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ETHNOBIOLOGIES OF RUIN AND RESURGENCE: LABOR, ECOLOGY AND LAND SYSTEM TRANSFORMATIONS OFF THE TRANSAMAZON HIGHWAY, BRAZIL

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ABSTRACT

ETHNOBIOLOGIES OF RUIN AND RESURGENCE: LABOR, ECOLOGY AND LAND SYSTEM TRANSFORMATIONS OFF THE TRANSAMAZON HIGHWAY, BRAZIL

Robert B. Davenport

Land frontiers in the Brazilian Amazon continue to be dominated by the expansion of cattle ranching and large-scale deforestation events. Theory on smallholder agriculture argues that the agroecological intensification of land use – which would counteract land extensive speculation – depends on population pressure and land scarcity. This region has a low population density, however, which would mean that agroecologically intensified systems of land use cannot be explained by local adaptation alone. Instead, social organizational factors spanning multiple political and ecological scales can induce land system changes. Further, phenomenological anthropology supports the hypothesis of human ecological survival and sustainability in cultural learning processes. As such, how can alternative land use and livelihoods emerge and effectively counteract pressures of speculative deforestation in the Brazilian Amazon? If so, how – based on what economic, cultural and ecological factors? What implications would emerge in terms of human labor's relation with global environmental change, for tropical forest conservation and restoration, and in continuity with Indigenous forest agriculture?

This research used participatory observation, remote sensing analysis, oral histories, botanical history, ethnobotanical and socio-economic surveys to assess socio-ecological relations and land system changes across a variety of land holdings along the Transamazon highway. The municipality of Medicilândia, Pará – a major producer of cacao seeds for commodity markets –was singled out for its unusual history of failed state sugarcane plantations, which were subsequently re-consolidated into smallholding cacao agroforestry. Remote sensing analysis was conducted to identify land use/cover historical trajectories on individual holdings and across landscapes as a whole.

The research found that a new class of 'true' smallholders are emerging in the region, who cultivate significant agrobiodiversity in more concentrated patterns of agroecological management. As a native Amazonian tree, cacao's history is both social and ecological, and endemic fungal ecologies both threaten production while encouraging this crop to be managed at small scales. Further, cacao production is not limited to high fertility 'terra roxa' soils (Nitossolo Vermelho), which the state originally deemed the only soil suitable for development. Medium fertility Argissolos (Ultisols in the USDA terminology) are also viable for production and extend over hundreds of thousands if not millions of hectares. The findings – historical, socio-economic and ecological – suggest that the role of smallholding cacao and other agroforestry systems in more equitable rural development, connected with tropical forest conservation and restoration, could be significant.

for Nathaniel,

in memoriam

1. Introduction

(In this dissertation I have in most cases altered names, except for individuals who were comfortable with and/or insisted on the use of their actual names.)

In the Mud and Weeds

Most colonists who migrated deep into the Brazilian Amazon in the 1970s had come from outside the region. These newly colonized areas were *terra firme* – literally 'firm earth' – meaning that the land is not seasonally inundated by overflowing rivers, nor is it accessible by water. As the Brazilian military regime had determined to settle the Amazon interior, the colonists would have to come over land. And so, in 1970 massive machines were brought in to crack through the rainforest. In 1971, disoriented colonist families were settled on or near the newly established Transamazon highway, but ironically without any form of motorized transportation. They would spend large portions of their lives on foot, walking endlessly on *picadas* (access and tenure defining trails) through the jungle, trails that later would become *travessões* (side roads). The climate was exceptionally wet at this time, however, and the roads and trails were usually deep in mud. Colonists sloshed through mud between their *barracas* (shelters) at their government assigned plots, and the highway and government technician camps, which were located up to 80 kilometers away. "A land without people for a people without land," declared the eponymous, then

military dictator president, Emílio Médici. Never mind that this adage had already been used elsewhere, for the 1948 Zionist invasion of Palestine, or that the indigenous *Arara* had been forced to move 12 kilometers south, to form a new territory extending another 40km to the shore of the Iriri river.

More than half of the colonists had arrived from southern coffee lands or the northeastern *sertão* (backlands) (Moran 1981). These areas were semi-temperate or arid climates and ecologies – thousands of miles away, where land was either scarce, due to its concentration in large mechanized operations, or barren, for lack of water. The ambitious state planning of that time, and the longstanding struggle by the smallholder and peasant colonists to sustain themselves, left residues in the landscape: a defined pattern of land tenure, a few ruined structures and a fractured community that did not trust cooperatives. Notwithstanding, the colonists had developed a socio environmental identity of "live, produce and preserve" (Schwartzman et al. 2010).

Figure 1.1 The Transamazon highway under construction circa 1970

Nearly fifty years later, I was interested in the aftermath of Brazil's short lived political "side show" of peasant resettlement. I employ the term "side show" as used in military theaters and I use the term here because the Transamazon peasant resettlement scheme was a sideline to the real intentions of the dictatorship and its favored clients in occupying the Amazon interior. It is also important to recall that from the 1980s onward the Brazilian Amazon frontier had a profound impact on the global community's imagination of tropical rainforests. Environmental movements to save the rainforest used images of deforestation, sometimes from the Transamazon, as a symbol of everything that was wrong with the frontier. Colonist settlement encroached on indigenous worlds, destroyed the environment, the soils were

supposedly fragile and not suitable for agriculture, it all led to poverty with colonist settlers picking up in a few years to start the whole destructive cycle all over again, further into the rainforest.

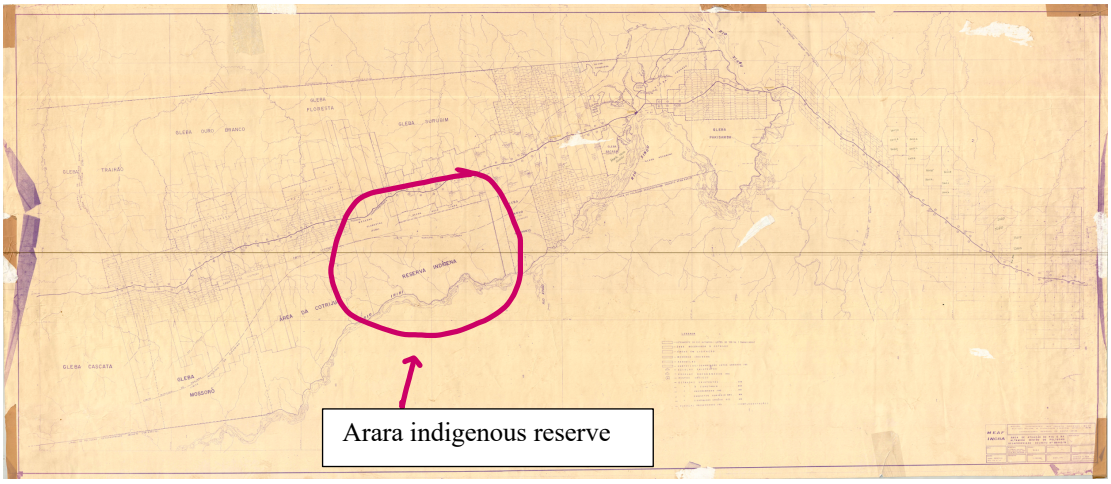

Figure 1.2 Government map of the Programa de Integração Nacional (PIC or National Integration Program) land organization map in 1974. What would become Medicilândia is just north of the Reserva Indigena (Arara Indigenous Reserve) at the center-left of the map. Credit to Anderson Serra, UFPA, Altamira for this digital scan of the original paper map.

While some of the latter tropes are true, others, as we will see, are not. For example, the public and some scientists often took deforestation as a matter of *poverty* of people and of soils, when in fact it was the state that had obligated deforestation on the Transamazon as a symbolic display of 'productivity.' There was an abrupt end to the Brazilian military regime's emphasis on Amazon land distribution for the poor after 1974, and thereafter, the frontier would be increasingly dominated by conflicting frontier politics and geographies, and increasingly by large-scale and often more capitalized cattle ranching, land accumulation and increasing inequality (Hecht and Cockburn 2010, Schmink and Wood 1992, Browder and

Godfrey 1997). Notwithstanding, the 'poor' had already been fixed in the public and scientific consciousness as firmly linked to the social and ecological disaster of the frontier. Even today, the 'poor' are still associated with Malthusian (population based) destruction of the forest and encroachment on indigenous worlds (Hecht et al. 2014).

I carried out much of my fieldwork for this dissertation in Medicilândia – a municipality 90km west of Altamira – which has a markedly different pattern of land use than other areas on the Transamazon[1]. The Transamazon, and more in this part of the Transamazon than than anywhere else, had simultaneously been subject to a lesser-known state initiative to stimulate cacao (*Theobroma cacao*) agriculture. Decades later, notwithstanding such ongoing prejudice about a frontier driven by 'poverty' it seemed that at least in this part of the highway, in Medicilândia, diverse, migrant smallholders and peasants had managed to form an alternative landscape in the midst of a post-frontier mess. This was the area that had received the most intensive government attention in terms of setting up what was a rather utopian but short-lived development plan, involving directed settlement, salaries paid to the landless, low interest loans, state organized markets, state health clinics, and even a hugely ambitious project to turn the Amazonian landscape into a modernized network of sugarcane plantations comprised of hundreds if not thousands of 100 hectare lots.

[1] I also conducted fieldwork in Apuí in Amazonas state, located about 1000km west of Medicilândia. Apuí, unlike Medicilândia, is overwhelmingly dominated by pasture formation, extensive management using fire, and Nelore breed cattle – the more typical colonized landscape. In Apuí, tree cropping was isolated in the larger landscape in the form of very small plots of coffee and cacao, and some vine farming in the form of guaraná.

But It was also an area that received intensive state attention in the early years for cacao farming – a native Amazonian tree that, notwithstanding, had not previously existed in this particular upland forest area.

Fifty years later, however, sugarcane has vanished. Near the highway, the landscape has sustained a combination of original forest cover, secondary forests, and agroforests – and is the only municipality on the Transamazon – or in the recently colonized Brazilian Amazon for that matter – for which the principal economic activity is not cattle ranching, logging or soy farming (IBGE). Medicilândia's landscape near the highway is now largely organized around the cultivation of cacao, açai palms, mahogany, and many other valued tree species, and the municipality produces more cacao seeds as a raw commodity than any other in Brazil. The colonists have peacefully bordered the neighboring Arara indigenous territory since the 1990s, and the Arara territory comes up to meet the highway itself between km 120 and 140. Yet, Medicilândia was originally a village named after the state's industrial project for sugarcane (*vila PACAL*). Multiple efforts were made to further occupy Arara indigenous land to the south, which failed. Indeed, the Amazon environment has historically tended to swallow up or cause ruin to agri-industrial projects --- from Fordlândia to the Jari cellulose project — imported models of development have a history of going to ruin in this environment.[2]

[2] For example, see Greg Grandin (2009) for an excellent treatment of the history of the Fordlandia project.

In the pages that follow, I first provide a description of Medicilândia's landscapes, with a focus on cacao farms and agroforestry systems, and a discussion of the emergence of cacao in the ruins of state policy that was previously oriented around sugarcane production. This is followed by a brief description of the cacao tree itself. I then move to narrate the dissertation's engagement with key models and methods for thinking through issues of ruin, resurgence and **diversity** (both social and ecological) in tropical agriculture. Finally, I outline the dissertation chapters to follow.

Someone had told me that Medicilândia – a municipality centered 90km west of Altamira in the state of Pará in Brazil – was perhaps the most *agricultura familiar* (small family farm) place in the Amazon. I was curious as to why. In Medicilândia, instead of pickup trucks, motorcycles and scooters dominate – driven by young women and men in flip flops, the young men riding as fast as possible in the middle of town and pulling endless wheelies. One sees young women gossiping and laughing, and families piling out of the multiple churches on Sunday evening. Churches, along with 24-hour funeral parlors, seem to dominate the steep streets. The streets smell of rice and beans, tough chunks of beef and gristle, boiled manioc, diced tomatoes and cabbage. Dogs begging, vultures hopping, plastic bags flapping, and the whine of *sertanejo universitário* – an unfortunate genre of commercial country music.

I first arrived in Medicilândia in 2014 after a 12-hour bus journey from Santarém and spent the night in a rickety hotel room with a dust encrusted air conditioner. Later I would meet the mason who built it, telling me he had just

'eyeballed' the lines of the building as it went up. It's a town wrenched off of the ground largely by hand, with wood and buckets of cement. The red mud everywhere, and gutters sloshing. The Sisyphean effort at mopping the tiles and uneven jagged sidewalks in the front of small stores. Constant mopping in the early morning in the quickly rising temperatures. Entire families stacked on motorcycles, cluttered storefronts stacked with sacks of clothes or sewing or school supplies or cell phone cases, imported rice or cases of beer or pipe fittings or hardware or wheelbarrows. Tiles stained with the famous red earth, or *terra roxa*.

Literally, terra roxa this means 'purple earth' in Portuguese, but the phrase is a folk adaption of the pronunciation of *rosso* (red) by Italian immigrants who had worked on these red soils on coffee estates in São Paulo and elsewhere. But terra roxa was also imagined by the Brazilian state to be a prerequisite for intensive agriculture. It is a remarkable soil that occurs around the city Altamira and along the Transamazon highway to the west – high in nutrient retention capacity because the clays are not as weathered or as old as are most soils in Brazil, where the majority of lands are ancient geologies. Terra roxa was good for most crops, but its exceptionally dense clay structure would end up causing unexpected difficulties for some crops, like black pepper.

I walked between boisterous cell phone toting people of all ages – this was a highly diverse community; the majority were of African descent. Completely by chance, in 2014 I had arrived on the eve of the start of the county's state sponsored cacao festival. There were going to be field workshops with extension agents, vendors

and kiosks, live music entertainment along the highway that ran through the center of town. I had little idea just how precarious was this apparently well-organized event. This time, in 2014, the state's remaining authorities on cacao – actual researchers from CEPLAC – Brazil's Executive Commission for Cacao Agriculture Planning – were going to be present. Two years later, however, the event would be renamed "CacauTech" as a cheap marketing show with minimal extension or research presence. Rather than extension agents, at CacauTech I met an English speaking 'chocolatier' from São Paulo.

But that very first morning in 2014, I walked over to the county government building, a modern oval structure next to the Catholic Church and the rural workers' union hall (sindicato dos trabalhadores e trabalhadoras rurais), to find Elisangela, the municipal secretary of the Environment, who had gotten the whole thing together. Elisangela was a cacao farmer herself, and cared. As it would turn out, she would soon be fired from the municipality for her communications with the federal Ministry of the Environment about invasions of public land and deforestation in the northern extreme of the municipality. I had called her from Santarém- she had said, go with the field workshop! So, there it was: happily, I boarded a yellow school bus and was trundling along with farmers and youth 15 kilometers east to kilometer 75.

I thought of the landscape being shaped through time. For example, the remains of wooden stakes that had held fields of black pepper vines twenty years ago were common sights. I imagined how the sugar cane, which the state had forced the colonists to grow from 1974-2000, had covered the landscape. I imagined the

burning, smoke and brute labor and hauling needed to get all of that tonnage out and up to the government refinery, illogically poised on top of a hill without easy access to water, here at 3 degrees south, the sun burning into you, the pre-cutting fires to burn the cane before cutting it, the smoke and fleeing snakes. I thought of the bureaucrats up at the Bank of Brazil building, which at that time was a commanding modern building with pioneer views, but today is a ruin covered with vines and graffiti. And the nine extension agents of that time, in bell bottoms and with poufy hair, with their fleet of government Volkswagen beetles – good for the mud but notwithstanding constantly getting stuck.

Today, the Transamazon is paved from this point to the east, although with gaps in low areas. Also, the ground has moved significantly and rather mysteriously in many places, forming craters and causing the traffic to skirt the road. Sometimes the highway could cave in on itself forming a larger crater. I was happy enough to have boarded the bus, and shyly kept to myself, looking out the rattling windows. The landscape on this part of the highway, and also stretching to the west of town along the sticky red mud road, was one of the most diverse in terms of cultivation patterns that I had ever witnessed in Amazônia. Cacao orchards and agroforestry, bottomlands rife with naturally occurring stands of açai, tiny pastures on that bumpy soil, and, in general, the landscape undulating to the hilly horizon with variegated orchards and woodlands. This was a different sight, a different feeling, compared to the grim and stoical caldron of baked pastureland dominating the roads in Mato Grosso and elsewhere on the Transamazon.

After about 15 minutes we turned south onto a *travessão*, or dirt feeder road, and rattled 5 kilometers south, past woodlots, pastures and then re-entering trees. The bus pulled into a side dirt lane skirting cacao. At that time, I had not known that this place was actually the *agrovila*, or state planned agrarian village, dating from the 1970s. After asking directions from a couple walking on the road, we continued about a half kilometer further south and then ducked into the trees to the east, skirting tiny homesteads, brushing the tree branches and weaving through dirt lanes such that I was completely disoriented. The bus eventually pulled up in the orchards next to a small clearing, which had become a parking lot for motorcycles. The clearing contained a large wooden shack on blocks, a muddy pond and some wood frame platforms. We entered the trees where plastic chairs had been arranged in a semicircle – the participants were old and young, male and female, afro-Brazilian and euro-Brazilian – baseball caps and open collared shirts for men, jeans and blouses for women.

We spent that morning seated in the shade, discussing cacao and then walked into the orchards and in and out of small clearings, and older forest fragments. The extension agent sent out from Belém was Japanese-Brazilian. She made sure to demonstrate how easy it was to spread fertilizer in the orchard. No, it wasn't necessary to uncover the soil, just sprinkle the fertilizer around on top of the leaf cover, like this! We walked through the orchards and talked about pests and diseases, including *vassoura de bruxa*, the notorious "witches' broom" fungus that had wiped out cacao agriculture in Bahia starting in 1989. Witches' broom was native to the

Amazon, and the clear demarcation between rainy and dry seasons meant that here it could be more easily managed. Simple manual methods were fine. But one had to clean off the areas colonized by the fungus during the pruning season, in October and November before the start of the rainy season.

We also talked about trees that accompanied the cacao in the orchard. For example, embaúba trees (*Cecropia*), a very fast-growing pioneer species that comes up in gaps. This species was present everywhere inside cacao farms, these trees harbored ants inside their hollow trunks, and their leaves were rich in phosphorus. The farmers here today were well aware of this tree's association with ants but did not know about the phosphorus.

Figure 1.3 An about to retire extension scientist on her last trip to the TransAmazon. Photograph by author.

The area under the trees was a different world – an understory gallery, about 6-8 feet tall, extending out in all directions. From under this short canopy, one could see just the trunks of other tree species – Brazil nut, *andiroba*, avocado… açai, *cumaru.* These nut, oil and fruit tree species were interspersed amongst the shorter cacao trees, growing over them. The cacao trees were organized along a 3 x 3-meter grid.

To acquaint the reader with the character of these systems, I here provide, first, an illustration of types of cacao agriculture. And second I have included a few visual examples from Medicilândia's farmed landscape. In the first figure below, cacao agriculture has been classified into three broad types, "technified cacao," "planted shade," and "rustic." Most of what I would observe in Medicilândia would fall into the "planted shade" category… A rough tally of the systems in which I had walked and worked indicated that around two thirds were species diverse, "planted shade" systems with the remaining third managed as monocrop orchards, or "technified cacao." "Planted shade" could mean deliberately seeded or planted saplings, or managed spontaneous regeneration, or a combination of the two. On smaller family farms under 10 hectares in size, tree diversity per area was greater, usually with a variety of timber species, but sometimes managed for fruits and oils. On larger sharecropped farms over 10 hectares in size I saw more of "technified cacao" – but not always. Some of the original colonist lots that were still managed at the 100 ha scale had deliberately adapted into the planted shade system. Even

technified cacao was, notwithstanding, usually not a true monoculture – they were often weedy with other spontaneously growing tree species.

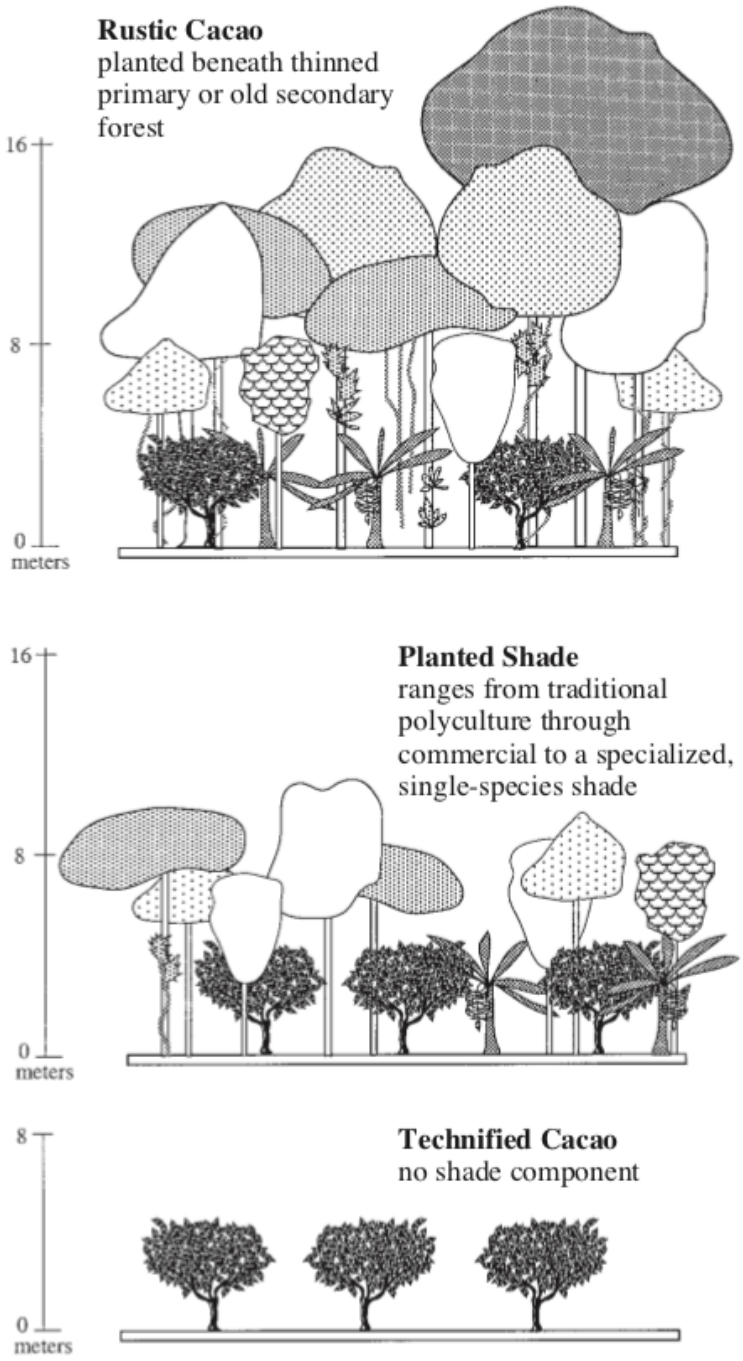

Figure 1.4 Schematic of different types of cacao systems, adapted from Rice and Greenberg (2000).

Figure 1.5 “Technified cacao” on a former sugarcane farm.
The spacing of the cacao trees is, notwithstanding, similar to the shade and açai systems in the figures below (roughly 3 x 3 meters). Photograph by author.

Figure 1.6 Commercial cacao–açai palm "system" on a former sugarcane farm.
Photograph by author.

Figure 1.7 Side view of commercial aacao-açai system
with pioneer Cecropia tree on a former sugarcane farm. Photograph by author.

Figure 1.8 Commercial cacao shade "system"
with Mahogany, Ipê and other favored tree species in the overstory, with cacao trees below, on a former sugarcane farm. Photograph by author.

Figure 1.9 Planted shade cacao system on a very small farm.
Tatajuba, paricá and other species in the overstory; cacao and banana trees in the understory. Photograph by author.

On km 115 south, on the road west of town, on km 95 north, side roads on which I heavily surveyed, *all* systems had shade trees, averaging about six species per system. The most commonly identified species were Mahogany, Tatajuba, Cedro, Ipê Amarelo, Ipê Roxo, Castanha (Brazil nut), and Embauba (Cecropia). The first five species are valued timber trees, the sixth a nut producing tree whose harvest for timber is prohibited, and the seventh was Cecropia. As for the size of these systems, the documented average for the Transamazon west of Altamira was about upwards of 25 hectares of cacao per land holding (Calvi et al. 2010). These were very large cacao farms! In West Africa, for example, cacao farms of 3 hectares are considered very large. Yet, these farms on the Transamazon were not plantations. Labor was mixed between family owner, day labor and sharecropping, with participants moving

between these roles across the landscape. In those areas in which the crop was farmed as “technified cacao” – the landscape was quite heterogeneous, in part because the size of an area that could be feasibly managed by one family alone rarely exceeded 5 hectares. The crop resulted in a patchy landscape, even if planted using the “technified” method – see the first figure below. But more species diverse shade systems – which were the majority –blended in with surrounding advanced secondary and primary forests in the landscape – see the second figure below.

Figure 1.10 “technified cacao” dominated landscape km 95 south

Landscape was formerly in sugarcane. Shade and fruit trees are still part of the picture. Photograph by author.

Figure 1.11 Cacao farm landscape km 80 north
with technified cacao and planted shade systems bordering advanced secondary forest patch. This landscape corresponds to light green mixed with dark green in the land cover map below. Photograph by author.

Cacao Agroforestry, Sugarcane and the State

Given this variety within these systems and across the landscape, I was thinking "agroforestry" in a broad sense. The category "agroforestry" is rather wide-ranging. In the literature, agroforestry can mean anything from swiddens to two associated woody perennial species (Nair 1993). Obviously, there is a large area in between these two poles. In terms of defining these systems, one could start by saying that, unlike indigenous areas in the Amazon, here there was no swidden–forest continuum. This landscape could easily support such migratory agriculture, but land

use and property accumulation practices prevent such an approach. Still, this place was nonetheless "weedy," both ecologically and socially. I had heard disparaging academic quips about cacao agrobiodiversity, like "well, that's just 30% cacao and the rest whatever". Yet, for me, what was fascinating was the organization of the landscape that allowed for a certain resilience – politically, socially and ecologically. While the state had specified a monocrop and modern management – a modern and disciplined approach – the reality was somewhat different. The state agency that had promoted the monocrop system – CEPLAC – had been in decay for decades.

I argue that Cacao farming organized in smaller areas of land would not be driven by population pressure on the land (cf. Boserup 1993, Netting 1993), but by complex interrelations of ecological conditions, social structure and development imagination. These conditions lent themselves to the landscape's figurative and literal weediness – a weediness of adaptation on the land in political, socio-economic and ecological terms. The *politics* of this landscape situation, we will see, was shaped initially by state bureaucracy. Yet, its evolution involved socio-economic and institutional adaptations to survive *in spite of* the state, and, sometimes, to confront the state on its own ostensible terms, rather than to rely on bureaucratic ignorance and official collusion. For example, colonists would demand that the dysfunction of the sugarcane mill be addressed, and they would demand that the state maintain the highway. In this region, ignorance and collusion were oriented toward large-scale speculation on land; at smaller scales, however, socio-economic and political adaptation was geared against the grain of power. In Medicilândia, in fact, land use

had been adapted on top of the ruins of state infrastructure for industrial scale sugarcane.

As the site of the Brazilian government's ambitious plan to settle the Amazon in the 1970s, the landscape of Medicilândia tells this unexpected story. After the road was developed in the 1970s, the federal government chose to make the area a shining example of modernized sugarcane agriculture. One can see the multimillion-dollar government sugarcane refinery south of the highway. It looms up silently in the tropical haze as an oxidizing basilica, now state-owned scrap. A stone's throw away, in the ruined plaza of a village built for bureaucrats, stands the abandoned Bank of Brazil, draped with vines and graffiti. The refinery and the bank: respectively, they were the pride of the state and the most modern and active administrative building in the region. But the sugarcane complex suddenly collapsed in 2000, and like Henry Ford's failed Amazonian rubber colony in the 1930s, its machinations slowly decompose in the rainforest environment.

Figure 1.12 The ruined Abraham Lincoln Sugarcane Agroindustry Project (PACAL) mill-refinery, at distance of 3 kilometers from side road kilometer 95 south. Photograph by author.

Today, the sugarcane plantations have vanished, and the rusting refinery overlooks a newly forested landscape consisting of cacao farms and agroforests, remnant twenty to fifty-meter-tall trees, forest regrowth and primary forest fragments. Cacao has become the principal livelihood in a pattern of tree-cropping and agroforestry that has emerged on a landscape that parallels **terra roxa soil** along the highway – about 500 square kilometers in total – both where sugarcane was once farmed, and in other areas with the same soil type. All cacao land use is represented by the color purple in the map below. However, cacao farms are of different types: some formed on the original government distributed lots of roughly 100 hectares, and also on smaller holdings or *chácaras*, holdings that tend to be 25 hectares or less.

Chácaras are represented by the black dots – which are concentrated in the terra roxa soil area, but also in pockets on some of the *travessões* (side roads). Moving roughly five kilometers off of the main road, however, on many (but not all, see km 85 north, 95 north) of the travessões, the landscape shifts to larger landholdings and pasture – the yellow areas in the map. The latter type of land use is typical for the Transamazon, where industrial soy and corn has not yet arrived. In these pastures, towering, dead, Brazil nut trees stand as skeletal sentinels of the history of fire.

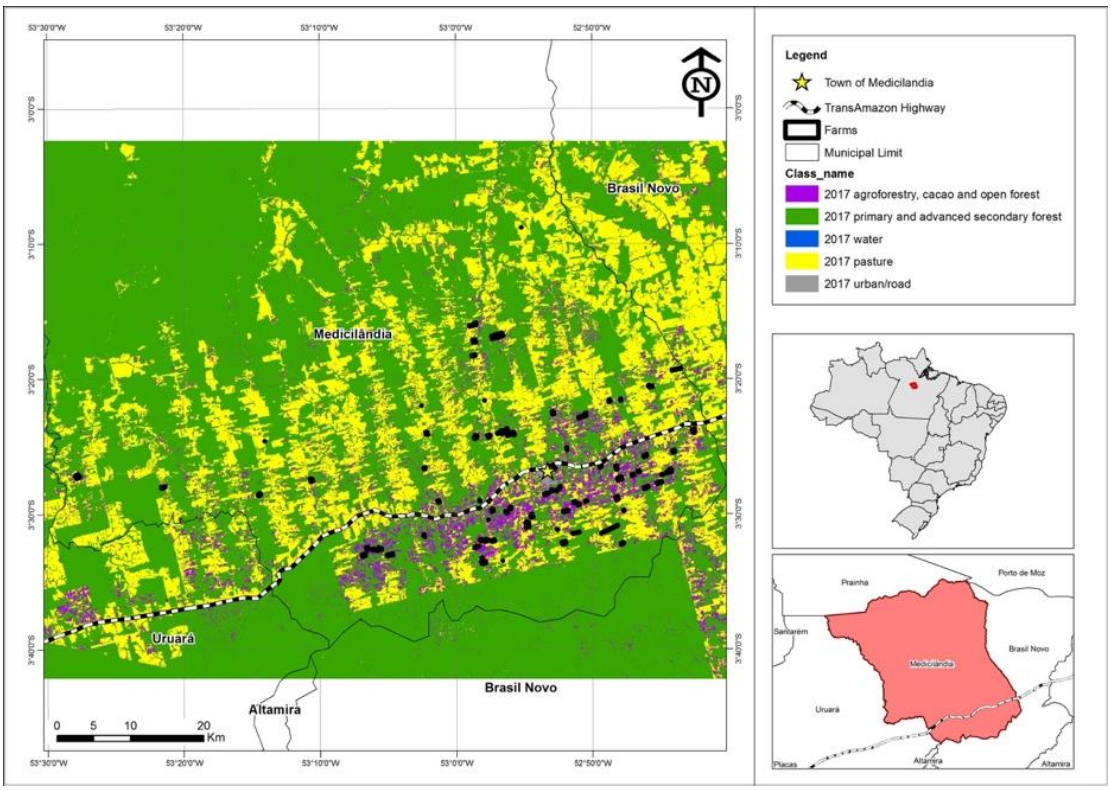

Figure 1.13 Land cover classification for the Medicilândia landscape, based on Landsat 8 satellite images from 2018. Cacao agriculture is represented by the purple color. The black dots represent a survey sample of small land holdings. Remote sensing classification of land use by author. Map by Felipe Martenexen.

Thus, state policy and presence on the Transamazon set a stage for a land systemic reaction to ruined sugarcane development. Looking at the case historically and ethnographically, it would eventually become clear that this had been driven by **debt** – a struggle to adapt to institutional conditions, rather than environmental conditions. In this unusual case, land holders in the former sugarcane zone replanted with cacao, with sharecropping labor managing to sustain the holding, and often with the cacao slowly degrading in terms of production, but not ecologically. These relations explain the higher concentration of chácaras on terra roxa. In contrast, in other soil areas – terra mista - smallholders did not expand across the landscape, as much as they created niches to try to maintain tree- based livelihoods in the shadow of the dominant regional system – i.e. grass and cattle. In contrast, this livestock system requires very little labor once it is formed; it relies on seeding *braquiária* grass and Nelore breed herds, rather than manually tending to crops.

CEPLAC's lingering ability to distribute productive hybrid seeds was fundamental in this transition. Yet CEPLAC's social and extension policy was a strange holdover from the twentieth century – somewhat out of sync with frontier expansion and political power. And yet, an alternative type of relationship to land developed in relation to this limited and nearly forgotten policy, which also included social protest, and agroecological experience and adaptation. And ecologically speaking, while CEPLAC had organized a production system based on monoculture (Perfecto 2009), the internal species diversity and the landscape patchiness of cacao farming was radically distinct from the vast ecological deserts of pasture and soy

plantations that I had witnessed in Mato Grosso. Thus, while cacao "bureaucracy" in Brazil had lent itself to modern technical management, rather than true forest farming, actual humans in the landscape seemed to learn, in fact they desperately wanted to learn about ecological relations of plants and soils on their farms.

In livelihood or socio-economic terms, cacao did involve hard work, and a miserably volatile commodity market. And many plots I saw were multispecies thickets – mostly abandoned. But other plots were deliberately filled with valued timber and fruits and oils. Work, I had seen, could be an enjoyable thing in this landscape. Cacao work was often full of lively conversation and humor and took place in the *shade*. If agricultural work were to be called 'drudgery' (e.g. Scott 1976; Chayanov 1986), in this landscape I observed that drudgery was not about physical activity but rather about *lacking knowledge*. Drudgery was that blind going forward with no idea about the organisms and ecology into which these colonists had migrated. What made people despair and desist was wasted work, slaving under the sun, wasted soils, the vagaries of capitalist markets, the sudden devastation of a crop due to a disease. Yet, thus far, in this area in which cacao was native, diseases like witches' broom had not made the crop unviable.

I should additionally qualify my interest in this landscape by saying that I had not come to Medicilândia to follow the story of chocolate. What fascinated me was rather the mystery of an alternative socio-ecological system, here in the middle of frontier chaos and a post-frontier mess. This cacao landscape was a crude mix of smallholding in confrontation with land speculative attitudes. It involved farmer

experience and observation, and combined indigenous knowledge, with distinct Christian cosmologies. Focusing on consuming chocolate tastes and distinction for the sake of chocolate houses or gentrified galleries could be interesting. But I rather liked the cacao tree here, right where it stood. What I loved about cacao was its fruit pulp, even more than chocolate. The pulp's wondrous flavor was what had attracted tropical humans, monkeys, squirrels and rats for many thousands of years. I also loved the shape of the tree, the way it nestled itself under other species, the way that cacao was not one but perhaps a mix of species (no one knew), and with close cousins in the Amazonian forests – cacaui (*Theobroma speciosum*) and cupuaçu (*Theobroma grandiflorum*).

Figure 1.14 Two trees from the Theobroma genera.
At left, cacao (Theobroma cacao) next to a Cacaui tree (Theobroma speciosum) at right, which is sometimes referred to as 'native cacao' by colonists. The latter's fruits are gathered by the Arawete and Asuruni indigenous tribes, south of Altamira.

The Cacao Tree

The cacao tree (*Theobroma cacao*) evolved in the forest understory in the western Amazon basin. Its natural history is somewhat shrouded, however, as a semi-domesticated species, or group of species (Young 1994). For example, there is only speculation to explain how cacao moved from the western Amazon to Mesoamerica, where it enters an archaeological record as a Pre-Columbian commodity. The Incas did not trade cacao seeds, however, and there is no evidence of human use of seeds east and west of the Pacific coast of Colombia.

