation were likely to be those further from town, as mentioned above.

Finally, hypothesis 1d is not supported by the analysis presented here – road access is generally not statistically significant in influencing the odds of property occupation, and when it is, the relationship is perverse (Table 4.14). This indicates that properties closer to roads are less likely to be occupied, which is opposite the

hypothesized outcome. The reasons for this may be many, including that land closer to roads has a higher value and therefore ranchers might be more willing to violently defend it, or because such properties were occupied early in the 1980s, lessening their importance in these models.

Beyond the model results applying just to the hypotheses presented in Chapter 1, the overall trend from the model presented in Table 4.8 compliments those described by researchers who have considered agricultural production and peasant economics for quite some time (Ross 1978; Bunker 1981; Foweraker 1981b; Wood 1983; Chayanov 1986 [1925]; de Almeida 1990; Ellis 1993; Treccani 2001; de Souza Martins 2002; Walker et al. 2004; Caldas et al. 2007); the fact that better soils and accessibility might influence the likelihood of occupation is perhaps unsurprising. However, in addition to confirming the significance of drivers of landscape change being of importance to agriculture, the results presented in Chapter 4 also present results which mirror what we know about the history of the struggle over land in the South of Pará.

Table 4.11 indicates that land occupations (11 of them) taking place in 1986 tended to occur significantly more often on properties of larger size, which follows the ending spasms of the *luta posseira*, and the beginning of what Simmons et al. (2007) term the DALR period. During this period, investment in the region was high, leading ranchers to assert their rights over landholdings they had previously ignored. At first, in the early 1970s, the results were disastrous for the landless, with gunmen kicking them off their land and options for retribution being limited. However, by the 1984 collapse of the military government, social movement organization preserved through rural worker's unions (STRs), the CPT, and upstarts such as (at the time) the MST, slowly began to

assemble organized resistance. At this stage, the most important item in the struggle of the landless was to begin a long fight against latifúndia and unproductive rural establishments (Sader and Silverstein 1991; Opinião! Editors 1995c; Hammond 1999; Fernandes 2000; Simmons 2005). Larger properties fit this bill, perhaps leading to occupation of properties, as Table 4.11 indicates –for each 100 hectare increase in property size, the property was some two percent more likely to be occupied, all other variables held constant. Furthermore, the resource quality model, which only considers those variables measuring agricultural quality, has very little explanatory power (Table 4.13), especially in comparison to the exposure model (Table 4.12), which measures only those variables which are of high importance in the stated struggle of agrarian reform SMOs in the region.

The struggle against larger properties continues to be important in the occupations taking place in 1987, though not in a statistically significant way (Table 4.14). Other models specifications, however, appear to indicate that in 1987 the strategy of the landless had not modified greatly, though it would appear that properties with title problems were actually nine times less likely to be occupied (Table 4.14). It appears that another factor, such as the fact that some unknown characteristic of properties with title makes them more attractive, the significance of title in alternative model specifications a perverse result, and can only be accounted for if one assumes the landless movement purposefully picked properties with adequate documentation. While this is possible, at least according to some ranchers in the region, it is doubtful; perhaps some unaccounted for variable or spatial effect could explain this perverse relationship. Still, if the object of social movement organizations is to maximize their confrontation with property holders

in the South of Pará, there are few better options than to select a productive and fully titled property; such a selection is guaranteed to garner interest by the news media and others in the region.

The 1990s ushered in a period of intense land conflict, where agitation and struggle were commonplace. However, as the record of “first occupations” in Table 4.7 displays, the struggles were typically not over properties which had been occupied for the first time. Instead, new occupations were relatively uncommon, with those properties being occupied for the first time typically having a high proportion of forest, definitive title, labor violations, and environmental violations (Table 4.17). This mirrors the evolving strategy of some of the most well-known social movements; as the landless movement has matured, it has incorporated the struggle of more than just the self-identified landless agriculturalist (and their distaste for *latifúndia*). As described earlier, slave labor is a problem in the South of Pará, and could be used as a justification for expropriation of a property, no matter its level of productivity. The same can be said of environmental violations. Therefore, it would appear that the strategy of the landless evolves just as any other political movement. SMOs have adopted new strategies in order to frame their struggle in an overarching social movement fighting for the rights of the global peasantry, which includes more than just a desire for a piece of land to work (Via Campesina 2008). What is surprising is that this integration is at once visible statistically in one of the primary fronts in the struggle for land-reform.

In sum, it appears that the broad hypothesis that SMO groups enact DALR on private landholdings with particular characteristics appears to be supported by this research, though the particular characteristics involved actually change slightly with time.

While in the mid-1980s property size appears to be the most significant variable modifying the likelihood of occupation, by the end of the 20th century, labor and environmental violations, combined with high proportion forest and title issues were more significant. Overall, however, when all property occupations are considered, nearly all of the characteristics named by key-informants (Table 4.1) are statistically significant in modifying the odds of occupation. Another interesting result of the analysis presented in Chapter 4 is that, over all years and specifications, the exposure model outperforms the resource quality model; it appears that the interests of social movements are, at least statistically and according to the way they were conceived here, trumping the need for SMO members to gain access to agriculturally well-endowed properties.

6.1a. Limitations of Methods and their Implications for Hypothesis 1

Though some clear results can be gleaned from the analysis presented in Chapter 4, a few caveats regarding the interpretation of these logistic regression models are in order. For one, land-cover data are sparse, with a substantial gap of eight years between 1988 and 1996. Obviously, quite a bit of deforestation and other land-cover changes may have occurred over this time and the significance of the variables measuring deforestation in this period may be different if the data were available. Furthermore, though the number of first occupations belies the fact, the period was quite active in the struggle for agrarian reform, and significant events, including the massacre of 19 protesters at the “S curve” of Eldorado do Carajás, took place during this gap in observations. Related, the failure of the scan-line corrector on Landsat 7 limits the availability of land-cover data after 2003 for the region, and Landsat 5 data were not available at low cost. Any further investigation of how the broader landless movement selects properties for occupation

would do well to remedy these data gaps. Additionally, other independent variable data are missing; an investigation into absentee landlords and largeholder/landless movement collusion could be useful as well. A final concern is the coarseness of many geographic datasets that had to be used in this analysis as no better data were available. If more detailed soils data, temporally dynamic title data, and highly accurate property boundary data were available there is a chance that results would change somewhat.

The “exposure” and “resource quality” models also have limitations, and, as the primary focus of Chapter 4 was to explore the impact of all the listed characteristics on property occupations, regardless of desire (beyond the desire to occupy a property), the models may not capture the interests of these groups (SMOs and SMO members) as well as they might. For instance, when speaking with SMO members, myself and others¹¹³ did not explicitly ask what properties they desired in agricultural land; instead, we asked what would lead them to occupy a property. In some ways, the answers that SMO members provided may more closely reflect the desires of their SMO, rather than the definition of the optimal qualities of their ideal agricultural plot.

A final caveat is important; spatial autocorrelation may be a serious problem with some independent variables, and the process of land occupation itself may be spatially autocorrelated. Notably, close proximity to a town inevitably leads one to be close to a road, better soils tend to be located near one another, and larger properties are somewhat clustered together in the study area. A future exploration of these spatial characteristics through the use of a spatial probit model could be a valuable contribution to not only the problem of SMO-driven DALR, but also of use to the sub-discipline of spatial analysis.

¹¹³ Many of these interviews and discussions took place as part of the data collection process for the Simmons et al. DALR project (2005).