In mature forests in the neotropical Amazon, Theobroma cacao can grow upwards of twenty meters. Cacao trees have a tendency to shoot vertical stems, straight up, from the trunk and branches. The tree's leaves are long and oval and come to a point, about a foot long. On the growing stems of seedlings, and on vertical shoots of adults, the leaves spiral around the stem. These stems carry most water and energy as they are the wood forming part of the tree. On horizontal or inclined stems, the leaves alternate on each side. Tiny flowers emerge all over the trunk and on lateral branches, not at the tips as one might associate with temperate fruit trees.

The tree can only grow at tropical temperatures. It needs to be shielded from the wind and cannot withstand drought. It needs a warmer climate than either tea or coffee – averaging around 80 degrees' Fahrenheit throughout the year. Rainfall can be as low as 45 inches, as in the Ivory Coast, or as high as 150 inches, as in Java, if the rain is evenly distributed. While cacao was cultivated in Venezuela up to 2000 feet above sea level, it is not usually farmed above 1000 feet above sea level (ibid.).

In some cases, cacao is still cultivated within forests, such as in Cameroon, or in Bahia.

When ripe, the fruit pods vary from deep purple to orange to red. The pods sit on small stems, it's a simple task to cut one down with a *podão* (pruning pole) – a small metal blade combined with a hook, shaped like a small halberd, fitted on the end of a ten-foot pole. One uses a *facão* (machete, or cutlass) to cut into the pod diagonally, and pop the pod open. Inside is a pulpy white mass of large well-articulated seeds. One can pop the semi glistening pulp surrounding the seeds into one's mouth. The pod husks are sharp, so you want to do this avoiding contact with your cheek. At this point, the seeds are extremely bitter if you decide to bite into them. But the fruit pulp is more delicious than fine chocolate. The pulp tastes vaguely like pistachio ice cream – but lighter on the palate, tangy, naturally sweet. It makes a delicious juice; the pulp is gathered in artisanal fashion across cacao growing areas in Brazil. The pulp is why many species of monkeys, such as howler monkeys, adore the fruit. And they disperse the seeds.

I also liked the way that humans worked with the tree, using manual methods and small tools. I had grown up being humiliated by machine work on a modern American farm in northern Virginia. I had eventually learned to fend for myself, to repair the internal combustion engine – even to love mechanics and running farm equipment, inhaling diesel smoke. But here in Medicilândia I thought about a different type of value, or life, or livelihood, associated with manual work. Working with cacao meant a series of manual tasks, but none of them so onerous to call the

work brutal or violent *per se*. All ages and bodies participated. Sure, it was hard work – from pruning to collecting pods to manual gathering of the fruit pulp, to fermenting and drying the seeds. The work was repetitive. In certain cases, the work could be brutally exploitative, as has been documented in cases of West African child slavery. But what I saw in Medicilândia was that, rather than around land accumulation and labor exploitation, the exploiter in this landscape was external and financial, i.e. the regional middleman merchant, who had refused to be interviewed.

Figure 1.15 Cacao work off of the km 80 south travessão in Medicilândia

Figure 1.16 Cacao work off of the km 80 south travessão in Medicilândia

Agriculture in the humid neotropics varies tremendously, from plants or trees in mature forest assemblages (Brazil nuts), to semi-domesticated landscapes (Açai), to highly disciplined agriculture in rigid artificial environments (Soy). Thus, I believed that 'agriculture' wasn't a simple trajectory or formula for state power or capitalist frontiers. For example, my dear father, had asked me about Brazil nuts. "Can't they grow those trees in more efficient plantations?" Nooo! I had retorted like an inarticulate and frustrated ape. I had previously conducted research on programs that had transcended historical debt peonage in gathering Brazil nuts in native forests. The latter was one of the last extractive economies still in place in the region and was sustainable for organizing cooperatives that valued both indigenous and colonist contributions. I asked myself – why this mental disease, this dogged insistence on capitalist efficiency and 'economies of scale?' If not capitalist engineering, was all

manual human interaction with the environment "folklore" doomed into association with a cultural past – interesting and entertaining niceties, but without institutional relevance? What was the role of anthropology in describing political, socio-economic and ecological alternatives, and their relevance to ourselves, embedded in Western societies?

After all, this was the Amazon. I looked into the middle ground of human natural relations – not necessarily the ontology of nature in an indigenous cosmology, but the mess of uncelebrated social experiences and environmental history. Both social – rural peoples, peasants – and ecological – semi-domesticates, agroforestry. What would it be about a plant, or tree, that might draw humans back into forest gathering – a domesticated but more attentive relationship with place, with soil, with forest, and to the roaming rhythms of landscape? As such, agriculture would not be narrated as a question of state power infrastructures, writ large (cf. Scott 2016), but by messy socio-ecological histories and cultural learning, writ small (Tsing 2015). Cacao was a crop prone to host many other species – from lichen to ants to wasps to fungi to other trees, vines, herbs and epiphytes. And a cacao "plantation" was not a monoculture or an easily disciplined or monitored land use machine, like for oil palm. For example, cacao "plantations" in coastal Brazilian Bahia were actually forests – the famed *cabruca* system of extensive cultivation under the *coronéis* (land barons), a world depicted in novels by Jorge Amado[3].

[3] Here see Schroth and Ruf's work (Schroth et al. 2004) on cacao forests

An Ethnobiology of Ruin and Resurgence

One of the more striking places I had seen in the field was of a roughly 20-year-old regrowth forest. About 8km off the Transamazon on the km 105 north *travessão* or side road. I had gone there on a day in early December 2016 with Mello[4]. Mello was one of the few remaining older colonists. Wearing round spectacles, he had a nerve problem in his neck such that to turn to look at me he needed to pirouette his entire body.

Figure 1.17 Secondary regrowth on an abandoned sugarcane lot

Mello was of that ilk of Amazon migrant that thought expansively about extracting natural resources like gold and other minerals – not just in Brazil, but in French Guyana and elsewhere across the continent. He was understandably cynical in

[4] In this dissertation I have in most cases altered names, except for individuals who were comfortable with and/or insisted on the use of their actual names.

his view of the Brazilian government and institutions – after all, this lot had been his chance to get into an industrial arrangement with the state to get rich, growing sugarcane. And he had tried to opt into this system, even though his lot was of mixed fertility – i.e. not terra roxa. But he had been forced, like the others, into debt, and had to leave, with his children, to live in Manaus. He had returned, alone, nearly twenty years later, to look after his property.

It would be hard to imagine that this land had been in sugarcane. The new forest now took up the entire area. In the picture above, you can perceive the property line dividing the now advanced regrowth forest in the middle ground, from the "dirty" pasture in the foreground, which has a different owner. On the front edge of the regrowth forest are two fragile looking Brazil nut trees, remnant from the primary forest that once stood here, each about 40 meters tall. On the right tree we can perceive that the tree has been burned, with the right side charred and broken trunk/branch. Brazil nut trees are not adapted to fire and these trees are holding on for life. But they now have the help of the regrowth, which has come up remarkably quickly. For example, the regrowth helps the Brazil nut trees by allowing pollinators – large black orchid bees – to get up to the crown when the tree flowers in December.

In the satellite images below, the first from 1992 and the second from 2014, Mello's lot is circled in red. Most colonists in this region would call this lot *juquira alta* – high or advanced scrub. The word juquira has a negative connotation in Portuguese: that of land in weeds, out of order, no longer productive. It was no surprise that in the context of migrant colonization, historically spurred on by

INCRA, then later through private interest, that regrowth forest would be viewed negatively. After all, this entire region, the upland forests between the Xingu and the Tapajós river, had been in dense primary forest prior to 1970. Primary forest was still there in ragged fragments between the side roads. INCRA had obligated colonists to clear at least half of their lots – about 50 hectares each – to indicate productivity.

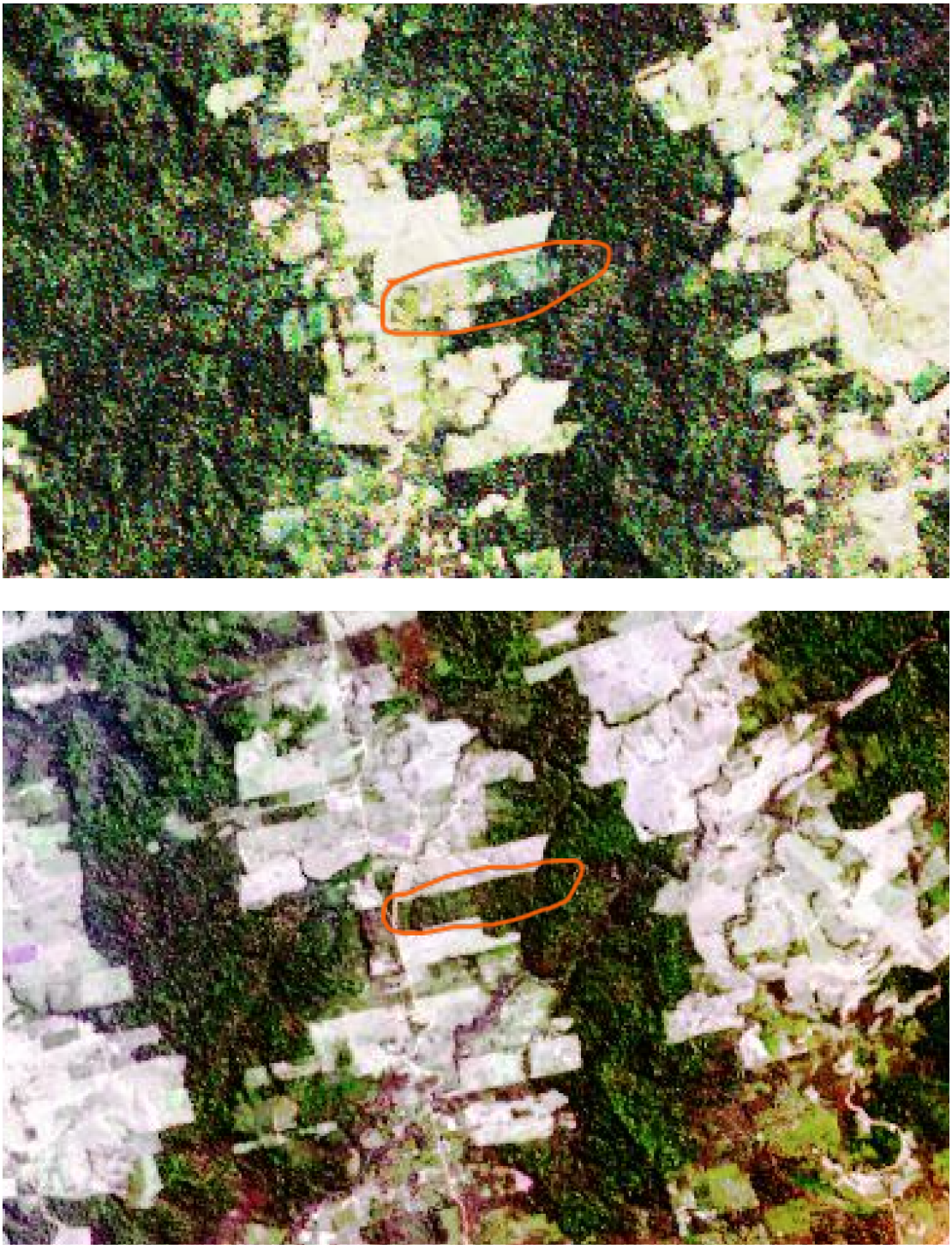

Figure 1.18 Landsat image of Mello's lot (circled in red) in 1992 above and in 2014 below.

When talking to farmers, I sometimes interjected with a question and its response – what does Pará grow best? Juquira! –secondary forest was everywhere after deforestation. Juquira in effect was what these colonization areas – at the scale of individual farms – had been "producing" for decades, in a stellar fashion and much better than any cultivated crop. Secondary forest had become such a phenomenon on the transamazon that it inspired several papers in the sociological and geographical literature (Perz and Skole 2003, Walker and Perz 2002). Mello was proud of his lot, notwithstanding that he hadn't cultivated anything there for at least 16 years. You see, it was land – and no he wasn't interested in selling it. Land was like a potential mine – a geological asset. The state might decide to pay indemnification for minerals. I asked Mello – do you have this land registered in the CAR, or environmental land use registry? – Negative. There was no need, because he wasn't producing anything! The CAR land use registry was the principal policy instrument being used in environmental governance to supposedly control deforestation. The CAR was a national land management database for individual land holdings, that specified areas that were deforested, along with areas that by regulation required restoration, and including permanently protected zones along waterways.

I offered, if one were to consider the balance of greenhouse gases in the planetary atmosphere, the carbon pulled down by this regeneration could be a windfall. Yet, for carbon economists and conservation scientists, carbon was a negative quantity – deforestation – conjured into a positive in a financial model (e.g. Nepstad et al. 2013). For two decades, this had been one of the dominant

conservation approaches in the Brazilian Amazon – to try to build incentives to prevent clearing forest, to spare land for nature, and to bank carbon in trees and roots. Yet, here, on the Transamazon – much deforestation had already occurred. How were the powers that be, from some far-off government or NGO office space, going to conceptualize payments to land holders without standing forest? In any case, payments for nature seemed more like myth here on the Transamazon. Few had yet heard of any such thing in practice, as much as carbon models would go on being touted in podcasts, radio and blogs in the United States.

However, another word in the Brazilian vocabulary, *capoeira* or *capoeirão* in this particular case of high secondary forest – was sometimes used to refer to regrowth. While of course also referring to the martial art – in Portuguese capoeira means fallow forest and connotes regeneration. Capoeira, unlike Juquira, is thought of as connected or joined to human use of forests. Capoeira was not what Mello had in mind, as he was thinking of a more immediate commodity or compensation. But as we stood there next to the towering young trees, it was fascinating to see the scale of regrowth. For Mello's sake, I didn't mean to change the subject. All that had happened here was that the industrial model of land use had collapsed, with the forest growing back with a vengeance. But the difference between the meaning of juquira and capoeira is a contrast of models and of socio natural relations. And I bring it up here because this dissertation seeks to uncover how labor, ecological and scale conditions can transform socio natural relations and even value itself.

Framing the Project in Terms of Tropical Agriculture and Diversity

I had been wandering around the rather bleak and dusty colonized Brazilian Amazon during research for a master's degree in tropical forest conservation and management. After getting frustrated with the almost absurdly technical modeling of carbon and reduced deforestation policy, I started to become interested in reforestation in this region of ruin. Few were paying any mind to reforestation in a proactive, socially connected way. Rather, it was generally assumed that deforestation, property speculation, and cattle were part of an inevitable expansion of the frontier – tied to violent mining, timbering, indigenous expulsion and removal of the standing forest. On the other hand, celebrants of neoliberal order believed that, given proper investment, the frontier could be converted into an enlightened plantation of combined livestock range and grain agriculture (e.g. Porder 2013, Garrett et al. 2018), which, in turn was tied to industry moratoriums on new deforestation, municipal level credit blacklists – all serving to bring an end to deforestation, sometimes even with Swiss financing.

2019 and 2020 have proved that this model – of economic intensification and simplified land use, coupled with regulations and with incentives – has not gone as planned. Deforestation to claim land, using whatever messy institutional or illegal means, has increased dramatically. Yet frontiers in the Brazilian Amazon have never been so simple, and of course clearing forest for pasture in this biome is in part the perversity of a politicized development imagination. But in trying to scale solutions to save the Amazon, global attention has gradually shifted away from what had been a

socio-environmental outlook on conservation (de Toledo et al. 2017). However, some of the scholarly literature speaks to socio-environmental diversity in defense of the forest, and also to vast complexities underlying land use change (Hecht 1985, 2010). It speaks to very distinct geographical relations in migrant colonization and the emergence of rainforest cities (Browder and Godfrey 1997).

Early research on Brazilian Amazon frontiers had emphasized institutional complexity. Susanna Hecht's studies on land value and deforestation (e.g. Hecht, 1985) showed how deforestation created institutional rents and tenure in the eyes of government bureaucracies with contradictory mandates. The institutions drove deforestation, but also conflict, as a result of the way different actors played out their interests invoking the state. Today, on the other hand, conservation science and policy research make for wonderfully sophisticated geospatial models that assess policy effects for the entire national biome (e.g. Soares-Filho et al., 2010; Cisneros et al., 2015). And at the other geographical extreme, land change scientists and sociologists analyze frontier areas by running statistical regressions on hundreds of colonist farms based on demographic panel data, but strangely sterilized of the diversity of lived experiences (e.g. Guedes et al., 2014).

The region encompasses incredibly diverse attitudes about land, nature, development and the state, but this diversity gets short shrift. Along with its tribal indigenous peoples (just over 200,000 people), the Brazilian Amazon harbors a very diverse population of 24 million (IBGE 2010). Significant intraregional variation exists for land use and livelihoods; many of these have been argued to be sustainable

(Hecht 2003, Hecht 2009, Smith 1996, Brodizio 2008, Adams et al. 2009, Steward 2013, Pokorny 2013, Davenport et al. 2017, Guariguata et al 2017). Social diversity goes hand in hand with an environmental diversity that complicates our standard categories – life and livelihoods in the region are at once urban and rural (Padoch et al. 2014), forest and agrarian in character, riverine lowland and terra firme upland (Brondizio et al 2013). Thinking with diversity allows for an appreciation of the social life of forests in connection with social practices, institutions, markets and cities.

Rather than modern agricultural or livestock intensification – which could either strip the forest or spare the forest depending on which way one looked, I was interested in how to engage this *diversity* in tropical agriculture, in so-called *socio*-biodiversity. This involved including migrant colonists and peasants, rather than rendering them invisible and unworthy of attention. Brondizio wrote of the invisibility of the migrant colonists on the Transamazon – who were considered rudely out of place, poor migrant mongrels (Brondizio 2004). But while state led settlement on the Transamazon did involve violence on indigenous worlds and the forest, the recent context speaks to an alternative possibility – socially based re-agroforestation on a ruined frontier (Schroth et al. 2016). My approach to contemporary anthropogenic forests is based, firstly, in historical and political ecology, developed by scholars such as Fairhead and Leach (1996), Hecht et al. (2014), Paul Robbins (2001, 2003, 2015) and Diane Rocheleau (1995, 1997), among others (Porro 2005). These scholars connect ecological dynamics with social and

institutional or cultural factors in space and time, using mixed methods. In the dissertation I combine remote sensing analysis, participant observation, farm surveys, walk the land interviews, lengthy testimonials, video, photographs and GPS markings. I attempt to view the landscape, and the scales of which it is composed – ethnographically but also systematically.

And thus, this dissertation fills an observational ground from which we can better appreciate diverse migrant colonists' agro-environmental land practices and experience, interactions with the state, and struggles with markets. The state of the art on these matters was frustrating, in my view, because land change science in the Brazilian Amazon sometimes suffers from rigid assumptions in modeling socio-ecological and socio-economic relations. These model assumptions vary: from environmental determinism; to isolating household decisions from the surrounding context in a domestic mode of production; to an overly simplified geography in terms of economic 'opportunity costs'; to hypothetical policy effects that do not take into account how policy is manipulated and used on the ground. In this dissertation, I challenge some of these limitations in modeling knowledge about land use change and livelihoods in the Brazilian Amazon and develop more nuanced empirical comparison of livelihood and land use change cases.

This, you see, was more difficult than one might think, given the fraught importance of the Brazilian Amazon and the way the region has been framed as a region that desperately needs barriers, or alternatively, as plantation style development. This was not an area of intervention for anthropologists and here I

would be largely alone. Just to try to *think* through these problems, I would draw on perspectives developed by ecologists, soil and plant scientists, geographers, natural resource economists, and institutional scholars of socio-ecological systems. I try to put these perspectives into earnest and critical use, rather than to deconstruct their methods. I tried to make scale sensitive, controlled comparisons of land use changes, document institutional relations and social organization, and draw in ecological observation and phenomenological experience. I entered the world of work and ecology of smallholding farmers by combining participatory observation, ethnobotany and farm surveys. Through an engagement with plant histories and ecological processes, I link human labor with the non-human. In interviews and in tracking institutional and market situations, I focus on cultural attitudes about livelihoods, governance and nature.

Surely, this was an ethnographic project, but usually this felt as if I were developing a research project in another dimension, and then chucking up personal journalism on the basis of that effort. There was a profound disconnection between the art of working in the field and thinking through observations; compared to the 'rhetorical' emphasis in my academic department, for which what happened in the field was inconsequential relative to the production of a text. Doggedly, I tried to make systematic, controlled comparisons across farm cases in the field, to identify and enumerate key factors in the emergence and organization of alternative land use systems. For example, I worked to compare how soil type, distances and the size of

holdings influenced land use decisions at different sites.[5] Using this system analysis methodology, I studied how these factors variously played into land use decisions by deliberately structuring the research design. My aim in part was to try to reimagine how productive social reforestation might be consolidated in a low population post-frontier and explain why farmers might adopt labor demanding agroforestry across an entire landscape, when labor was at a premium.

The scarcity of labor helps to impel the logic of cattle ranching that dominates the colonized Brazilian Amazon. This was a key consideration: population densities in rural areas in this region are extremely low compared to most tropical areas on the planet, usually 3 persons per square kilometer or even less. In Sulawesi in Indonesia, for example, population densities are around 20 persons per square kilometer; on Java they are upwards of 100 persons per square kilometer. In high population areas in the tropics, cacao farming has been framed by anthropologists as a vehicle for capitalist frontiers, where the poor attempt commodity production but destroy indigenous reciprocity and forests (Li 2010). But with low population density in rural areas, in the Brazilian Amazon cacao farming has very unusual characteristics. By global standards Brazil's cacao farms are very large. But in comparison to typical patterns of ranching or soy agroindustry in the Brazilian Amazon, cacao orchards are so miniscule so as to be almost invisible from a geographical standpoint – meaning that it is difficult to gauge cultivated agroforests at a scale commensurate with regional deforestation. Furthermore, that the cacao tree is an Amazon native makes for an

[5] See, especially, chapter 7 for a detailed description of this methodology.

unusual set of ecological considerations, considering that the cacao commodity is produced mostly outside of the Americas.

Getting into this story would thus draw from work and theories on tropical agriculture and agroforestry, smallholder and peasant economies, geographical 'middle range' theory on land system transitions, and the phenomenology of environmental experience and of scale. To start with, environmental anthropology has a long tradition of examining anthropogenic forest regrowth in the tropics. Tropical swidden agriculture was a staple in the anthropological literature in the twentieth century, making forest entwined agriculture visible to outsiders and also delving into the cognitive interface with plants (e.g. Conklin 1957). The literature on swiddens sometimes became useful as a political economic "foil" to imperialist models of land use and development. Swiddens, thus for Geertz and Dove, were landscape models for thinking about the organization of labor and the political economic conditions surrounding local or indigenous forms of land use (Geertz 1963, Dove 2011). For example, Michael Dove had examined so-called jungle rubber in Southeast Asia – Imperialists had attempted to install rubber plantations but much to their confusion they were confronted with the competitiveness of smallholder rubber incorporated into swiddens, which integrated food with commodity crops, and used creative organization of household effort.

In anthropological work on agriculture, an underlying model of thinking was "intensification" – i.e. processes of land use decisions in relation to demographics, territory and land rights. Intensification in anthropology was viewed in connection

with and in the context of co-existence of extensive land management, including extractivism, gathering and hunting. Thus, in anthropology, intensification was concerned with diverse practices in tandem, rather than simply a linear shift into modern, technologically enhanced agriculture. Intensification for anthropologists could be positive or negative, however, depending on the context. Geertz for example wrote of the perverse agricultural 'involution' of packing more and more human labor onto rice growing sawahs – which could be attributed to the history of imperial colonization and the high density of the population on Java. Intensification in this instance led to the decreasing productivity of labor. On the other hand, for Dove, intensified management of food and commodity crops like black pepper, combined with jungle rubber in swiddens on Kalimantan – allowed for taking advantage of ecological processes in connection with household labor, in a highly productive arrangement.

Inspiring Dove's work was perhaps anthropology's most enthusiastic adherent of intensification thinking: Robert Netting. In his comparative studies of agriculture, Netting's overall thesis was basically that land tenure and management practices would adjust or adapt themselves based on the "practical reason" (cf. Sahlins) of land use organization. Thus, for the Swiss village of Törbel, commons were located higher up on the alp, with privately held gardens further down the slope, closer to village residence. In Netting's model, intensification involved a creative process of amplifying the value of land and labor, especially through management care and attention to ecology. Netting's model is thus radically distinct from the often-cited

Chayanov peasant model – for which household subsistence requirements force the repetition of labor 'drudgery' and the marginally *decreasing* value of labor (see Chayanov 1986, Scott 1976, 2009). In Netting's version of self-coherent systems, by contrast, smallholder labor was viewed in terms of its increased value, ecological relations figured prominently, and connections to capital and states were not presented in terms of class or subjectivity.

In terms of the emergence of the state, anthropologists and especially archaeologists have often posed the connection of cultural complexity with the emergence of concentrated agriculture. For the Amazon basin, however, it had been difficult to conceive of agricultural concentration or intensification based on the archaeological record. Most traces of pre-Columbian civilizations had been swallowed up by the incredibly active biotic environment. Rather than complexity, there was a staunchly held position about environmental limitations on culture – the soils could not support complex civilizations (Meggers 1971). But starting perhaps with Roosevelt's work on Marajó island, the model of environmental limitations on culture in the Amazon was upended (Roosevelt 1994). This was followed by groundbreaking work on anthropogenic dark earths and on the role of humans on the semi-domestication of scores of Amazon tree species (Clement et al. 1999, 2010). The record spoke to something completely different than wandering bands in the forest – and indeed to Amazon civilizations making highly sophisticated modifications to their environment that involved trees, soils, dikes, mounds and other earthworks.

However, these civilizations were not entirely agricultural, but also forest, river and estuarine based – they lived amongst seasonal ebbs and flows, while enhancing soil fertility. It all suggested that rather than a linear process of population *driving* intensification, it was more the *choice* or type of agriculture or land technology or architecture, which was key to cultural development. In particular, it suggested a different model for thinking about tropical agriculture – tied not to some inevitable subjugation in hierarchical agricultural civilizations – but to alternative, diverse relations and histories.

The diverse practices of peasants and smallholder agriculture are becoming once again a focus in environmental anthropology. Peasants have always been connected with political forms of property relations and states, whether feudal or modern[6]. Notwithstanding, they are good to think with in terms of the ruins or fringes of capitalism, and in terms of ecological and social resurgence (Tsing 2015). And as Mathews (2011), Lyons (2014; 2016) and others have described, peasant attitudes about nature and soil are in a close but not at all straightforward relationship with states and modern agronomy. For example, migrant colonists to the Transamazon weren't at all averse to the state or to agricultural extension services – they had depended on the government for their very existence. But after being abandoned by the military and then civilian governments, colonists organized a social movement in the 1990s to demand that the state fulfill its mandate, and became instrumental to pushing the state to protect territories between the Iriri and Xingu rivers from frontier

[6] Bloch

land grabbing (Campos and Nepstad 2006, Schwartzman et al. 2010). Rather than hapless destroyers of the rainforest, this movement developed a slogan of (*Viver Produzir e Preservar* ("live, produce and preserve").

On the other hand, peasant land occupation and use is never exclusively determined by state organized property or state science and extension. Peasants work through or against political control over land in multiple ways, and peasant landscapes are not, by default, repetitions of an inherent peasant 'form' or 'model' of land use, except perhaps to the extent to which labor is limiting. "Peasants" in the Brazilian Amazon vary immensely, from rubber tappers (CITE), to fishermen (Nugent1993), to smallholding commercial agroforesters (Smith 1996, this study), to temporary gold miners (Cleary 1990), to açai and babaçu forest extractivists (Brondizio 1995 2005, Porro 2005) – peasants in the Amazon are better understood, not as some longstanding articulated pattern of subsistence farming, such as in the Andes (Mayer 1998), but in terms of a chaotic and occasionally destructive universe of options, including migration and speculation (Cleary 1993, Campbell 2015).

People have tended to associate the category 'peasants' with marginal or antiquated forms of rural life – people whose livelihoods depend on producing on the land but who are tied to wider spheres of political and economic influence. Further, scholars often tend to associate peasants with trradition; folk cultures that hold aspects of pre-modern social organization and beliefs. The reality however is that peasants – actors on the peripheries of modernity – have accompanied social change, and more recently, environmental change, in a very long history. And thus, more

broadly, rural livelihoods, are re of a universal and timeless phenomenon of practical reason – not a holdover from feudal pasts. There is also a politics to rural organization, which tends to be lost on American publics, given that the country has not had an agrarian styled economy since the mid twentieth century. Agriculture in the United States involves labor, but where labor is largely 'invisible' in the operation of supply chains and technological control, and where most plant material grown in the American Midwest is not used for food, but for financialized products like sugars, ethanol and plastics. However, when human labor is immediately tied to self-ownership in production, logics shift, from maximum utility, to creative allocations of technique and task. We can look for these alternative socio-ecological systems abound in the contemporary, just as much as they abounded in the past. The different today is in how globalization infuses processes of rural production in ways that cause 'ruin' in attempts to discipline landscapes into uniformity: while the glory of seed and chemical companies has been to expand the range of certain grain crops; but discourses about land use efficiency are matched with increasing ecological imbalances and new relations that emerge across scales.

However, we cannot focus on the ecological weediness of plantations alone; we need to think about how human labor redirects and remakes landscapes in collaboration with more than human labor. As such, this is not focus on a peasantry of land use 'traditions', but an attempt to think about peasantry in terms of socio-ecological relations *in situ*, which involves improvisation, as well as collaboration with and knowledge/experience of the more than human. Moreover, smallholding

agriculture is also fundamentally different from capitalist farming, even as articulated into global supply chains. Many tropical commodities today – coffee, cacao, rubber and bananas – are today dominated by smallholdings, whereas a century ago these crops were mostly produced on plantations. Does the sale of these commodities into global supply chains mean that smallholders are simply peripheries of the plantation form? Not always. This dissertation explores these relations, to see when, where, how and why relations shift, how land decisions (systems) change, and conditions of survival. This is to look within and across landscapes as they comprise varying attitudes and possibilities – it does not merely describe the histories of how the landscapes coalesce into particular forms, but it shows how, internally, within the landscape, relations evolve. To do the latter, research has to engage mixed methods. This means thinking in terms of systems, which involve units of analysis; phenomenological engagement with the immanence of experience; and measurement using survey and geographical tools. Engaging these tools, one can achieve a descriptive synthesis, but descriptive ethnography, strictly speaking, is neither a phenomenology of process (Ingold) nor is it systems analysis. It works best when combined with the latter two. As such, to achieve descriptive synthesis of change, what I do is to engage socio-ecological relations in the act, to track how they change, and these variously function/impact larger land systems across time and space.

Thinking in terms of relations and in terms of experiences of production, one can appreciate that a smallholding peasant farmer's own labor is integral to, not alienated from, the logic of cultivation and value – that is, if they are determined to

actually cultivate something besides *brachiaria* grass. For example, when a smallholder works to plant species in a complimentary fashion, that labor is part of a decision-making process about how the overall system works; whereas when a smallholder deforests their land, they are working with a speculative logic of value, in which the labor that goes into deforestation is identical to any other labor. For these reasons, I went to many farms to participate in different kinds of work – ranging from harvesting to pruning to planting to wielding a mechanical weed whacker through 2-meter-tall regrowth. I walked with them on their land holdings, cataloguing the names of trees and their uses. I, or the farmer, would sometimes draw the farm to explain the holding, why decisions had been made in the way that they had, how some forests were kept as a reserve or allowed to grow back, why others were used to form polyculture agroforestry plots.

In accompanying farmers, the key consideration was labor, and the phenomenology and ecology involved in work processes. Tim Ingold for instance has long argued that human cognition is experiential and conjoined with ecological relations in a world of process. Humans – as do nonhumans – learn, experience and communicate in tandem with their environment; in humans this material connection is both biological/ developmental and psychological in character. Thus, Ingold's contribution has been to show how the practical and lived relations between humans and biological and geological components of landscapes contain cultural meaning and moral resonance. The calling of such an approach to landscape is not to drape symbolic representation over the world, but to delve into the landscape: "meaning is

there to be discovered in the landscape, if only we know how to attend to it." This type of landscape apprehension is by necessity temporal, and only by engaging as such "can we move beyond the division… between the scientific study of an atemporalised nature, and the humanistic study of a dematerialised history." (Ingold 2000: 208).

To be sure, however, Ingold has not worked with phenomena associated with political economic or social organization. Rather, he has focused on how learning occurs through movement, observation, livelihood, habitation, skill – i.e. on life processes and the ecological contexts of people's interactions with their environments. Ingold's emphasis on the immanence of perception, movement, and knowledge in an environmental context is helpful, but it can be joined to other methodological approaches to work across societal relations with the environment over time. The material and ecological approach can be combined with landscape histories that include social and political organization (e.g. Howard 2017). My challenge was thus to combine Ingold's approach to experience and ethnoecology, ethnographic approaches to social and political economic organization, and comparison of land use changes – to both describe and analyze system transformations. Combining phenomenological, political and ecological work on landscapes is exceptionally challenging – being very different discourses, amongst which a rapprochement is hard to achieve.

I would thus link the phenomenology of labor with a broader geographical and analytical focus on the transformation of the systems and scales of land use**.** In

thinking in terms of land use organization, landscapes and scale are intimately connected– as patterns and processes, society and nature – in relations over long periods of time. I approach 'scale' as an analytic or a tool in appreciating nonhuman-human relations. Of course, scale can be politically constructed, and it can be a matter of ecological extent and grain – but we can treat natural science's approach to scale, and social science's approach to scale, as interrelated challenges. Scales are frameworks of observation, through which particular phenomena and relationships emerge based on the application of the observational framework (Sayre 2009).

Thinking with scale can be a method, and also it can be an ethnographic question. For example, Anna Tsing's work has been concerned with the issue of 'scalability' (Tsing 2012, 2015). For Tsing, 'scalability' refers to a condition in which system elements and system function remain the same when shifting the frame of reference or observation. In a global commodity value chain, there is an implied or imagined increase in the magnitude of producing a commodity. But, as argued by Tsing, the classic capitalist metaphor of 'economies of scale' represents a profound problem in fusing relations into capitalist dispositions. Because capitalism may assume to transcend scales, this imagination is part of capitalism's cultural force, if not an actual objective characteristic of commodity value chains – which are anything but 'scaled' or neatly fitted (Tsing 2012), when comparing across sites.

The challenge is thus to trace, methodologically, how political models, social organization, and ecological relations, move across scales. And to be able to document how political and development plans interact with the reality of biophysical

and social organization on the ground. The *point* of Tsing's focus on scalability is contingency – biological and social relations and temporalities across difference and diversity. And thus, the essence of scale is precisely 'non-scalability' – as a methodological proposition for looking at how models shape the world in concrete ways, but also in terms of windfalls, disasters and reconfigurations that occur in spite of or alongside modeling of knowledge, governance and capital accumulation. This approach, which compares and contrasts relations across scales, positions the 'scale making' of states or capital as a kind of perception or imagination, across which other relations spill. This is useful because it allows for thinking about transformations of scale. For example, on the Transamazon, an agro-industrial project, paradoxically, set the conditions for diverse, socially messy, and unequally patterned, reforestation of ruined plantations.

Such land system transformations involve conflicts, frictions and synergies, in relations that are at once political, ecological and phenomenological in character. For example, at least in the Brazilian Amazon, cacao farming is organized around small holdings and mobile labor; whereas deforestation and ranching is organized around expansive land exploitation and mobile cattle. While they may exist side by side in the same landscape, the scales through which these two systems function are radically different: the former, on foot, using hand tools and grafting techniques, and practices invisible to the state except for a withering extension agency without any maps. Compared with the latter, cattle ranching system, which mostly absent of human labor, and which relies on the biological uniformity and resilience of the Nelore

breed. Cattle ranching is attuned to power and status and capitalist dreams, empowered through crony state connections, and invited to the policy table by international NGOs, from both a financial and an environmental governance standpoint. These divergent socio-ecological systems draw in other relations, from the seasonal rhythm of rainfall influencing fungal ecologies, to public banks shaping land speculation. Again, scales are frameworks of relations; we can see them by attending closely to landscapes.

Yet how might land use systems sustain socio-ecological or even political transformation, in fraught connections with crony capitalism, neoliberal imagination and techno solution models? What role do we ourselves have to play, with our bare hands? Can a land use system recuperate older practices or remodel new ones, when traditional practices are not already there? Much peasant studies work has been sure to connect agroecology with a social movement sensibility based around peasant 'identity' as traditional or Indigenous farmers. Yet 'peasants' cannot be defined by being pre-modern or traditional, full stop. This dissertation is a move in the direction that in our contemporary Anthropocene 'we are all peasants – and that the calling of a 'peasant agroecology' is to not only support resistance movements involving traditional communities but to, somehow, transform cognitive, agroecological, political and financial regimes in partnership with our indigenous and nonhuman kin.

2. Chapter one – The Time of Trees

Varying work rhythms and the mobility of labor across the landscape sustain the cacao land system; but semi-feudal land relations and poverty are perpetuated with sharecropping.

THE TRANSAMAZON colonist world would be increasingly dominated by cattle and land accumulation after the 1970s. Ironically so, as the area had been settled with a vision of land reform, and cattle ranching would favor larger capitalized actors. Medicilândia was the only municipality in recently colonized Pará where the main economic activity was not cattle ranching. Why was Medicilândia different? If we were to go by a determinist model of human ecology, it would be the soil. The significant presence of terra roxa – a soil that I will describe in this chapter – meant that humans had adapted to their environment by planting more intensively farmed crops. But this would not explain why the road into Altamira, 90 kilometers east, also dominated by terra roxa, consisted of vast ranches, not tree crops. One day I tried to think this through, by walking up to the dusty third floor of the hotel where I had stayed two years ago. This was the tallest building in town, and I was trying to get a better view of the landscape. There, two kilometers to the southwest, glinting in the hazy sunlight, loomed the sugarcane refinery, an oxidized basilica of junk towering over jungle orchards.

Sugarcane the crop however had disappeared from the landscape. The government owned land on which the refinery stood – about 250 hectares – had been recolonized into small peasant farms of between 1 and 5 hectares. This dense pattern

of land tenure was very unusual in the colonized Amazon. These squatters were unrecognized by the state, except through informal signed contracts of ownership; no one talked about them in the human ecological literature.

While this reoccupation was fascinating, however, I had found during my fieldwork that the social redesign of land tenure and use was happening in different ways all over this municipality. In particular, the rather large government proffered lots of between 100 and 120 hectares (247 and 297 acres) were being split up into smaller farms – *chácaras* in Portuguese. Also, municipal statistics showed that two thirds of its agricultural economy was comprised of perennial farming – especially cacao – represented in the table below. Also, while the average size of its land holdings was smaller, per capita, people made more income.

Table 2.1 Deforestation, production and development indicators for three representative Transamazon municipalities

	Medicilândia, Pará	**Brasil Novo, Pará**	**Apuí, Amazonas**
Avg. landholding size in 2017*	87ha	232ha	310ha
% of agricultural economy in cacao and other perennials in 2017*	66.4%	41.3%	5.8%
% of agricultural economy in cattle ranching and other livestock in 2017*	29.6%	51.8%	80%
Production of cacao seeds in 2017**	46,940 tons	5,370 tons	20 tons
Areas of cacao planted in 2017**	38,570 ha	5,600 ha	30 ha
Average cacao plot size in 2017*	15 ha	6.0 ha	1.2 ha
Average productivity in 2017**	1,217 kg/ha	959 kg/ha	676 kg/ha
GDP/capita in 2018*	19,672	16,582	9,731

* IBGE and IBGE 2017 agricultural census
**Embrapa/IBGE

The table above displays agricultural economic and land use indicators for three municipalities that represent the range of Transamazon conditions. Brasil Novo

is adjacent to Medicilândia to the east, where the same conditions of directed government settlement applied. But Brasil Novo has half of its agricultural economy in cattle ranching, compared to 30% for Medicilândia, and its average land holding size is larger. Apuí, in Amazonas state, is located 1,000 kilometers to the west. It is a municipality where the state arrived *after* initial waves of settlers. It is a much more recent *frontier*, where cattle ranching dominates with 80% of the agricultural economy, and where the average land holding size is over 300 hectares.

How did land tenure interrelate with land use, and what would this imply for how distinct socio ecological systems pan out in a landscape? While my methods to address this question would evolve, I began to approach it using participatory observation. In this chapter, I thus enter the world of smallholders and peasants by working and walking with them in *chácaras* or sharecropped plots between roughly 5 and 20 hectares (12.4 and 49 acres) in size. I do this because 100 hectares – the government organized lot size is a rather large area; only in regions with industrial scale agriculture – such as in the Midwestern United States, Brazil and Argentina – are farms of 100 hectares (247 acres) deemed "small." Lots that had not been subdivided tended to be split up into smaller management areas with sharecropping tenants of diverse ethnic backgrounds. Going small, intensifying, was in contrast to most post-frontier landscapes in the Brazilian Amazon, with few exceptions dominated by cattle pasture or mechanized plantations (Richards and VanWey 2015).

The chapter will focus on how a few colonist smallholders and peasants regard their livelihoods while walking and working, mostly involving cacao perennial

farming, but also other species in agroforestry systems and annuals, like tomatoes. These work practices can only be maintained relative to the human body, because most of the work is manual. In this landscape such manual experience can interrupt capitalist time, as a touch of hand with branch, hand with plant, echoes in terms of some embodied significance. I am curious about a non-alienated or at least less alienated human relationship with trees, soils, and other organisms. Because their own labor and experience are imbricated – smallholders and peasants who dedicate themselves to tree crops are not capitalists. Plantation or livestock economies of scale do not dictate smallholders' interaction with the environment, but rather the qualitative character and energy balance involved in relationships between the human and the non-human. These relationships could suggest a particular resonance or significance of manual, rather than machine, technology, learning and respect for older ways of life.

With a dignified economic return, human hands and small tools resonated in touching branches and fruit, in working alongside kin and neighbors. The challenge for these smallholders and peasants was in how to maintain a system that reflected the concrete effort of manual work, without these humble efforts becoming devalued and alienated in market chaos, bureaucratic confusion and debt disasters. Also, the particularities of labor, technique and ecologies were fundamental. For example, farming techniques that are often beneficial in cool temperate zones, such as exposing soils to the sun after winter to increase their biotic activity and fertility, can spell disaster in this equatorial environment.

Before entering the ethnographic material, the chapter will first briefly address the literature on peasants and smallholders on the transamazon. I do this because I will be seeking to decenter a deterministic economic logic about land use decisions. More specifically, the temporality of work with trees is distinct from the temporality of cattle ranching. Cattle ranching involves a plodding colonization of land transferred into carcass weight – a financial operation based on the plantation scale reproduction of non-native herbivores and grasses – and the relative absence of human labor. Cattle dominates the entire terra firme portion of the colonized Brazilian Amazon – Mediciliândia was the only county with an alternative economic base. But cacao operates very differently, as will be described in detail.

Then, in the subsequent part of the chapter, I will use participatory observation in farming and walking through the landscape to show the temporality of working with trees. This will provide a view on the temporal and spatial qualities of cacao and agroforestry, and on the attitudes and outlooks about production, with an interest in the interruption of capitalist time (or scales, see Tsing 2012). The ethnographic material involves three males – Raimundo, Ademir and Chico – with different perspectives and motivations, and different fortunes. The chapter attempts to provide an empirical illustration of management techniques and the temporality of labor, rather than labor intensification in the abstract.

The study of human occupation of the Transamazon

The TransAmazon highway was an ideal site for natural experimental thinking about colonists and tropical deforestation. Initiated as a government project with relatively ordered land tenure, compared to the chaos and violence of southeastern Amazonia, it was possible to compare the effects of land occupation over time on ordered farm units of 100 hectares each. With a focus on human adaptation to the environment derived from North American school of cultural ecology, researchers worked to try to model agriculture and deforestation on a land use frontier (e.g. Moran 1981). By the late 1990s, most if not all geographical and sociological research in the TransAmazon was using large data sets, based on surveying hundreds if not thousands of individual farm households (e.g. Walker, 2003; Caldas et al. 2007; Pacheco 2009). Researchers tried to isolate land use change correlations with factors such as farmer age and household composition, household labor, distance to market towns, household wealth etc.

This literature made many valuable contributions, in terms of developing models of the patterns of deforestation and land use change, and macro institutional effects on the former (e.g. McCracken et al. 2002). Secondary forest regrowth was conceived in terms of land abandonment, rather than on an idea of rotating agriculture (Perz and Skole 2003, Perz and Waker 2002). Research findings indicated that Amazonian natives (both indigenous and caboclo) outperformed migrants to the region in terms of agricultural yields, use of technology and well-being (Entwisle et

al. 2005). Soils were not uniformly acidic and nutrient-poor; colonist farmers were less constrained by the environment than by institutional failure (Moran 1981).

But agroecological or institutional questions never became the mainstay of this body of research, which continued a rather mechanical focus on models for human ecological adaptation. For example, Moran's group had suggested that soil type was the determining factor: sugarcane and cacao were correlated with the presence of *terra roxa* alfisols. Environmental determinism? This finding had not taken into account that government bureaucracies had obliged colonists to plant sugarcane and cacao on those soils, or why the fertile *terra roxa* alfisols immediately adjacent to Altamira were occupied by livestock. Or why it was that the experiences of growing cacao on so-called *terra mista* (mixed earth) of less fertility were not taken into account, or why the cousin species cacui (*Theobroma speciosum*) was encountered only on less fertile *terra mista* soils.

The ambitiousness of this body of research on population and land use change – data collected from hundreds of surveyed families, and landscapes thousands of kilometers in extent – led to certain model simplifications in grappling with the geographical scale of the analysis. And there seemed to be two key limitations. First, while noting that institutions impacted colonist farmers, this literature would use household demographic models to make sense of the famous "fishbone" of deforestation viewed from space. But most of this research, as it developed after Moran's initial fieldwork, did not articulate the tangible resonance of human interactions with the non-human environment (but see Smith 1982). There was no

accounting for processes of agroecological innovation or diversification, for variation in institutional/bureaucratic and commercial situations in how they impacted land use for farm cases. Second, the models did not account for significant differences between modes of inhabiting the landscape and the land systems or complexes peculiar to each, e.g. cattle vs. cacao agroforestry.

Raimundo

Two years after my first visit to Medicilândia, I was walking the same farm we had visited on the day of the field workshop that I described in the introduction. I was with Raimundo, a young-looking 50 something, short with a large middle, quick and agile as we ducked within or skirted alongside various groves of trees he had planted on his own or with kin and neighbors. For 13 years he had saved money to farm, working as a security guard at the more recently constructed, leaky roofed, Bank of Brazil on the highway. This land was inherited from his wife's brother Elias. "I want to make a *chácara*, including an orchard, with a little of everything…"

With Raimundo, anything was possible. "You know this? It's *graviola*, I planted 60 trees, a bunch of them died, but there are still 20 left. That there is valuable, it gets 12 *reais* a kilogram of fruit pulp. One tree gives 8 – 10 kilograms, and it's delicious. They use it to make cake icing. Here, I want to plant 3, 4 *covas* (rows) of manioc, it has a good market…. People around here are only thinking about cacao and cattle, they forget about other things… here I want to make a mini orchard with banana, orange, lime – about 50 *taiti* (lime) trees, they *da dinheiro demais* (make

a lot of money). Here I'm going to clean up this area and plant corn, it's going to be *chique* (chic). First, we have to clean up the vegetation, we've got 4 mechanical weed whackers. When we do it, we work till 11 o'clock, after that the sun gets unbearable – we get back into the shade to work."

In a lower lying part of the farm Raimundo shows me black earth. *Terra preta*. Even more fertile than *terra roxa*. Here one can plant pumpkin, okra, cucumber – we step over to rub his black large humped ox, pleasantly tied up with a nose ring. As they glide overhead, the intelligent screech of two macaws rings out in the late afternoon. We then walk through a grove of embaúba or *cecropia* trees. It's a good place to plant a bit of sugarcane, and there is a bit of it here, he takes his machete and cuts up a bit for us to chew. Then, we walk over to another low-lying area where he said his brother in law told him he was crazy to plant açai because the area was *juquirada* (overgrown). Raimundo told me proudly that he had managed to cultivate about 600 açai palms here and was processing the fruit in town and selling the pulp. Just this açai he told me was going to give him 500 liters of fruit pulp.

This enthusiastic small farmer was hoping to get more land into horticulture. Past this was a roughly 12-hectare area where a 25-year secondary forest had been burned, apparently to start a new orchard. Soft ash was heaped in piles, and still warm. Raimundo took me amongst blackened downed trunks, some still smoking, hopping over them and through the soft ashes, telling me their names of the trees and their value. Certainly, I would not be sharing pictures. The burned area would normally be recognized in terms of the colonist farmer's impingement on the tropical

rain forest. Yet Raimundo was secure that he was not destroying nature, that this was part of a cycle of regrowth. He told me that they were sentimental in burning but they knew that they would be replanting trees – *replanta* – like a general ethic. Some of the trees were deliberately standing, and the burned area would be planted in cacao with other trees together. You plant trees like *cedro*, *andiroba*, avocado, *ipê roxo*, you plant a row of açai…

Raimundo's chácara was on his wife's family's land. They were a mixed race family from Bahia that had migrated south to Paraná, and then back up north to the Amazon in the 1970s. Raimundo's family lived in the main town, 22 kilometers away, while his brother Carlos, who sharecropped part of the chácara, lived in the *agrovila* (rural village) next door. Even Raimundo's other brother, who lived in Manaus, was farming here. He sharecropped a larger area of cacao with another brother living at kilometer 120. He told me it took three days to get here. He had left Manaus on a Tuesday, and I met him on that week's Saturday morning, when the three brothers, Raimundo's wife and son, in laws, hired carpenter and resident sharecropper were working together – about 12 people altogether –were working together to put plastic sheeting over the wooden drying platforms. This was called an *estufa* – a platform used to dry cacao before selling to middleman merchants, who, if there were a sufficient amount to acquire, would arrive on the farm to buy it.

Raimundo's wife's lot had been divided up amongst kin and was draped with all sorts of ownership and labor sharing relations. "here, Raimundo said, my nephew shares the crop with me – two thousand trees, he also shares with his grandfather two

thousand more, thus he's taking care of four thousand. His mother has eight thousand trees over there, she takes care of the trees by herself – she pulls down the fruit pods, she weed-eats the area, she breaks up pods, she does everything."

Terra roxa soil

I will briefly allude to some of the remarkable properties of the soil underlying our feet, before leading us into another chácara in this landscape, 6 kilometers due west–southwest. Terra roxa covers a great deal of this area, especially south of the highway, although there are waves of the soil type extending about 5-10 kilometers north on the *travessões* between kilometer 105 and 80. Interestingly, *roxa* is a popular derivation of the Italian *rosso* (red), as these soils were present in the southern Brazil coffee lands in which immigrant Italians worked. It is a rich clay soil, strikingly red, with amazing physical properties, not acidic and with high plant availability of phosphorus. The clays are very peculiar, resulting from ancient basalt flows – apparently in the separation of the Gondwana supercontinent into Africa and South America during the Mesozoic. The soils contain magnetite, and one can add hydrogen peroxide to the soil, take a magnet and witness the separation of minerals. Terra roxa occupies a curvy strip over which the TransAmazon passes – originally the Brazilian state had been extremely optimistic about settlement on these soils.

Terra roxa is remarkably difficult to work with if dry, when you can barely get a pick or hoe into it. However, if you soak the soil with water, unlike many clay soils that I would associate with stickiness, it loosens up, becomes more friable, and

workable. I learned this helping Ademir and some hired day laborers – Ademir was a rather surly German smallholder living in the Tiradentes agrovila on kilometer 80 south. I had worked with farmers of many different backgrounds – Baianos, Gaúchos, Mineiros, Nordestinos, Maranhenses. The work that day: there was an irrigation pipe coming up a long distance from an artisanal well in some bottomland, from that, a long plastic hose, and Ademir watered, while the hired day worker from Maranhão and myself came behind with pick-hoes to break up the soil. We were planting tomato seedlings. Hands got calloused quickly with the wooden handles. The sun is threatening at midday, and it is insufferable to work exposed in the fields without a cloth masking the neck and sides of the face. The pitch of the pick-hoe, over and over, and the heavy *terra roxa* soil, red and sticking to your boots. Some wore low topped boots, most however wore flip flops. Sweat soaking my shirt, and delicious cold water from a cooler. But terra roxa made peasant and smallholder's work relatively easy, because it required less work fertilizing the soil. One could dig a hole in the ground, stick in a cacao seedling, prune the tree a couple of times, and one's work was done until the tree began to bear fruit in year 3 or 4. And it supported annual, intensively managed crops like tomatoes, which fetched a good price.

Harvest work

Cacao work also had its advantages, as it took place under the trees, where the temperature dropped significantly. Surrounding Ademir's hectare of tomatoes were dense stands of cacao trees, without much else planted. This was called *bate folha*

– leaves hitting each other – a traditional, non species diverse, way of raising the crop in this landscape. At the top of the sloping, cleared hill on which the tomatoes were located, there stood a fragment of forest, and a 50-meter-tall Brazil nut tree, majestically standing sentinel at the edge of the forest fragment. Is that your "forest" I asked Ademir? Ademir was surly, hardworking and conservative, he seemed against the worker's party. Ademir's father was an original colonist, a German from Espirito Santo. A truck accident had taken his father away about 3 years ago, and the land had been divided up into roughly 8 segments amongst several brothers and sisters. Ademir's plot was about 15 hectares in size. He seemed skiddish about any kind of formal interview.

Tall and barrel chested, in his mid-thirties, he was bemused that I would be participating in the work. He qualified my presence by saying "he likes to take pictures." But it's easy to make friends when working alongside someone on a farm. He ran small shack-bar in the agrovila, selling 5 reais bottles of beer on Saturdays and Sundays, and had recently constructed a modestly sized but well-built house with a tiled veranda and pink exterior – a light color to help diffuse the heat. The house was on top of soil that was almost pure sand, just outside the Tiradentes agrovila. His plot of land was about 4 kilometers from his home.

Harvesting cacao is usually group work as the work is best accomplished with multiple hands that make light work. I did it with crews on Raimundo's chácara, and here on Ademir's, in a crew of 8 including Ademir working along with local folks that he had hired. This easy to learn work proceeds in stages. The first is the picking

of fruit with the *podão*, a sort of mini halberd on the end of a 15-foot pole. The second is the gathering of the fruit into mounds, the third is the breaking up of the pods, the scooping out of the pulp and seeds, the gathering of the wet pulp and seed mixture into sacks. The tools for the latter are a pair or latex gloves – or just one glove – perhaps a narrow wooden mallet for scraping out seeds that are stuck inside the pods, and a very short tiny bench or stool, about one foot tall, and the plastic tarp or sheeting. On my left is Bruna, 29, from Anapu. Bruna came here with her aunt when she was 16 – got married, stuck around. She left at one point and came back. On my right is a 20-year-old Luiza with a two-year-old child – she chatters and has a delicate face. The young man also on my right who is breaking up the fruits with a stubbed machete is deaf. Beads of sweat are clustered on the top of his nose.

You slip on dishwashing gloves because you are scooping out seeds with fleshy pulp, which is very acidic. Sometimes you pop the seeds and pulp – the juicier the better – into your mouth for an addictive treat, rolling the seeds around – but don't chew! The raw cacao seeds are very bitter. The pod's husk has a sharp edge. We are constantly joking and laughing. From the tiny square stools, we crouch over the pods on top of the tarp, scoop out the seeds and pulp, and toss the empty pods behind us into the leaves. Most of the pods have loose, white pulpy seed clumps that are easy to scoop out; others are tougher, the seeds are hard and brown, hard to scoop out by hand, so you use a wooden mallet.

Some, but not many on this day, have seeds that have already sprouted as a result of *vassoura de bruxa* (witches' broom) fungus. The work proceeds by

advancing on the pile of pods, rolling out the sheet of plastic as we advance. Then the seeds are scooped into burlap sacks and, at least here with Ademir, they are tied up. This work in the shade, communing with folks who live together in the agrovila seems a peaceful contrast with working in the equatorial sun. To be laboring in the sun between 10 and 3 – is not to be taken lightly. I thought how different this work was, compared to the hard labor of the hundred person crews brought here to cut sugar cane from the mid 1970s through the 1990s.

Chico

Raimundo and Ademir were happily working on land owned by themselves. My third visit is with Chico, a *meeiro*, or sharecropper on one of the original lots skirting the highway, owned by Pernambuco. Today approximately 80 of the lot's 100 hectares is in cacao, but 20 years ago the majority had been worked for sugarcane. Large labor crews of 100-200 men would come from Maranhão during the harvest season. This was the first lot I visited, because I could get to the front of their lot on a motorcycle taxi and walk in. Pernambuco the landowner was one of the first colonists to be in these parts, because he was actually one of the government's contracted heavy bulldozer operators building the road in 1970. In the morning I would go into a bakery with the television blaring cynical national Globo news, which had brainwashed the country that the worker's party was at the root of the country's corruption and recession woes. I asked for a hot and sugary coffee. Then I went onto the street again, next to a butcher's shop and the public utility and lottery

ticket office. There is already a line of twenty at 7 in the morning. I go over to a stand of motorcycle taxis, who are going to charge me 10 reais to go 4 kilometers.

We speed through the rapidly warming light. Pernambuco's lot is at kilometer marker 94, located just over a rattling wooden bridge, archetypical for the Brazilian amazon, with longer boards placed longitudinally in two tracks for tires. There is always the sound of the boards clunking when a truck comes down from the red mud onto the boards. And we cross the bridge, and I pay the motorcycle taxi, in the dusty area in front of Pernambuco's low-lying house. I walk past the sulking wooden shacks and barns, the cacao drying *barcaça* (also a drying platform, but with a roof on wheels that can be rolled into position if it rains) into what I understand used to be land brutally trained to sugarcane. Pernambuco tells me he used to have three large trucks, working cane, and 200 laborers. I was very secure! *Eu estava bem estabilizado*. He told me one morning, there in the low area, often flooded, where he had just planted corn. I was the largest planter of sugarcane here, he says.

Pernambuco had expected to benefit tremendously from the sugarcane project. In 1972, the newly formed National Institute for Colonization and Agrarian Reform (INCRA) had decided to use government financing to build an industrial scale sugarcane refinery at kilometer 92, just to the south of the highway. Told by visiting bureaucrats that they would become rich, some colonists eagerly accepted the idea. INCRA obligated colonists – as state beneficiaries – to grow sugarcane, in a 15-kilometer radius around the refinery. This would be the dominant land system in this area for a quarter of a century.

But the sugarcane complex suffered from the beginning. With misguided planning and administration, the colonist community patiently produced sugarcane for over two decades, before the government abruptly determined to shutter it. But this happened *after* the government had advanced significant credit to the colonists for the large labor crews that came from the state of Maranhão to cut the cane and haul it into the refinery. Because the credit was discounted from the value of delivered sugarcane, INCRA had no cash to pay back the colonists, and instead chained them into debt with the Bank of Brazil. The accounts had already been adjusted, they said. We bureaucrats have our hands tied. You, the colonists, not INCRA, will have to pay back your debt to the Bank of Brazil.

Scores of colonists were abruptly put into arrears for the value of the sugarcane that they had grown but could not sell, as the refinery was their only market. These debts had high interest rates, and the interest was continuously capitalized; many colonists' lots were sold at auction; the Bank of Brazil building that served the refinery industry was eventually shuttered; the state's land on which the refinery stood was invaded by squatters who established chácaras.

Thinking of that past time, I saw that there was one sumaúma tree that remains on the low-lying flat areas on Pernambuco's farm, which was spared. It would have overlooked the 200 acres of sugarcane that filled most of Pernambuco's lot, down to the riverbanks. Flowing to the north, the water of a tumbling river glistens with the sun darting down and lifting back up from the east. The tree looms overhead on my left as I walk in. It would be hard to know that this land was recently

planted in sugarcane. Many tall trees, vines on the slope that trundles down to the river for the first several minutes of walking, then a two-crop cacao and açai system on the left, then just cacao on the right. I walk back along a rutted road, slowly at first. I see a wooden shack perched on a bank above a stream bottom below, where Pernambuco had planted his corn. There is a plastic sheet arranged on some lashed together poles, covering a spot to defecate.

A sultry dog starts to growl but doesn't get off his haunches as I determine to move past. Then along more cacao, without trees except for embaúba or *cecropia* in gaps and an ancient Brazil Nut tree standing sentinel like the sumaúma. The land starts to slope upward, and I pick up my pace, the cacao looks disciplined as a single crop, then further up the hill I listen, to the left and to the right. There are voices to my left and I see motorcycles tucked in under the shoulder high branches. Woop woop. Hey-ooo. And there they are. Chico and his day workers that he has hired, cutting down cacao from the trees, and I hop under the branches to join them.

Late that afternoon, Chico and I are walking downhill back to the front of the lot from his sharecrop plot. There is a precarious tractor track, deeply rutted, with round stones the size of basketballs. rarArAAA! A Macaw cries out, with her mate. In bright conversation, they swoop down and spin with their long red and blue tails to visit another Brazil Nut tree. Golukilukigulu! Parrots in formation, speeding through the pearl lit dusk. Chico is showing me how the person or persons responsible have not taken care of the cacao in an area that we are now walking past – about 5,000 trees? 10,000? Chico shows me where to look. He is wearing flip flops, Bermuda

shorts, an old polo shirt and a baseball cap. He carries a machete on his belt. He points toward a branch that looks dead, its brown dried leaves all still attached. One disease out of many affecting the tree, he says but the way to manage disease, says Chico, is by paying attention to the trees. Especially in pruning, which is understandably labor intensive. In fact, controlling certain diseases like *vassoura de bruxa* (witches' broom fungus), perhaps the most difficult of all, can only be done by hand. But it is work that a human body can accomplish with minimal technology; nor is the work back breaking. With cacao, like peach trees, the idea is to keep an open center, to let in solar energy. The hybrid cacao trees were bred by CEPLAC to produce more fruit, however not in full shade. Cacao trees have to be controlled in their desire to grow upward – they are shade trees originally, but the canopy is 40 meters up, so cacao trees, hybrids notwithstanding, easily get up to 20 meters. Pruning work involves an assessment of each tree's character, and a set of hopefully decisive actions about how the plant will respond to cutting certain branches and where along the branch. I had worked pruning on a different farm. That day the idea was simply to remove the *galhos* – the green stems shooting upward from lateral branches, and, especially, to remove vigorous central branches that were trying to become the trunk and to take the plant up to another vertical level. We used the same podão tool that we had used to cut the pods, to prune the branches, making sure to sharpen the steel with a sharpening stone.

In his mid 50s, Chico had been born in Paraná in the south. He said he was mixed with Guaraní indigenous blood. He arrived on the TransAmazon in 1980, nine

years after the start of government land distributions, Chico's father had bought land with cash. They had come up in a truck on the Brasilia-Belém highway, two men, one woman and two children, and himself, twenty years old. Then, they had come to this particular area in a bus from Belem, six of them. He started working when he was seven years old, he told me, going with his mother on labor crews in Paraná, working fields of wheat and corn. The area here on the Transamazon was very different now compared with the sugarcane era – he told me. Then it was smoke and suffering. And now there was only himself remaining. His remaining brother I learned was killed in a motorcycle accident just a few weeks after I had sat down to work with him, a beaming, slightly grizzled man, also of short stature like Chico. he was drinking *pinga* (rum aguardiente). What can you do, he said?

How long have you worked with cacao? More than 30 years working with the crop, he said. *Mexendo com lavoura que eu aprendi*. He learned by working in agriculture. He started in 1984, working on kilometer 100 and 105, in every corner of Medicilândia, he had worked with cacao and black pepper. Black pepper had had a very good market, compared with cacao. The region had grown a lot of pepper, but then a blight appeared that wiped out the crop across the entire Transamazon in around 1999. Cacao had had an average price back then, but now, the price was phenomenal.

Another afternoon, in the sultry shade, sitting on the ground next to the cooking shack and the growly but now friendly dog, Chico tells me about his work experience as a sharecropper. On Pernambuco's lot, he told me, he spent 30 days,

more or less, to prune 6,000 trees spaced out over 6 hectares. It took a month, arriving on a motorcycle, rolling cigarettes using note paper, listening to urban flavor music on his cell phone. But this cacao is badly managed, tall, hard to harvest. Not like where he was before. Where were you before working on this lot, I asked. Before 2002, he had lived and worked on kilometer 95 north, messing with *lavoura branca*, or annual crops, like tomatoes. In 2002, he came to live in the town and worked in labor crews, weed-eating pastures, weed-eating cacao, not messing with sharecropping. I worked nine years as a barber, then about 11 years ago, 2005, I grew 5 hectares of cacao, about 5,000 trees, as a sharecropper for a landowner on kilometer 85 north. My family did it, my wife and children there along with me.

The thing with cacao, he told me, is that for the person who knows how to work with it, you plant cacao in January or February, then you have your bananas in by October. You can cover your expenses in one year just by planting bananas, which come in during the first year, while you wait for the cacao to start producing in around year four. It is the obvious thing to do, and so there isn't any risk planting cacao for the person who knows what they are doing. He had done that on kilometer 85 north, planting banana and some açai, and leaving certain trees standing: ipê, jarana, maçaranduba, castanha. Then, cumaru and tatajuba seedlings sprouted up spontaneously. Ipê, jarana, maçaranduba and castanha (Brazil nut) trees would grow to be the tallest; along with tatajuba they were all excellent timber, and together would form a cover over the agroforestry system. Cumaru trees, the seeds of which

produce medicinal oil, grow to a middle range above the height of the cacao trees and below the canopy.

The old area was located 8 kilometers in on the kilometer 85 north travessão, about 13 kilometers from town, or about 20 minutes on motorcycle. What was time consuming, he said, was getting to the back of the lot, to the cacao itself. The lots designed by INCRA are long rectangles, with the short side facing the feeder road, with 2 kilometers to make your way in, along a picada. To dry the cacao, we had to stretch it out on plastic sheeting, we didn't have a barcaça, or cacao drying platform with a rollable roof cover that could be quickly put into place before a rain. It was a really good place. Cold, mineral water, a special place, *bacana* (awesome).

The *meeiro* or sharecropper is obviously in a riskier position relative to the owner of the land, and there can be a lot of variation in the economic outcome. In 2016, however the price for dried cacao seeds sold to middlemen merchants was 9 reais – just under 3 U.S. dollars – per kilogram. If a plot is well cared for, or on fertile soil, like terra roxa, one could expect perhaps 1 kg of dry seed weight per tree per year. With approximately 1,000 trees per hectare, that meant, split in half with the landowner, 4,500 reais, or just under U.S. $1,500 per hectare. Thus, with 3 hectares of cacao, the sharecropper would gross U.S. $4,500 per annum at that price. The problem was that the middleman price would vary widely, often within one season. By early 2017, the price was down to 6 reais. These sorts of agronomical calculations were always part of the conversation.

Here on Pernambuco's lot, even with it being simpler to get back and forth to town, the expenses are higher, because Pernambuco charges 100 reais to use his tractor and wagon to haul cacao out to the front of the lot – about 1 ½ kilometers. This year, Chico spent about 30 days pruning, about 6,000 trees spread out over 6 hectares. The most recent harvest of 500kg, took about 34 days of work, counting everybody involved – with 10 people in two groups of 5 working breaking up the fruit pods and collecting the seeds into sacks. It took seven days to cut the fruits out of the trees, and four days to consolidate them in piles.

So, after paying his workers, 50 *reais* or about US $15-25 dollars a day depending on the exchange rate, Chico would pull in about 800 *reais*, roughly US $250-400 in roughly two weeks, equal to a Brazilian minimum salary. The cacao trees here were tall, and poorly cared for, in his opinion. *Bagunçada*. A mess. It takes more time to harvest and the crop isn't as good.

Below is a graph figure approximating the temporal shifts and intensity of working during the year, based on interviews averaging the work of a typical sharecropping family. Although a one-time event in establishing a plot of cacao perennials, I have included the work intensity of slashing and burning 3 hectares. Fire doesn't do the whole job. It is extremely labor intensive to clear Amazon forest.

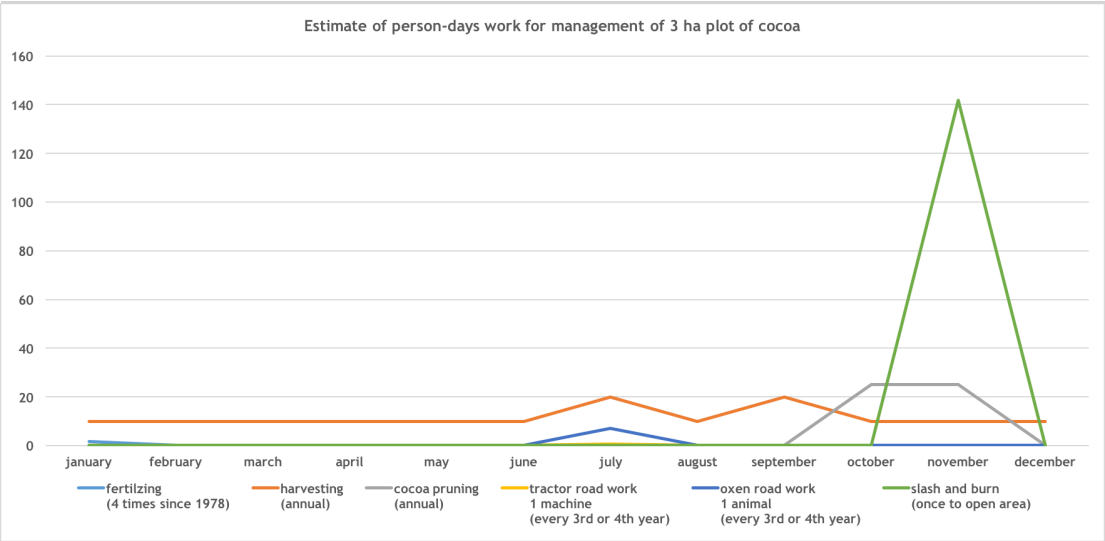

Figure 2.1 Estimated person-days' work by month in a 3-hectare cacao perennial or agroforestry system

Chico was working on an area slightly larger than represented by this figure: 5 hectares at his old sharecropped plot, and 6 hectares here on Pernambuco's lot. Imagine, the other area Chico was forced to leave behind, he had harvested 1200kg on 5 hectares[7]. It would take four days to cut down the fruit with two people (8 days), two days to pull the fruit together (4 days), and just one day with 4 people to break up the pods. Good sound pods, good fruit. So about 15, maximum 20 days of labor. The cacao trees weren't as tall and awkward to reach.

While Chico had made a good livelihood on his previously sharecropped plot, here, facing the TransAmazon highway itself, in the center of former sugarcane modernity, he was pulling in less than half the harvest in the same time. Pernambuco doesn't know what he's doing, said Chico. He pays his day workers like shit, 30, 40

[7] Both the 500kg and 1200kg harvests cited here are poor harvests.

reais a day (10-13 U.S. dollars). And the food, you have to be here for lunch to believe it, the food he brings for his workers. I heard that his wife cooks the food like that on purpose so that the workers won't ask for another plate. I just laugh: cheapness all around. *Melhor trabalhar nas minhas costas*. Better to rely on myself, said Chico. I was there on kilometer 85 north sharecropping from 2009 to 2016. But then his sharecropping contract expired. After four years spent forming the crop, and five years of harvesting it. "We didn't have electricity there, there wasn't a road to the crop." It seemed as if Chico was painting the move with the inevitability of modernity. But in the same breath, he seemed to long for the place.

> *True land reform is needed, obviously, I don't have my own cacao because I don't have the land. I'd be planting cacao if I had land. I'd be great if I had 10 hectares. If I had obtained land 10 years ago, I'd be driving a nice car. Just a little land. These lots are huge, he says, too much land for one family to take care off. There are how many sharecroppers here?" He starts to count them off out loud: two, five, six, eight, nine, ten, eleven sharecroppers he has here. At the other place, it was a chácara, 10 hectares. The owner had bought 5 hectares … after working with some cacao there for two years, he sold a lot that he had at Miriti and with that money he bought 5 more hectares. The owner was completely different. Here with Pernambuco you'll die of hunger. But the other landowner didn't like to see anyone suffering. Working with him, your belly was full. Barriga cheia (full belly). He wasn't mesquinho (cheap). Pernambuco remembers if you owe him 10 reais, and his own son is ripping him off. He's so cheap that he doesn't get anywhere. And no one wants to work with him. It's sad, he's sending workers away.*

I sympathized with Chico's situation, and what would constitute actual land reform. One could see that with the original land tenure plan of 100 hectares, it was impossible for one family to manage the land in horticulture or agroforestry. Labor is

not limiting for cattle, whereas for cacao, a lot of with 60 hectares in perennials would need 400 person-days of work per month during the peak harvest months, and 500 person-days during pruning months. A demographic model of household utility, applied by so many researchers, could not represent the economic bifurcation between two management systems or temporalities. One family can only manage about 5 hectares of agroforestry or horticulture by themselves. Such a system I would argue is a labor empowering means of securing a livelihood, without self-exploitative drudgery, given approximately 20-30 days of work needed during peak harvest and pruning months. 6 or more hectares of horticulture in a chácara, with additional shared or temporal labor, meant livelihood security, as we saw with Raimundo and Ademir. On the other hand, I had seen how other lots of 100 hectares in size – planted in even more labor intensive sugarcane during the heyday of the TransAmazon's development – be completely abandoned.