6.2. Hypothesis 2

Given that the results of the first portion of the analysis presented here appears to indicate that specific characteristics contribute to property occupations in the polígono dos castanhais, I now turn to the second part of the work – preemptive deforestation and the land-cover impacts which stem from land-conflict. As mentioned in earlier sections, the legal and social situation of land in Brazil seems to provide an incentive for largeholders to deforest their properties in order to maintain “productivity” and prove the land is being used for some “social benefit.” Hypothesis 2a states that largeholders deforest their properties in advance of occupation when their property is directly and specifically threatened with DALR. In both model specifications presented in Chapter 5, the variable “Number of DALR Actions” is significant and robust, leading to approximately 36 hectares of deforestation (0.6 percent) for each DALR activity. In other words, deforestation is significantly increased on those properties explicitly targeted by some form of land-reform agitation, whether it be protest, declaration, threat, or outright occupation (Table 5.9 & Table 5.10). This result appears to support the hypothesis that largeholders increase their efforts to deforest their properties when they are threatened. Furthermore, because the dependent variables in both models were developed using the forest change before an occupation occurred (or, for properties which were never occupied, the total change), hypothesis 2a is supported by these results.

Hypothesis 2b states that DALR on nearby properties leads largeholders to deforest their holdings in order to discourage occupation. The model specifications in Chapter 5 actually do not provide enough evidence to support or reject hypothesis 2b; while the significance of the spatial component in the spatial error models in Table 5.9 and Table 5.10 do indicate that deforestation is spatially autocorrelated, the spatial

correlation of deforestation with DALR actions is not represented. However, running the same model specification on only those properties which were never occupied, renders the variable “Number of DALR Actions” insignificant, indicating that hypothesis 2b is not supported, albeit in a roundabout manner (as one might expect, significant variables in such a model are those considering market access and the passage of time).

The overarching hypothesis, that largeholders undertake preemptive deforestation in order to secure their claims to property, is largely supported by the models presented in Chapter 5. While market-access and the passage of time are significant contributors to deforestation on the largeholdings of the poligono dos castanhais in the percent deforestation models (Table 5.10), the Number of DALR Actions focusing on a property are of high significance, and remain robust even when spatial effects are accounted for. However, the strength of the variable is fairly weak, with each DALR action only increasing deforestation by half of a percent. Nevertheless, 0.5 percent is upwards of 50 hectares of deforestation per DALR event on the largest properties in the region, and even the smallest “largeholdings” would see deforestation of 2.5 hectares for each conflict event.

Similarly, the models taking total hectares of deforestation as their dependent variable support the overarching hypothesis. Though property size and the passage of time are highly significant and robust (retaining significance in both OLS and spatial error specifications), the Number of DALR Actions variable is also significant at the five percent level for the spatial error model, and each conflict event leads to nearly 37 hectares of deforestation. Because these models consider both properties which have been occupied and those that have not, the significance of the variable is important.

6.3. Land-Cover Analysis and its Implications for Hypothesis 2

Statistical models do not provide the only support for Hypothesis 2, however, as can be seen in Figure 5.4 through Figure 5.13. These small-multiple maps show land-cover change on three ranches (Fazenda Cabaceiras, Fazenda Macaxeira, and Fazenda Peruana, respectively) over a (slightly different) time period. Each of them shows the land-cover change on the respective property which can be linked with the land-conflict events taking place there.

The first incident of conflict on Fazenda Cabaceiras took place in 1985, shortly before the first land-cover observation in Figure 5.4. However, conflict did not start in earnest until early 1999, when the property was explicitly threatened for the first time. Given the first explicit threat actually predated the first occupation of the property by only a few months (with the first occupation taking place in November 1999, four months after the 1999 land-cover observation in Figure 5.5), it appears that the 5 percent decline in forest cover could have been part of a preemptive effort to bolster claims of productivity on the ranch. Ongoing conflict and, in particular, illegal deforestation, appears to be noticeable in 2000 (a loss of 250 hectares of forest in the center part of the property can be seen). Conflict continued through 2003, when the ranch was slated for expropriation. All told, between the first occupation in 1999 and 2003, ten percent of the property had been deforested, compared with five percent in the time step before occupation.

Fazenda Macaxeira displays a similar trend, as has already been described by Simmons et al. (2007). However, Figure 5.8 through Figure 5.10 show this progression clearly. In the early period, Fazenda Macaxeira was primarily forest cover, with 75 percent closed-canopy forest in the 1980s. This high level of forest cover would not last

long, however, and efforts to bring more of the property into production are apparent both from land-cover observations in 1988, and the fact that in 1987 the Brazilian Ministry of Labor had raided and fined the ranch for use of slave labor to clear new areas (Pinheiro 1987). By 1995 a survey team began investigating Fazenda Macaxeira as a potential site to locate some 1,200 occupiers of the Cinturão Verde forest reserve surrounding the Carajás mine in Parauapebas. Within a few months, the ranch was occupied (in March 1996) by nearly 2,000 people. However, at this stage much of the original forest cover had been removed, and even more would be taken from the property between 1996 and 1997 when the ranch was expropriated. Between 1996 and 1999, 10 percent of the farm's forest cover was removed, some of which may have been done preemptively. However, as can be seen from the land-cover observations for 1999 to 2002, forest cover declined once the area had been converted into an agrarian reform settlement as well, with a 12 percent decrease in forest cover over the observations after settlement formation. Both ranchers and occupiers are compelled to deforest in the South of Pará.

The case of Fazenda Peruana is similar to that of Cabaceiras; between 1996 and 1999 forest cover dropped rapidly on the ranch, roughly coinciding with the first threat of occupation of the property by the MST, which took place in 1998. As mentioned in Chapter 5, between 1996 and 2003 when the property was first occupied by the MST, 44 percent of the forest cover on the property was removed.

These cases support the statistical analysis of Chapter 5, signifying that at least some of the deforestation taking place in the South of Pará has been accomplished by ranchers as a response to property occupation. This is not to say that deforestation only occurs in this manner, however; smallholders and the landless both contribute

significantly to deforestation in some instances to be sure. To further uncover these different pathways to a similar landscape – one devoid of closed-canopy forest – further work is clearly necessary. Of particular interest would be a similar evaluation to the one presented in this dissertation, but with a more temporally detailed land-cover dataset. As Landsat data become freely available with the opening of the Landsat data archive in 2009 this may become more financially feasible. Unfortunately, even this vast high-quality archive has gaps and drawbacks, not the least of which are the failure of Landsat 7 and the impending retirement of Landsat 5. Furthermore, the polígono dos castanhais is difficult to acquire cloud-free data for, meaning the scenes available are often much further apart than the theoretical temporal resolution of the earth-observing mission.

6.3a. Limitations of Methods and their Implications for Hypothesis 2

The spatial regression models presented support hypothesis 2, but they do not do so conclusively. The explanatory power of these models is moderate at best, and a few variables which would be necessary to speak more conclusively as to the impact of land conflict on the forests of the South of Pará. Specifically, The models presented in Chapter 5 could be assisted by improved knowledge of absentia among largeholders, better location information for farm headquarters (rather than using property centroids), and variables indicating whether neighboring farms had been the subject of landless movement agitation.

A further limitation is that the models presented here only cover the deforestation associated with the first occupation of a property. In other words, only forest cover in the period before the initial occupation is considered. A more complete land-cover dataset would be necessary to address the land-cover impacts associated with subsequent

occupations, and would also shed light on the land-cover change associated with occupation itself. In other words, the analysis presented here leads to a more refined one based more seriously on the “property lifecycle” idea. By decomposing dependent and independent variable observations into periods based upon property control, a more complete picture of deforestation associated with the various stages of land conflict could be completed. Such work has already been proposed (Walker and Simmons 2009), and will be enabled through freely available Landsat imagery.