Chapter one conclusion: Agroecological Invisibilities

This chapter has attempted to initiate a path toward a reconsideration of culture and ecology in a landscape largely without anthropological attraction of identity or alterity or cosmology. The words for non-humans are Portuguese and the conversation often focused on production. As we are seeing, it is a 'ruined' modern agrarian landscape, inserted in a tropical forest environment, with recent human migrants, themselves of various ethnic and cultural identities. Do they represent settler colonialism? I have tried to zoom in on the complex material and temporal

character of livelihoods. I have observed how these smallholders and peasants managed their livelihoods and gauged their own work in relation to specific trees and soils. I have zoomed in on the complex material and temporal character of the landscape.

Landscapes may not have identities or metaphors draped over them, freezing them in time, so much as ongoing resonances in interactions between biology and culture. “Blanketing metaphors actually serve to create and perpetuate an intellectual space in which [deterministic or mechanical] human ecology … can flourish, untroubled by any concerns about what the world means to the people who live in it” (Ingold 1993: 171). As such, I have tried to take a step closer than has been usual in human ecological modeling of the TransAmazon, to get a sense of the livelihood perspectives and motivations of smallholders and peasants.

As I walked the landscape, and worked with Raimundo, Ademir and Chico, I learned to appreciate their and their collaborators’ decisions in relatively small areas. Innovation and technique seemed to be more important considerations than labor intensification per se. Labor intensity was obvious for this type of horticulture: a family could maintain no more than about 5 hectares of tree crops or agroforestry by themselves – but the organization of work and temporal rhythms, of harvest, pruning, managing vegetation – the how, where, when, why – were important. The ability to move back and forth between town and country, mixed livelihoods, labor trades and sharecropping, were other important factors. If only land tenure could be organized relative to the humble scale of these efforts.

The conservation of agrobiodiversity in smallholder landscapes has been documented (e.g. Dawson et al. 2013; Harvey et al. 2008). But due to the dualism inherent in the idea of the frontier – and the dominance of cattle in the landscape – the TransAmazon and other smallholder landscapes in the Brazilian Amazon, like Rondônia, have been largely left out of the discussion on agroecology and critical landscape ecology so influential elsewhere in the Americas. Brazilian Amazon smallholders, like Amazon traditional peasants (*caboclos*), suffer from a "identity" invisibility, in part because of academic and popular perceptions about the Amazon as being divided into indigenous forest and capitalist modernity (Nugent 1997, Brondizio 2004). Further, as the smallholder/peasant on the TransAmazon supports neither the nature-indigenous or modernization-development pole, they have become something of a flotsam population, abandoned by the state, but repeatedly surveyed.

Yet the useful trees in this landscape have profound historical ecological and ethno-ecological relevance – the colonists are cultivating or valuing the same species that native and caboclo populations have done for centuries (Miller and Nair 2006). Other species in the Amazonian landscape – e.g. mangos, breadfruit, citrus – result from the Columbian exchange (Crosby 2003), but the majority of the planted and useful species are Amazonian. We will return to the cultural and ecological resonance of different species in chapter three – Invisible Transamazonia.

But first, we need to get a better sense of the state's hold on this place, and the models and farming arrangements that were imposed upon it. More critically, we need to appreciate how the interaction with the state and the environment transformed

these migrant colonists, reconstituting them through the ruin of the state, matched with a surrounding hegemony of cattle ranching tied to political and financial interests.

3. Chapter two – In Transamazônia

Sugarcane plantation ruins set a strange stage for social reforestation at smaller scales.

Government directed settlement on the Transamazon highway was unusual compared to how frontier settlement has tended to occur across the eastern Amazon and in Pará. At least at the start, political networks or access to capital did not determine how land was being distributed on the Transamazon. Being a beneficiary on the early Transamazon made land tenure less a question of political favoritism or of speculative maneuvers – many were ragged migrating peasants with little but the clothes on their back when they arrived. But with this initial state directed prototype for peasant resettlement, the colonists were eventually abandoned by the state. And even with state support, in the early years, if they did not simply give up and leave, they were struggling to survive in the face of the unknown environment and thwarted attempts at farming.

Furthermore, while the Transamazon was initially such a government run land distribution program, drawing in willing migrants from the northeast and the south, colonists in Medicilândia would be forced to participate as managers in a sugarcane plantation network. The plantation model of land use on the Transamazon was expressed here in terms of modernist state planning that would attempt to discipline the land and labor into an efficient network of production. This agro-industrial mode of development was surging in the twentieth century and was akin to U.S. promoted

approaches to organizing sugarcane networks on Puerto Rico, which had served to expel small farmers from the land and turn them into labor crews.

In Jamaica and Haiti, however, peasants had remained firm in resistance against the modern plantation form, in smallholding communities. And theoretically, to frame this story I use Sidney Mintz's work on these latter social transformations and resistance to plantations in the Caribbean. Peasantries are defined by Mintz as 'small-scale cultivators who have access to land… producing a large part of the products they consume, but also selling to (and buying from) wider markets, and dependent in various ways upon wider political and economic spheres of control (Mintz 1989: 132). In the Caribbean, Mintz went further to argue that many communities in Jamaica and Haiti were 'reconstituted peasantries' that had begun in slavery, deserters or runaways, plantation laborers or whatever – and had become peasants as a mode of response to the plantation system and its connotations, and a mode of resistance to externally imposed regimen (Mintz 1989). Thus, Caribbean peasant livelihoods and the landscapes themselves were lived critiques of capitalism, at least that form of capitalism that had been expressed through the plantation form.

The situation on the Transamazon is rather different, however, because the colonists themselves had been the plantation managers themselves, while labor crews had been organized externally to the community and brought in seasonally from Maranhão. The colonists in effect awkwardly reemerged as smallholder peasants after the collapse of the state plantation network. They were forced to try to appropriate what was left of the state, transform and rebuild landholding, agricultural, and

marketing systems into an emerging post-frontier culture. But the interest of exploring this social and also ecological transformation is still the 'reconstitution' of a smallholder peasant response to capitalist land use.

The objective of this chapter is to trace the social and ecological history that set the stage for such life and land system transformations. These transformations are still nascent but may suggest rural development and cultural alternatives to speculative pressures and attitudes that continue to devour the region elsewhere. Medicilândia is a land use anomaly, which doesn't fit the expected pattern of land use for the recently colonized Brazilian Amazon. It is the only municipality on the Transamazon highway in which the principal economic activity does not consist of cattle ranching and logging (see IBGE statistics at the start of the previous chapter). When one drives into the municipality, there is a striking shift from pasture/cattle to a tree-dominated landscape.

Methodologically, this chapter is mostly about recounting the past and description of the current landscape. I will rely heavily on oral history and engage the now rather dusty literature that deals with this case. In particular, this narrative will start to outline how land tenure and land use involve scales at which, and through which, socio-ecological relationships are perceived and materially negotiated. In these experiences, social transformation is linked to ecological transformation. The chapter is structured as follows. In the next section, I describe the landscape of the Brazilian Amazon 'post-frontier' in a long traverse from Santarém to Medicilândia. Then, I introduce the chapter's primary interlocutor – Rogério – who tells the story of

migration from the northeastern Brazilian state of Ceará. Rogério will accompany us throughout the rest of the chapter. The following sections describes agroecological conditions of migrant colonist farming on the Transamazon highway in the early 1970s, leading to the state's sugarcane project. The final section describes the collapse of sugarcane and of the restructuring of the landscape in its aftermath.

The Transamazon Highway

Prior to the 1970s, the land between the Tocantins and the Tapajós river tributaries of the Amazon was inhabited mostly by indigenous peoples. In 1964, with the support of the U.S. Johnson administration and the CIA, a military led coup removed Brazilian president João Goulart. The incoming Brazilian military government was set on expanding the nation's territory with the aid of foreign capital. In public discursive terms, however, it was said that settling the frontier would protect Brazil's Amazon from American foreign influence.

Figure 3.1 The Transamazon highway in 1972.
Note introduced pasture at right with nascent fire-resistant babaçu palms.

From the perspective of an airplane flying at jet cruising altitude, the land between the Tocantins and Tapajós rivers, through which the Transamazon highway would be constructed, appears to be flat. Development planners assumed that the area could be settled according to a determined geometric arrangement of *agrovilas* (agro-

villages), *agropoli* (agro-towns), and *ruropoli* (rural-cities). The third military president Emilio Medici believed – or the government and foreign advisors that surrounded him believed – that land colonization in Amazonia could be used to address the issue of drought and peasant uprisings in the Brazilian northeast and south. The National Integration Project (PIN) would be designed, at least at first, around a system of smallholder farmers' settlement, combining subsistence with commercial agriculture. The plan was contemporaneous with other land reform projects of that period, namely in Taiwan, South Korea, etc. – the impulse to defuse communism through state led land interventions.

But state directed colonization of the Transamazon west of Altamira was unusual. At least in its early years (roughly 1971-1974), at the height of the military dictatorship, there were scores of boots on the ground here. This was the original operating ground for the National Institute for Colonization and Agrarairn Reform (INCRA), which, regardless of being woefully underfunded since the 1970s, has had jurisdiction ever since over government land destined for social distribution. Unlike southeastern Pará (cf. Schmink and Wood 1992), the area was less disposed to violent conflict or to *grilagem* – falsified land claims. Here, INCRA was actively directing settlement. In roughly 100 hectares (247 acres) lots along the highway 'track' and for 12 kilometers to either side, which initially were a set of *picadas* or forest trails.

This was an exception to how colonist settlement has worked elsewhere in the region. Elsewhere in the region INCRA would develop settlement plans *after* colonists moved into an area (e.g. Castelo dos Sonhos in southwestern Pará, as

documented by Campbell 2015). On the Transamazon, for the first few years, the state vetted beneficiary families for the Transamazon before they arrived, elaborated documents, paid salaries to the colonists, provided technical assistance and credit, and guaranteed a market for rice. The agrovilas hosted health clinics, schools and ecumenical chapels. Arriving colonist families committed their labor to attempting to raise commercial crops under the state's guidance.

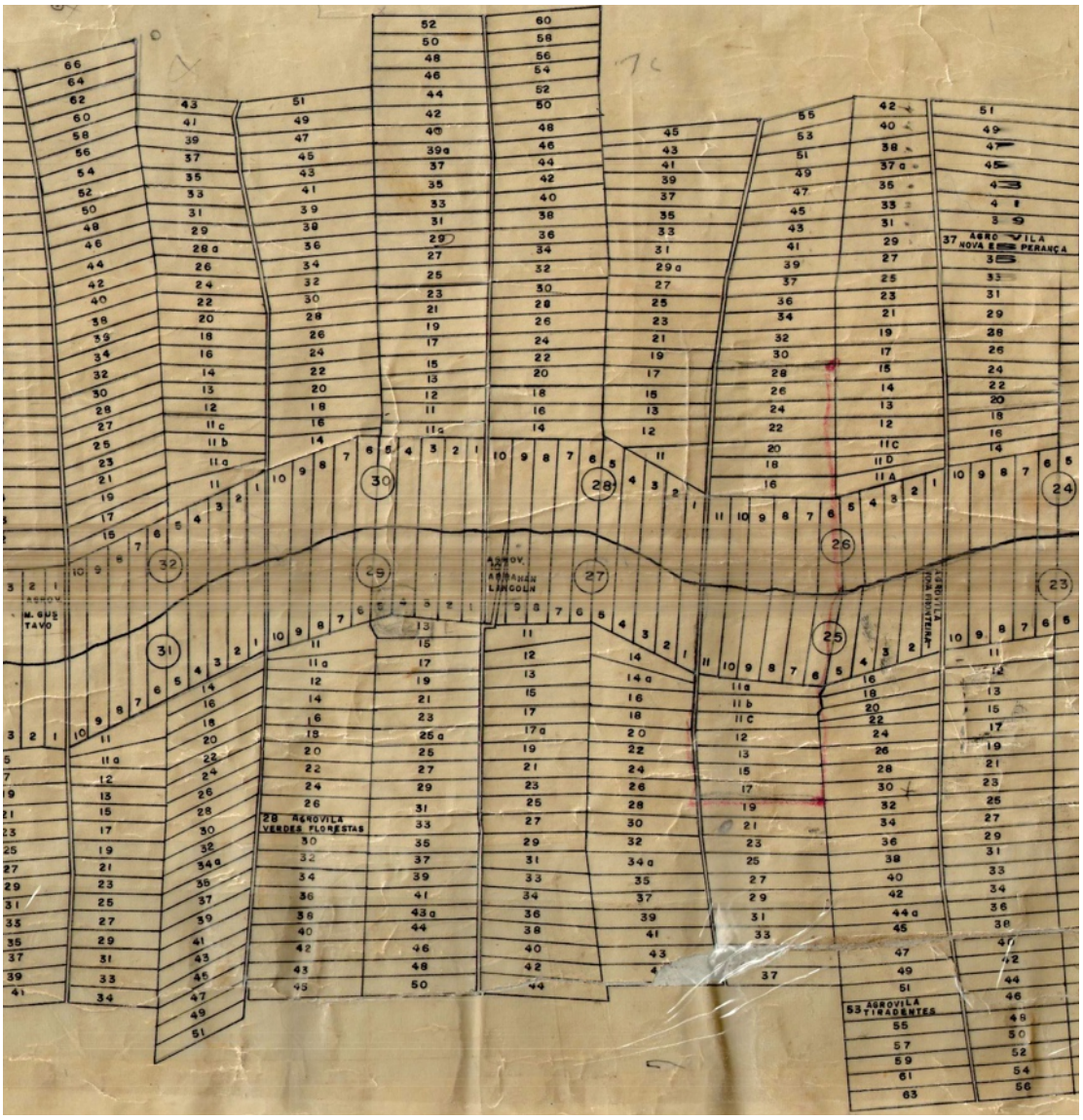

Figure 3.2 Brazil government map of Transamazon land cadaster from the early 1970s. Note the agrovilas: "Verdes Florestas" (Green Forests), "Nova Esperança" (New Hope), “Nova Fronteira” (New Frontier), “Abraham Lincoln”

These lots were roughly all 100 hectares, except for lots facing the highway, which are 120 hectares. Each lot is thus 2 kilometers long, which takes nearly half a day to walk! In other parts of the highway, the government distribute 500-hectare glebas – but only to more capitalized actors, intent on cattle ranching. Indeed, the

military dictatorship has long been viewed as involving the consolidation of class-based capitalist accumulation in Brazil. The state did not sustain its interest in social policy for the landless; and state directed, green revolution planning for smallholder agricultural enterprise was woefully unsuited for the Amazonian ecology. The state was simultaneously distributing land to very large ranch operations, involving significant tax subsidies (Hecht 1985, Hecht and Cockburn 1989) – the land cadaster on the Transamazon was also being used to distribute larger *glebas* of 500 hectares, but not in Medicilândia, where the average lot was 100 hectares. Larger land distributions increasingly took priority after 1974, as the state shifted into supporting capitalized interests (Smith 1982: 18; Browder and Godfrey 1997).

State organized land distribution on the Transamazon however could be viewed almost as a short-lived symbolic gesture. Social unrest was on the rise in the northeast of the country in the late 1960s, further exacerbated by a series of harsh droughts in an already water scarce region. While the dictatorship built the Transamazon project to defuse social unrest, at the same time it brutally suppressed social dissidents and resistance to the dictatorship in the northeast (Pernambuco) and in the center west (Araguaia). Further, the dictatorship was intimately linked to large cattle ranching interests, wherein tax subsidies and favoritism coalesced into a particularly political form of land use and occupation (Hecht 1985).

So, it was not that the state tried to modernize the Amazon and failed; it was that the transamazônica could be read as a sideshow: The Brazilian state was not interested in peasant modernization per se, but in consolidating capitalist alliances

between the urban bourgeoisie, rural land occupation, cattle ranching, timber and mining extraction. In Medicilândia, the state (INCRA) held on, ostensibly in support of family farming. But a quarter century later, migrant landless peasants, who had found themselves managing sugarcane plantations, suddenly found themselves penniless peasants all over again.

The unusually long duration of a state project on the Transamazon meant that size of land holdings would remain consistent – around 100 hectares per colonist family. After the collapse of this system – and forced into debt with the Bank of Brazil – colonist farmers would shift to using family and shared labor to reforest the landscape with cacao and other trees. 100 hectares (247 acres) was more than enough land for perennial crops or agroforestry. But for these sugarcane growing colonists, who had struggled to sustain livelihoods through market-based agriculture, 100 hectares was too small an area for profitable ranching. A 100-hectare lot at most might support about 60 head of cattle. Putting cattle out on a few score hectares, at this well-established stage of land tenure, was penury.

Also, the colonists had been forced deeply into debt, when the sugarcane network was abandoned by the state in 2000. When INCRA determined to close the sugarcane mill, the colonist farmers' accounts had already been credited, and were thus in debt with the Bank of Brazil. Without a market for their sugarcane, they were instantly put into arrears and many farms went up for auction. Rather than a state program actively impelling reforestation, there was thus social resistance to state abandonment in recuperating land with their bare hands, without capital. But without

this artificial "control" on land possession and use, the landscape might have shifted into the more expansive system of pasture and ranching, which I describe in the next section. Inequality amongst the colonists would have allowed for certain families to buy up land – forming ranches – the usual pattern for the Transamazon (Ludewigs et al. 2009). For example, 90km to the east, livestock pasture dominates the area surrounding Altamira – a landscape with identical soils. The state's controls on land tenure, as we will see, led to a reconsolidation of land systems into smaller units of management, using cacao and agroforestry. I argue that labor exchanges across the landscape, the use of shade agroforestry to adapt for soil types and more frequent droughts, and high incomes from cacao in smaller areas, allowed tree-based production to consolidate itself and counter cattle ranching's political economic dominance elsewhere in the region.

Arrival

About once every two months, I would be driving between Santarém, on the shore of Amazon river itself, and Medicilândia, located in (what had been) upland forest on the Transamazon. This meant traversing a variety of landscapes, some of which resembled what this world looked like decades ago – relatively dense *terra firme* (upland) forest. Santarém was located on the shores of the confluence of the Tapajós and Amazon rivers, a 'caboclo' riverine city dating from the 17th century. The much more recently settled Transamazon, however, was dominated by ranchers, smallholders and "neo-peasants" (Adams et al. 2009), recently hailed from Ceará,

Pernambuco, Bahia, Minas Gerais or Paraná. Traversing between the two meant heading southeast out of Santarém, past soy plantations, a small hydroelectric project, then a forested area with landholders cultivating black pepper in small openings, then up to a plateau of upland forest – affected by logging but still continuous – then descending down upon the Transamazon itself, which stretches roughly east to west.

Figure 3.3 Google map sketch of described overland route (bright red line) from Santarém on the Amazon river, to Medicilândia on the Transamazon highway. The municipality is outlined in a lighter red. Note Belo Monte hydroelectric site at east on the Xingu river, Fordlândia at west on the Tapajós river, and Arara indigenous reserve inside and south of Medicilândia. Scale: one inch = 60 miles.

After leaving the extension of this older river town and its suburban caboclo communities on tiny plots of land, the landscape shifted to a perhaps thirty to forty-kilometer-long stretch of soy plantations extending to the horizon. Sometimes with a dramatic plantation home encased in the middle of its technological prowess, with

two rows of dying decorative palms (species?). Then, once reaching the Curuá-Una river, driving over this small hydroelectric dam, wistfully gazing at the dead trees in the flooded watershed, you would hit a set of small settlements, and the road would begin to climb into a drier forest plateau with multitudes of towering Brazil nut trees (*Bertholletia excelsa*).

On these lengthy drives traversing Amazônia, I day dreamed about forest regrowth in the midst of climatic change. I came to the start of a long but relatively narrow clearing, a long plane of pasture stretching to the horizon like a de Chirico painting playing with perspective. Here, a 60-meter-tall Brazil nut tree – its thick branches cradling upward like an oversized tropical oak – was in bloom. The flowers had sprinkled the road with their gem like structures, and I immediately pulled over, and got out of the truck to walk over to pick them up – sweet smelling white flowers with their heavy petals that took the strength of large orchid bees to open. The trees produced wooden spheres that would careen down from the canopy during tree's seeding season, starting in December. It was well known in the region that one didn't want to stand under Brazil nut trees during this time, as when toppling earthward these could kill a person. Noble things –the tree presided here over a cacophony of diversity and regrowth.

Continuing on the road, I passed slash and burn openings where smaller colonists were growing black pepper vines directly next to the road. This same crop had been tried on the Transamazon to the south, but abandoned after a fungal blight devoured the plants around 1975. I saw the pepper in rows of stakes, or sometimes,

the clearing hadn't yet been planted with pepper and the opening was quickly coming up in secondary regrowth. Here I was in the midst of thousands of square miles of degraded tropical forest – a "despoiled landscape of the not-there" (Raffles 2002: 153). The landscape would not impress an ecologist or biologist interested in primary tropical forest ecology. The roadside vegetation was blanketed with red or yellow clay, tall clumps of brachiaria grass, vines and shrubs. In places where the forest had been cleared with fire, babaçu palms spit up out of the charred soil – a fan of green, with mature babaçu palms with their palm leaves rustling. In areas dedicated to livestock, there were the white Nelore breed young bulls and cows with their gentle long ears and bony carcasses plodding between dry and concentrated tufts of brachiaria grass, with exposed soil in between. Further back, the bleached cradling arms of dead brazil nut trees. Notwithstanding this description of deforested land, however, the landscape was shifting in and out of formation – it quickly formed *capoeira* or *juquira* – secondary regrowth stands of babaçu interspersed with Cecropia and other trees.

This landscape could be seen as an ecological ruin, but I was struck by the speed of secondary regrowth. Pará was famous for its weeds – how easily scrub forest could re-colonize the land, provided that it had not been burned too often. The *Cecropia* genus, for example, became a welcome sight – as these trees meant that forest succession was underway. Cecropia is one of the most widespread and well-known groups of pioneer species in the humid Neotropics (New world tropics). In spite of its ubiquitous and conspicuous existence and its significant ecological

function, however, it has rarely been studied, by taxonomists or others. One of the reasons involves the fact that aggressive ants live inside most species. Cecropia trees are few-branched, usually with candelabrum-like branch structure (Berg et al. 2005).

There were no buses that travelled this road. And these were dangerous roads on which to move. Ubiquitously, rancher or other wealthy member of this society drove white Toyota Hiluxes – arrogant symbols of capital that could transcend the vagaries of the road. The Hilux is also the favored model of trafficking cartels and terrorist movements. These Hilux trucks moved with a geographical cynicism – tearing past families stacked on motorcycles, leaving them smothered with dust that would spew up like a mini volcano. The truck I drove, however, was over a decade old, for which modest smallholders might opt. Its model name (L200 Outdoor), for locals, stood for *Ai que dor* (oh what pain) in Portuguese. Less withstanding of abuse, it would be battered by the rood environment.

It was rare to have a smooth road. That the roads were largely unimproved meant that one could feel tangible differences depending on the soils. For example, the yellow clays in latosols were harbingers of woe. Boulder infested morasses of kaolinite clays so tightly packed that they feel like metal corrugates. One would skid to a speed of 20 km an hour or less to navigate these difficult stretches. Hitting undulations of stones and the mini hills and valley of the clay makes travel on these roads painful. While most of the soils are yellow latosols, or yellow-reddish podzolic soils (argissolo in the Brazilian terminology), however, there are some areas in which

ancient basalts flows have been left near the planet's surface, where ongoing erosion of parent material has allowed for mineral enrichment.

In this case, the color red can mean fertility – soils with significant content of iron and manganese. The Transamazon stretches along the northern edge of the Pre-Cambrian shield – the ancient continent Gondwana. In these areas on the Transamazon, the soils are the result of weathering basalt parent material that is over a billion years old. The area with perhaps the most terra roxa is Medicilândia, mostly on the south side of the highway. The basalt parent material is here because this is a diabase dike, which, in a molten phase, squeezed through a fracture between Silurian and Dilurian sandstones during the Jurassic. Rounded, dark-gray boulders commonly jut about on the landscape and especially in river beds. These boulders are traces of ancient lava flow.

Soils on the Transamazon vary from yellow to red, sometimes orange, sometimes with a purple or green tint. Seeing red *terra roxa* was always a welcome sight – it usually meant that, if dry, the clay would be settled, flatter. On the highway, seeing that particular color of red, one could travel fifty or even eighty kilometers an hour over the road surface. Called red structured nitosols – woefully characterized as an 'alfisol' in the USDA system – terra roxa occupies only about 3% of the Transamazon's area. It's a soil of remarkable physical properties. Literally purple earth, for the Italians who named it "rosso" in Brazil's southern coffee lands, the soil is not acidic and has amazing physical properties. The soil is remarkably difficult to

work with if dry, when you can barely get a pick or hoe into it. However, if you soak the soil with water, it loosens up, becomes more friable, and workable.

Yellow-reddish podzolic soils (argissolo in the Brazilian terminology) – meant mixed or less favorable places to farm. But these soils were still valued – farmers called them *terra mista* (mixed earth). These crude approximations – based on experience – worked in that the reddish tint, sometimes, was a good thing: it could mean the presence of iron and manganese oxides (??). A soil less acidic, less dominated by aluminum and iron cations. When soils are old, or greatly weathered, aluminum and iron tend to bind densely into clay molecules, thus preventing the release of phosphorus and other nutrients. Highly acidic aluminum and iron salso uffuse the soil solution in the form of Al+++. Farmers learned to read these lands, using what knowledge they had from the south or the northeast, sometimes using a machete to slice into the earth and pull up a simple profile. There was variation in the soil and soil fertility not reflected on soil maps, which were often completely wrong.

In general, however, these soils were ancient surfaces beveled by millions of years of weathering and erosion – some of the oldest soils on the planet. Without volcanic activity to enrich soil mineral content, and with underlying rocks being generally acidic, many Amazonian soils are indeed complicated to manage, unless one is planting crops like manioc that evolved in this region and which grows in very acidic soils, and even in sand. While Amazonian soils are sometimes perceived to be 'poor' by scientists and in terms of oft repeated narrative about fragile and temporary

fertility in slash and burn – many soils in Amazonia are quite manageable, especially by using shade, limiting the use of fire, and preserving organic matter.

I was approaching Medicilândia from Uruará, at the point, 120 kilometers to the west, at which the traverse from Santarém meets the Transamazon. Night began to draw in, quickly, as it does at the equator. I was nervous. The most devilish element on these roads were the nocturnal logging trucks. Wired together behemoths – often without headlights – that served only to move the logs – often without doors, or headlights, some might improvise with a flashing LED. These trucks would often travel by night so as to avoid interaction with government agents. The drivers were unskilled men serving the syndicates that logged without permits. On the road, sight of a logging truck – or, more often, its accompanying impenetrable cloud of dust, meant getting onto a safe spot on the shoulder, and coming to a full stop with your headlights on. The clouds would cover you, the blinking LED light out there in the dark, slowly approaching, as the dust burned your nostrils. Then, after the beast had moved on, a minute or so to wait for the dust to settle, before driving on again.

Rogério's story

I finally arrive in Medicilândia that evening, and park in front of Jorge's general store. His house, where I am staying, is located behind the store. Jorge told me about Rogério – as he would know about the history of sugarcane and the mill. Rogério wore cowboy boots, rode a decades old motorcycle, and dressed in black – for, as Rogério told me, he was attracted to that color. He also touted a gold necklace,

and a digital watch. He had his shoulder length hair stuffed under a baseball cap. One of the original state sponsored colonists, he was now in his late sixties. But he had been one of the youngest beneficiaries. He kept late night hours announcing at the community radio station, where he would often sleep through the wee hours to continue announcing at dawn. like a flow of warm water, he made a practice of sending personalized greetings, using the names of whole communities in the agrovilas and on the side roads.

His family owned a 247-acre lot located on the kilometer 95 southern side road. It was Sunday, and I was going to visit him there at the lot. Today, about 85% of this farm was in cacao tree orchards, managed by 18 tenant families. Working with the tenants, depending on their needs for fertilizer, and depending on the general needs of the lot, daily he commuted by motorcycle between his house in the government village that formerly administered the sugarcane mill, to the radio station on a hill in the middle of the town on the highway. He then would move from the radio station to his lot, usually either a very dusty or very muddy short trip, taking about 20 minutes to cover about 7 kilometers.

He was adored by the community. But many took him with a a bit of suspicion, for, as Jorge told me, he was a Godless anarchist. In this deeply Catholic and evangelical world, where existence was usually punctuated with “thanks to God,” he struck a fascinating figure. Apparently, he had been involved in the Tapajós river gold rush – petty mining that had had its heyday in the 1980s. Such that during his lifetime he had covered huge distances moving around the country. His life had taken

him to the edge of indigenous worlds: here on the Transamazon, the edge of the Arara, there on the Tapajós, with the Munduruku. But he was still trying to figure out, as I was, the mess into which his fate had been cast.

That Sunday afternoon, and we were sitting out on the cement floored verandah under the tin roof. Bugue and Bala, who are sharecroppers on Rogério's lot, stopped by, intrigued by my presence. Rogério is magnanimous – please, come in, have coffee. We all sit there under the tin roofed verandah, listening to the story of how he and his family came here, and of his relations with the government, told with what was perhaps a bit of Northeastern Brazilian bravado.

My father, he says, was very brave (*valente*). His nickname was Ze Preto (Mr. Joe Black). It was the 1950s in the interior of Ceará, deep in Brazil's arid northeast where the *patrões* (overlords) owned all the land. The poor – including Rogério's father – were akin to feudal peasants (see Forman 1975). This was the land that had seen the rise of millenarian movements, and community accepted bandits who preyed on the landowning elite. The most famous bandit being the figure of Lampião, who led raids across the Brazilian northeast up until the 1930s. Rogerio told us his father had come from Pernambuco and had met his mother young; both AfroBrazilian, they lived in the *sertão* (backlands) on a *fazenda* (ranch) named Sitio Penha. On this ranch, a widowed patroness was lord of the land. Her uncle was state governor and the county judge was a relative. Dona Celvita determined everything – it was up to her who lived well, and who might from time to time be strapped up to be whipped.

And one day, Rogério's father, who worked as the *guacheba* (low status foreman) refused a particular task, and, on the spot, Dona Celvita fired him and told him to get off the place. Without a right to anything. She refused to compensate them for their belongings. But she asked Rogério's mother, who worked as a domestic in the big house, to stay on. And my husband? The patroness addressed his mother "woman, why are you leaving with this useless man." She replied: I would follow him and my children into hell. Dona Celvita taunted Rogério's father, telling him he hoped he would suffer. They prepared to set off, on one donkey: Rogério and his three siblings, his mother and his father. This was Sitio Penha, in Iguatu, Ceará, on the shores of the Jaguaripe river.

They left for the town of Iguatu, skirting groves of spiny stunted trees in the blinding sun. Then on to Fortaleza, where they found humble lodging. On the radio: ladies and gentlemen! Tomorrow a boat is leaving for the Amazon. The announcement was part of program in the state of Ceará to help northeasterners emigrate to the Amazon, out of these areas affected by drought. The program paid for travel. There was no land included in the deal; families would have to fend for themselves wherever they landed. Rogério's family had settled on going to a town called Altamira. They had heard stories about the Amazon – the "Indians" and jaguars; yellow fever and malaria; the patrões who stole women. But all of this paled relative to what they had lived through in Ceará.

The family took the boat, and arrived in Belém, where they were immediately quarantined by the government for measles. Belém is the original colonial gateway or

entrepôt city located on the south side of the Amazon's immense estuary. While enduring the disease over the course of a month, they stayed in stilted wooden shacks, listening to the slosh of river waves under the boards. Then another radio announcement led them to board another boat for Altamira. Belém took several more days by boat. River travel was the only way in and out of the area. Altamira was located above the *volta grande*, the big bend, a long rapids stretch of the Xingu river difficult to navigate,[8]. Large river boats had to dock at Vitoria de Xingu on the north side of the big bend; from there the journey to Altamira took a week over land. Altamira was still a small river settlement engaged in rubber tapping and trade in jaguar hides. Various indigenous tribes lived and thrived here – Arawete, Xikrin, Arara – occasionally attacking rubber tappers or trappers. There had also been conflicts with the settlement (check book by Altamira writer).

When they arrived at Vitoria do Xingu, Rogério tells me how he remembered his father dramatically kneeling down on the river docks, clutching rosary beads with one hand, a machete with the other. He promises his wife he won't let her be kidnapped. But then friendly riverine people started to arrive, asking about them – where were they from, where were they going? They made the overland trip to Altamira. Such that Rogério's family arrived in the Amazonian interior in about 1957, thirteen years before the Transamazon colonization project. In the 1950s and 1960s, cattle ranching had started to emerge in the immediate area surrounding Altamira. At

[8] Here, in 1989 the notorious Kararaô hydroelectric project was defeated by a coalition of Kayapó, Transamazon smallholders and the Catholic Church. But the project returned thirty years later, renamed Belo Monte, to erase the original indigenous name.

this time pasture land extended about fifteen kilometers outside the town; beyond was the upland forest. Rogério's parents secured a new livelihood as ranch caretakers, and Rogério thought ranching a decent livelihood.

But the federal government, in 1971, through INCRA, was going to be distributing land on the highway. Rogério was 24 years old, his wife Celina was 23. Married with several children, they lived with Rogério's parents on the Altamira cattle ranch. This is our chance, he told his wife. Because he was from the northeast, Rogério was eligible for an INCRA lot on the Transamazon as a very young man. The median age for government beneficiaries who migrated to the area in the early 1970s was closer to 45. Rogério and his parents also opted to join the program in 1972. They all went out to the area at kilometer 95 west of Altamira – an all day journey. There was just a picada trail leading into the tall forest, south of the newly opened road. Lot 20, sector 31. There it is on the INCRA map on page ten above – the fourth lot after the lots bordering the highway, about 4 kilometers southwest of the future sugarcane refinery, in a straight line. This is where you'd like to stay, the INCRA official asked? Yes, this looks good. Along with his father, his sister and his brother and law, they had each opted for a lot. Four lots total, or 400 hectares (988 acres).

In this way, the PIN/PIC/INCRA program settled about six or seven thousand families. This early wave of migration was organized, but land tenure – staying on the land – was a struggle, to grapple with the ecology and the expected or perceived scale of interaction. But then came the piun (black flies). His father, sister and brother in

law quickly sold. I'm going to stick it out, said Rogério – I don't have any land back in Altamira.

Settling

Jorge, who I mentioned earlier, managed his late father's immense general store in the center of Medicilândia, had told me about the horror of the black flies (simulid). Said with that Portuguese nasal stop – *piun*. The tiny flies had tortured the community – smaller than mosquitoes, they moved in swarms; their attacks were not limited to particular hours of the day. They were active during the rainy period of the year – at this time from November to June, peaking in May during the rice harvest. They left tiny bites that swell and itch like mosquito bites, but more numerous and which reach any and all parts of the body. Colonists would tie off their sleeves and collars, wear a hood, apply thick red *urucum* oil to exposed skin, on the neck, face and hands. The black flies attacked children with such fervor that it sometimes led to poisoning. While in most cases human reaction to the bites is limited to temporary swelling and irritation, in some victims mucocutaneous hemorrhaging occurs – due to hypersensitivity or a response to a toxin in their saliva. "Black fly biting becomes so intense during the rainy season that some families abandon their lots and seek respite in the roadside agrovilas or in Altamira. The peak of simulid feeding coincides with the rice harvest in May, and settlers in some areas experienced difficulty in contracting harvest labor." (Moran 1981)

At this time, Medicilândia at kilometer 90 west of Altamira was a planned "ruropolis" – a planned rural city to articulate the regional space articulating agrovilas, or agrarian villages, and agripoli – or agricultural administrative towns. As state beneficiaries, these first colonists were beholden to the government and to keeping accounts with the National Institute for Colonization and Agrarian Reform, INCRA. The agropolis Brasil Novo (New Brazil), hosting INCRA's offices, would be located at kilometer 46, while the ruropolis would host several extension agencies and, as we shall see, the most ambitious agricultural project of the Transamazon.

Jorge told me that forty-eight families came to this ruropolis designated part of the road in October, 1971. At first they lived in improvised shelters – *barracas* (lean-tos with tarps). Soon after, half (twenty-four) of the families decided to quit, mainly it seems because of the black flies. Movement was only by foot or vehicle. But the hilly road became nearly impassable during the rainy season. And no one had a vehicle. What if a child was sick from black flies, and one had to seek help in Altamira in the incessant February and March rains?

With it raining eight months out of the year, the unimproved highway was exhausting – if one had to go to Brasil Novo at kilometer 46 to resolve a document, salary or credit issue with INCRA, the round trip journey could easily take eighteen hours, setting out on foot, well before dawn, from one's assigned plot of land, then reaching the highway, hoping to hitch a ride to the east, or just walking, hoping for passable conditions. At least at this time in the history of the road, the trip was less

likely to be made in vain. The government officials responsible for authorizing colonist credit or salaries could often be found at their offices.

Those colonists that stayed were directed by INCRA to clear at least half of their land. As the lots were 100 hectares (247 acres) in size, this meant clearing 124 acres of primary forest, or losing the holding. Settlers would start to clear underbrush in June prior to felling trees in July or August, leaving them to dry for a couple of months (Smith 1982). Nigel Smith, today an emeritus geographer at the University of Florida, documented social, ecological and agricultural conditions on the road in the mid to late 1970s. Along with the cultural ecologist Moran, these scholars studied interaction with the forest. This was a foreign environment; the colonists did not immediately know the names and interactions of species, how the ecology worked, the properties of the soils. Notwithstanding, they were going to start small farms cultivating rice and other annual crops in clearings in the jungle. Burning the forest was difficult during initial settlement of the area – downed vegetation did not always dry out, and fires were often smothered by moisture, necessitating the extremely labor intense process of going through areas to stack up logs and branches, in order to burn them a second time.

Smith describes how, as beef, chicken and fish were largely unavailable, settlers in the early days of the highway hunted various animals. With the rains permitting migration across the drier upland forests, large bands of white lipped peccaries (*Tayassu pecari*) roved through the agrovilas during the wet period, in search of fallen fruit. Shooting these, or other animals like paca (*Agouti tapir*) was

common – setting up a hammock or pole platform three meters above the forest floor, near Brazil nut or other trees with falling fruit. There was also fruit-gathering, especially during the rainy season, involving Brazil nuts and cupuaçu (*Theobroma grandiflorum*). These nut and fruit species have remained over time in the landscape and have come to be favored and planted species in contemporary agroforest farming.

Settlers feared attacks by the Arara indigenous, who had moved out of the immediate range of bulldozers. At kilometer 80, the Arara had left behind a large communal house of babaçu palm fronds. The high-roof design of the dwelling, some eight meters above the ground, effectively reduced heat radiation. They had also left behind their swidden gardens (Smith 1979). Most of the new government designed buildings, on the other hand, were miserably hot, with low ceilings, covered with asbestos panels. In the 1970s, the mean temperature along the highway was 26 centigrade, but climbing to 38 degrees in the shade during the dry season. But during this period nights were cool in the rainforest; one would need a blanket. Outdoor work began early, usually by 6:30. The equatorial sun is hard to bear after 10am, thus stopping work until the midafternoon. Today, one sleeps in a hammock in the rural forested landscape with a sheet. In towns, temperatures are significantly higher, and one needs air conditioning.

Early days on the road were thus full of awkward if not life-threatening encounters, between an imagined pastoral existence, and the ecology. As described by Smith, attempts to farm permanent plots of rice and corn and other annuals or semi-annuals, led to severe erosion problems on the steep topography. Neither terraces or

contour ploughing was used. Root and tree crops established during the wet season, could withstand the dry period, but annuals – like the rice and corn planted in open areas – would quickly wither under the extreme sun. As such, annual crops had to be planted at the onset of the rains and harvested in May or June (Smith 1982). As we will see, attempts to farm annual or semi-annual row crops, in large open and exposed fields, would be complicated through numerous biotic, climatic and technological factors.

Patchworks

Migrants continued to pour into the area after the INCRA lots had already been distributed. Land abandonment was common, as described above. Newcomers, if they had a modicum of capital, might buy up such abandoned lots, already cleared of half or more of their forest. But with five or more years of abandonment, these lots would be well on their way in terms of forest ecological succession, already grown back in 15-meter-tall secondary stands dominated by Cecropia – so called *juquirão* or *capoeirão*.

In 1978 Smith found that rice accounted for 30% of income on sampled farms along the Transamazon west of Altamira. But the crop was plagued with ecological and economic difficulties. By the time I arrived in 2016, rice had completely disappeared. Following the directive of the planners, colonists awkwardly farmed this crop, using government arranged loans. And yet, even with this support – capitalized monoculture brought numerous complications for those who determined to stay on the land. For example, rice had to be harvested very quickly when it ripened in May,

or risk being devoured by noisy flocks of blue headed parrots and painted parakeets. (Smith 1982).

The government – INCRA – promoted upland rice (*Oryza sativa*), as the principal subsistence and cash crop. The provided variety however had been developed for temperate zones. In May, storms could flatten entire fields of the the long and top-heavy plants. Knocked to the ground, the rice would be eaten by rats and ground doves, and what remained would also take longer to harvest. Planners had opted for a single variety for the entire region – with most of the colonists growing an average of 8 hectares (just under 20 acres) of rice, harvest time meant labor shortages – not all colonist families could harvest the crop themselves and had to hire help.

Rice harvesting was usually done by hand using machetes or sickles. For home consumption, the rice would be cut just below the seed head and pounded in wooden mortars to separate the chaff, then tossed in the air using a large, circular flat basket. But if produced for market, the crop would then be carried to a threshing machine. These had been provided by the government in 1971 and 1972, but by 1973 they had fallen into disrepair, and colonists would need to rent or somehow procure a working machine. In this commercial temporality, there was a challenge of getting the sacked rice to a drier before the rice fermented and molded, an accelerated process in the humidity and solar energy here at 3 degrees south.

INCRA initially provided trucks to procure and ship the rice to drying facilities. But after 1973, the colonists would have to contract the shipping themselves. And incoming deliveries were not efficiently administered by the

government storehouses. By 1977, trucks were waiting ten days to unload, the rice fermenting under the equatorial sun. After unloading, the state agency responsible for warehousing the rice for the state-guaranteed price, would discount several fees, including the value of the crop spoiled during the delay. And the colonists weren't paid on delivery – he or she would be required to wait for payment at the state Bank of Brazil. Several weeks later, and only after several precarious journeys to Brasil Novo or Altamira to visit the bank, colonists would finally receive a payment that often would no more than cover expenses, and in many cases, result in a loss.

Eventually, INCRA abandoned this rural development plan around rice. Images from the Transamazon showed bedraggled peasants, covered from chin to toe with clothes wetted with oil to try to stop the biting flies. About half of the initial colonists simply gave up and returned to their region of origin. The bureaucrats' priority would now be to install a modern capitalist system to counter the perceived failure of the settlement project, which had become a public relations disaster. Yet, even the scale of the rice farms had required the paying of labor crews for everything from clearing the forest to planting and harvesting (Smith 1982: 73). Many if not most families were not composed of sufficient young adults or teenagers to carry out everything themselves.

Thus, most any capitalist model for farming was not sustainable, given the ecological vagaries and shortages of labor, equipment, fuel, inputs and commercial market conditions. Again, these lots were 100 hectares (247 acres) in size. The government had needed to attract settlers with a sufficiently large amount of land but

cultivating such an amount of land by hand would be impossible. In constrast, swidden agriculture in tropical forests involves both subsistence and cash crops and are quite common in the Amazon and other humid tropical forests. But they are managed at a significantly smaller size (.5-2 hectares or 1-5 acres, or less). But deforestation on the colonist lots was entirely different, designed as permanent land conversions, even though the land was instantly back up in secondary forest regrowth within a few years. And using family labor alone, however, monocrop farming for the market at scales of over 3 hectares (just under 8 acres) leads to too many weeds, pests, mechanical, financial and logistical challenges. While these colonists had embraced risk by going into commercial monocrops with the state, they immediately experienced its shortcomings: what would be the point of devoting labor under this horrid sun, tormented if not poisoned by black flies, attempting to raise a single crop for a market that was hardly worth the effort?

In order to remain on the land, livelihoods had to be mixed. There was wage work off farm, some rice, some cattle, some timbering, maybe collecting Brazil nuts, selling prepared foods, sewing, managing a small store, informal work– and some home gardens. Livelihoods often involve migration and seasonal activities in Amazonia – a smallholder might also get involved in petty scale gold mining (Cleary 1993). Colonists were not risk averse per se: they were indeed interested in the potential payoff to cash crops, and in diversifying. For example, black pepper (Piper nigrum), a vine crop, had been a small-scale cash crop alternative to rice in the 1970s. It had the advantage of being produced in a smaller area – about one hectare as

opposed to 8 hectares – and, unlike rice, not requiring mechanical harvesting to get the crop to market. Unfortunately, by the mid 1970s the crop was already wiped out on the Transamazon by the *Fusarium solani piperi* fungus (Smith 1979: 424). The only community in Pará that had managed to sustain black pepper cultivation at this time were the Japanese colonists at Tomé-Açu, south of Belém.

But imported grasses, once they had been established, didn't need to be weeded, and with that grass, cattle put on weight with little assistance. Cattle were a political-economic strategy, facilitated by the biological flexibility of the animal and its plant associates (Hecht 1993). There was the prestige of being a rancher, with early morning easy rounds across the land on a horse, then spending the midday in a hammock on a verandah. (Smith 1982, Fearnside 1986) Thus, non-native grasses, *brachiaria* and *pipum*, would be planted, altering the vegetation altogether. Although pasture was also subject to vegetative succession, especially with babaçu palm, herbaceous plants and secondary forest growth was slower in comparison with annual crops. And yet, while the 100-hectare lot size was too large for the commercial system of annual crops with family labor, it was too small for a livelihood based on cattle. Rather, 500 hectares was the size needed to maintain a profitable cattle operation.

It was clear from interviews and from the age of planted stands of cacao and other trees, that from the 1970s through the 1990s, many colonists were planting cacao along with mahogany and other trees, even within the sugarcane zone, where they were technically prohibited from doing so. Rogério in fact had 'hidden' some

cacao at the back of his lot. And outside of the designated sugarcane area, to the west, the state had incentivized cacao in larger stands of 40-80 hectares, on sideroads km 105 south, km 110 south, km 115 south. Word of the new land for cacao had drawn new migrants here from Bahia in the 1980s, then the center of Brazil's cacao production. There were also lots further to the east and west that determined to engage in cacao based agriculture quite early, starting in the late 1970s. These farmers also perceived themselves as having more than enough land to produce (cacao). The lots that came into producing cacao outside of the sugarcane zone were some of the most fortunate, in economic terms.

Some of those incoming migrants who came later, after the land had been distributed, who worked at the mill, or who were part of the seasonal labor crews, managed to hold on in this landscape by squatting on former INCRA land and in government-built residences. I met Edileia, a charismatic woman in her late 40s who had created her own small about 15 hectares (42 acre) farm on the side road named *vai quem quer* ("go if you want") – on former INCRA land. One man I met who lived in the PACAL village had been on staff at the mill as a wood cutter. I had met a short statured man, now in this mid 50s, from Maranhão, who had been famed as one of the best cane cutters in the county. He had reconciled with his partner, a woman who also had claim to former INCRA land. There, he was proud to tell me, he would be planting hundreds of açai palms on a gently sloping embankment of a small river, where he would hope to while away his later years in the watery soft shade with access to this rich delicious fruit.

Rogério also managed to squat – obtaining one of the comparatively well-built houses in the PACAL village. Thus, he perfected a daily migration ritual across this landscape. On the days he was on the air, he would set out in the evening from PACAL village on his motorcycle, arrive at the radio station in the new center of town. Then, after the sunrise show, back out to the lot on km 95 south, then back to the PACAL village at midday.

Sugarcane

As we continued to sip hot sugary coffee that sultry Sunday afternoon, on a tile floor under a tin roof overhang, Rogério told me that in 1973, INCRA officials had come to tell the colonists "you are all going to be rich." INCRA was determined not to be viewed as a failure. That agency's bureaucrats had a solution: sugarcane. INCRA saw the stretch of the highway between km 80 and 105, occupied by fertile terra roxa, a pathway to a modernized and complex project to symbolize the development of the regional economy (Bunker 1984: 213). As the Amazon imported most of its sugar and cane alcohol from the Northeast; INCRA proposed that the project would stabilize the colonists and provide jobs. The state was not interested in fostering sustainable 'peasant' agriculture, but a capitalist model. And thus, INCRA turned its vision from rice to sugarcane, in effect attempting to solve the problem of inappropriate scale by ramping up the scale even further.

Sugarcane would be financed by the government and organized around a central mill. Rather than dispersed along the highway and on difficult to access side

roads, production would be administratively and geographically concentrated. Instead of various out of repair threshing machines, there would be one central mill/refinery. The colonists could thus still serve INCRA, but instead of family farming, on 8 hectares of rice, this would be 80 hectares of cane – colonist managed plantations, using a combination of tractors, trucks, and contract labor crews of 100 to 200 men.

The *Projeto Agroindustrial Canavieiro Abraham Lincoln* (Abraham Lincoln Sugarcane Agroindustry Project, or PACAL) perhaps was named in deference to American and multilateral aid to Brazil during the cold war. It was similar to the U.S. modernized sugarcane industry in Puerto Rico. The Transamazon plan would integrate individual INCRA assigned lots – 100 hectares or 247 acres – within a centralized industrial complex. In Puerto Rico, the U.S. had converted a landscape of haciendas into operations dominated by mill owning companies (Mintz 1960: 24-25). In this case, however, PACAL would be managed by bureaucrats far away in Brasilia.

The 7-million-dollar investment created pressure for INCRA to secure a return on its investment, therefore the agency directed colonists within a 10 kilometer radius to cultivate sugarcane and nothing else. INCRA then set about bulldozing these lots, and stockpiling timber for the mill. While the PACAL project involved less than 10% of the INCRA colonists in the Transamazon project, its budget was more than half of the total. INCRA obligated colonists within a 10 km zone around the site of the new mill to grow sugarcane and nothing else. Entire lots of 100 hectares 247 acres would be deforested for the crop. Whatever colonists' ideas for living here – pepper, cacao, cattle, manioc etc. – this was no longer an option. In the sugarcane zone, except for

sugarcane, the colonists could not opt for state support in the form of credit and extension services. Keeping cattle on these lots would not be feasible; INCRA demanded that the entire lot be dedicated to the project.

Financially, labor costs would be credited to the colonists, but would be held in account, only to be reconciled after processing of the sugarcane. Labor costs would be deducted from the value of the processed sugarcane. The labor in this system would be imported, and seasonal. But there was no way for this landscape to sustain this level of intensity, even if for the short harvest period. Sugarcane is one of a few crops that cannot be organized *commercially* at small scales (Scott 1999). Its production is complex, unpleasant and technically complicated, requiring significant mobilization of labor and machinery. It has to be fired before it is cut, and must be processed within 3 days, or the crop is lost. This necessitates working trucks and passable roads.

An evaluation was conducted of the site by the Brazilian Institute of Sugar and Alcohol, who determined that the site was inappropriate (Bunker 1984). Notwithstanding, INCRA-Brasilia determined to go forward. INCRA started to build the mill, and to bulldoze the surrounding lots for the cane. It sited mill to be built on top of a prominent hilltop so as to produce a striking impression on the landscape. INCRA contracted a company from São Paulo to build it, at an exorbitant cost. The constructing firm, perhaps deliberately, to capitalize on the contract, mismatched mechanical and processing components, such that the mill's productive capacity was immediately limited (ibid).

In 1973, Rogério told us, trucks carrying sugarcane for planting started to arrive. Sugarcane is usually planted as stems that, once harvested, continue to send up new stalks, called ratooning (like rice), for several years, before needing to be planted afresh. An airstrip was built to fly in bureaucrats from Brasilia, these functionaries would be then taken to the PACAL village, about half a kilometer from the refinery itself, which hosted restaurants and bars, a hotel, technical offices and the Bank of Brazil. The latter was the most active and modern building in the region. It would be powered by electricity from wood fired electrical generator at the refinery, and thus had air conditioning. Chic modernity in the middle of the Amazon!

Even with the colonists dutifully playing their part, the system was already breaking down from the beginning. To start with, INCRA realized, soon after installation of the buildings and machinery, that they had overlooked a vital element – water. Sugarcane mills require copious amounts of the stuff. Water abounded in this landscape, but the the mill had been built on top of a large hill. INCRA immediately found themselves in a quandary. Several million more then had to be invested in constructing a river reservoir and elaborate pump system to move water half a kilometer and up about 100 meters.

The mill was completed in 1974. “Through coercion, huge, irregular loans, and extensive mechanized clearing, the INCRA directors finally achieved a sugar crop that would come close to using the full capacity of the mill.” (Bunker 1984: 215). Yet, as the first crop was nearing harvest that year, INCRA realized that the mill’s mismatched components would snarl capacity. As the crop had been financed

through internal grants and the Bank of Brazil, INCRA panicked, requesting bridge funding. The crop needed to make a return to pay back the debt arranged on behalf of the colonists. Because the project was a showpiece, central INCRA authority in Brasilia approved, but too late to save a significant part of the crop. (Bunker)

While INCRA reimbursed some of the advanced expenses, and refinanced this debt, the colonists were badly shaken because of the size of their loans through the Bank of Brazil. Colonists associated with the mill's management, who simply rubber stamped INCRA's executive decisions, got preferential treatment: all of their cane was processed; while more peripheral cooperative members didn't get their sugarcane processed, and remained in debt. (ibid)

In 1978, INCRA again lost a large portion of the crop. At this point, INCRA invited a private company from semi-temperate Rio Grande do Sul, on the border with Uruguay, to take over. So called *gauchos* often of German heritage, they would not only take over administration of the plantation network, but would be granted 400,000 hectares of land to the south in the remaining Arara indigenous land. Bands of between 100 to 200 Arara remained in this area however (Smith 1982: 90). "The Arara had maintained limited trading relations with Altamira until the violence of the road-building crews had made them retreat into the forest… after several attacks on surveyors, FUNAI embargoed the area while it attempted to contact and pacify members of the tribe. These efforts were stopped in 1979, when two FUNAI agents were seriously wounded." (Bunker 1984: 218) "These FUNAI staff were evacuated by helicopter to Altamira with several arrows protruding from their bodies." (Smith

1982: 91). The first peaceful contact between the Arara and FUNAI took place in 1981 (Fearnside 1986: 22). These skirmishes prevented the gauchos advancing further south toward the Iriri river, and the current territorial map has held to this day. Arara land starts approximately 12 km south of the Transamazon, extending to the Iriri river. It comes right up to the edge of the Transamazon for a twenty kilometer stretch starting at km 120 in western Medicilândia.

Continuing with the sugarcane enterprise, however, the gaucho managers declared abruptly that northeasterners were undisciplined workers. They would import their own labor crews from the semi-temperate south. The new men however were not used to working in this environment. They badly managed burning the cane. Not being able to withstand the difficult equatorial conditions, many workers started to defect. Also that year, some colonists, after using these crews to burn their cane fields, then lost their crop because trucks were unable to get in and out of sugarcane lots on the muddy and deeply rutted side roads. (Smith 1982: 79) The gaucho cooperative promptly abandoned its tenure, and the CIRA producers' consortium took over as a private company.

But throughout its history a combination of centralized bureaucracy and self-interested management afflicted the system. The new plant management from Pernambuco determined to contract their own labor crews, trucking in the seasonal labor from more than six hundred miles away. The labor crews continued to be credited to colonist accounts, but were overvalued by the management. The hauling trucks were also contracted by the mill administrators and credited to the colonists'

accounts. It didn't matter to the management that the labor or hauling was expensive, because these costs would be deducted from the colonists' income at the end of the production cycle.

With fits and starts, for the next 20 years, in an area around the mill, sugarcane dominated the Medicilândia landscape. From July through October, the landscape would be aflame and suffused with acrid smoke. And the mill cut timber from the landscape, both to market and to generate power – workers cut firewood for the steam powered turbines. 10,000 tons to power the mill during the harvest and processing, between July and December, around 500 hectares of forest land.

Collapse and reconfiguration

We are still listening to Rogério. It's a Sunday afternoon at the start of the rainy season, which now begins three months later than in the 1980s. It is now drizzling and the drops resound on the tin roof. An antique, mechanically gutted tractor sits in the driveway. There is a road leading up a long hill skirted by advanced secondary forest. Rogério's entire adult life revolved around these skirmishes with the PACAL cooperative.

The other issue involved how much it rained back then. "With the climate the way it is today, this would be an ideal place to grow sugarcane" says Rogério. "But not then." "Because it rained so much here, the cane grew like crazy. However, with producing sugar there was too much water, and too little sucrose. That and the labor costs were the things that started to entangle the operation, which would eventually

lead to disaster. The other thing was that the government would inject the financing itself, but there wasn't any return on it."

Sugarcane dragged on for nearly two decades with the same fits and starts, frustrations and hopes. The plant might close, then reopen, the migrant cane cutters would arrive in lorries, and spend 3 months rotating between farms, sleeping in tents on the lots on which they slaved. The dénouement of the sugarcane complex, however, went beyond anyone's expectation. In 2000, a few months before the harvest, INCRA suddenly shuttered the mill. Without any formal announcement from Brasilia. But, Rogério told me, the government "forgot" to compensate the colonists for their debt held by the Bank of Brazil.

> *It was a crime, a massacre, it was like those massacres when they burn the Christians with their families. Think about it. A Brazilian citizen enters here in 1971 and gets a lot (of land). Worked, sweated, thinking, with my wife and children we're going to be better off someday, with a car and a house — and suddenly, a government official shows up at my door and presents a document — it says you have 24 hours to pay the debt or your lot will go to auction. Are you joking? No, says the official, I've been sent by a judge. What?! It was a massacre. To close the mill — and not to compensate the citizens to cover their debt. The Bank of Brazil went into legal proceedings with the colonist producers to collect. What we couldn't believe was that INCRA would not assume our accounts. And so the bank came after us. To think, we had always paid our debts with our production. Our sugarcane was standing there in the field." (January 2017)*

The debt stood at 200,000 reais (~70,000 U.S. dollars). Rogério had less than 200 reais. Desperate to come to some other arrangement with the bank, he took pictures of everyone and everything on the lot, houses, a small school, the children

swimming in the pond, the people who had been born on the farm. He made a picture album, and went to Altamira to talk to the judge, to engage the social side of the situation. Sir, that is my history, and the history of 19 other families. Look, its written here, you can't auction off someone's home. Can you leave these documents with me, asks the judge – I will need to speak with higher authorities on this matter. – your lot will not go to auction. But you must still pay your debt, in parcels.

The bank was not always as kind with other farms, and some did go up for auction. But through such desperate maneuvers most families did manage to keep their land. Those lots that planted the most sugarcane would be the hardest hit. The debt remained, and was recapitalized, snowballing to over a million reais after 15 years. It was only with the help of local federal representative Zé Geraldo (worker's party) to reduce and renegotiate the debt, when Dilma Rousseff was still in office.

A few years later, perhaps around 2003, Rogério went to Brasilia with colonist neighbors – to advocate for themselves and the community. They somehow arranged a meeting with an INCRA representative in the middle of the night, in the open and disorienting federal complex, designed by Le Corbusier. The moment was vivid in Rogério's mind. Bedraggled colonists, practically peasants, huddled together in the elevator going up to the 14th floor of the drab official building. Entering an office suite, with the INCRA officer, a Rogério remembers, a tall black man with a big beard, inviting them to sit, have coffee. The official says – that project was a like a bottomless sack! Then asks – who took the money? Silence. Well, from the looks of you gentlemen it was not yourselves. OK, we'll make a new project for you, and

compensate you for your loss. Back in the elevator. The comrades returned to the Transamazon. They never heard again from INCRA.

Figure 3.4 The Abandoned Bank of Brazil building in the PACAL village

By the time I first set foot in Medicilândia, sugarcane, similar to rice, had vanished from the landscape. Machinery, capital and labor intensive sugarcane, administered from afar, had ruined the colonists. Left with their land, but with burdensome debts, how were they to continue here? If, as with most of the sugarcane producing colonists, they lived on one lot of 100 hectares, they did not have enough land to sustain themselves with cattle. Annual or semi-annual crops might be used, but as we have seen these had precarious markets, and were complicated to sustain in this ecology.

What was left? There was still the bare minimum of a cacao agency, that proffered hybrid seed stock. Cacao was relatively less complicated to harvest and sell.

Even though it required labor, the cacao harvest did not occur all at once – it was spread out over nearly six months, in pulses, with sometimes up to six harvests. Cacao was easy to sell, a liquid crop, practically a currency, going through the middlemen merchants. Even though the middlemen held all of the financial options on price volatility, they would come out to your farm to pay you for your product in cash. You could harvest the crop with your bare hands and a few simple tools and sacks, fermenting and then drying the sticky sweet seeds – no matter if on a tarp, under clear plastic draped wooden tents, or in *barcaças* – rollable roof structures for drying cacao seeds.

Thus it was that whole families set about reforesting the land with cacao, by themselves, without the bank, and largely without the government, except for stopping by CEPLAC for seeds. Clearing off the former sugarcane was much less difficult than clearing secondary or primary forest. The cacao could be planted together with bananas, to shade the young trees. Mahogany could be planted within or skirting cacao stands. Most of the sugarcane colonists were on terra roxa lots concentrated on the south side of the highway, thus they could at least ask the government for hybrid seed stock, sure to produce. Terra roxa was such a resilient soil that even after over two decades of continuous sugarcane cropping, it could still host the trees.

In short, I suggest that Medicilândia's colonists were thus able to renegotiate the management and labor intensity of the agroecological system, within an already established size of land holding. They would be planting, pruning, fertilizing and

managing stands of cacao at an intensity that could be sustained within the family at small scales. If not managed entirely from within the family, additional cacao would be put out for sharecropping either with kin or with other parties, and largely without bank transactions or credit. Self-disposed labor would be a key factor in how value accrued to this new system, not the capital to hire labor crews, or to acquire cattle. Nor the value of lands conjured into property by slash and burn. Cacao farming – both orchard style and as agroforestry – would come to be organized through the shared labor of producing families themselves, or through sharecropping.

Chapter two conclusion

This chapter has told a story of migration and socio-ecological transformations, starting in the Brazilian northeast and leading to the Amazon. the process was not based on political savvy nor on economic advantage in acquiring land at the start of the Transamazon project. I described struggles to adapt livelihoods in this tropical ecology and in the context of institutional and market dysfunction. I described the land tenure structure of INCRA's sugarcane industry, and the various factors which made it impossible to sustain. I described the termination of the industry, the debts forced onto colonists, and the re-assimilation of a socio-ecological system in which cultivation practices shifted to better connect with the size of the land holding.

The Transamazon represented the first attempt to intensify agriculture within the Brazilian Amazon land frontier. State controls on land use however produced a

visible bifurcation between two broad landscape configurations: one area dominated by agroforests in commercial cacao farming, and surrounding areas dominated by cattle ranching. Moving roughly ten kilometers off of the main road, and with increasing intensity toward the north, and east and west outside of the municipality, the landscape shifts into larger cattle ranches. To the south, however, remains the Arara indigenous reserve. This area was invaded briefly in the 1990s, before the colonists stopped and withdrew. In the 1980s and 1990s, they started to come to the highway zone to proffer mahogany seeds. But the Arara no longer enter colonist territory, due to FUNAI restrictions.

Finally coming back to Mintz – Rogério's willing social transformation in migration and settlement, and his participation in the state's vision for capitalist land use, led to a necessity of political and ecological creativity. Paradoxically, the collapse of sugarcane allowed for this unusual social and ecological transformation and an unusual opportunity to de-intensify agriculture. Because the sizes of these sugarcane plantations were actually "small" relative to cattle ranching, and because collapse of the system produced debts that made recapitalization or refinancing of the system impossible, the land was thus recuperated through a sort of anti-capitalism. This relied on limited support from the state in terms of hybrid cultivar seed germplasm, and through organizing labor, splitting up holdings amongst kin, and subdividing management amongst sharecroppers.

Through this unusual case of a re-agroforestation transition on top of what had been industrially imagined development, we can appreciate that landscapes are often

comprised of interruptions and confusions of outsider-imposed models or 'scales' of land use. In chapter four (The Wild and the Plantation), I will examine this theoretical problem in depth. And, by linking Ingold's phenomenology of landscapes from the last chapter, with Mintz's critique of capitalism through peasant resistance to the plantation form, we can start to appreciate landscapes themselves as assemblages of life. However, we cannot simply start at a descriptive, ethnographic level – the reality of these relations emerges in collaboration across the landscape, not through the sensibilities of the anthropologist per se. Plantations constitute landscapes by imposing visions of scale, but environments and life processes 'speak' in terms of their own relations in response or resistance to externally imposed regimes. Environments have power; going feral, they foil human organization. But they can also be part of social politics/change and renewed social ecologies. Frontiers, plantations, are alienating models of development; they apply visions of scale. But they can also implode or collapse, leading to new configurations of socio-ecological land systems, as will be detailed in the next chapter (Invisible Transamazonia).

4. Chapter three – Invisible Transamazônia

Scrutiny of satellite images reveal previously invisible cacao ‘forests’; and migrant colonists create agroforestry alternatives to land use dominated by fire, grass and cattle.

This chapter explores the forest and agrobiodiversity transition that occurred after the collapse of sugarcane. In the first third of the chapter, I first acquaint the reader with how environmental anthropology has often approached anthropogenic forest making as a scientific counternarrative about land use change. This question applies here, because, for the Transamazon highway region, Emilio Moran and colleagues developed models for ‘frontier deforestation’, where reforestation was strictly a process resulting from abandonment, and land system transitions received no attention. I make a defense of anthropology as a legitimate social *science* of land system change. In the second third of the chapter, I proceed with a discussion of the sugarcane and adjacent landscapes at different scales, supported by some numbers from a remote sensing analysis. From there, we zoom in further, recounting the livelihood and land use world that emerges after the collapse of sugarcane. The latter third of the chapter parallels description of use/management decisions, techniques and agrobiodiversity, based on the folk knowledges and experience of two cacao producers who determined to reforest their land from either sugarcane or from cattle

pasture. I explore the creativity of their methods and I catalogue the agrobiodiversity that is present, with its useful and ecological resonance.

What had got me thinking about anthropogenic tree cover and forest creation was Fairhead and Leach's landscape ethnography on northern Sierra Leone (Fairhead and Leach 1996). Here, a savannah forest transition zone had long had a particular narrative associated with the landscape. For Fairhead and Leach, colonial administrators, followed by twentieth century natural resource scientists, argued that the locals had removed the trees. Thus, all but forest island fragments remained. But by comparing older flyover photographs across several decades, F&L saw that what was actually happening was an *increase* of forest cover around villages. And in accompanying villagers, F&L saw practices leading to the resurgence of forest covers, in terms of "ripening" soil by cassava mounding, by cattle grazing (of savanna grass land), fire management, and multiplying savanna trees from suckers. Thus, "[v]illagers consider their landscape to be enriched through settlement and use' (F&L 1994:iii) and believe that "forest patches and their underlying soil conditions are not natural but the product of human management." (1994:iii).

To some extent, F&L had gotten their own inspiration from Darryl Posey's famous work with the Kayapó (Mebêngôkre) indigenous tribe – in work that showed both the practical and linguistic organization of anthropogenic forest making in Amazônia. At that point in the 1980s and 1990s, ethnobiological work in Amazônia was a surging field (e.g. Posey and Balée 1989). It was not, however, limited to

indigenous peoples, but considered other anthropogenic forests in the ruins of colonization and settlement, most famously the babaçu forests of Maranhão, reformed in Afro-descendant peasant interaction with the landscape, centuries after intensive application of fire. Forest regrowth was also present in the Amazon estuary, supported by human diet and sale of açai palm fruit (Brondizio 2008).

The work of Darryl Posey and Fairhead and Leach were superb anthropological interventions that understood ethnobiological processes as substantive phenomena, but then deliberately connected lifeworlds, language, and then satellite imagery in order to critique the scientific status quo. The key methodological takeaway from F&L was that remote sensing in the form of aerial photographs and satellite images, can be used to connect overall landscape change with oral history and cultivation practices. Image analysis techniques in fact have to be connected with analysis of social organization and use of the environment, such that changes in individual (farmer) activity can be appropriately culturally contextualized (Nyerges ad Green 2000: 274).

More recently, the study of land system change however has been situated with 'postpostivist' work in geography and the environmental sciences. But even so, land change science (LCS) is connected with anthropology and political ecology through older traditions of studying landscapes and human environment relations more broadly, dating back to the nineteenth century and thinkers like Alexander Humboldt (Turner and Robbins 2008). Some cultural ecologists have been very clear about their 'scientific' identity and quantitative emphasis. Emilio Moran and

colleagues for example worked for decades modeling frontier land use change and development on the basis of hundreds if not thousands of surveyed farms. They joined forces with institutionalist scholars like Elinor Ostrom (e.g., Moran and Ostrom eds. 2005) to think about how rules and institutional frameworks govern land and resource use. Moran and others involvement in the book/project People and Pixels (Liverman and National Research Council (US) Committee on the Human Dimensions of Global Change 1998), for example, was very much in a "post-positivist" genre of linking socio-institutional analysis with land change science.

However, what was originally a rich human ecology on the Transamazon was later fused within a scientific Amazon economic geography that modeled frontiers largely through a single and dreadfully dull dimension of land use change – i.e. deforestation and pasture expansion (Thaler et al. 2018). Economic geography and LCS in the Brazilian Amazon has been overwhelmingly focused on the inevitability of frontiers. This, even as cross-scale and nonlinear confusions are immediately apparent from perusal of the few anthropological works on the matter (See Tsing 2005). But, if Moran's scholarship was supposed to be institutionalist in collaboration with Ostrom, where were the land/resource/ecology institutions and their variation?

None of the 'frontier development' science produced by Moran and company has dealt substantially with counter or alternative trajectories of socially intentional land system change. For example, the figure below shows the development of Transamzon west of Altamira, through Brasil Novo and Medicilândia on to the start of Uruará. The blank white areas at the right of the figure represent the Xingu river

and land on its eastern bank, and at the lower / lower-right edge is the Arara indigenous reserve. In the figure, at right, we see that deforestation throughout this 6,000 square kilometer landscape goes at a rapid clip until 2008, then starts to slow down. Pastureland increases rapidly, then also starts to slow down. But why has a large area of secondary forest consolidated around the highway in the southwest of the image after 2000? I have circled this area in purple in the final image. It wasn't as if Moran and others didn't have an idea what this was about. Or not? It is almost as if the phenomenon is invisible or not worth speaking of, because they had no 'scientific' way of accounting for its existence.

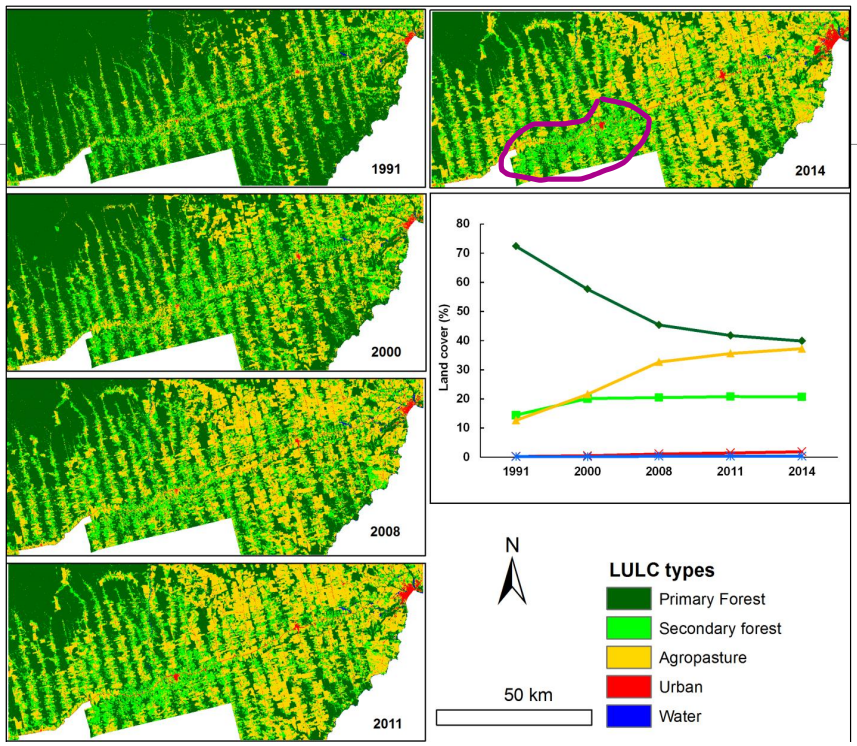

Figure 4.1 Emilio Moran's time series of land use change across the Transamazon west of Altamira and the Xingu river (1991-2014). This subregion comprises an area of approximately 6,000 square kilometers.