6.4. Overall Conclusions

The overall conclusions of this dissertation research – that landless movements in the South of Pará occupy properties with certain characteristics and the response of landholders tends to include deforestation to enhance claims of ownership – point to a few important policy implications. First, given that some properties are more likely to lead to contentious interactions between the landed elite of the South of Pará and the landless poor, efforts to limit conflict could integrate this information. Rather than focusing on diffusing conflict on all properties, it may be more effective to use tools such as judicial restraining orders to limit the ability of SMOs to occupy those properties which are larger than average, are located closer to town or roadways, or have a higher proportion of forest. Second, and somewhat similarly, lawmakers in Brazil may do well to more stringently enforce environmental and labor violations which appear to be more important in recent cases of land-conflict, and perhaps clear up confusion about statute law (which tends to support expropriation for environmental or labor law violations) and constitutional law (which does not) treatments of these transgressions. Third, another intuitive policy implication is that, given the importance of applicability, the lives of

smallholder colonists on already established settlement projects in the region may be greatly improved by establishing better all-season transportation infrastructure.

Furthermore, though not a universal driver of occupations, higher proportions of forest appear to strongly increase the odds of occupation on those properties occupied more recently in the poligono dos castanhais. This indicates that there may some justification, at least from an environmental perspective, to constitutional reforms aimed at modifying the land statutes and focus on beneficial use. Current law supports the removal of forest to prove use of the land, which removes a valuable and beneficial ecosystem service provider; modifying the constitution to support good stewardship and to remove the incentive for occupiers to occupy forested properties would be environmentally and socially responsible in the long term. The righteous demands of the poor must be balanced by the need to preserve the environment which, at broader scales, provides them with many services they may otherwise have to pay for.

The support for the second set of hypotheses, those focusing on preemptive deforestation by largeholders, also leads to some specific policy implications. In particular, largeholders are provided with an incentive to show productivity through deforestation – a new measure of productivity and “social benefit” is obviously necessary. While rural agro-industry is certainly labor-extensive, perhaps those farms who had legally registered farm hands and good labor conditions could be measured as “productive” and “socially beneficial,” while those lacking these conditions could be considered eligible for land-reform. By implicitly measuring productivity through “area in production” the stage is set for massive environmental destruction. If labor laws and environmental standards were enforced (as current law requires good labor conditions,

official paperwork for all rural laborers, and the adherence to environmental standards), there would be little incentive to deforest or continue with the labor practices which have conditioned the landless in the South of Pará to view largeholders as their enemy (and vice versa). This recommendation aside, there are certainly properties which should be re-evaluated for agrarian reform purposes, but if the process were more legalistic than crisis-oriented, a more peaceful process of land-reform could be enacted.

This is not to say that only largeholders should be monitored for environmental violations. The case of Fazenda Macaxeria, presented in Chapter 5, makes it clear that deforestation is also a problem after expropriation and settlement formation. This mirrors other research on land-cover change within agricultural settlements in Amazonia (McCracken, Siqueira et al. 2002; Simmons et al. 2002; Caldas 2008), and points to the need to develop environmental policy which more holistically addresses causal chains (i.e., underlying drivers leading to proximate causes) which lead to tropical deforestation. In the South of Pará, this would mean implementing policies which would limit further deforestation within settlements and on largeholdings, while providing colonists and largeholders with support to develop more sustainable agricultural practices. There are a number of promising agricultural practices and technologies, such as silviculture, intercropping, and soil treatments which do not rely on petrochemical fertilizers, but very little social or political will to implement them. Part of the hesitation for the adoption of these (admittedly experimental) techniques stems from the knowledge, always in the back of the Amazonian producer's mind, that more land is available somewhere; eventually available land, even the inaccessible parts, will no longer be available. By addressing this mental roadblock, and turning to alternative agriculture and intensification, Brazil may be

able to address both human suffering due to land conflict and environmental destruction simultaneously.

6.5. Broader Implications for Human-Environment Research and Global Change

Beyond the immediate contributions to policy formulation regarding land conflict and the environment in Amazonia, this work also emphasizes a limited number of ongoing theoretical advances in the field of geography and human-environment research in general. First, it has contributed to our knowledge of how environmental managers (in this case largeholders) respond to threats toward their control over their property, thereby illuminating at least one aspect of their environmental decision-making process.

Furthermore, this work has shown that the environment (in the form of forest cover) can be a factor in environmental decision-making (i.e., overall, proportion forest on a property leads to a much greater likelihood that it will be occupied). These are valuable findings in that they provides us with more information on how environmental managers behave in an environment that is important on a global scale, something the National Academies has named as an important knowledge gap in human-environment interaction (Brewer and Stern 2005).

Second, this dissertation is a step, albeit a preliminary one, toward fusionist research perspectives which are interdisciplinary and seek to integrate social science and environmental science in a way that has the potential to influence policy (Kates 1987; Eden 1998; Fullerton and Stavins 1998; Gibson et al. 2000; Batterbury 2005; Liu et al. 2007; Turner II et al. 2007; Turner and Robbins 2008). In particular, by integrating land-change science with contentious politics, this work moves the project of bridging various frameworks together to achieve a better understanding of human-environment

relationships forward, taking to heart the calls by others (Zimmerer and Bassett 2003; Simmons 2005; Simmons, Walker et al. 2007; Turner and Robbins 2008).

The political ecology portion of this fusion contributes to the greater project of political ecology in that I have drawn on earlier efforts to integrate an explanation of contention and conflict into the framework (Simmons 2005; Simmons, Walker et al. 2007). Specifically, moving beyond power relations, which tend to be the primary explanatory device in political ecologies of conflict and environment (Peluso and Watts 2001; Peet and Watts 2004), the framework developed by Simmons et al. (2007) allows for the researcher to explore the generation of conflict through politics and the empowering efforts movements to connect with one another, rather than how the interests of the powerful (be they development agencies or the wealthy) dictate how and when conflict arises. Here I simplify the arguments of the authors of the volumes edited by Peet and Watts (2004) and Peluso and Watts (2001) substantially, but the integration of contentious politics with political ecology builds upon the approaches which these authors propose, and does so by providing the tools to understand contention in the place and time of interest, without relying on explanations based entirely on locale.

Third, this work shows us that land conflict can have a significant impact on forest cover, and does so over a long period of time. In addition to agronomic expansion, ranchers in the Amazon have to deal with the threatening gaze of social movements, and the struggle for land is far from over. While the states of Rondônia and Pará are among the most active in the struggle for land, the potential for the expansion of this fight to the states of Amazonas and Mato Grosso (as well as other parts of Pará) is substantial, and may result in much more significant environmental impacts (Anonymous 2003; Simmons

2004; Scolese 2005; Simmons, Walker et al. 2007). Furthermore, as agrarian reform is an issue far beyond Amazonia (e.g., Mexico and China), the potential for the struggle for land to bring about further environmental change through agricultural extensification is substantial. In Mexico, agrarian reform is on the rise as the traditional form of community management, the ejido (itself the product of past agrarian reform efforts) is being reorganized into land units more akin to private property (Johnson 2001; Perramond 2008), opening the possibility to further environmental change (be it positive or negative). It is my hope that the research presented here will be among the first projects in a new wave of work that can inform development and agricultural policies to provide a more productive and environmentally friendly agrarian reform by show how land conflict has resulted in both environmental and social wrongs.

Fourth, this work fits within the rising call to consider “coupled human-natural systems” (Liu et al. 2007; Turner II et al. 2007; Turner and Robbins 2008). While this work is not a full expression of the power of such a call, it does illustrate how current explanatory devices dealing with the environmental impacts of land conflict involve simplifications. For instance, a common theme in the literature dealing with land conflict is that title problems lead to significant social and environmental issues in Amazonia because a lack of title leads property holders to invest less in their property (probably true, though not addressed here) and leads others to occupy it (a claim contradicted by the results of this analysis). While the basic idea of couple human and natural systems research is that, when considered together, human and natural systems exhibit complex, emergent, behavior (Liu et al. 2007), another outcome is that researchers begin to learn that explanations in one realm (e.g., the human system, or society) fall apart when applied

to the coupling of that realm with the other (i.e., when human-environmental systems are considered).