There was a problem here with knowledge on the Transamazon. But to be able to engage this problem proactively I would have to work like a scientist, using mixed methods. So where could land change science / sustainability science come in, if I had no 'scientific' examples or alternative methodological approaches for this region? Some of the most productive collaborations between sustainability/LCS and political ecology for example have involved what are called middle range theories. Middle range theories are empirically based examinations of specific phenomena rather than grand theories about social or ecological systems in totality. They are focused on discrete, observable processes, such as in how many humans might rely on a particular area of land in terms of hunting and gathering or cultivated crops. One anthropologist that perhaps represents this work is Julian Steward, who today is often invoked by cultural anthropologists almost as a 'villain' of materialism, one step away from Marvin Harris (Raffles 2002). But Steward's cultural ecology was never an attempt to explain everything. It was, as Geertz put it, "an explicitly delimited field of inquiry, not a comprehensive natural science" (1963:10). The point was that changing relationships between land tenure, agriculture and ecology could be compared empirically across multiple societies (Netting 1993).

Shifting to contemporary work, today's middle range theories for land system change are usually the work of geographers and track back to humanist scientific interest in landscape complexity and in the substantive nature of landscape and place. The difference is that that today geography and LCS work explicitly within an arena of global environmental change and sustainability science (Turner and Robbins

2008). LCS collects empirical data on land use and environmental changes and interprets these in terms of causal situations. With middle range theories of land system change, historical, structural relationships and changes can be made visible through research data. More critically, land change science reaches for theoretical generalization that can also transcend place-based specificity, while retaining sensitivity to context and an overall geography and diversity of 'land users'. The point is to try to better understand dynamics of socio-ecological systems and to foster dialogue with other human-environmental sciences (Meyfroidt et al. 2018). As such, theories of the mid-range are useful because they can be used to engage complexity while retaining sufficient simplicity to generalize on causes and effects.

Especially, middle range land system changes theories have become useful tools for thinking through landscape transformations. For example, frontiers are a kind of middle range theory about land use change processes; another middle range land system change theory is the forest transition, wherein certain societies allow their forests to grow back, or are actively involved in replanting them. In France in the early 19th century, for example, peasants learned to improve land in the plains, while more marginal land in mountainous areas were gradually abandoned in a rural exodus (Mather and Needle 1998). In Europe and North America, reforestation in the eastern United States occurred with humans' release on land from agricultural purposes.

Returning to the tropics, however, an entirely new theory has been developed in contrast to frontiers or the European model of forest transition, which is called

smallholder tree-based intensification theory (Lambin and Meyfroidt 2010; Meyfroidt et al. 2018). This theory proposes that forest cover increases with human dedication to a working, productive landscape (Hecht et al. 2014), where dynamics at the farm scale influences planting or maintenance of trees. The theory has been applied where rural communities actively restore forests with mindfulness of so-called ecosystems services (Chazdon 2008). While the theory is often rather abstract, cultural learning is supposedly also involved.

There is also a body of socio ecological land systems science for Latin America as a whole (Boillot et al. 2018). Regional research emphasis areas include the evolution of monitoring and observation of land systems – for example, how to distinguish cacao agroforestry from other forest successional areas, or in how to monitor mangrove forests. Another research area is in conceptualizing socio-ecological land systems in order to compare structure and function and dynamics, bridging between local and regional land change processes and regional to global interactions. Conceptualizing socio-ecological land systems includes thinking through intensification processes – for example, how the latter includes consideration of the spatial differentiation of landscapes, gendered livelihoods, and agrobiodiversity (Zimmerer et al. 2018).

Getting back to the point – I saw that invisibility had been imposed on this landscape. On the one hand, Moran and colleagues' relentless focus on 'frontier development' and the family/household unit had built an overly simplified vision of land change processes and patterns. In contrast, my developing hypothesis was that

the ‘family’ could and should not be viewed in isolation – what was more important was the combined environmental and institutional composition of the overall landscape. And ‘intensification’ here needed be separated from the cattle complex: agroforestry was distinct from bovine politics. Yes, cattle made a great deal of economic / livelihood sense for commercially oriented landowners in this region. But cattle had emerged as the overwhelmingly dominant land use through a series of institutional/property, biological, and financial/credit maneuvers over time.

In other words, human labor-based farming, or ‘true smallholding’ was perversely out of place in this region, so disposed as it was to land development speculation. This made planting trees and attending to them by hand almost like a revolutionary act. So, while smallholding would continue to be viewed with skepticism in terms of environmental impacts in this forest region, I was skeptical about the models used to explain land change dynamics. There was something wrong here in terms of *scale* – meaning, that the units (in research) were too uniform, and the relations (land use) assumed to flow from a blanket theory about peasants, strangely catapulted into one of the most speculative land regions on the planet. Sure, it was about peasants, broadly speaking, in that these were migrant colonists who often employed their own labor. In that sense, yes, they were different from capitalist farmers for whom a business model is simply its capacity to expand, wherein labor is simply purchased. But one needed to figure out what relations actually existed on the ground, across the landscape, and especially, across multiple scales.

In short, the study of socio-ecological land systems, and theory on land system changes or transitions, are useful here as a basis for 'scientific' observation and comparison of structural and functional situations experienced by diverse farmers, and their relevance to land decisions. I could group and categorize farm cases, while *also* ethnographically describing farmer experience and case specific constraints and obstacles to livelihoods. From there, I could link field observation of plants and soils with farm specific and more collective institutional factors, to explain the prevalence or abandonment of crops. Finally, agroecological and critical landscape ecological scholarship was also useful to think with, as developed by scholars like Ivette Perfecto. Perfecto and other agroecological scholars put forward an alternative model of landscapes in Mesoamerica, not in terms of nature 'spared' from working peasant landscapes, but in terms of nature 'shared'. Using the latter, one could drill down further, to micro-environmental conditions – shade, soils, microorganisms, and their interactions with human work and plant management.

Previously Invisible Cacao Forests Made Visible

What now follows is a brief presentation of the results of a scale-sensitive, remote sensing study from 2015. From there, we will follow farmer methods and experiences. Below are two maps made with remote sensing imagery, the first from 1992, the second from 2014. The technical methods for producing these maps are contained in an annex to this chapter. Let's focus on the map from 1992. In 1992, sugarcane production was still a major focus at km 92 on the relatively recent

Transamazon. 14 INCRA established land lots are outlined in black, but I am going to name and discuss nine of these. These are labeled in the map: the 200 hectares pertaining to INCRA and the refinery; Pernambuco's land, west of the city on the highway; Rogério's land, to the southwest of the refinery; Romualdo's land, comprising two 100 ha lots, on the north side of the highway just east of town; Micías' land – the father of the rural workers' union president on km 90s; Valdir's family's land; Luiz Melo's land; and Getulio's land. All of these are in the form of rectangular, government patterned, 100 hectare lots. Valdir's family's land is in the form of a 100ha lot in 1992; by 2014, it is a 20ha chácara as the land has been subdivided amongst siblings.

Pernambuco's lot I had gone to study because it was close to town, Rogério's story as an outspoken radio announcer and critic of system had drawn me there; Romualdo was my storekeeper host who lived in town; they were a relatively prosperous family that owned two lots just outside of town. Micias was the father of Valdo who was head of the rural workers' union; Valdir was a true smallholder who inherited a chácara of 20 hectares when his family split up the lot amongst siblings; and Getulio was my roommate after I stopped living at Romualdo's.

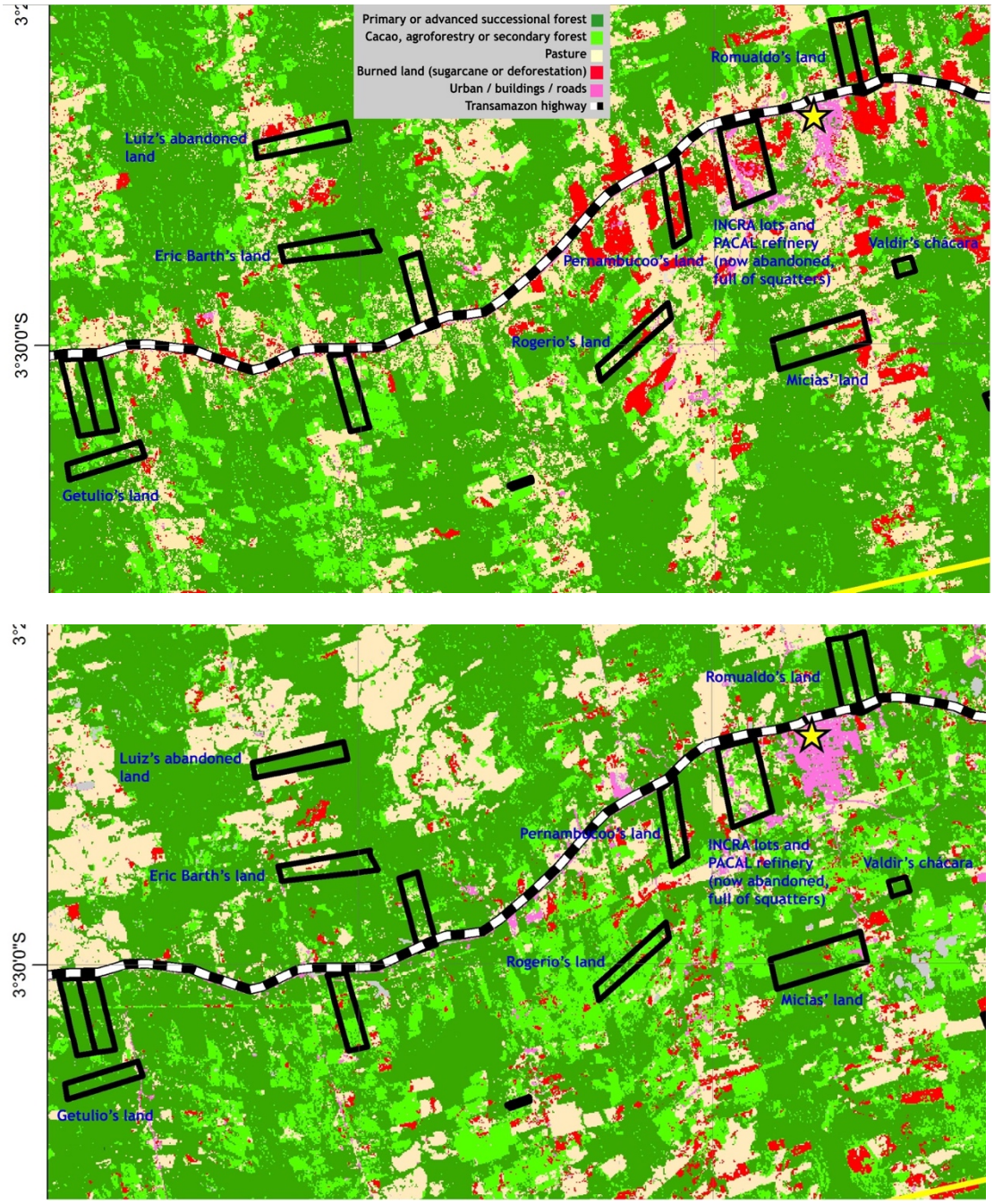

Figure 4.2 Sugarcane and cacao landscapes. 1992 above. 2014 below.

All of these lots increased their tree cover between 1992 and 2014, in parallel with the land system transition in the sugarcane zone. Tree cover is decreasing during

this time in areas where cattle ranching and pasture increasingly dominates, especially to the north of the highway. In 1992, we can see sugarcane through the size of the red colored patches, on all of these lots to some extent, and distributed across the sugarcane zone (the area in which it was obligated to plant). Satellite images can be much better discerned through 'ground truthing' at georeferenced locations: this means the confirmation of land classes – cultivated agroforests, for example – where geospatial data based on on-the-ground observations can then be plugged in to the analysis software itself, to improve manual classification or automated learning within the software. Further, participatory and survey knowledge of relations between farming techniques, soils and crops lend to more precise identification of land cover. The image is from July or August, during the harvest, thus one can assume that these are burned sugarcane areas in which a sizeable portion of the soil is exposed and reflecting sunlight. In the remote sensing analysis, one can distinguish between pasture and burned or bare soil because of the ground cover and the spectral consistency of light reflected. Also, the size of the burned patches is about 40-80 ha – this an expected size of land on which to harvest sugarcane using labor gangs of around 100 persons. Also, the satellite image is July or August, whereas deforestation for pasture or for cacao happens in December, just before the rains. Much larger crop plantations exist in the world, but this scale – perhaps around 80ha (180 acres) per mechanized operation is similar to that of modernized sugarcane for Latin America and the Caribbean in the twentieth century, for example, those that existed on Puerto

Rico that were studied by Mintz. Around Turrialba, Costa Rica, for example, sugarcane is also harvested at this scale.

We can see a clear transition in the vegetation in the sugarcane zone within 10km of refinery from 1992 to 2014: from around 40% of the land area in semi-mechanized sugarcane, to a recuperation of most of that area into tree cover, except for a few new areas of pasture: just north of the refinery (the gaucho Daniel), and across from Micías' property, who was a cattle speculator from Altamira who only visited occasionally and relied on hired hands, and one other property located in between Pernambuco's and Rogério's lots. Differently sized and shaped patches suggest how these three areas are being transitioned to pasture, not burned for sugarcane or to establish cacao plots. While the burned patches for sugarcane are curved, likely following topography and the sugarcane fields; the burned patch at km 85 s – for cattle – is rectangular or at right angles, thus following the property line. There are many smaller patches of burning going on, which one can assume are either secondary capoeiras being opened up for intensive cacao patches, or fires set to clean pasture, rather than to deforest entire properties.

I could make these interpretations as I had walked through all of the marked lots with their owners, workers, or family members. To the west and south of the highway, we can see how lots that were located farther than 10 kilometers from the refinery took on different patterns. Few of these lots were involved with sugarcane. An exception is Luiz Melo's lot on km 105n. In 1992, the lot is halfway deforested, and I knew it had been in sugarcane, not in pasture, because he had taken me there, so

while the color is not red, it means that the sugarcane has not been burned for harvest yet. In 2014 – 14 years after the shuttering of the refinery – the lot was now indistinguishable from primary forest. Indistinguishable, meaning that the spectral wavelengths reflecting from the vegetation into space – were similar in structure to those reflecting from primary forest.

Using a combined manual and ground-truthed system of land use classification, I distinguished between more secondary forest and agroforests, and primary forests. However, advanced secondary forests – like half of Luiz's abandoned lot – and what I knew to be older agroforests, were very difficult to distinguish from primary forests based on the satellite images alone. In areas where cacao had been planted in the 1970s and 1980s, the cacao areas had become 'cacao forests' – and these areas can be seen at the extreme west of the image. Still, I knew they were cacao forests because I had walked these areas. Ground truthing, again, means empirically verifying the type or class of vegetation by an on the ground visit to the land in question – to see for oneself – and then to incorporate marker points into the analysis software. Most of km 105 south, 110 south and 115 south are in full cacao cultivation, and without ground truthing a land change scientist might assume that these were forests that had been 'untouched' by frontier settlement. Unlike the land that was replanted after the abandonment of sugarcane, in these cacao forest areas cacao trees were often 30 years old or older. At this age, cacao trees tend not to produce as much fruit, unless they are subject to heavy pruning.

I had also gone to walk Getulio's land on a number of occasions. He was living in town rather than at the house on his land and worked as an on-demand truckdriver hauler for my host Romualdo. On Sunday nights all three of us would go out to the muddy restaurants lining the transamzaon to drink beer at a plastic table. Getulio was looking for a way to improve returns on 40,000 cacao trees that had been planted in the 1980s. His family was from the south of Bahia, where cacao had been in full swing at that time – and they had heard of land ripe for cacao trees on the transamazon. Rather than those early cohorts of landless colonists, settled by the state, later arrivals like Getulio's family brought their own capital to purchase land, and secured bank credit with CEPLAC's co-signing the loans for projects of 10,000 trees at a time. Getulio had not come to Pará until later – in the 1970s he was in the Brazilian Navy, stationed in Rio de Janeiro. But 30 years later, Getulio was trying to figure out what to do with ageing and fungal infested cacao orchards on km 100 south. These were the cacao forests that I knew best – Getulio's land was clearly in this strange advanced succesionary cacao category. In a later chapter, I accompany him in an ill-fated interaction with a carbon land restoration program (the Monkey Thanks You chapter).

Some of these ageing orchards were fine in terms of productivity. For example, Romualdo's lots are also 'dense' in terms of their vegetation structure, as seen through remote sensing analysis. There, Romualdo I believe was working with 6 sharecroppers. On Eric Barth's mixed cacao-cattle lot on mixed soils on km 105n, the cacao was interspersed as I remember with many large trees, including a Sumauma

around which the family had gathered for a photograph on the day I had visited. These agroforests were well attended to and produced well. But Getulio's cacao was 40 hectares large, approximately 40,000 trees, and they had gotten leggy, hadn't been pruned. Many trees had prominent vertical shoots jutting up from older lateral branches. The trees' energy was being used to grow up in stature, not to make fruit. Remember that cacao evolved in the jungle understory and gets up to about twenty meters tall a forest successional situation. But trees in the forest, while having similar patterns of genetic diversity (any tree grown from hybrid cultivar germplasm has the same genetic variability as trees in the forest), don't produce much fruit, because of the growth patterns of the tree and those fruits may be located well above ground level…

In 2014, looking outside of the (former) sugarcane and cacao landscape in 2014 we can see a separation or bifurcation in the landscape between cacao and cattle ranching. While I had not interviewed many cattle or ranch land operators extensively, I knew their operations because I had been with their neighbors. So why didn't most of the former sugarcane growing colonists, when faced with the collapse of that industry, simply burn the cane and then plant grass seed and livestock? The difference here was that one had had to have capital to purchase cattle; but cacao could be established by hand. Thus, in this particular landscape, cattle tended to be established by newcomers and outsiders, as they hadn't been involved with the INCRA refinery fiasco. Most of the original colonists in the sugarcane zone were put

into financial arrears, and unable to work with a bank, so the only way to recuperate the land was through piecemeal applications of labor in planting trees.

Based on Moran's work, we might see this landscape in terms of a frontier. Frontiers are also a middle range theory about land change processes; while smallholder tree-based intensification theory is another middle range theory. As a frontier, the explanatory model is that pioneer families settle, the forests were cut down, different cohorts of settlement arrive and continue to deforest in pulses; secondary regrowth occurs but is more a product of abandonment. But here, analyzing these satellite images, we see the emergence of anthropogenic commodity agroforests that seem to approach the biomass and vegetation structure of primary forests over longer periods of time. These anthropogenic 'chocolate forests' existed but were heretofore invisible to science, and they seemed to support the theory of smallholder tree-based intensification.

Drinking sweet coffee with Rogério throughout a long Sunday afternoon I could figure out of what these patches consisted in the satellite imagery through the oral history. The state's project of modernist agriculture had come to ruin. Away in Brasilia, in a government building designed by Le Corbusier, a bureaucrat with a tie clip made an abrupt decision to stop the processing of sugarcane at the Abraham Lincoln mill. From there, with the state held together by procedural paperclips, the Bank of Brazil sent out its agents to tell the colonists – state subjects of frontier settlement, now peasants all over again – that their land would go to auction. I knew that, for example, Pernambuco had had to sell a series of other lots and some urban

buildings that he had acquired during the functional years of the mill. He had been a willing tool, literally so I suppose as a large machinery operator, and beneficiary of the dictatorship, but was then subject to abandonment.

So what happened afterward? After the ruin, some lots were simply auctioned this off, a few were abandoned. But many if not most colonists managed to hold on and weather this bureaucratic abuse. As they were also forced into significant if not impossible debt, colonists started to imagine what they could produce largely with their bare hands. And with what was left of the state, namely the hybrid cultivar cacao seeds distributed by CEPLAC, for a token fee. Colonists outside the sugarcane zone, but who were also on terra roxa, had started to plant cacao. Thus the practice of planting cacao was clear in the community's mind. Farming operations went from being colonist plantations, to smallholding and sharecropping, often amongst kin. Groups of colonists, families – most of them with children living with them or nearby – would replant those sugarcane areas. The soil had been degraded during decades of mechanization and heavy application of fertilizer. But the soil here was less compacted and easier to work than in areas that had been converted into pasture. Sugarcane was a grass, but it was not a 'turf'. Rather than that dense, uneven turf with termite mounds and patches of exposed soil, as often happened with pasture, turning sugarcane areas into orchards was relatively feasible, and could be accomplished without additional mechanization. It could be done gradually and by hand.

Agroforestry Alternatives

It was Valdir that had confirmed the hypothesis about the land system transition – that there had been a paradoxically positive effect from the concentrated pattern of land tenure around sugarcane. That the size of the holding, along with debt, had constrained options after the cruel shuttering of the sugarcane refinery. Back in Medicilândia, the rusting refinery sat festering behind the gates. There were perhaps a dozen government vehicles sitting in the compound, which had not moved in seventeen years. The pump stations at the bottom of the hill sat next to the water reservoir that had become a popular bathing spot. The ruined reservoir now had a waterfall spillway. The bridge almost collapsing.

Valdir, now in his late 50s, was of German descent – a 'gaucho' from Rio Grande do Sul – and had come with his family to the Transamazon as a teenager. Located on km 90 sul, his family had grown sugarcane. Roughly about the time that the industry stopped, the family had split up the lot amongst the children, into chácaras or small farms of about 15 ha (40 acres) each – meaning that the original lot was divided into 6. Their small farm was now divided between his own labor that he managed together with his partner, and a portion that was let out to sharecrop.

I went to his farm located about 4km south of the town of Medicilânida, on km 90 south, to participate in pruning cacao trees. We walked out beyond the dirt yard and the chickens and ducks, past mahogany trees in the midst of the cacao. We found a big bushy tree. Immediately, Valdir is up in the branches, maneuvering with the ten-foot long podão. First, one clears out the vertical shoots, but then, the idea is

to get the tree into a structure in which it would collect solar energy – but not too much – and direct energy into fruit.

Figure 4.3 Valdir pruning using a podão pole while standing in the tree

This chácara is located about 5km from town, on km 90 south. His brother runs the *balneário dos pobres* (poor persons' pool) by diverting the river water into a concrete area next to some volleyball and soccer fields, with a shack set up to sell beer. This was once the center of the sugarcane landscape. Today it has transitioned into a patchwork of small holdings, patches of 5,000 trees, 10,000 trees. There are numerous Catholic and Evangelical churches along the road, even though it only stretches 12 kilometers before stopping at the edge of the Arara indigenous reserve.

After pruning work, Valdir and I went to take a dip in the river below his house. Red with iron, the water was laden with dark grey boulders of ancient basalt. We soaked in the water and spoke of jaguars. Was he pulling my leg about the area

harboring a red, a spotted, *and* a black jaguar, here, about 5 km from the town? Valdir had been raised in the Catholic popular tradition. He had been president of the rural workers' union. He told me stories about their having to walk side roads on foot to meet with farmers, how the job had been a struggle. Now, he was a contented smallholder, committed to agroecological practices, not using pesticides.

We then went to mix a vat of liquid fertilizer in a plastic tub below his house. The cacao was fertilized using backpack sprayers. So, Valdir, tell me about this cacao – how does one plant it? We started going over the labor details of how farmers formed stands of cacao. In this area, more often the practice was to slash and burn a small area in establishing cacao trees. However, some did use a non-burning technique to plant within standing forest, that had been developed with experimentation in the community – *roça sem queimar* or literally farming without fire.

The following description of typical slash and burn cacao planting comes from Valdir. Let's say that you are a small farmer who wants to plant cacao trees from which to make a living. The first thing is to start the nursery – to germinate seedlings. These are often hybrid cultivar seeds, which are obtained by going to CEPLAC. CEPLAC has a biological station at km 100 south. This is the one thing that CEPLAC manages to do for farmers – collect fruit pods from hybrid varieties, put them in sacks, and trundle them 10km into town. There, farmers are able to pay a small fee (about U.S. $20) and obtain seeds. Farmers previously had to demonstrate that they had terra roxa soil on which to plant cacao, because CEPLAC sought a full

proof result. With terra roxa, one could simply dig a hole and plant a seedling, do a bit of pruning, and the trees would produce. Medium fertility soils, as we will see, required more attention – some fertilizers applied, and the use of shade trees in the agroecosystem to conserve soil moisture during the more frequent droughts. Cacao can be grafted or cloned but the majority in this area start seedlings from seed. Monteiro told me that this was part of how CEPLAC hoped to keep the population under its control – "nothing shall be done without CEPLAC." And yet, everything was being done in an improvised, precarious fashion.

So, one makes a nursery for seed started or grafted tree seedlings. Nursery work starts in July. It takes about two days of work to form a nursery, setting up a structure to shade the plants. This can be done by hand using wooden stakes and palm leaves. One can opt to pay for a special nursery mesh roof – designed to reduce solar energy by half, but babaçu palm leaves work quite well. One obtains small sacks to fill with soil. Then one fills the small sacks. You can also use specially manufactured seedling containers. Filling these – for the quantity of trees to be planted in 3 hectares (7.4 acres) will take three days. The soil for the seedlings can be terra roxa or a mix of composted material with less fertile soil. But *terra preta do indio* is the best – that mysterious soil full of stable organic carbon formed over hundreds of years of prior indigenous living (Woods and Denevan 2009). Then, one day to add the seeds to each sack or seedling container. Six full days. The next six months are spent watering the seedlings, which takes about ten minutes a day. It is best to set up the nursery next to the land area in which they will be planted, but this is not always possible.

In looking at where to plant cacao, one wants to consider the relief of the land, the type of soil, the depth of soil horizons. Obviously, rainfall is very important, as these are not irrigated systems. Land exposed to the north and west will be affected by the sun much more than land exposed to the south and east. Let's say we are going to work in an area of 3 hectares (7.4 acres), by hand. That means 30,000 square meters, using a slingblade to cut down the vegetation that is not trees, but vines and brush. If this is a recently fallowed area, say between 5-10 years old, this will be more difficult. In younger fallows, the undergrowth is extremely dense. In an advanced secondary forest, say of 10-20 years, this process is less arduous. Primary forest will be the least difficult in terms of clearing undergrowth.

The next stage is tree felling. However, the farmer will leave many if not the majority of trees standing – *jarana, tatajuba, ipê roxo/amarelo* – for shade and as valued for wood. Assuming that the farmer has a chainsaw, tree felling will be relatively easy. Otherwise, one will have to fell trees using an axes and hand saws. The latter was most commonly employed in the 1970s, when few chainsaws were available. Let's say that this will take ten full days of work to clear the undergrowth, and two days to cut down the non-valued trees. Then, the burning. This will require a team of 4 persons, and one day (4x1). Hopefully the area burns well, burns through all the downed vegetation, and without killing the standing trees. The month to do this is in December, a few weeks before the rains starts. This time is now significantly later in the year. The rains began in November in the 1980s. Today, they start in January, even late January.

Then, setting out the stakes, measuring where trees will be planted. This will take two persons working for six days (2x6). Then, digging holes. One person can dig about 200 in a day. We use a digging iron and a post-hole digger, with two wooden levers – you slam the digger in the soil, open the handles to catch the soil, pull out the digger, close the handles to release. Repeat. So, if we have spaced the cacao roughly 3x3 meters (1100 trees per hectare), this means a total of fifteen days of labor. Two persons in theory means 7.5 days (2x7.5). Then, carrying the seedlings, which are now hopefully at least five or six months old, to the area, and distributing them according to the staked plan. It will take two persons two days to distribute the seedlings (2x2). Then, planting the seedlings. One person can do this by themselves, planting about 1000 per full day. It thus takes about three days to plant the seedlings – gently tapping out the seedling roots holding soil.

It will have been well over a month of full-time shared labor to get to this point. One can imagine setting the seedling in the earth, scooping soil in around the seedling, gently packing the soil. The clay soil coating your hands, filling your fingernails, painting your face with a forearm wiping one's brow. The rains already started. Wearing boots, your feet wet. It might be better to wear flip flops. There will be the ash on the surface of the ground, low lying vegetation sprouted.

The next stage is the replanting of other species amidst the cacao. One can use bananas, mahogany, pineapple, açai palms. This next stage takes twenty more days. One is thinking in terms of how the area will be used for the next five years. In all of this, there are various factors that span from manual to machine, that involve time and

distance. Does the farmer have a means of motorized transportation – say, a motorcycle? Do they have a chain saw? Or rather than burning the area, can he or she grade the area using tractors?

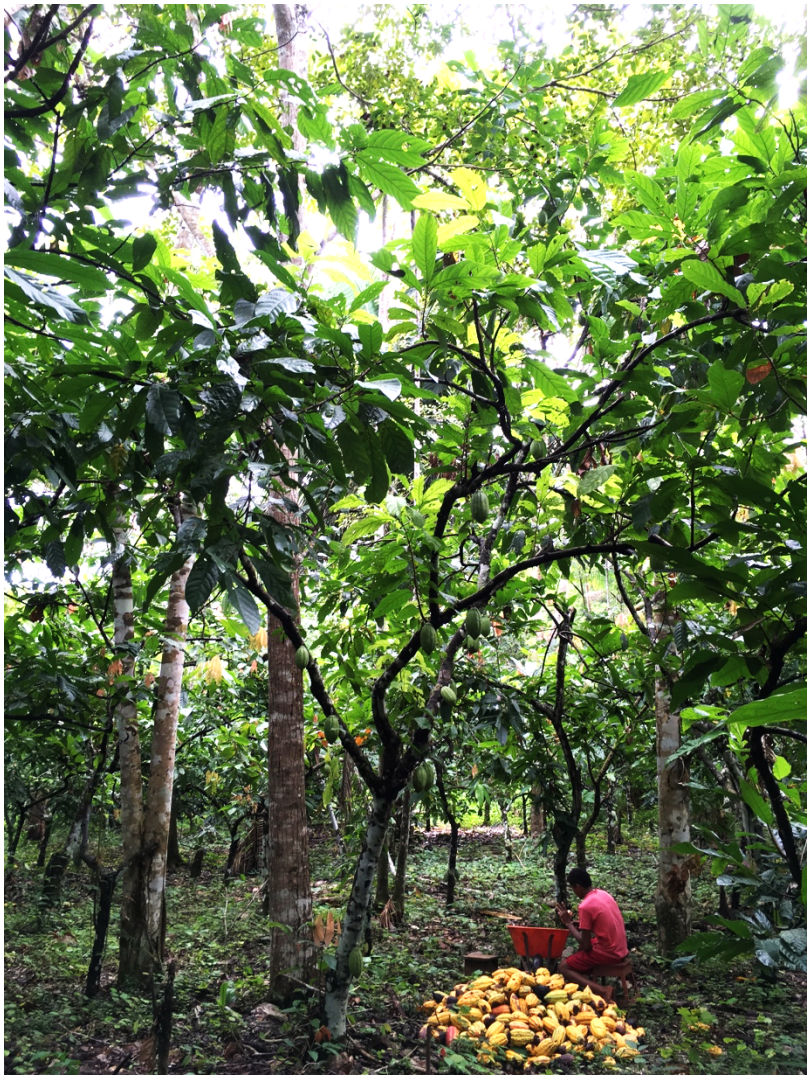

Figure 4.4 Valdir's mature agroforest, working with a neighbor on a harvest day

Valdir's chácara was now a mosaic of primary forest remnants, traditional cacao systems established with fire, and roça sem queimar. Below is a list of the species planted or favored in the areas in which cacao was planted:

Table 4.1 list of planted and favored valuable species in the two farms under consideration in this chapter

Popular name	English name	Scientific name	Planted or Favored	Uses
		Valdir's system		
Cacau	Cacao / Cocoa	*Theobroma cacao*	planted	butter, powder, liquor, fruit pulp, latex
Andiroba		*Carapa guianensis* Aubl.	planted	oil
Mogno nativo	Mahogany (native)	*Swietenia macrophylla*	planted	timber
Mogno africano	African mahogany	*Khaya* (genus)	planted	timber
Castanheira	Brazil nut	*Bertholletia excelsa*	naturally occurring	nuts
Ipê		*Tabebuia* spp.	naturally occurring	timber
Jarana		*Holopyxidium jarana* (hub.) Ducke	naturally occurring	timber
Abacate	Avocado	*Persea americana*	planted	fruit
Mangeira	Mango	*Mangifera indica*	planted	fruit, shade
Ingá		*Inga* spp.		fruit
Genipapo		*Genipa americana* L.	naturally occurring	fruit
Embaúba	Trumpet tree	*Cecropia* sp.	naturally occurring	Phosphorus rich organic matter
Biribá		*Rollinia mucosa*	naturally occurring	fruit
Caju	Cashew	*Anacardium occidentale*	planted	nuts
Goiaba		*Psidium guajava*	planted	fruit
Acerola	Barbados cherry	*Malpighia emarginata*	planted	fruit
Cedro	Cedar	*Cedrela odorata* L.	naturally occurring	timber
Jaca	Jackfruit	*Artocarpus heterophyllus*	planted	fruit

Açai	Açai	*Euterpe Oleaca*	planted	fruit
Paricá		*Schizolobium amazonicum*	naturally occurring	?
Pitomba		*Talisia esculenta*	naturally occurring	fruit
Gamelina		*Gmelina arborea*	planted	wood pulp
Monteiro's system				
Cacau	Cacao / cocoa	*Theobroma cacao*	planted	Cocoa butter, powder, liquor, fruit pulp, latex
Ipê preto		*Tabebuia* spp.	naturally occurring	timber
Tatajuba		*Bagassa guianensis*	naturally occurring	timber
Cajá		*Spondias dulcis*	planted	fruit
Manga	Mango	*Mangifera indica*	planted	fruit
Açai	Açai	*Euterpe Oleaca*	planted	fruit
Jarana		*Lecythis chartacea*	naturally occurring	?
Buriti		*Mauritia flexuosa*	naturally occurring	fruit
Laranja	Orange	*Citrus sinensis*	planted	fruit
Babaçu		*Orbignya phalerata*	naturally occurring	oil, others
Castanheira	Brazil nut	*Bertholetia excelsa*	naturally occurring	nuts
Mogno Nativo	Mahogany	*Swietenia macrophylla*	planted	timber
Seringeira	Rubber	*Hevea brasiliensis*	planted	latex
Teca	Teak	*Tectona grandis*	planted	timber
Jacarandá-da-Bahia		*Dalbergia nigra*	planted	timber

Even if one were using the CEPLAC method of *derruba total* (total cut down) – one would immediately be planting bananas and other trees. The method of slash

and burn made for a 'permanently' managed system. But cacao, like the frontier, went weedy. New species popped up, from Cecropia to Brazil nut trees, inside the "system." What do we do with them? Without knowledge some colonists cut down the Cecropia – thinking that they were harboring noxious ants. But these ants controlled other insect pests. Many did not know that Cecropia leaves were rich in phosphorus – the most critical nutrient in these systems, because of its adsorption to aluminum and iron cations in clay, making it unavailable to plants except in areas of organic decomposition.

But others sought to learn, passionately, in direct contact with interspecies processes. For example, I had met Monteiro at the beginning of my fieldwork, who had not participated in 'Cacaufest'. This was because of his commitment to a folk science and alternative cacao farming practices. In 1977 he had migrated to the then recently opened Transamazon highway from the northeastern state of Piauí. He had kept cattle for a decade before determining to quit cattle altogether to maintain polyculture agroforests and forest reserves. Lithe and about six feet four inches tall, Monteiro gestured with curling hands as if he were a tree himself.

Figure 4.5: Monteiro standing by abandoned cattle loading chute

Soon after I met Monteiro, he had offered to take me on one of the side roads to see the landscape. We drove up km 85 north, the side road on which he owned two 100-hectare lots side by side, about 12 kilometers in. The landscape up until his farm is a majority tree-cover mosaic of agroforests, smaller pastures, regrowth secondary, and primary forest patches – typical for the cacao consolidated landscape in Medicilândia. The soil here was mostly terra roxa – but Monteiro's land was comprised of a variety of soil types, from yellow clay latossolos to terra roxa. He had kept productivity records for a decade and his folk research had come to the following conclusion: managing soil fertility meant organic matter and shade – it wasn't necessary to introduce fertilizers physically brought in from elsewhere. Mixed clay soils supported cacao trees, because the organic matter was 'built in'.

Cacaufest seemed like a 'show' to Monteiro. He had seen the scientific state come and go. He had seen how CEPLAC dictated practices and how these practices needed to be questioned, and how the state rarely came through in terms of its ostensible authority. He was also part of a small group of perhaps 25 producers who

had managed to organize a small chocolate factory cooperative just outside the town of Medicilândia, which occupied part of the former INCRA land where the ruined sugarcane refinery stood.

He lived on the second floor of a wooden frame building just off the muddy, noisy, motorcycle clogged, highway and its parallel service roads. Below, wooden benches and plastic tablecloths facilitated serving out smothered chicken, okra and syrupy beans during the heat of the day. In the evenings, the bustle settled. On the service road on the other side of the highway, there was a tiny outlet store for the chocolate factory, with some cement benches and a bit of artificial turf grass. Evenings are pleasant in Amazônia with the fading heat and the humid, vaporous smells of weather and vegetation. There was less yelling and bravado, and smaller groups settled in to talk, and maybe have a chocolate or an ice cream. Monteiro was usually there, holding court outside the chocolate store as a cooperative owner/producer, where I went to talk with him.

Monteiro, Valdir, Elias and about twenty others had banded together to try to see for themselves how cacao might respond without the use of burning. A folk scientific movement had happened, experimenting with a system of farming called '*roça sem queimar'* – planting without burning – to retain all organic matter by avoiding fire altogether. First, one opened up (*broca*) secondary forest regrowth (*capoeira*) in the form of *picadas* (alleys) using sling blades, machetes and chain saws. Then, a cover crop like *mamona* (castor bean) or *mucuna-preta* was used to shade out the ground vegetation. The larger trees were kept standing except in the

alleys, where one also planted banana and sweet potatoes. Then, one leaves the organic material, which will lie under the shade, to decompose. Then, one returns a year later, using slingblades, chainsaws and axes, to clear out the mamona, which as a soft wooded bush is much less arduous than cutting trees, and to set stake for the cacao. One plants cacao trees, black pepper vines, cupuaçu and others – along a narrow trail. Other trees get planted along with these main crops – especially mahogany, açai, copaiba, ipê, and Brazil nut (Serra 2004). This method takes twice as long but preserved the soil's organic material.

By 2019, however, Monteiro had been diagnosed with Parkinsons' disease and was on an intense regime of medicines to get him through the day. I could only visit him around eight in the morning. After about one hour, he needed to take medication and was pained in sustaining a conversation. But he wanted to show me the areas where he has set out his *sem queimar* (no burning) experiments about fifteen years earlier. One Saturday in March of 2019 – after a several day long gap in the pounding rains – we determined to set out, about ten in the morning. We reached the state planned agrovila, a village with an elementary school and an abandoned health clinic. There, we had the requisite early midday meal, at the house of relative. Monteiro, after eating, dropped down onto the crude tile floor of the veranda, rice grains peppering his grizzled chin. He was in pain, exhausted, and we took about an hour break in the midday heat, playing with some dogs and eating Jambu tree fruit from the home garden. Then we continued into his land, about two kilometers north of the agrovila.

Figure 4.6: Monteiro's agroforest lot

His land was full of cacao agroforests and felt like a *forest*. The diversity, richness and amount of vegetation was significant. On Monteiro's land, like Valdir's, there were at least seven planted and seven favored tree species being used. While this might not seem like much, these were just the 'keystone' species that structured this anthropogenic environment (see table 1 above). We walked past stands of graceful açai palms, which shadowed shorter stature cacao trees. Monteiro stopped to sit and commune with an adult, 50 meters tall, Brazil nut tree that he remembered. Brazil nut trees are a canopy 'climax' slow growing species, pollinated by large black orchid bees. Brazil nut trees only create fruit if connected with a rainforest understory. Monteiro seemed to have developed almost a relationship with the tree, as he sat contemplating it.

Figure 4.7 Monteiro contemplating an adult Brazil nut tree in the midst of cacao trees

Monteiro feels awful again, however, so we take another long break. Bruna, who I've hired to help me with these interviews and surveys, finds a few cacao fruit pods in this early afternoon heat to indulge in the pulp. Monteiro lies upon the leafy bed of this forest orchard… containing planted species like Rubber, Mahogany, Açai, and Teak. But many, many other species were growing in this anthropogenic ecology.

Figure 4.8: Taking a break in the cacao

Also, here were some fungal infected branches, infected with witches' broom disease… Witches' Broom disease was the most detrimental pest in this region. As if under a strange spell, disease infected tree parts take on a characteristic writhing or otherwise deformed aspect.

Figure 4.9: Witches' broom disease infected branch

The fungus responsible for the disease, Moniliophthora perniciosa, is, like the cacao tree, native to Amazônia. However, pruning out witches' broom from trees here effectively controls the disease because another endemic Amazon fungus, Trichoderma stromaticum, consumes M. perniciosa during the dry season. Any cacao farmer's survival thus depends on manual pruning work. Farmers climb into the trees with machetes and use long pruning poles while on foot to cast infected tree branches, flowers and fruit pods to the leaf littered, fungal replete soil.

I knew the latter only after about another year of connecting the dots – how ecology and climate assemblages synergized or not with manual human work. We had not talked of witches' broom when we were out with Monteiro – the disease was not very prevalent on his land. But it became clear, in conversation with former extension scientists, how the lack of T. Stromaticum in Bahia's environment,

combined with the lack of genetic diversity had caused the collapse of cacao in Bahia after 1989. Whereas in Amazônia the disease could be better managed. Here, what walks, talks and participatory activities with farmers showed, was the importance of labor – dedicated, sometimes arduous, but never considered 'drudgery'. These farmers were obviously committed to making these agroforests. There was a creative and determined character to forming and to the maintenance of them, and in knowing how to manage for soil fertility.

Over large areas, for example, bringing in nutrients from elsewhere was not always practical. While Valdir had corroborated the role of tenure and lack of capital in attuning post sugarcane areas back into cacao, Monteiro had corroborated that soil fertility was not the most limiting factor in cacao production; rather it was labor and technique. Labor and technique were smallholder peasants' owned means of production, in an oddly functional forest commodity geography. Here, when small ownership and available labor were combined, it made for a radical political economic and agroecological alternative to the hegemony of cattle ranching that suffused the region. Moreover, there was no gender discrimination in cacao production, as often existed for cattle.

Both livelihood and ecological relations in these smaller plots were more sustainable – my statistical research indicated that cacao and other perennial incomes were on average 10 times as high per land area compared to cattle. Moreover, while I had not studied soils and biodiversity systematically, it appeared that soils did not degrade in agroforestry systems, and that biodiversity was conserved in the

landscape. Moreover, there had existed a collective learning movement – connected to the state but setting up an alternative pole of knowledge based in experience and experimentation. Here, the modernist state had flopped to an extent way beyond the pale of most other twentieth century situations, but the continuance of a tiny wing of the state, in the form of CEPLAC, had kept a social agrarianism and ultimately land regenerating option alive.

For farmers, state scientific knowledge was thus simultaneously incredibly useful and at the same time, incredibly inept. Around this time, I also travelled back to Belém, to talk with Fernando Mendes, a socio-economist and head of research at CEPLAC. We talked about alternative development, about cacao history and genetics and so forth. Fernando had worked with the agency since the 1980s, had contracted malaria – both kinds! – and was a dedicated government servant. Monteiro came up. Monteiro and roça sem queimar! Monteiro, aff,– he asked for special financing! But how was that going to be possible without organized data and proper scientific repetitions! Fernando was exasperated. Monteiro had in fact tried to play the data game, but it was a mess to rely on sharecroppers as partners in producing experimental data.

This impasse in the state's connection with farmers struck me. Here was a severely underfunded, federal government agency, combined with a modern scientific attitude to statistical relevance, but then, all for the purposes of backing up a financial flowchart for banks? It all seemed so poorly concocted. Of course, one could conclude that CEPLAC was responsible for the way this landscape had turned out.

Without a source of germplasm from forest bred hybrid cultivars, none of these agroforests would be productive. But without a reverse, peasant movement, that had made significant demands on the state, in ardent determination to secure livelihoods with humble means, it would have all come to naught. Labor, ecology and land system transformations were not about a 'moral economy' of peasants hoping to be left alone; but rather about demands to be recognized, to be made visible and valued within a larger governing framework, which, for fifty years, had failed them.

Chapter three conclusion

This chapter has provided a multiscale framework for visualizing and appreciating relations involved in agroforestry production and landscape recuperation. The landscape did in fact 'transition' per consolidating a 500km^2 area of consistent species diverse tree cover in Medicilândia. The increase in land dedicated to agroforestry increased by approximately 50% from 1992 – 2014 and has since consolidated further. Sugarcane areas were entirely re-agroforested. However, expansion of pasture has continued outside of the cacao consolidated zone. And at larger scales, in Moran's 6,000km^2 regional analysis (see figure 4.1) – secondary forests or agroforests simply do not register as a significant trend, because of the constant cycling of secondary areas back into pasture. By increasing the scale, however, an entirely new phenomenon becomes apparent – that of an increase in anthropogenic tree cover, which in certain instances is indistinguishable from primary

forest in satellite imagery. In all, my findings confirmed the theory of smallholder tree-based intensification as a forest transition pathway. This 'intensification' however is of a different character than that of industrial agricultural intensification, because it is based on labor and manual techniques.

I have also showed how farmers employ agrobiodiversity their systems, through cultural experimentation with soil fertility and alternatives to fire. Their experiments engage a different concept of soils than that of temperate climate agronomy. *Shade* is just as if not more important than nutrient load in tropical soils' ecological viability and thus, fertility. With tropical soils, plant-soil relations are sometimes sustained in less nutrient rich conditions, which can fly in the face of temperate latitude understandings. Soil fertility of course matters, but the viability of any system can be managed. In chapter seven, I will show how former sharecroppers and bar owners have taken up new agroforests on medium and degraded fertility soils that were held 'off limits' by CEPLAC. The viability of cacao agroforestry – on medium or degraded fertility soils – but not on very low fertility soils – is perhaps one of the most significant findings of this dissertation. Cacao livelihoods are indeed viable in areas never previously supported by the state, using shade agroforestry.

In this chapter I have shown how the use of mixed methods in from land change sciences reveals the extent of anthropogenic 'cacao forests' in this Transamazon geography. I have substantiated that this alternative geography and culture of land use is indeed significant and real. Also, the theory of smallholder tree-based intensification is supported by the data. Lands formerly in sugarcane went to

tree cover; lands planted early on in cacao have also increased their tree cover as their 'cacao forests' have aged. Overall, the landscape is now more 'closed' than in 1992. In the broader 6000km^2 landscape that extend to the Xingu river, however, there has not been a 'transition' so much as a maintenance of anthropogenic tree cover across a 500km^2 area, which is visible at the lower left of Moran's land change study in figure 5. Any increase in secondary or anthropogenic forest cover at this larger 6,000km^2 scale is being offset by pasture formation.

In the next chapter, we turn to the *longue durée* that underlies this unusual phenomenon of Amazonian land system transformations and connect these with the phenomenology of embodied labor and experience. There is a strange sticking point of cacao as a labor demanding – but also a labor rewarding – crop. Cacao can be left to its own devices in gradually decreasing use in swiddens or successional agroforests – and it often is – but to produce well it has to be maintained, mostly in terms of pruning. As we will see in the next chapter this was a vital connection between the ecological and climatic assemblage around cacao, its native fungal and soil associates, the management practices of smallholders, and sharecropping labor propping up the productivity of large cacao estates on 100-ha lots. This history involves the biology and genetics of the cacao tree, its semi-domestication by indigenous peoples, its role in a colonial and modern commodity economies, and interrelationship with Amazonian fungi. By engaging the problem of scale, the next chapter will also interrelate social with ecological processes, which have allowed alternative land systems to emerge.

5. Chapter four – Between the Wild and the Plantation

Witches' broom fungal disease is best managed using manual techniques, in essence reserving the crop for small-scale management.

This chapter will show how a necessity for manual pruning of the cacao tree to control witches' broom fungal disease, has helped position cacao as an antidote to more typical frontier land use, in essence preserving it for smallholders and sharecroppers. Unlike speculation on frontier land and cattle ranching, cacao has produced a heterogeneous forested and agroforest mosaic in lands formerly cleared for sugarcane on Medicilândia's former frontier. The chapter will develop these connections in three parts. The first part is an environmental history of cacao in the Amazon. I show how the tree migrated and evolved with humans and nonhumans. This part shows how the tree's genetic and ecological characteristics, have made the crop resistant to plantation organization in both the historical and contemporary Amazon. The second part participates in the work of pruning trees and the manual control of endemic witches' broom fungus. It shows how the temporal rhythms of climate and fungal ecology work in sync with an embodied labor process. It bridges from historical ecological to phenomenological theory about landscapes, using the theory of Timothy Ingold. The third part then brings in the political character of landscapes, through a focus on scale. It starts by working through a concept of scale,

then applies the concepts to Medicilândia's history and geography, to account for smallholding and sharecropping processes and patterns.

In the last chapter, I tried to sketch out how middle range theory can be useful tool for thinking through relations in a landscape. This does not simply mean 'hypothesis testing' but rather an attempt to synthesize/ consider a totality of relations in geographical phenomena and change. In middle range theories (Meyfroidt et al. 2018), land system change are processes that involves multiple scales and relations. Land system change can involve relations that are exogenous to a landscape in question, such as states determine to reforest a particular area; while some relatinos are endogenous, e.g. farmer responses to climate and to livelihood or market context (Lambin and Meyfroid 2010). A landscape however is not coterminous with a scale but a way to consider social and ecological relations in their entirety. This involves political visions or planning ideas; it also involves micro climatic conditions on a farm; it also involves the manual work techniques, knowledges and values of people. However, the words landscape and scale should not be thrown together in the same phrase – e.g. the 'landscape scale' – as this can create confusion. But relations are not fused into landscapes as a totalizing *infrastructure*; relations are specific to the contingencies and histories of scales, whereas landscapes emerge across multiple relations and thus from multiple scales.

in this latter section on scale will thus concentrate on the thorny theoretical issue of scale in tension with uses of the term landscape and show how this tension plays out in the chaos and confusion of the Brazilian Amazon. I begin by leaning on

the work of Nathan Sayre (2005), and Rangan and Kull (2009), to develop a working definition of scale and of the 'production' of scale. Then, following the work of Anna Tsing (Tsing 2000, 2005, 2012, 2015), I outline a relevant tension between scalability and non-scalability. Using the insights of Kenneth Olwig (Olwig 2002, 2016), I illustrate the historical moment of nation-state 'scaling' and compare it with Tsing's concept of plantation scalability. Then, with the help of Ingold, Sayre, Rangan and Kull, Tsing, and Olwig together I argue that appreciating the temporality of landscapes goes beyond knowledges or languages drawn up in perceptions of 'form'. I argue that landscape assemblages emerge through lived, scale-sensitive relations, and tensions between experience and perceptions. These relations, experiences and perceptions are at once ecological, social and political. Thus, rather than posit 'scaling' as a ubiquitous type of agency that structures perceptions and knowledge, and thus the world – I am interested in how scale refers to the contextual conditions of relations, and tensions between perception, categories, politics and phenomena. I work with the above cited geographical and anthropological scholarship to develop a dynamic concept of scale – moving between operational, observational, and interpretive 'moments' of scale.

For example, when INCRA abandoned the sugarcane refinery in Medicilândia, the landscape set up a process of reconfiguration of scale-sensitive relations. The observational or regulatory scale of the state – i.e. the land holding size of 100 hectares – had been held in place via the apparatus of sugarcane production. The sugarcane farms however were a state-controlled network. In the early days of

the Transamazon highway it rained much more than it does today – creating much frustration with the low level of sucrose in the cane. The scalability idea that had been sold to the colonist land managers was constantly getting stuck – literally in the physical environment and also in relation to disconnected state administration and finance. Upon the state' abandonment of the system the interpretive scale however shifted to value embodied labor and human mobility. This was an imagination distinct from frontier expansion of the land cadaster, or plantation production. And the operational scale shifted into a less labor onerous, smaller size and more patch heterogeneous, pattern of tree-based farming, denser human settlement, and significant squatting on lands formerly managed by the state. These three levels of scale are conceptually based on Annales school historical thinking and will be further elaborated below.

Briefly, my methods in this chapter include interviews and conversations with plant scientists and community members in Medicilândia, Santarém and Belém, reviews of the botanical literature, and participatory observation.

A deep history of the cacao tree

Between the Tapajós and the Xingu rivers – the land that the Transamazon highway traverses – one does not encounter wild cacao in the forest. Knowing that cacao was a native Amazonian species, this confused me. Evandro, who had been county secretary of agriculture in the 1990s, had shown me 'native' cacao in a walk in the remaining primary forest at the back of his lot – but after groping through the

literature and the internet I saw that he was referring to the species *Theobroma speciosum*, or the cacaui tree. Why would there be no naturally occurring stands in Medicilândia, elsewhere on the TransAmazon or in indigenous forest land? I was confused because I knew wild groves or even stands could be found along the Amazon river north and west of the Tapajós, near older river towns like Paratins, a fifteen-hour boat trip up the Amazon from Santarém on the way to Manaus.

In early 2019, I learned about isolated groves of 'wild' cacao near the mouth of the Tapajós river and Santarém. (I have not yet visited these trees). These trees were often located on or near anthropogenic 'dark earth' soils. It was thus likely that these 'wild' trees were themselves the outcome of indigenous landscape formation, but on a millennial scale. At the now near ruin of a government (CEPLAC) biological station at km 100 on the transamazon highway, I'm looking at the facility's list of hybrid varieties. These are abstract and difficult to interpret, with names like IMC 67, BE 10, MA 15. There is the list appears the MOCORONGO clone – *mocorongo* is a wry nickname for the somewhat phlegmatic residents of Santarém. I confirmed in interviews that this was a propagate from the 'native' Santarém groves, which has been crossed with other propagated clones to produce hybrid seeds for the past 40 years (personal communication with Elpidio Francisco Neto, Feb. 2019). Sometime in the 1970s or 1980s – it was difficult to figure out given the near ruined state of the extension agency, vegetative material from one tree within these Santarém groves had been collected, graft-cloned and then crossed with other selected cloned individuals to produce controlled hybrid fruits and seeds.

Cacao trees resemble apple trees in that their fruit seeds express a wide swath of genetic diversity. Apple seeds, if strewn to form 'wild' orchards, will produce trees with all sorts of forms and fruits. When Amazon cacao was first brought to the Atlantic forest in Bahia in the 18th century, the entire genetic diversity of the region developed from the seeds of six fruit pods brought to Bahia by the Frenchman Federico Warneau in 1746 (Lima and Silva Neto in Mendes 2017: 12). After being planted near the Rio Pardo, the tree propagated across the Atlantic rainforest, both in extensive domesticated form (the cabruca system) but also dispersed by monkeys (personal communication with Elpidio Francisco Neto, Feb. 2019). Notwithstanding, however, this wasn't enough genetic diversity to withstand Bahia' cacao being decimated by the witches' broom fungus in 1989, a story to which I will return below.

Rather unlike apples, however, cacao's phenotype expression can be controlled for a single generation with controlled crosses between individual trees, such that in the Brazilian Amazon cacao orchards and agroforests cacao trees are grown from *seeds*. Clones are used only to the extent that they are the propagated individual parents of seeds, which themselves pass on significant genetic diversity, expressing certain traits in the first-generation hybrid (F1). In contrast, in Indonesia, Malaysia, and in parts of Colombia and Ecuador, many if not most farmed cacao trees are cloned through vegetative propagation.

In cacao management terminology a hybrid is simply another word for a cultivar. Thus, technically speaking, wild cacao trees are hybrids, as are trees resulting from seeds from crossing clones in state biological stations. Both are the

result of exogamous pollination. Hybrid refers to the genetic character of the plant. Even though its flowers are hermaphroditic, 95% of cacao pollination is exogamous, i.e. with other genetic individuals. What makes second generation genetics from a hybrid stand "less productive" are the fact that all the seed trees in one stand of cacao would be the result of the same genetic crossing --- thus, when F1 refers to the original cross, F2 seeds would be from trees that themselves had resulted genetically from two genetic individuals (clones) only. Thus, the selected expressive traits become less prominent in the phenotype after the first, F1, generation, as the traits disperse. These controlled hybrid crosses are meant to bring out genetically expressed factors like production and resistance to disease. Yet, F2 trees would thus lose a significant part of the expressive traits cultivated by the original cross. F3 would be even less expressive of the selected traits. The loss of characteristics is especially apparent in terms of how much fruit the trees bear. While seeds from F1, F2, F3 trees are certainly not infertile – and in fact there is dispute about the nature of the term hybrid as it applies to cacao – the uncontrolled pollination of hybrid varieties does not yield consistent traits.

Yet, the overall ecological resistance of cacao cultivars to diseases is argued to be higher using such hybrid cultivars. Brazil's CEPLAC tree breeding programs considered hybrid seed a better way to maintain genetic diversity in the landscape. Also, growing cacao seedlings from seeds is less onerous and expensive than working with grafted clones. However, the key takeaway here is that there was no clear authority or genetic pattern established between the state and cacao farmers. Most

cacao farmers, let alone the actual extension agents, had little to no idea about the genetic pedigree of their trees in their agroforests. The one individual state extension worker that remains on duty – Chagras was his name – pulled fruits at random out of the biological station at kilometer 100. That genetic crossing then spills out into the landscape via human cultivation.

Figuratively and literally 'seedy', the state's breeding and distribution programs were the collective agent that brought *Theobroma cacao* to the land between the Tapajós and the Xingu rivers. Yet, this modern form of landscape shaping could be considered in continuum with the deeper history of landscape relations in the Amazon. On the Transamazon highway, smallholding and sharecropping cacao had arrived with the simplifications and disasters of state governance and capitalism, and involved the removal and marginalization of indigenous peoples. But even in Europe, where the modern nation-state emerges, landscape practices can be connected with ancient material relationships and processes, such as the 'heft' of walking with livestock, long before the emergence of the state (Olwig 2016). Thus the challenge would be to explore countervailing lines of human with nonhuman relations in a region famous for its multiple anthropological views on nature and society (Castro 1996). While older indigenous historical ecologies and perceptions were laden in this region, similar questions might be asked of the landscape practices of diverse colonists in their relations with the cacao tree. In the larger region in which I stood there were multiple imaginations and histories in visions of Amazonian 'nature' – which has not been empty of humans.

How can we approach these landscapes in a way that preserves a tension between human and nonhuman histories without fusing social into natural phenomena or vice versa? Historical ecology is a subdiscipline of anthropology that keeps this balance; the subdiscipline connects archaeological and contemporary temporalities. According to Isendahl, the anthropological concern of historical ecology is to emphasize the role of human activities in ecosystem development, rather than as disturbance factors (Isendahl 2016: 129). Historical ecology in this anthropological sense bridges archaeology, paleoecology and other cognate disciplines. Partly a reaction against processual archaeology's cultural ecological outlook on adaptation to environmental forcing factors, historical ecology places stronger emphasis on the socio-cultural complexities of human agency, decision making, problem solving and landscape transformation (Balée and Erickson 2006). Historical ecology thus places humans squarely within the environment at the same time that the environment is made part of us. Methodologically, the subdiscipline uses artefacts – living plants, landscapes, and even language – to reconstruct the combined social and ecological character of landscapes. Historical ecology however is less often concerned with overarching models and power, and more on processes and patterns that have a more pedestrian character – over temporal scales that range from decades to millennia.

Historical ecology emerged in part out of anthropological focus on lowland South America, i.e. the Amazon and nearby areas in today's Bolivia, Paraguay and Colombia. These are places in which 'modernity' and capitalism have had tangential but nonetheless profound influences, producing perverse and sometimes violent

hybrids. Historical ecology's argument is that the Amazon has significant anthropogenic qualities involving the character and distribution of soils and plants, which predate the arrival of European humans and nonhumans. The Amazon is not pure 'nature', these places are filled with indigenous, European (e.g. Raffles 2002) and African resonances.

The advent of the Anthropocene however pushes these issues by raising even more profound questions of human-geological imbrications, biological exchanges and their specific temporalities, not to mention the sustainability of life on the planet. Cacao is a particularly interesting tree with which to think about these problems. The tree is indelibly associated with the Columbian exchange. It is unusual, however, as the tree's seeds were an indigenous commodity with their own biological exchanges in the Americas prior to 1492. On the Transamazon highway, the Brazilian state had reimported cacao back into a favorable ecology after thousands of years of human and non-human distribution, domestication, transport to Europe, and the transformation of cacao farms and plantations in Africa and more recently in Indonesia. Before and after the Columbian exchange, the plant had made significant geographical forays.

Unfortunately, few accounts of early trade in cacao provide description of the physiology or ecology of the plant/fruits (Bartley 2005). With modern European exploration, the first to document the existence of distinct cacao varieties was Alexander Von Humboldt (1821). Humboldt noted differences between cacao varieties encountered in the Amazon, compared with those found in Mesoamerica and

the Antilles. Humboldt also recorded that wild stands of cacao could not be found north of 6 degrees latitude. Yet, by this time in the 19th century there were domesticated plantations well north of this line, around Caracas and Maracaibo on the coast of the Caribbean numbering 16 million trees (Bartley 2005).

Most species in the Theobroma genus, including the cacao tree (*Theobroma cacao*), are 'native' to the western Amazon basin. There are 22 species within *Theobroma*, and 17 species in the related wild genus *Herrania* (Cuatrecasas 1964). Many cacao scientists were from Trinidad: Caribbean plant scientists with anglicized names. Cheesman (1944) for example studied the genetic origin of cacao. He argued that it had two main areas of origin. The first was 400km radius centered on the confluence of the Rios Napo, Caquetá and Putamayo on the border region between modern-day Colombia and Ecuador. The second was an area in eastern Peru – the Ucayali river. Basil Bartley, another scientist from Trinidad, who spent his career at the International Center for Tropical Agriculture (CIAT) in Colombia, also thought this latter area important; this was the area in which the first European contact with South American cacao is recorded. On the Vilcanota river, here at nearly 13 degrees south, cacao stands are encountered above 1500 meters. Bartley quotes a report from Clark (1981) describing a tree being 50 feet tall with locals making a sort of crude chocolate from the seeds. The Ucayali river, in the same area, was explored by F.J.

Pound (1943), also from Trinidad, who was looking for varieties resistant to Witches' Broom fungus (*Crinipellis perniciosa*).[9]

Today in the Amazonia and Guyana shield, "wild" stands of cacao trees are found embedded in the forest matrix of the high terraces of the upper and middle tributaries of the Amazon (Solimões, Jí-Paraná/Madeira), upper tributaries of the Orinoco, and along some other river systems (Patiño 2002). Wild stands may result mainly from dispersal by animals, especially howler and spider monkeys (Lachenaud and Zhange 2008). As a riparian species that grows well on the alluvial banks along rivers, up to 600-900 m altitude with greater altitudes up to over 1500 meters observed near the equator. While the tree grows in soils of varying fertility in the "wild", it is usually indicative of good soil fertility. The high terraces of large rivers carry larger populations than do small rivers, likely because of greater fertility of the floodplains. Away from rivers, cacao also grows in upland forests, provided that the site has relatively fertile soil. Wild cacao reaches up to 25m in height and >30cm in trunk diameter, occupying the lower and middle strata of the forest's vertical profile. Individual cacao trees live for more than one hundred years, and stands can persist at one site for more than two hundred years.

9 The collection made by Pound was not extensive; only fruits from a few trees were collected and then the clone variety P 31 was propagated (Bartley 2005)

Figure 5.1: Flowers emerging on a cacao tree trunk

The trees tiny flowers are hermaphroditic containing 30 to 70 ovules. The plant's pollination is limited exclusively to species of midges in the family *Ceratopognonidae*, in the genera *Forcipomyia*, although, ants and "tripes" and "afideos" may pollinate the trees accidentally (Chapman and Soria 1983). The ovary is surrounded by a circle of infertile stamens. The complex structure of the flower, which includes two physical barriers, including the infertile stamens, requires active insect participation. *Theobroma* and *Herrania* genus are unusual for both having this unusual trait to the flowers – with barriers to the "gametes'. There is some mutability between species within the genera as whole, but cacao itself has never been crossed with other species in the genera. Yet, other species within the genera have been successfully crossed. For example, cupuaçu (*Theobroma grandiflorium*) has been crossed with cacao de urubu (or buzzard's head cacao) (*Theobroma obovatum*).

Cacao's specific evolutionary history has been difficult to ascertain given uncertainties about its domestication (Young 1994). Cacao was argued to be semi-domesticated species by Clement et al. 2010. Clement and others assumed that human attraction to cacao in the Amazon basin was due to its fruit pulp, not seeds. Thus, the "wild" stands in the Western Amazon basin were a result of human as well as nonhuman dispersal. Ancient human use of chocolate had been documented only for Mesoamerica and Pacific coast, and not for the Amazon basin east of the Andes. That however has recently changed, with clear archaeological evidence of seed use and chocolate in Amazonian present-day Ecuador (Zarrillo et al. 2018).

Cacao scientists have hypotheses about human-nonhuman relationships in the history of the species and consolidation of two broad cultivar groups or genetic varieties of cacao, plus a third group that is a mix of the first two. The absence of physical barriers to the northeast, east and southeast of the western Amazon facilitated *Forastero* type cacao dispersal by animals – monkeys, small rodents and birds. Yet, being that the tree cannot withstand colder weather or sustained wind, cacao could only travel across the high Andes mountains with human assistance. Thus, humans would have carried the second *Criollo* type variety fruits/seeds only across the Andes – due to their lower tannin content. Criollo seeds are less bitter than Forastero seeds. Hence, the Criollo variety was hypothesized as a human selective trait of cacao east of the Andes, which was then transferred into Mesoamerica (Cheesman 1944). Montezuma's cacao was Criollo, even if the word technically

means European descent. The earliest documented domestication of cacao happens with the Maya in the Yucatán peninsula (Bartley 2005).[10]

Thus, the Criollo variety is associated with Mesoamerica, but is a result of early selection for domestication as humans moved seeds over the Andes and across the Panamanian isthmus (Santos Dias and de Resende in Borém et al. 2012). Forastero variety in contrast dominates Amazon wild cacao, both via animal dispersal (monkeys, small rodents, birds) and human dispersal, across the Amazon basin (Barrau 1979). Smith (1999), for example, argued that cacao, being "native" only west of the Madeira river, had been cultivated in the middle and lower Amazon by the dense indigenous populations that occupied the region before being decimated by diseases after encountering Orellana's expedition in 1542.

The figure below presents a conceptual drawing of the original genetic home (*berceau botanique*), dispersal trajectories and geographical outer limit (the dashed line) of spontaneously occurring wild stands. The dotted line outlining where 'wild' cacao might potential exist in South America is not at all specific. The absence of cacao in the upland forests between the Tapajós and the Xingu was a matter of historically constructing the tree's movement. And its "wild" status in Mesoamerica (the Criollo group) is a product of its being made endemic through human cultivation. Its "wild" status in the Amazon (the Forastero type) is a product of less intensive domestication – mainly along the Amazon river itself – and natural dispersal.

10 Santos Dias and Resende in Borém et al. 2012 actually discuss three hypotheses: south-north (Cheesman 1944); north-south (with cacao originating in Nicaragua) (Patiño 1963, Mora Urpi 1958), and natural and broad origin and dispersal (Cuatrecasas 1964)

Thought to be the remnants of colonial or modern era plantations, 'wild' stands are found as far south as Alta Floresta in Mato Grosso (Bartley 2005, chapter 5).

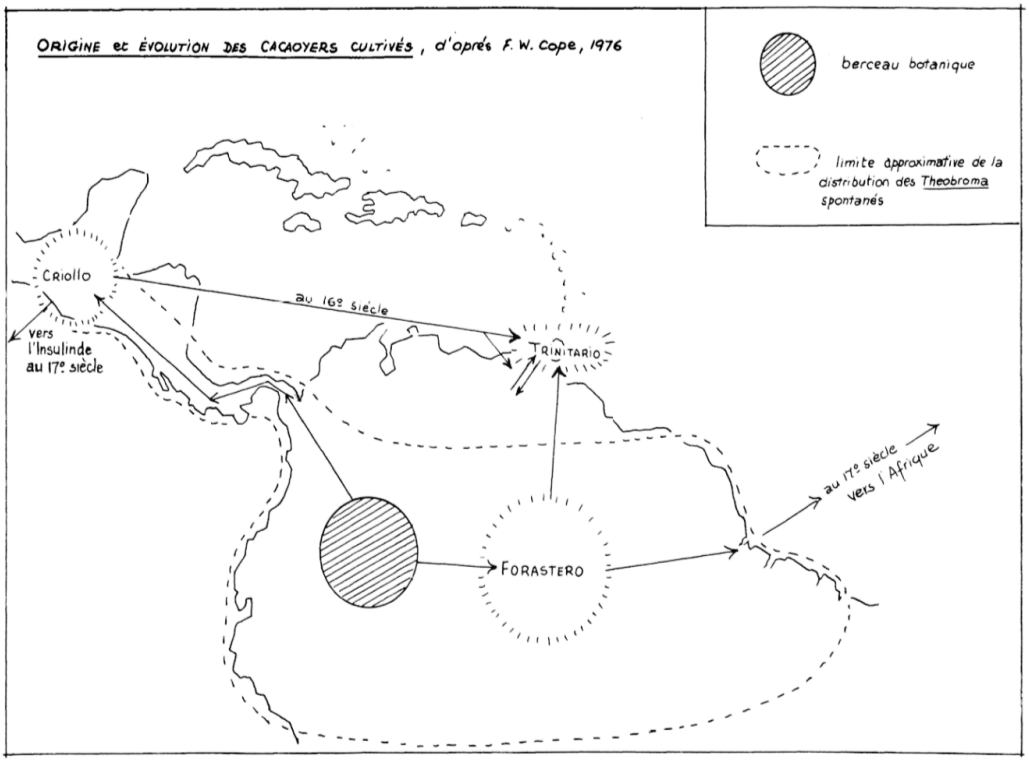

Figure 5.2: Hand drawn scientific ma by Barrau (1979, hypothesizing about cacao's history and recent evolution

In the (16th century into the 17th) expansion of cacao exports to Europe, the tree was grown in plantations in Mesoamerica, on the northern (Caribbean coasts) of Colombia and Venezuela, and in the Antilles (Touzard 1993). Then, after the consolidation of the cacao trade Amazonian Forastero was "discovered" by Europeans. The Forastero type was taken to West Africa in the 17th century, and also to Trinidad in the early 18th century. There, on Trinidad, farmers crossed the Criollo

with the Forastero, forming a third genetic group of cultivars – the Trinitario type, resulting from the crossing between the two original geographical groups.

Cacao was the Amazon's first significant commodity export, which linked the river basin with Europe in the 17th and 18th centuries (Alden 1976). In the early colonial period, the Portuguese wanted land less than they wanted products and people in the river or near its edge: cacao, but also cloves, nuts, a medicinal oil called *drogas do sertão*, turtle and manatee oil, fish, and, in the days of Indian slavery before 1755, human beings. The Jesuits were a competing sovereignty with the Portuguese crown in the Brazilian Amazon prior to 1757, and were significant players in mercantilist extractive and labor economies. Indigenous slave raiding was common in the region up until the mid 18th century, with slave hunting parties sent up from Belém, and *bandeirantes* entering from the southern Amazon, both ransoming captives from indigenous groups.

With European demand for chocolate increasing into the 18th century, the extraction of wild cacao increased, becoming the first commodity to link the Amazon to Europe (Alden 1976). In the interest of building up its colony, the Portuguese crown had directed the colony – including both settlers and missionaries – to harvest wild cacao, and to try to establish it in orchards. Indian labor – often enslaved – was used as paddler crews on large canoes that would leave Belém for the interior during the annual ebb in the river flow, to harvest cacao in the forest (Alden 1976).