Fifth, this research is confirmatory of previous research on deforestation and land-use and land-cover change in general. That is to say that it builds upon the project of land-change science; this work has shown that land-cover change is a spatial process, and that the passage of time is important, both confirmatory findings. However, the findings presented here also show that a new underlying driver of deforestation may be at work, at least in parts of the Amazon; land conflict activity significantly impacts forest cover. With the potential for the struggle for agrarian reform to extend to other parts of the Amazon, the “lungs of the globe,” like a cancer, this finding should be of concern to policymakers and researchers alike.

Finally, this work provides a base from which to further explore new and exciting concepts in environmental management, human-environment interaction, and the amelioration of conflict. For example, one emerging perspective is that landholdings in the Amazon, and other rural parts of the globe, experience a “property lifecycle” rather than a “household” one (Barbieri et al. 2005; VanWey et al. 2007). Largeholdings in Amazonia may exhibit the same trends VanWey (2007) and Barbieri (2005) have observed on smaller ones; land-use strategies in places like the Amazon (i.e., remote and agriculturally-dominated, near-forest, frontier environments) appear to occur with little change coming from household structure, they appear to only progress from forest to agricultural, and options for property managers are limited. Another item of interest stems from the increasingly evidence that national-level political change can have a profound impact on the environment. Currently, in Brazil, a president and legislature

generally considered friendly to the landless, and the environmental movement, is in power; though President Lula has fallen short of juggling these two sometimes competing interests flawlessly, it would be interesting to explore the environmental and social ramifications of a political sea-change. Given the fact that political change enabled, in many respects, the rise of the landless movement and the contentious struggle they currently engage in, it would not be surprising to learn that national politics changes the environmental imprint of conflict in Amazonia; knowing what that imprint may be is another matter.

Regardless of future work, the forest of the Amazon basin continue to fall at alarming rates (Brasil 2008a; Brasil 2008b; Mello Franco 2008), and monitoring environmental law continues to be problematic (Wallace 2007). Work such as this will only help illustrate the complexity and strength of the connection between humans and environmental change – a combination of continued scientific exploration and active policy making will be the only way to get close to what, until this point, has remained outside of the grasp of humans the world over: a more peaceful and sustainable relationship with each other and the environment.

APPENDICES

Appendix I

Characteristic	Citation
Proximity to major road	(Alston et al. 2000; Fearnside 2001a; Simmons et al. 2002; Wright and Wolford 2003)
Proximity to town	None
Large forest reserve	(Foweraker 1981b; Fearnside 1987; Hall 1989; de Almeida 1990; Pace 1992; Alston et al. 2000; Fearnside 2001a; Branford and Rocha 2002; Simmons et al. 2002; Simmons, Walker et al. 2007)
Environmental violations	(Fearnside 2001a)
Title/Legal problems	(Foweraker 1981b; Hall 1989; de Almeida 1990; Branford and Rocha 2002; Wright and Wolford 2003; Simmons, Walker et al. 2007)
Open land (pasture, etc.)	(Wright and Wolford 2003; Alston, Libecap, and Mueller 2000)
Better soil	(Fearnside 2001a)
Accessible water	(Branford and Rocha 2002)
Labor violations (slave-labor)	None
Vacant landlords	(Fearnside 2001a; Simmons, Walker et al. 2007)
Large size	(Hall 1989; Branford and Rocha 2002; Simmons et al. 2002; Simmons, Walker et al. 2007)
Already experienced an occupation	(Branford and Rocha 2002)
Landlord encourages an occupation	(Foweraker 1981b; Alston et al. 2000; Fearnside 2001a)

Table 6.1 Authors mentioning specific characteristics predisposing properties to occupation by landless movements.

Appendix II

1986 Occupations (<i>n</i> =11)	Specification 1		Specification 2		Specification 3	
Independent Variables:	Odds Ratio (Std.Err.)	P > Z	Odds Ratio (Std.Err.)	P > Z	Odds Ratio (Std.Err.)	P > Z
Proportion Forest ¹	5.34042 (1.029252)	.465	5.044481 (14.29799)	.568	9.951288 (34.09)	.502
Suitable Soils Binary ²	1.029252 (.8070915)	.971	.7614814 (.5631355)	.713	1.426219 (1.197927)	.673
Title Problem Binary ³	3.27357 (3.827977)	.311	3.110979 (3.885023)	.363	5.997858 (8.159263)	.188
Labor Violations	2.178502 (2.258697)	.453	1.636002 (1.587367)	.612	3.031117 (3.331011)	.313
Area of Property in Hectares					1.000264 (.0000956)	.006
<i>Latifundio</i> Binary ⁴	7.580073 (5.747809)	.008	8.09039 (6.294326)	.007		
Environmental Violations ⁵					.2723385 (.4267004)	.406
Forest Reserve Violations ⁶	.5894148 (.7846679)	.691				
Env. Violations from Newspaper Reports ⁷			3.296256 (3.389152)	.246		
Distance to Major City ⁸					.9599908 (.286629)	.171
Distance to Towns ⁹			.9841486 (0.353371)	.656		
Cost Distance to Town ¹⁰	.9022417 (.1041251)	.373				
Distance to River	1.104057 (.4304095)	.800	1.057295 (.4125601)	.886	1.511246 (.6911826)	.367
Highway Binary ¹¹	.6975368 (.6362066)	.693			1.071677 (1.18874)	.950
Highway 10km Buffer Binary ¹²			.6587424 (.5757496)	.633		
<i>Latifundiarista</i> ¹³	1.27218 (.9035206)	.735	.9537231 (.6727095)	.946	2.123529 (1.609863)	.321
<i>n</i>	181		181		181	
<i>Log Likelihood</i>	-34.219278		-34.018525		-30.721138	
<i>Pseudo R</i> ²	0.1748		0.1796		0.2591	

Table 6.2. Odds ratio results for 1986 occupations, logistic regression models with three specifications. Specification 3 is discussed in detail in text.

Notes associated with Table 6.2 through Table 6.5: ¹Proportion forest in time period before occupation listed in column heading. ²Suitable soils are those rated as moderate to highly suitable for smallholder agriculture by soil scientists at EMBRAPA. ³Properties without definitive title as indicated by SUDAM. ⁴Properties exceeding the regional average. ⁵Environmental violations as named in regional newspapers or through remote sensing measurement in time period before occupation. ⁶Forest reserve violations as measured by remote sensing. ⁷Environmental violations reported in regional newspapers. ⁸Euclidian distance to the cities of Marabá and Eldorado do Carajás, the two largest cities in the *poligono do castanhais*. ⁹Distance to local towns in the region. ¹⁰Cost-weighted distance, considering road access. ¹¹Highways in this case are the major paved roads in the study area, including BR-230, BR-222, PA-150, and PA-257. ¹²Properties within ten kilometers of the aforementioned major highways. ¹³A binary variable where known land grabbers or other violent property owners, as indicated by newspaper reports, are indicated.

1986 Occupations (<i>n</i> =11)	Specification 1		Specification 2		Specification 3	
Independent Variables: ¹	Coef (Std.Err.)	P > Z	Coef (Std.Err.)	P > Z	Coef. (Std.Err.)	P > Z
Proportion Forest	1.675304 (2.29126)	0.465	1.618295 (2.83438)	0.568	2.297702 (3.42569)	0.502
Suitable Soils Binary	.0288325 (.784153)	0.971	-.2724896 (.739526)	0.713	.355027 (.839932)	0.673
Title Problem Binary	1.185881 (1.16936)	0.311	1.134937 (1.24881)	0.363	1.791402 (1.36036)	0.188
Labor Violations	.7786375 (1.03681)	0.453	.4922554 (.970272)	0.612	1.108931 (1.09894)	0.313
Area of Property in Hectares					0.000264 (.000096)	0.006
<i>Latifúndio</i> Binary	2.025523 (.758279)	0.008	2.090677 (.778000)	0.007		
Environmental Violations					-1.30071 (1.56680)	0.406
Forest Reserve Violations	-.5286251 (1.33127)	0.691				
Env. Violations from Newspaper Reports			1.192787 (1.02818)	0.246		
Distance to Major City					-.040832 (0.29857)	0.171
Distance to Towns			-.0159784 (0.35906)	0.656		
Cost Distance to Town	-.1028728 (.115407)	0.373				
Distance to River	.0989917 (.389844)	0.800	.0557135 (.390204)	0.886	.4129346 (.457359)	0.367
Highway Binary	-.3601999 (.912076)	0.693			.0692245 (1.10923)	0.950
Highway 10km Buffer Binary			-.4174227 (.874013)	0.633		
<i>Latifundiaria</i>	.2407317 (.710215)	0.735	-.0473819 (.705351)	0.946	.7530793 (.758108)	0.321
Constant	-6.014421 (2.52947)	0.017	-5.564465 (3.27666)	0.089	-7.25502 (3.89167)	0.062
<i>N</i>	181		181		181	
<i>Log Likelihood</i>	-34.219278		-34.018525		-30.721138	
<i>Pseudo R</i> ²	0.1748		0.1796		0.2591	

Notes: ¹Variable descriptions included on page 306.

Table 6.3. Coefficient results for 1986 occupations, logistic regression models with three specifications. Specification 3 is discussed in detail in text.

1987 Occupations (<i>n</i> =9)	Specification 1		Specification 2		Specification 3	
Independent Variables: ¹	Odds Ratio (Std.Err.)	P > Z	Odds Ratio (Std.Err.)	P > Z	Odds Ratio (Std.Err.)	P > Z
Proportion Forest	2.672131 (.5777417)	.649	2.409984 (.555124)	.703	6.888406 (14.1427)	.347
Suitable Soils Binary	.8722893 (.7919536)	.880	1.094992 (.9965995)	.921	1.652922 (1.33690)	.534
Title Problem Binary	.474639 (.4828498)	.464	.1087752 (.1250726)	.054	.5754615 (.611147)	.603
Labor Violations	1.596804 (2.112845)	.724	1.595121 (2.219702)	.737	2.020566 (2.52034)	.573
Area of Property in Hectares					1.000059 (.000051)	.247
<i>Latifundio</i> Binary	3.961772 (3.028034)	.072	5.424556 (4.404942)	.037		
Environmental Violations					.7006403 (1.03322)	.809
Forest Reserve Violations	1.578875 (2.081564)	.729				
Env. Violations from Newspaper Reports			2.109728 (3.237944)	.627		
Distance to Major City					1.005948 (.024402)	.807
Distance to Towns			1.00045 (.0372344)	.990		
Cost Distance to Town	1.089284 (.0870573)	.285				
Distance to River	.8499561 (.2535668)	.586	.7096821 (.2244649)	.278	.8529088 (.278217)	.626
Highway Binary	.67417 (.7267639)	.715			1.03803 (1.11919)	.972
Highway 10km Buffer Binary			.0772863 (.0971254)	.042		
<i>Latifundiarista</i>	1.439906 (1.048942)	.617	1.318434 (1.013329)	.719	1.916998 (1.37095)	.363
Constant	181		181		181	
<i>N</i>	-32.762555		-30.084701		-30.084701	
<i>Log Likelihood</i>	.0844		0.1593		0.1593	

Notes: ¹ Variable descriptions included on page 306.

Table 6.4. Odds ratio results for 1987 occupations, logistic regression models with three specifications. Specification 2 is discussed in detail in text.

1987 Occupations (n=9)	Specification 1		Specification 2		Specification 3	
Independent Variables: ¹	Coef (Std.Err.)	P > Z	Coef (Std.Err.)	P > Z	Coef. (Std.Err.)	P > Z
Proportion Forest	.9828763 (2.1621)	0.649	.8796199 (2.30505)	0.703	1.92984 (2.05312)	0.347
Suitable Soils Binary	-.136634 (.90790)	0.880	.0907474 (.910143)	0.921	.5025449 (.808808)	0.534
Title Problem Binary	-.745201 (1.0173)	0.464	-2.218472 (1.14983)	0.054	-.552583 (1.06201)	0.603
Labor Violations	.468004 (1.3232)	0.724	.4669494 (1.39156)	0.737	.7033776 (1.24734)	0.573
Area of Property in Hectares					.0000593 (.000051)	0.247
<i>Latifúndio Binary</i>	1.376691 (.76431)	0.072	1.690936 (.812037)	0.037		
Environmental Violations					-.355761 (1.47467)	0.809
Forest Reserve Violations	.4567124 (1.3184)	0.729				
Env. Violations from Newspaper Reports			.7465591 (1.53477)	0.627		
Distance to Major City					.00593 (.024258)	0.807
Distance to Towns			.0004503 (.037218)	0.990		
Cost Distance to Town	.085521 (.07992)	0.285				
Distance to River	-.162571 (.29833)	0.586	-.3429382 (.316289)	0.278	-.159103 (.326197)	0.626
Highway Binary	-.394273 (1.0780)	0.715			0.373251 (1.07818)	0.972
Highway 10km Buffer Binary			-2.560238 (1.25670)	0.042		
<i>Latifundiarista</i>	.3645778 (.72848)	0.617	.2764446 (.768585)	0.719	.6507602 (.715152)	0.363
Constant	-3.95612 (1.8676)	0.034	-1.628626 (2.39404)	0.496	-4.92853 (2.11865)	0.020
N	181		181		181	
Log Likelihood	-32.762555		-30.084701		-30.084701	
Pseudo R ²	0.0844		0.1593		0.1593	

Notes: ¹Variable descriptions included on page 306.

Table 6.5. Coefficient results for 1987 occupations, logistic regression models with three specifications. Specification 2 is discussed in detail in text.

1999 Occupations (<i>n</i> =4)	Specification 1		Specification 2		Specification 3	
Independent Variables: [*]	Odds Ratio (Std.Err.)	P > Z	Odds Ratio (Std.Err.)	P > Z	Odds Ratio (Std.Err.)	P > Z
Proportion Forest ¹	17440.67 (115566.9)	.141	8163.012 (51489.3)	.153	18556.32 (108078.6)	.092
Suitable Soils Binary ²	22.5317 (48.6038)	.149	13.59415 (27.6826)	.200	12.95526 (27.69285)	.231
Title Problem Binary ³	.0377537 (.0882159)	.161	.0091128 (.019873)	.031	.0059556 (.0143933)	.034
Labor Violations	61.06642 (138.1639)	.069	87.47276 (22.9291)	.079	90.63067 (221.3465)	.065
Area of Property in Hectares					.9994787 (.0005482)	.342
<i>Latifundio</i> Binary ⁴	.2202418 (.4240816)	.432	.2409829 (.541388)	.526		
Environmental Violations ⁵					105.0123 (291.3862)	.093
Forest Reserve Violations ⁶	1.033134 (3.089551)	.991				
Env. Violations from Newspaper Reports ⁷			84.73444 (213.008)	.077		
Distance to Towns ⁸			.9450514 (.096885)	.581		
Cost Distance to Town ⁹	1.384348 (.3663445)	.219			1.026167 (.446493)	.953
Distance to River	.7908515 (.7326539)	.800	.4742432 (.286433)	.217	.4159096 (.297389)	.220
Highway Binary ¹⁰	20.8315 (47.82243)	.186				
Highway 10km Buffer Binary ¹¹			.0328545 (.084972)	.187	.0474853 (.1317583)	.272
<i>Latifundiarista</i> ¹²	.1667477 (.3557933)	.401	.0703093 (.170586)	.274	.0412118 (.1225621)	.284
<i>n</i>	181		181		181	
<i>Log Likelihood</i>	-9.3960149		-8.7093453		-9.1451253	
<i>Pseudo R</i> ²	0.5107		0.5465		0.5238	

Notes: *Variable descriptions included on page 311.

Table 6.6. Odds ratio results for 1999 occupations, logistic regression models with three specifications. Specification 3 is discussed in detail in text.

Notes for Table 6.6 and Table 6.7: ¹Proportion forest in time period before occupation listed in column heading. ²Suitable soils are those rated as moderate to highly suitable for smallholder agriculture by soil scientists at EMBRAPA. ³Properties without definitive title as indicated by SUDAM. ⁴Properties exceeding the regional average. ⁵Environmental violations as named in regional newspapers or through remote sensing measurement in time period before occupation. ⁶Forest reserve violations as measured by remote sensing. ⁷Environmental violations reported in regional newspapers. ⁸Distance to local towns in the region. ⁹Cost-weighted distance, considering road access. ¹⁰Highways in this case are the major paved roads in the study area, including BR-230, BR-222, PA-150, and PA-257. ¹¹Properties within ten kilometers of the aforementioned major highways. ¹²A binary variable where known land grabbers or other violent property owners, as indicated by newspaper reports, are indicated.

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1999 Occupations (<i>n</i> =4)	Specification 1		Specification 2		Specification 3	
Independent Variables: ¹	Coef (Std.Err.)	P > Z	Coef (Std.Err.)	P > Z	Coef. (Std.Err.)	P > Z
Proportion Forest	9.76656 (6.62629)	0.141	9.007369 (65.30763)	0.153	9.828566 (5.82436)	0.092
Suitable Soils Binary	3.115166 (2.15661)	0.149	2.609639 (2.036358)	0.200	2.561502 (2.13458)	0.231
Title Problem Binary	-3.276672 (2.33662)	0.161	-4.698076 (2.180733)	0.031	-5.123417 (2.41675)	0.034
Labor Violations	4.111962 (2.26252)	0.069	4.471327 (2.548555)	0.079	4.505689 (2.44499)	0.065
Area of Property in Hectares					-.0005215 (.000549)	0.342
<i>Latifundio Binary</i>	-1.513029 (1.92553)	0.432	-1.423029 (2.246584)	0.526		
Environmental Violations					4.654078 (2.77478)	0.093
Forest Reserve Violations	.0325971 (2.99046)	0.991				
Env. Violations from Newspaper Reports			4.439522 (2.513832)	0.077		
Distance to Major City					.0258302 (.435108)	0.953
Distance to Towns			-.056516 (.1025179)	0.581		
Cost Distance to Town	.3252291 (.264633)	.219				
Distance to River	-.2346451 (.926412)	.186	-.7460349 (.6039788)	0.217	-.8772875 (.715033)	0.220
Highway Binary	3.036466 (2.29568)	.186			-3.047334 (2.77472)	0.272
Highway 10km Buffer Binary			-3.415668 (2.586317)	0.187		
<i>Latifundiarista</i>	-1.791273 (2.13372)	.401	-2.654851 (2.426227)	0.274	-3.189031 (2.97396)	0.284
Constant	-11.30072 (6.06666)	.062	-4.641747 (4.381825)	0.289	-4.63453 (4.26175)	0.277
<i>n</i>	181		181		181	
<i>Log Likelihood</i>	-9.3960149		-8.7093453		-9.1451253	
<i>Pseudo R</i> ²	0.5107		0.5465		0.5238	

Notes: ¹ Variable descriptions included on page 311.

Table 6.7. Coefficient results for 1999 occupations, logistic regression models with three specifications. Specification 3 is discussed in detail in text.

Appendix III

Hectares Deforestation (negative coefficients indicate forest gain)	OLS 1 (n=180)		Spatial Error 1 (n=180)	
Independent Variables:*	Coef (Std.Err.)	P > Z	Coef (Std.Err.)	P > Z
Forest Year Control ¹	110.7181 (18.6158)	0.000	108.7454 (14.5968)	0.000
Suitable Soils Binary ²	-21.5669 (244.277)	0.930	-145.791 (315.254)	0.644
Title Problem Binary ³	568.898 (238.263)	0.083	-19.2875 (290.034)	0.947
Labor Violations	387.5139 (581.726)	0.506	744.358 (475.740)	0.118
Area of Property in Hectares	.1490101 (.026942)	0.000	.1636851 (0.02404)	0.000
Distance to Major City ⁵	-8.27580 (8.76863)	0.347	-13.9240 (9.83150)	0.157
Distance to River	151.2665 (90.2875)	0.096	80.84901 (92.5491)	0.382
Highway 10km Buffer Binary ⁹	-227.095 (318.637)	0.477	-32.1751 (358.582)	0.929
Latifundiarista ¹⁰	356.1021 (263.378)	0.178	135.1983 (241.825)	0.576
Number of DALR Actions ¹¹	54.35446 (18.9378)	0.005	33.57992 (15.6565)	0.032
Number of Deaths ¹²	-4.00737 (38.7026)	0.918	10.84835 (31.5866)	0.731
Constant	-483.552 (589.211)	0.413	-10.1620 (130.912)	0.938
Lambda			.117173 (130.912)	0.000
R ² (Pseudo R ²)	0.3370		(0.290)	
Log Likelihood			-1551.3107	
Moran's I (p-value)	1.411 (0.158)			
Lagrange Multiplier - Error	28.691 (0.000)			
Robust Lagrange Multiplier - Error	10.983 (0.001)			
Lagrange Multiplier - Lag	17.728 (0.000)			
Robust Lagrange Multiplier - Lag	0.020 (0.887)			

Notes: *Variable descriptions included on page 315.

Table 6.8 First Table of Alternate OLS and Spatial Regression Specifications for Hectares Deforestation Models.

Notes: ¹A control for intermediate time steps (years) between land-cover observations.

For example, if, due to data availability, the two time periods before a property occupation span more than one year the value of this variable will equal the number of years between observations (e.g., for change from 1984 to 1986 the value of this variable would be “2”). ²Suitable soils are those rated as moderate to highly suitable for smallholder agriculture by soil scientists at EMBRAPA. ³Properties without definitive title as indicated by SUDAM. ⁴Properties exceeding the regional average size (4886.21 hectares). ⁵Euclidian distance to the cities of Marabá and Eldorado do Carajás, the two largest cities in the *poligono do castanhais*. ⁶Distance to smaller towns or cities in the region. ⁷Cost-weighted distance to towns, taking into account distance to roads.

⁸Highways in this case are the major paved roads in the study area, including BR-230, BR-222, PA-150, and PA-257. ⁹Properties within ten kilometers of the aforementioned major highways. ¹⁰A binary variable where known land grabbers or other violent property owners, as indicated by newspaper reports, are indicated. ¹¹The number of direct-action land reform (DALR) activities which have occurred either on, or about, the property.

These activities include public declarations, complaints, protests, and occupations, among other things. The variable is meant to proxy for the amount of interest in a given property

¹²The number of people killed on the property, or because of their interest in the property, before occupation. This variable is meant to proxy for the intensity of conflict on a given property.

Hectares Deforestation (negative coefficients indicate forest gain)	OLS 2 (n=180)		Spatial Error 2 (n=180)	
Independent Variables:*	Coef. (Std.Err.)	P > Z	Coef. (Std.Err.)	P > Z
Forest Year Control ¹	111.276 (17.4403)	0.000	110.7062 (13.5107)	0.000
Suitable Soils Binary ²	-117.999 (228.398)	0.437	-236.250 (299.829)	0.431
Title Problem Binary ³	704.772 (295.740)	0.018	78.83648 (286.471)	0.783
Labor Violations	83.2995 (547.140)	0.879	361.9299 (460.687)	0.432
Latifundio Binary ⁴	1841.84 (260.281)	0.000	1901.698 (233.357)	0.000
Distance to Towns ⁶	-21.7569 (9.44727)	0.023	-5.78190 (13.6741)	0.672
Distance to River	143.5498 (83.0886)	0.086	64.07085 (97.8292)	0.513
Highway Binary ⁸	-453.052 (291.928)	0.123	-72.4905 (299.956)	0.809
Latifundiarista ¹⁰	107.1139 (249.228)	0.668	-51.1584 (233.821)	0.827
Number of DALR Actions ¹¹	68.20027 (17.4288)	0.000	48.15931 (14.7238)	0.001
Number of Deaths ¹²	-26.7439 (36.2027)	0.461	-2.01181 (30.5466)	0.947
Constant	64.49822 (447.887)	0.886	54.71815 (136.175)	0.688
Lambda			.110504 (0.16735)	0.000
R ² (Pseudo R ²)	0.4073		(0.369)	
Log Likelihood			-1544.9966	
Moran's I (p-value)	1.260 (0.208)			
Lagrange Multiplier - Error	21.135 (0.000)			
Robust Lagrange Multiplier - Error	8.867 (0.003)			
Lagrange Multiplier - Lag	12.425 (0.000)			
Robust Lagrange Multiplier - Lag	0.157 (0.692)			

Notes: *Variable descriptions included on page 315.

Table 6.9. Second Table of Alternate OLS and Spatial Regression Specifications for Hectares Deforestation Models

Hectares Deforestation (negative coefficients indicate forest gain)	OLS 3 (n=180)		Spatial Error 3 (n=180)	
Independent Variables:*	Coef. (Std.Err.)	P > Z	Coef. (Std.Err.)	P > Z
Forest Year Control ¹	107.1593 (16.6177)	0.000	103.6285 (12.6776)	0.000
Suitable Soils Binary ²	-320.898 (226.177)	0.158	-183.659 (295.518)	0.534
Title Problem Binary ³	234.3275 (287.347)	0.416	-197.868 (249.353)	0.427
Labor Violations	325.5667 (529.229)	0.539	558.9639 (442.740)	0.207
Area of Property in Hectares	0.798705 (0.28159)	0.006	.0928898 (.024262)	0.000
Latifundio Binary ⁴	1523.072 (292.366)	0.000	1414.429 (256.346)	0.000
Cost-Weighted Distance to Towns ⁷	94.99975 (25.6912)	0.000	2.389982 (76.7977)	0.975
Distance to River	71.91767 (76.9886)	0.351	20.45315 (76.6688)	0.790
Highway Binary ⁸	-2.35798 (290.584)	0.994	-46.8231 (289.504)	0.872
Latifundiarista ¹⁰	58.61811 (244.316)	0.811	-29.101 (224.123)	0.897
Number of DALR Actions ¹¹	53.67301 (17.3860)	0.002	29.99298 (14.6193)	0.040
Number of Deaths ¹²	-6.72558 (35.0054)	0.848	7.717103 (29.3734)	0.793
Constant	-722.606 (409.338)	0.079	-16.7159 (116.213)	0.886
Lambda			.119337 (0.16116)	0.000
R ² (Pseudo R ²)	0.4575		(0.375)	
Log Likelihood			-1538.0231	
Moran's I (p-value)	1.236 (0.216)			
Lagrange Multiplier - Error	18.590 (0.000)			
Robust Lagrange Multiplier - Error	8.418 (0.004)			
Lagrange Multiplier - Lag	10.175 (0.001)			
Robust Lagrange Multiplier - Lag	0.003 (0.956)			

Notes: *Variable descriptions included on page 315.

Table 6.10. Third Table of Alternate OLS and Spatial Regression Specifications for Hectares Deforestation Models

Hectares Deforestation (negative coefficients indicate forest gain)	OLS 4 (n=180)		Spatial Error 4 (n=180)	
Independent Variables:*	Coef. (Std.Err.)	P > Z	Coef. (Std.Err.)	P > Z
Forest Year Control ¹	106.4603 (17.2034)	0.000	108.8696 (13.5180)	0.000
Suitable Soils Binary ²	-72.04265 (231.706)	0.756	-183.709 (310.279)	0.554
Title Problem Binary ³	386.2632 (303.206)	0.204	-31.2823 (251.284)	0.901
Labor Violations	200.1264 (517.612)	0.700	313.1107 (422.427)	0.459
Area of Property in Hectares	0.0776967 (0.29055)	0.008	0.097980 (0.25241)	0.000
Latifúndio Binary ⁴	1485.246 (302.280)	0.000	1366.439 (250.681)	0.000
Distance to Conceição do Araguaia (Southeast of Brazil)	-60.72624 (45.1591)	0.180	-23.4082 (25.3568)	0.356
Distance to River	172.76241 (94.1993)	0.069	59.1509 (84.5356)	0.484
Highway Binary ⁸	-227.3506 (293.395)	0.439	-115.905 (284.610)	0.684
Latifundiaria ¹⁰	185.0831 (248.286)	0.457	-26.5330 (230.045)	0.908
Number of DALR Actions ¹¹	53.92536 (17.7476)	0.003	36.51109 (14.3015)	0.011
Number of Deaths ¹²	-7.89355 (36.1664)	0.827	9.421337 (29.6218)	0.750
Constant	320.6665 (870.224)	0.713	22.36049 (123.289)	0.856
Lambda			0.11673 (0.01622)	0.000
R ² (Pseudo R ²)	0.4189		(0.392)	
Log Likelihood			-1547.0377	
Moran's I (p-value)	1.350 (0.177)			
Lagrange Multiplier - Error	29.514(0.000)			
Robust Lagrange Multiplier - Error	11.678 (0.001)			
Lagrange Multiplier - Lag	17.943 (0.000)			
Robust Lagrange Multiplier - Lag	0.107 (0.743)			

Notes: *Variable descriptions included on page 315.

Table 6.11 Fourth Table of Alternate OLS and Spatial Regression Specifications for Hectares Deforestation Models

Percent Deforestation (negative coefficients indicate forest gain)	OLS 1 (n=180)		Spatial Error 1 (n=180)	
Independent Variables:*	Coef (Std.Err.)	P > Z	Coef (Std.Err.)	P > Z
Forest Year Control ¹	.022246 (.003103)	0.000	.0235237 (.002065)	0.000
Suitable Soils Binary ²	-.017635 (.040799)	0.666	.053652 (.045295)	0.236
Title Problem Binary ³	.1314893 (.054493)	0.017	.0275199 (.041074)	0.503
Labor Violations	-.122156 (.097160)	0.210	-.048611 (.067248)	0.470
Area of Property in Hectares	-.000004 (.000005)	0.440	-.000001 (.000003)	0.732
Distance to Major City ⁵	-.001038 (.001465)	0.480	0.001115 (.001394)	0.424
Distance to River	.0336494 (.015080)	0.027	.0097894 (.013177)	0.458
Highway 10km Buffer Binary ⁹	-.098701 (.053219)	0.065	.0016476 (.052024)	0.975
<i>Latifundiarista</i> ¹⁰	.1014913 (.043989)	0.022	.0425233 (0.34312)	0.215
Number of DALR Actions ¹¹	.0102688 (.003163)	0.001	.0058154 (.002212)	0.009
Number of Deaths ¹²	-.006301 (.006464)	0.331	-.002415 (.004462)	0.588
Constant	.1039033 (0.98410)	0.293	.0004013 (.017574)	0.982
Lambda			.127122 (.009917)	0.000
R ² (Pseudo R ²)	0.3337		(0.246)	
Log Likelihood			42.737123	
<i>Moran's I</i> (p-value)	2.109 (0.035)			
<i>Lagrange Multiplier - Error</i>	96.405 (0.000)			
<i>Robust Lagrange Multiplier - Error</i>	59.884 (0.000)			
<i>Lagrange Multiplier - Lag</i>	36.538 (0.000)			
<i>Robust Lagrange Multiplier - Lag</i>	0.018 (0.894)			

Notes: * Variable descriptions included on page 320.

Table 6.12 First Table of Alternate OLS and Spatial Regression Specifications for Percent Deforestation Models

Notes:¹A control for intermediate time steps (years) between land-cover observations.

For example, if, due to data availability, the two time periods before a property occupation span more than one year the value of this variable will equal the number of years between observations (e.g., for change from 1984 to 1986 the value of this variable would be “2”).²Suitable soils are those rated as moderate to highly suitable for smallholder agriculture by soil scientists at EMBRAPA.³Properties without definitive title as indicated by SUDAM.⁴Properties exceeding the regional average size (4886.21 hectares).⁵Euclidian distance to the cities of Marabá and Eldorado do Carajás, the two largest cities in the *poligono do castanhais*.⁶Distance to smaller towns *or* cities in the region.⁷Cost-weighted distance to towns, taking into account distance to roads.

⁸Highways in this case are the major paved roads in the study area, including BR-230, BR-222, PA-150, and PA-257.⁹Properties within ten kilometers of the aforementioned major highways.¹⁰A binary variable where known land grabbers or other violent property owners, as indicated by newspaper reports, are indicated.¹¹The number of direct-action land reform (DALR) activities which have occurred either on, or about, the property.

These activities include public declarations, complaints, protests, and occupations, among other things. The variable is meant to proxy for the amount of interest in a given property

¹²The number of people killed on the property, or because of their interest in the property, before occupation. This variable is meant to proxy for the intensity of conflict on a given property.

Percent Deforestation (negative coefficients indicate forest gain)	OLS 2 (n=180)		Spatial Error 2 (n=180)	
Independent Variables:*	Coef. (Std.Err.)	P > Z	Coef. (Std.Err.)	P > Z
Forest Year Control ¹	.0235586 (.002929)	0.000	.0243443 (.001964)	0.000
Suitable Soils Binary ²	-.015329 (.038356)	0.690	.0586632 (0.45385)	0.196
Title Problem Binary ³	.1964003 (.049665)	0.000	.0495245 (0.41014)	0.227
Labor Violations	-.100806 (.091885)	0.274	-.049896 (0.67230)	0.458
<i>Latifundio</i> Binary ⁴	.1008061 (.091885)	0.920	.0055831 (0.34272)	0.871
Distance to Towns ⁶	-.007346 (.001587)	0.000	-.000908 (.002006)	0.651
Distance to River	.0531772 (.013954)	0.000	.0183142 (0.14323)	0.201
Highway Binary ⁸	-.089193 (.049025)	0.071	-.004328 (.044389)	0.922
<i>Latifundiarista</i> ¹⁰	.0956876 (.041855)	0.023	.0453366 (.034496)	0.188
Number of DALR Actions ¹¹	.0092536 (.002927)	0.002	.0058988 (.002128)	0.006
Number of Deaths ¹²	-.006077 (.006080)	0.319	-.002076 (.004456)	0.641
Constant	.145822 (0.75216)	0.054	.0023795 (.018460)	0.897
Lambda			.126005 (0.01008)	0.000
R ² (Pseudo R ²)	0.3978		(0.262)	
Log Likelihood			42.496502	
Moran's I (p-value)	1.817 (0.069)			
Lagrange Multiplier - Error	66.657 (0.000)			
Robust Lagrange Multiplier - Error	36.498 (0.000)			
Lagrange Multiplier - Lag	31.655 (0.000)			
Robust Lagrange Multiplier - Lag	1.496 (0.221)			

Notes: *Variable descriptions included on page 320.

Table 6.13. Second Table of Alternate OLS and Spatial Regression Specifications for Percent Deforestation Models

Percent Deforestation (negative coefficients indicate forest gain)	OLS 3 (n=180)		Spatial Error 3 (n=180)	
Independent Variables:*	Coef. (Std.Err.)	P > Z	Coef. (Std.Err.)	P > Z
Forest Year Control ¹	.0213166 (0.00289)	0.000	.0232875 (.001921)	0.000
Suitable Soils Binary ²	-.069483 (.039298)	0.079	.0446076 (.045460)	0.326
Title Problem Binary ³	.0819193 (0.49926)	0.103	.0222766 (.037710)	0.555
Labor Violations	-.105215 (.091952)	0.254	-.047507 (.066868)	0.477
Area of Property in Hectares	-.000006 (.000005)	0.206	-.000001 (.000003)	0.668
Latifundio Binary ⁴	.0629524 (0.50798)	0.217	.0092988 (.038842)	0.811
Cost-Weighted Distance to Towns ⁷	.0215677 (.004464)	0.000	.021655 (.011790)	0.066
Distance to River	.0259537 (.004464)	0.054	.0124777 (.011578)	0.281
Highway Binary ⁸	.000357 (.050488)	0.994	.0051981 (.044239)	0.906
Latifundiarista ¹⁰	.0643856 (.042449)	0.131	.0407532 (.033984)	0.230
Number of DALR Actions ¹¹	.0101321 (.003021)	0.001	.0057364 (.002199)	0.009
Number of Deaths ¹²	-.004903 (.006082)	0.421	-.002710 (.017045)	0.540
Constant	.0236737 (.071121)	0.740	.0022543 (.017045)	0.895
Lambda			.123219 (.01755)	0.000
R ² (Pseudo R ²)	0.4099		(0.348)	
Log Likelihood			44.142885	
Moran's I (p-value)	1.835 (0.067)			
Lagrange Multiplier - Error	66.433 (0.000)			
Robust Lagrange Multiplier - Error	53.686 (0.000)			
Lagrange Multiplier - Lag	14.669 (0.000)			
Robust Lagrange Multiplier - Lag	1.921 (0.166)			

Notes: *Variable descriptions included on page 320.

Table 6.14. Third Table of Alternate OLS and Spatial Regression Specifications for Percent Deforestation Models

Percent Deforestation (negative coefficients indicate forest gain)	OLS 4 (n=180)		Spatial Error 4 (n=180)	
Independent Variables:*	Coef. (Std.Err.)	P > Z	Coef. (Std.Err.)	P > Z
Forest Year Control ¹	.0208949 (.003044)	0.000	.0237002 (.002045)	0.000
Suitable Soils Binary ²	-.0048832 (.041006)	0.905	.0424999 (.047468)	0.371
Title Problem Binary ³	.0971469 (.053659)	0.072	.0407014 (.037968)	0.284
Labor Violations	-.0890139 (0.91603)	0.333	-.067403 (.063936)	0.292
Area of Property in Hectares	-.0000006 (.000005)	0.221	-.000001 (.000001)	0.631
Latifúndio Binary ⁴	.062024 (0.05350)	0.248	.013052 (.039322)	0.740
Distance to Conceição do Araguaia (Southeast of Brazil)	-.0179593 (.007992)	0.026	.0016741 (.003797)	0.659
Distance to River	.0537333 (.016671)	0.002	.0124953 (.012832)	0.330
Highway Binary ⁸	-.0411053 (.051923)	0.430	-.011826 (.043620)	0.786
Latifundiarista ¹⁰	.0951989 (0.43940)	0.032	.0365952 (.035491)	0.296
Number of DALR Actions ¹¹	.0091003 (.003141)	0.004	.0062654 (.002155)	0.004
Number of Deaths ¹²	-.0050667 (.006401)	0.430	-.002601 (.004477)	0.561
Constant	.335806 (.154006)	0.031	.0000001 (.017958)	0.999
Lambda			.126735 (.009851)	0.000
R ² (Pseudo R ²)	0.3443		(0.247)	
Log Likelihood			43.51852	
Moran's I (p-value)	2.018 (0.044)			
Lagrange Multiplier - Error	95.205 (0.000)			
Robust Lagrange Multiplier - Error	66.587 (0.000)			
Lagrange Multiplier - Lag	29.395 (0.000)			
Robust Lagrange Multiplier - Lag	0.776 (0.378)			

Notes: *Variable descriptions included on page 320.

Table 6.15. Fourth Table of Alternate OLS and Spatial Regression Specifications for Percent Deforestation Models.

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