The Jesuits used indigenous labor to extract cacao for the economic benefit of the missions and were involved in organizing indigenous villages around cacao

extraction as collective mercantilist entities. When the Jesuits were expelled from the Amazon by the Portuguese crown in 1757, these indigenous villages, for a brief period, operated as commercial posts in the regional system, and sometimes under indigenous leadership (Alden 1976: 124). This was the period of the "Directorate" (1757-1790), a period of state monopoly subsequent to the secularization of the missions – which was a move to consolidate the "missionary-mercantilist complex" in favor of the Portuguese state (Harris 2010: 108).

However, when the Portuguese in the late 18th century attempted to "emancipate" these indigenous collectives and transform them into free labor, the social effect was that the indigenous people left the villages. The new Portuguese policy in the late 18th and early 19th century was to expand an agrarian plantation system. Rather than to be contracted to labor by settlers or forced into military service, indigenous people moved out of the settlements to set up farms and houses in riverbank hamlets, made up of extended families. This was because the state policy allowed smallholder producers to remain on the land in the interest of expanding the cacao trade. They started to plant orchards and larger gardens and to "enjoy her Majesty's honors" as independent producers (Sommer 2000: 311-12 in Harris 2010:121). Only the "wild" Indians – the *gentio* – deeper in the forest, continued to be recognized as legally distinct from the colonial citizenry. Mixed-blood persons were viewed as better serving the interests of the state, and the state provided incentives for the Portuguese to set up households with the indigenous (Harris 2010).

Amazonian export cacao came mostly from wild stands along rivers, but there were also attempts to establish plantations. According to Harris, these efforts largely failed: "Amazonia never succeeded in developing a plantation economy [during the colonial and early modern period]; environmental and labor constraints prevented dependence on a single export. Instead, its historical economy was generally diverse, seasonal and cyclical; this has consistently been one of the characteristics that separate Amazonia from the rest of Brazil (Harris 2010: 130-1). Unlike in neighboring Maranhão, the shifting land-waterscape prevented the accumulation of capital and an increasing concentration of slave labor in permanent land-based plantations. The labor and seasonality involved in cacao was distinct from that of sugarcane on the coast. Outside of the period of the cacao harvest, one slave could look after two thousand trees (Harris 2010: 122). Partially for this reason, fewer Africans were brought to Pará as slaves; around 50,000 compared to 5 million for Brazil as a whole (Smith 1999). Most African slaves did not work on cacao plantations but in the city of Belém or on the island of Marajó where the Jesuit cattle ranching estates after 1757 had been divided up amongst the provincial elite (Cleary 1998: 118).

Also, given relative ease of escape in this river system, many left to join maroon communities or *quilombos*; the largely indigenous interior welcomed *quilombo* knowledge and ability to trade in metal goods. Quilombolas (persons in quilombos) thus developed independent livelihoods, for example in the collection and trade in cacao, but also Brazil nuts and rubber (Marin and de Castro 2004). When

slavery was abolished in the late 19th century, afrodescendants sometimes took over former cacao orchards. A class of afrodescendant independent farmers emerged in Pará, focused around the town of Óbidos on the north shore of the Amazon (de la Torre Cueva 2011). Other cacao plantations along the river systems would go feral and recede into the landscape. By the mid 19th century, rubber had supplanted cacao as the Amazon's most sought-after commodity, and Amazonian cacao would be less valued in the landscape. In Brazil the center of its commodity production moved to the coastal state of Bahia.

Why did cacao resist the plantation form? The Amazon's particular environment was too unstable for the colonial economy to discipline. Rivers would swell and ebb as much as ten meters in the middle to lower Amazon every year. Livelihoods in the region have been less often settled or fixed to land, and more often migratory by nature (Cleary). Land use and possession was hard to pin down. And cacao was a semi-domesticate in riverine forests. While the Jesuits and then the Portuguese Crown and then during the early Brazilian Empire, commercialization "plantations" would be of two to five to perhaps ten thousand trees – a very small land footprint of several hectares, relative to the surrounding geography of millions of square kilometers. (In Bahia, the tree would figure more prominently in the overall landscape; while also be tended in an extensive *cabruca* system, but its ecological relationships would change.)

In the contemporary, colonized, Amazon, the cacao tree could be adopted by post-frontier colonist smallholders and sharecroppers. They could opt for a very

simple transaction with the state, filling in the cracks of the state's ruined model for sugarcane development. But the smallholding and sharecropping patterns of land management, again, would be a tiny land footprint, compared, for example to Indonesian islands subject to cacao land enclosures, described by Tania Murray Li (Li 2014). The reforestation on the Amazon post-frontier would be carried about by thousands and thousands of human bodies – and the cacao tree would respond to varying manual rhythms and mobility across the landscape and the reproductive cycles of a strange endemic fungus – witches' broom.

Seeing the trees

The first time I worked pruning cacao trees was with Bugue on Rogério's lot. I had to quickly learn how to wield a machete. I'm awkward using it, and I can't get it to cut cleanly. I've met Bugue up on a high point on the 100-hectare lot, where there are some Mango trees next to the gullied dirt road. I duck into a row next to Bugue and climb up into one tree to try to take care of the *galhos* – the green stems that shoot up vertically and pull water and nutrients out of other parts of the plant – and to clear out the *vassoura de bruxa*, the witches' broom fungus. There is quite a bit of witches' broom. Infected parts during its dormant period during the dry season take the form of young stems and branches curled up in a strange agony; or dark brown, mummified fruit pods. It's hard to use your right hand only and try to cut against the slope of branches to leave a clean cut. Hacking can weaken the tree, making it harder to heal itself. Much pruning work has to be done from up in

and standing upon the tree branches themselves. In Virginia, pruning apple and peach trees, we stay on the ground, and use long pruning scissors and hand saws on long handles, not machetes. Pruning goes much faster with a machete from up in the tree itself, but obviously it takes some skill to be suspended and swing a two-foot-long steel knife.

Figure 5.3 Pruning from within the tree

Down on the leafy floor of the orchard, I pick up the *podão* or ten-foot-long cutting pole. On the end is a small metal fitting like a medieval halberd – a hook blade on one side - such that you can cut either pushing or pulling. It's hard to aim the tool. I keep missing and quickly exhaust myself. Pulling it with the hook side is much easier. Cutting a branch of say, 3 inches in diameter takes many attempts. But Bugue is a good teacher. He shows me how to use the podão: don't handle it from the middle, he mentions to me, you'll always get the back end stuck on the ground. He seems a bit tired by my mistakes, but our mood improves as I improve.

The work isn't about a verbal conversation but about movement and practice. One starts to feel more confident using the tools and interacting with the trees, somewhat like learning to play an instrument. I try to be conservative, sticking to work taking out witches' broom infected parts, and vertical shoots – which doesn't require much artistry with the machete.

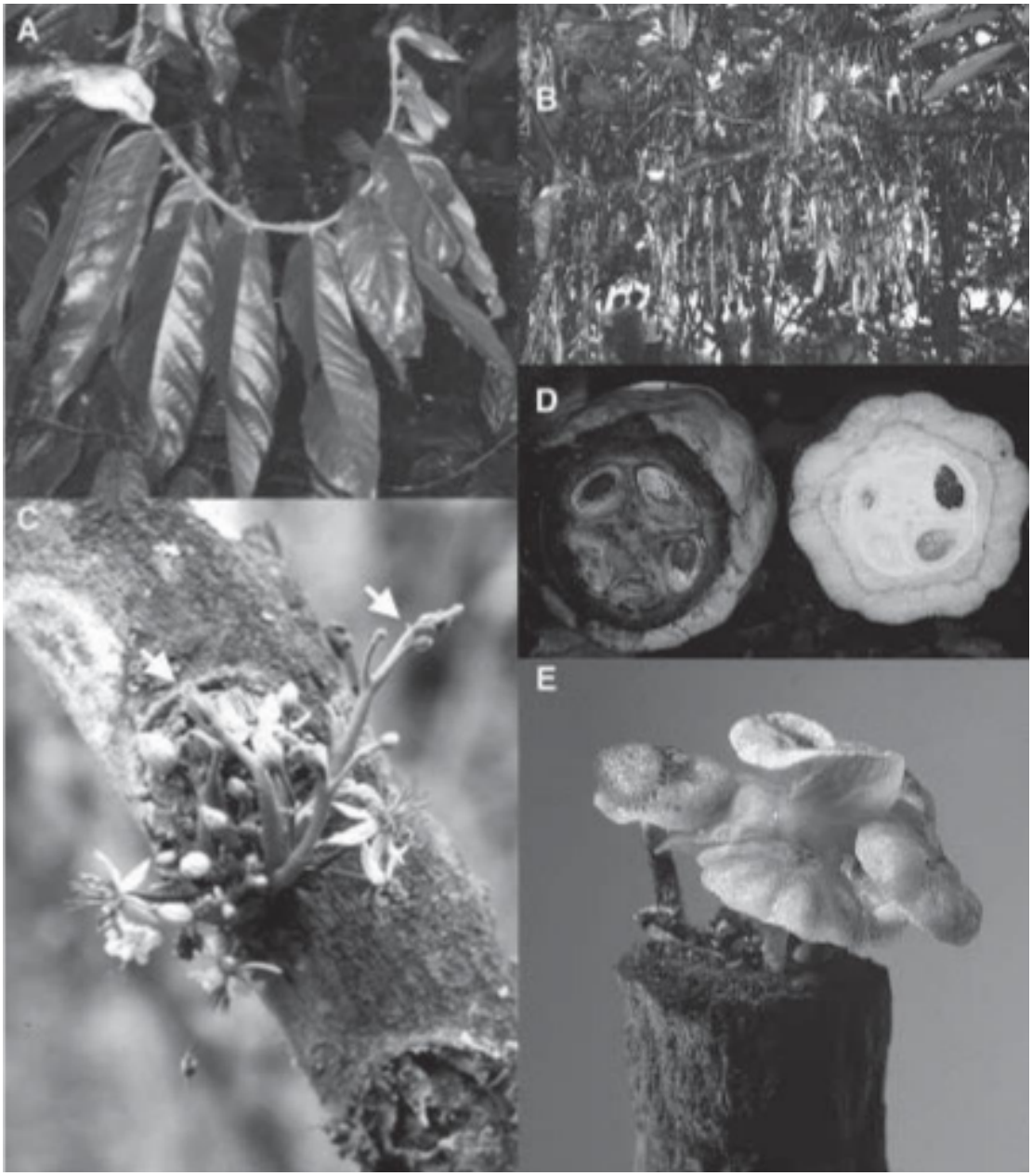

Figure 5.4 Symptoms of witches' broom. A, a green terminal broom with a deformed stem; B, mass of dead brooms on heavily infected tree; C, an infected flower cushion with some healthy flowers; D, diseased pod; E, basidiocarps (from Griffith et al. 2003)

Bugue was in his mid to late 30s. Strong enough to manage sharecropping four thousand trees largely on his own. During the harvest cycles – there were

usually about four of these from May through October –he would sometimes hire help for a few days breaking up the cacao pods in the shade. Then the cacao would sit in burlap sacks, crudely fermenting in its pulp residue, for approximately two-three days. Then the seeds would be spread out, in Bugue's case, on a large tarp to dry in the sun, another four days. Without a barcaça with a rollable roof, or an estufa or permanent tarp, one needed to keep a close watch on the skies, so as not to ruin the crop in a rain.

Figure 5.5 Late season harvest, and a pod affected by podridão parda (not witches' broom)

21

Figure 5.6 Working with Bugue's partner Cleonice; dishwashing gloves are often used when doing the work of scooping out seeds and pulp, because the pulp is acidic

Figure 5.7 Sacking up sun dried cacao seeds to sell to the middleman

Political or historical ecology has rarely engaged with phenomenology or participant observation as a matter of landscape's immanent qualities. Here, I turn to Timothy Ingold, who has made a rather audacious attempt to unify anthropological inquiry – archaeological, biophysical and cultural – involving landscape processes and patterns. Ingold has argued that learning and cognition cannot be separated from the material or the biological. Ingold's method is to begin with temporality to delve into the emergence of meaning, rather than to follow meaning in the verbal or symbolic rendering or depiction of temporality. Ingold's approach is resolutely phenomenological, to the extent that he has argued passionately against the problematic conflation of ethnographic description with participatory observation (Ingold 2011, 2014).

The phenomenological work of Tim Ingold is one way in which to approach landscape as a *lived and embodied* set of relations. Throughout much of his career,

Tim Ingold has tried to show how evolution and history involve processes that are mutually material and cognitive (Ingold 2000). Ingold is well known for his persistently material ecological outlook, yet his work has never discounted the role of thought and cognition. Ingold's writings explore the co evolution of organisms and cognition in an environment. Humans – like living nonhumans – learn, experience and communicate in tandem with their environment; in humans this material connection is both biological/developmental and psychological in character. Following Bateson, Ingold has tried to explore this dynamic, in opposition to Levi-Strauss (structure as culture) and Geertz (symbolic culture). Rather than to seek out the forms of cognition/culture that are transmitted or *genealogically diffused*, Ingold's interest is in how cognition/culture and material structures are *ontologically emergent*. To be sure, Ingold does not concern himself with phenomena associated with political organization or states. Rather, he has focused on how learning occurs through movement, observation, livelihood, habitation, skill – i.e. on life processes and the ecological contexts of people's interactions with their environments.

In a well-known essay "The Materiality of the Landscape" Ingold suggests that a landscape is a lived experience, neither consisting of human imagination imposed onto nature, nor consisting of non-human nature confronting 'man'. In turn, a landscape is not 'space' because it is not an act of disembodied representation, but a context of observation and movement. The key point is that for Ingold landscapes (and environments) are sensed and relational contexts of activity and life. Landscape is thus a process and patterning – the rhythmic temporality – of

the embodiment of relations, history consisting of working livelihood activities and movement. A landscape cannot be treated as an object; the landscape is an embodied pattern emerging from the interweaving of the life cycles of human beings, plants, animals and soils. For Ingold, landscape movement takes place on a scale "immeasurably slower and more majestic than that on which our activities are conducted" (Ingold 2000: 201). And perception itself is a matter of movement – one arrives at a sense of the landscape through casting one's eyes into the terrain; seeing is also an embodied experience.

Ingold's conclusion is that the practical and lived relations between human beings, trees and other components of landscapes contain meaning, value and moral resonance. This occurs, not by imposing a semiotic or symbolic frame, but by telling stories that open up an appreciation for relations with specific features of the landscape. The calling of an archaeological approach to landscape is not to drape representation over the world, but to delve into the landscape: "meaning is there to be discovered in the landscape, if only we know how to attend to it." This type of landscape apprehension is by necessity temporal, and only by engaging as such "can we move beyond the division… between the scientific study of an atemporalised nature, and the humanistic study of a dematerialised history." (Ingold 2000: 208) As such, Ingold's essay inspires an archaeological approach to the contemporary, uncovering meaning through attending to landscape, rather than by blanketing the landscape with a cultural script.

However, Ingold's material and ecological approach *can* be combined with landscape histories that include social and political organization. What I'm now going

to do is combine Ingold's embodied landscape approach, with deeper historical ecologies, social structures and political narratives. For example, there were significant processes and patterns embedded with our cacao pruning and harvest that were attuned to human institutions. One was the history and geography of the originally state organized settlement in this part of the Transamazon. Another was the prevalence of sharecropping and labor and livelihood adaptations after the collapse of a state infrastructure. Another was the botanical cacao wing of the state (CEPLAC). CEPLAC had been a significant force in the region's development thirty years ago. The state had 'inoculated' cacao here on and near the highway, but it persisted as a withering network. The agency was reputed to be so ruined as to distribute seeds already infected with witches' broom fungus. But it was labor, to a lesser extent soils, the middleman dominated, chaotic if liquid market exchanges, and this remnant source of hybrid seeds, among others, which were critical elements in this landscape's assemblage. The following table outlines these various material ecological and social structural elements.

The cacao post-frontier based on multi-temporal nonhuman and human relations:

Cacao tree genetics and seed propagation	Embodied, manual work with cacao (pruning, planting, fertilizing, weeding, harvest)
Witches' broom fungus and ecology	State distribution of cacao seeds, but limited disciplining of genetics
Terra roxa and terra mista soils of good fertility	Physical mobility across the landscape

Associated tree species and ecological characteristics	Land management subdivided through sharecropping and smallholding / greater ownership of production
Amazon climate pattern of rainy–dry season	Low cost transactions through middlemen merchants

Each of the above sets of relations involve specific temporalities or rhythms. These multitemporal relations are scale sensitive. For example, the scale at which pruning cacao trees occurs, and the 'non-scalable' aspects of this landscape practice. Pruning work or poda *fitossanitária* – epidermal pruning specifically for witches' broom and other diseases – was the central most important task in cacao farming and had to be accomplished annually. With Bugue, it would take 45 full days of work to prune 4 hectares or 4,000 trees. His daily but short motorcycle commute involved arriving around 7:30 am, and working till 11:30. Then, he returns back to his house behind a small evangelical church, just south of Rogério's house on side road km 95 south. Then he goes back out to prune in the afternoon. Bugue kept up a tremendous pace, going through nearly ninety trees each day. *Zelando* was the word used – elbow grease; most cacao farmers or sharecroppers would not prune as fast – perhaps fifty instead of a hundred trees per day. But at this pace, this pruning 4,000 trees would take three months. Pruning took place after the last major harvest in September, during the dry months of October and November. Pruning not only controlled witches' broom, but stimulated trees to produce fruit; it allowed for the distribution of solar energy and balanced a shaded micro-climate.

While I had heard of some farmers using copper chemical pesticide to deal with witches' broom, the most effective and common way to control the fungus was

simply to get into the trees and deal with it by hand. Both the Amazon climate (dry season) and the soil ecology helped control the disease. Witches' broom infected curled-up stems, and brown mummified fruits, could be simply cast to the ground. During the dry season the fungus was inert. (and the dry season was now longer than it had been during the era of the early frontier.) Landing on the leafy surface of the soil, witches' broom was then be consumed by another fungus, *trichomderma stramoticum*. The latter is native to Amazon soils but not to soils in the Atlantic forest in Bahia. There was thus also a biological control on witches' broom in the Amazon.

It required direct physical engagement to work at the *scale* necessary to clean out affected stems and fruits. Human binocular vision was important – being able to judge distances and maneuver hand tools effectively within the trees. Once, back in Virginia, I had seen my Cornell agricultural engineering trained brother take to an eight-acre peach tree orchard with a tractor powered mechanical shear. This had made a mess; the trees had not responded well. Along with worker friends from Guadalajara and Oaxaca, we went back into the orchard, pruning manually. My brother had torn through the orchard with his tractor in one day; the manual pruning process took three weeks. My brother did not participate in manual labor, or in human foibles; he was a lover of machines and their power. This made him successful in a North American context of agriculture, notwithstanding that the trees were pruned by hand and the peaches were hand-picked by weekend tourists.

Back in Brazil in Bahia, the cacao tree had been introduced into Bahia in the 18th century, where it remained largely isolated from witches' broom fungus. Yet in

Bahia there is no clearly defined extended dry season. It rains throughout the year in the Atlantic forest and fungal competitors like *trichomderma stramoticum* do not exist in the soil. Beginning in 1989 – some say this was a deliberate, malicious revenge – witches' broom – an Amazonian native like the cacao tree – was introduced into Bahian cacao landscapes. The fungus would decimate Bahian cacao within a few years. This devastating explosion of witches' broom was aided by the accelerated life cycle in the constant rains, and lack of ecological competitors. The historical disaster was classic example of a biological exchange gone feral, dramatically taking on new temporalities.

But the witches' broom epidemic in Bahia went on to affect other rhythms. Cacao production shifted back into the Amazon. The state of Pará today produces more of the commodity than does Bahia, and Medicilândia more than any other municipality in Pará. But in the Brazilian Amazon, cacao tends to be associated with little people's work. Powerful politicians aren't involved with the crop, unlike Bahia, where cacao was part of a system of hierarchy and landed estates. The blight in Bahia had been a disaster, causing suicides among the coronéis (patron landowners).

To summarize this section, the necessity for manual pruning of the cacao tree revolves around minute human contact with the nonhuman. There is a relative lack of 'scalable' infrastructure – which involves the organization of labor, the precarious conditions of the roads, smallholders' lack of capital, etc. – which has contributed to cacao farming not consolidating into plantation organization. This is not to say that cacao farming isn't an intensified form of agriculture – cacao is

certainly labor intensive. Yet cacao land use and tenure are not 'disciplined' to function in the way that mechanized plantations, deforestation and cattle sync with financial imagination. In the Amazon, cacao farming has consolidated through smallholding and sharecropping. These landscapes are embodied via labor and livelihood practices, walking and engaging trees. Drawing on Ingold's approach, I suggest that this is a manually practiced living relationship with another species. The physical scale of the human body is essential to how these relations work, rather than a perception of form. Pruning is always an ad hoc process. These relations could be glossed as 'small-scale'.

However, in the next section of the chapter I conceptualize landscape relations using multiple 'moments' of scale – operational, observational and interpretive. The embodied rhythms of labor may or may not operate in sync with environmental, social and political patterns formed at other temporal and spatial scales. Considering movements across time and space, I develop a concept of scale to follow both ecological, social and political processes and their connectedness.

Working with scale

This third section of the chapter will thus concentrate on the thorny theoretical issue of 'scale' in tension with 'landscape'. I will also show how this tension plays out in the chaos and confusion of the Brazilian Amazon. Scale is a devilishly difficult concept and talking about scale in a rhetorical manner easily creates confusion. In this chapter I hope to develop a working definition of scale that can allow for historical specificity. Anthropologist Nathan Sayre (Sayre 2005) has contributed to this question by trying to better specify scale in conceptual and methodological terms. Sayre's objective is to bring a central distinction used by ecologists – between observation (context) and appearance (emergence) – to reflect upon human geographical debate about scale. He takes the central insight shared among human geographers – that *scale is produced* – to reflect it back onto ecologists' distinctions between context and emergence. Rather than to reduce social phenomena to a 'postivist metaphysics' but to put different type of scales into conversation. Scale here refers to a context of relationships or processes. This is true for both ecological and social phenomena. Scale is defined as a condition or an attribute of observation or perceptual organization, rather than being an attribute of a thing.

The first step is to try to be more precise about scale has having both epistemological and ontological aspects. Using an ecologists' concept of scale, Sayre discusses how ecologists understand the co-dependent character of observation and phenomena. This co-dependency revolves around two terms that further specify scale: the 'grain' and 'extent'. In any ecological study a choice must be made as to how fine

– how small in size or how short in duration – are the units of measurement. This is called the grain. The extent then refers to the size of the study area – how large or how long is the overall context of the observations. Changing either the grain or the extent of a study often produces different results based on empirical research.

Ecologists have thus long appreciated that the scale of observation and emergent relationships and processes are co-dependent. For ecologists, observed processes and relationships are transformed when shifting scales, such that objective reality changes. For example, a pond-skater insect is able to skim across the surface of water because of surface tension. However, if we simply increase the size of the pond-skater by a factor of 10, the insect will sink because it has a new relationship to the surface of the water (Sayre 2005: 281). Yet, the surface tension of the water did not change; what changed was the pond skater's scale-specific relationship to surface tension. Here, note that size is a relational concept. The pond-skater became impossibly large in its immediate relationship to water molecules. Another example: a 6' wave in the ocean appears small from a cliff above the beach; find yourself in the surf confronted with that same wave about to break over you, and it becomes a different relationship – that same wave has become rather large.

Let's take another example – a landscape 'patch'. This might be thought of as a type of landscape form. A patch can emerge from ecological processes, or from political economic design, such as a plantation, or a suburban development. But the patch is more specifically an imprint of human land use and nonhuman habitat. But does a patch constitute a scale? No! A patch is an area instancing or comprising scale-

based relations and processes, but the patch is not a scale in and of itself. Patches can vary in size – 500 hectares of primary forest, 0.5 hectares of primary forest. Both the quality and the quantity of heterogeneity affects movement or habitat continuity of organisms. For many species, having many varied types of patches connected with each other can be more useful for mobility than one isolated patch – but it depends on the organism. For example, 1ha size patches, made up of forest, agroforest, secondary scrub, and pasture, are easy to negotiate landscapes for many if not most birds. But a much larger if more isolated patch of 500 hectares of primary forest may be less useful for overall landscape mobility. In contrast that same isolated 500 ha patch of primary or advanced secondary forest could suit certain monkeys or rodents but would not be useful for a roaming jaguar. For landscape ecologists, it is thus the quality and quantity of heterogeneity across the overall landscape – the structure of the landscape – that matters for the organism.

A patch has a size, but again remember that *size* is not commensurate with *scale*. Rather, size is relative depending on relationships. In agriculture, a 20-hectare patch managed as pasture is “miniscule” in a Brazilian Amazon context; but a 20-hectare patch managed in tree crops is “large”. In terms of human organization and social structure, a patchily organized landscape can indicate numerous holdings managed by individual families. Or it could indicate one landholding separated into sharecropping contracts. In the case of Medicilândia, for example, we have a patchy *pattern* of land use and land tenure evolving out of the state land cadaster and semi-abandoned bureaucratic organization of production. Of course, it important to

distinguish how scale is imagined in governing or economic systems, and how categories emerge out of this imagination and come to have scale-based effects. But, per Ingold, it may be that not all scale is imagined/envisioned in terms of words or categories or models *and then acted out*; many if most scales (contexts) are experienced and embodied relationships, skills and processes that produced structures in an improvised fashion, in situ.

Sayre's next step in his 2005 article is to take account of the human geographical insight that scales are produced. Sayre's intent is to bridge between the ecological and the human geographical understandings of how structure or patterns emerge in the world. Human geographers ask how and why certain structures or patterns come to impose themselves at different levels of social organization. I here turn to Anna Tsing's work to provide a concrete elaboration of Sayre's interest in putting human geography scales in conversation with ecological science scales. Tsing's recent work has been concerned with the issue of 'scalability' (Tsing 2012, 2015). For Tsing, 'scalability' refers to a condition in which relationships between system elements remain the same when shifting the frame of reference or observation. In a global commodity supply chain, there is an implied or imagined increase in the magnitude of systemics of 'producing' a commodity. Thus, "[w]hen small projects can become big without changing the nature of the project, we call that design feature scalability. Scalability is a confusing term because it seems to mean something broader, the ability to use scale, but that is not the technical meaning of the term. Scalable projects are those that can expand without changing." (Tsing 2012:

507). Yet, scalability is never complete and never perfected, argues Tsing. It is thus that following the historical contingency and failed scalable design can reveal unexpected emergence. Sensitivity to relations, processes and how these are historically and ecologically contingent (embedded) is vital to Tsing's theory of non-scalability.

In a 2012 article, Tsing follows two cases: the history of European colonial sugarcane plantations, and a contemporary ruin of scalability – i.e. the gathering of Matsutake mushrooms in industrially logged forests in the Pacific Northwest. The first shows us how scalability emerged historically, a model of thinking synergetic with the emergence of modern capitalism; the second shows us life and livelihood in the ruins of scalability. For scalability – the first case – sugarcane plantations became a landscape machine in colonial empires. In this early version of global capitalism, Tsing shows, the point is to erase persons and ecologies, to create *terra nullius* (Tsing 2012: 513). The landscape must be remade to get rid of entangling human and non-human relationships. Yet, even with this plantation-capitalism nexus emerging via the alienation of labor and nature, life slips through the cracks. Enslaved workers disappear to form maroon communities across Latin America and the Caribbean; in the ruins of industrial logging, new socio-ecologies spring up involving a fungus.

Thus, what scalability essentially tries to do is to transcend scale-sensitive context in the expansion of a mechanism. It is critically important to distinguish between how capitalist scalability attempts to *erase* scale-based processes, in contrast to how states (and state foresters perhaps) use or practice a *vision* of scale perspective

to assimilate and incorporate environmental form. In a scalability project, the goal is to make any small-scale relational context mechanically identical with a large-scale relational context. The labor that cuts the sugarcane is fungible, able to be remade and resourced for any global location and any natural resource – an expansion of the (non)model via slavery, then later disciplined labor and scientific modern management.

Scalability projects believe that transcending scale is possible, and this idea or understanding of scalability is part of capitalism's cultural force. However, to mechanize relations such that relations remain the same when shifting the scale, is not easy. As scale (context) shifts, so have the relationships concerned. Processes change; ecological, political and social relationships change. This tension could be seen as somewhat analogous to what can be observed for ecological systems. Increasing the size of the pond-skater larger did not 'scale' the relationship between the insect and water's surface tension.

The challenge however for human geography is in tracing how institutions and social processes do their work across scales. Note that Tsing's engagement with non-scalability has to do with the *contingencies* of social and ecological relations, not per se on the 'making' or constitution of scales. Tsing's focus shifted, from describing neoliberalism as a set of scale-making projects or performances (Tsing 2000, 2005), to showing non-scalability in contrast with scalability imagination (Tsing 2012). Tsing's focus on scalability shows us relations and processes rarely remain identical irrespective of context – the way that a scalability projects or

imagination would have us believe. Regional frontier culture, national franchise cronyism, and global finance capital – these imaginations/dreams promote visions of the world, often synergistically. Yet, this does not dictate what natural-social landscapes are doing, sometimes almost rebelliously, in response. This, keeping in mind that socio-natural landscapes, in spite of speculative or development dreams, will always have their specificity. The point is that while landscape rhythms and movement are imbricated in speculation or development dreams – the landscape *moves* in ways that don't go according to plan. It is critical to pay attention to both types of processes – both scalability vision, and non-scalability circumstances. Tsing's work invites us to follow contingency – in landscapes, in history, across geographies – and think ethically about scalability and non-scalability together.

Turning back to Sayre, the interest of putting human geography in conversation with ecology was to try to show how broad epistemological and ontological concerns are similar for both the social and natural world. Now, when either human geographers or ecologists say that scales are produced, they do not mean that a 'scaling entity' or 'scientific modeler' has arrived on the scene to install a language frame upon the world. Rather, what is meant is that social relations or ecological processes have coalesced as categories, categories that then might be used to conform relations at other scales. According to Sayre, a 'politics of scale' is when relations or processes relevant for one scale would be re-deployed at another scale – and if the relations and processes would be re-engineered via the deployment of that

category of observation. Thus, to say that scales are 'produced' is a matter of how relations and processes are observed and interpreted or narrated (understood).

Geographers Rangan and Kull (2009) extend Sayre's argument, arguing that there are three moments of action involving scale: operation, observation and translation. To provide clarity, they refer to the work of Henri Lefebvre and Fernand Braudel. Lefebvre, for instance, divides the issue into three moments: the issue of *spatial practice*, the moment of the *representation of space*, and *representational spaces*. Rangan and Kull translate these as *operational scale*, *observational scale*, and *interpretive scale*. Operational scale is similar to Braudel's concept of the structures of everyday life emerging via the *longue durée*. I.e. the routine and ongoing interactions, movements and rhythms of social activities and biophysical processes. In turn, observational scale is produced by dominant social actors who categorize and organize spatial practice according to what they think it *should* be. Lefebvre describes this kind of space (scale) as 'conceptualized' and different from the 'perceived' space. It is the space of scientists, planners, urbanists, technocratic subdividers and social engineers. Yet, these representations of space are shot through with knowledge (*savoir*) – i.e. a mixture of understanding (*connaissance*) and ideology – which is always relative and in the process of change (Lefebvre 1991: 41). Finally, there is interpretative scale, as consciously performed through images and symbols, connected with historical meaning. In producing interpretive scale, institutions, groups and individuals invoke explanations or narratives in the form of models, symbols, mythical storylines and performances. These serve to interpret the

experiences and outcomes of ecological and social change. The narratives invoke ideas of 'disruption', 'transformation' or 'evolution' (Rangan and Kull 2009).

In this scholarship on scale a connection is being made between scale, and the *governance* and history of social landscapes. We need to keep in mind however that European landscapes – and in fact the very word *landscape* – have a very particular history and meaning. Indeed, landscape history in Europe is contingent upon a specific 'interpretive' or political instancing of scale. Such a vision of the nation-state has been studied by Kenneth Olwig, who argues that polities and landscapes were historically the *same* in northern Europe. In the Germanic languages, including English, originally a landscape meant a place – an ensemble of people and environment and terrain. In the 16th century, Dutch landscape paintings were important political representations in the face of threats from imperialist Spain. Yet, the emergence of the special *form* of the nation-state would be imagined via the incorporation of spatial perspective – a visual collapsing of spatial and temporal scale – into a landscape 'vision'. And the genre of landscape painting would be changed by the influence of the re-discovery of Ptolemaic cartography. The latter would also change theater scenography. What changed was that images came to incorporate spatial perspective, visualized from on the ground – i.e. the pictorial representation of shapes that gradually diminish in size as they become more distant toward an infinite vanishing point. Thus, spatial perspective was able to smooth discontinuities of scale onto a two-dimensional surface. Also, "The use of spatial perspective in theater

scenery… made it possible to create a realistic illusion of temporal change occurring within the unified time and space of the theater" (Olwig 2002).

In Europe, this 'language' of spatial perspective in landscape painting and theater scenery was to shift the understanding of landscape. No longer a 'place', landscape became a universalized form of representation applicable to any phenomenon, including natural processes. However, just as a change in the projection of a map creates significantly different images of the world, so too do changes in the projection of perspective and representation. The scientific objectivity of a landscape is thus somewhat illusory – a matter of 'point of view'. Landscape could mean a landscape commanded by the vision of the state, illustrating interactions between society, flora and fauna, geology, and climate (Olwig 2002). And in their early forms of representation, the nation-state and such overarching 'scientific' vision were linked together. For example, the image of Hobbes' Leviathan overseeing the landscape. Again, the landscape here is a particular instancing of a political, narrative building, 'scale.'

This emergence of the modern nation-state via such a 'scaling practice' is a very particular sort of vision. *Literally*, a 'scaling practice'. Thus a 'space' of a nation-state was constituted through the interaction between physical and cultural landscapes. Olwig describes how this conceptual division helped create nationalist identities and imperialist expansion of the state, most notoriously expressed by Nazi Germany, but also by contemporary Israeli settlements 'scaling' across the occupied West Bank. The national space and its boundaries were envisioned through

chorographic landscape. Here, we can appreciate that the vision of the state was performative – emerging out of descriptive and graphic techniques of rendering spatial perspective onto landscapes and in the theater. But this created a significant tension. National space and its boundaries were illusory and utopian. This space could not be applied, without becoming dystopian, to areas made up of heterogeneous territories with varying histories, populations, languages, and religions, and its borderland areas of mixed nationalities.

Such a "nomothetic and yet descriptive" vision representing 'landscape', an idea foundational for the nation-state, was misused for subjective ideological purposes, writes Olwig. Notwithstanding, by the 1960s positivist spatial science would marginalize concern with such substantive or performative vision in mainstream English language geography. Some geographers however have continued to focus on landscape modeling. For example, Cosgrove, focusing on Venice, saw a vital connection between the rediscovery Ptolemaic cartography, surveying practices of land drainage and enclosure, the development of landscape architecture and the ability to understand, appreciate, and transform the world as perspectival spatial scenery (Cosgrove 1984). For Cosgrove the issue of perceiving the world as landscape scenery was connected with the act of physically shaping it, as in landscape architecture. Again, here a 'scaling practice' was to literally apply a vision to the environment.

Tsing and Olwig follow how imaginations of scale have specific histories and geographies. Tsing's engagement with the capitalist plantation model, and Olwig's

analysis of nation-state landsapes, are each 'producing' scale, but these are distinct operations. The plantation and the nation-state are very distinct *institutions* – even as much as both involve the subjugation of peoples and environments through scaling projects. Tsing argues that capitalist plantations evolve out of an imagination that attempts to transcend or erase scale-sensitive context; Olwig argues that the nation-state vision evolves to conform and organize scale. So states and capital can be in sync but they are not the same.

The above discussion may help us refine our gaze and also participation in landscapes. First, the plantation is a scale *erasing* project; the nation-state evolves out of a scale *conforming* vision; third, we have the ordinary humans and the nonhumans in *lived* landscapes – lived contexts of practice and imagination combined. Some of humans and nonhumans might be powerfully connected to capitalist or to state imagination, whereas others are not. But while state planning and capitalist speculation shape landscapes, socio-ecological landscape histories are not reducible to the colonization map or road infrastructure as interpretive figurations of the environment.

While it would be easy to rhetorically state that all entities have their own scaling practices, but the use of the phrase is insidious if not better specified. Without specificity, one could argue that state power itself would be *embodied* in cadastral maps, infrastructure plans, and bureaucratic behaviors. Yet if maps *perform* the environment, just as would a smallholder's trees, or a rancher's cattle, then all of these things would have equal ontological status. They all would have their scale-

making to do, just that they would be clashing or competing with each other in the landscape via respective materialities. Indeed, contemporary environmental anthropologists and STS scholars, in gesturing toward forms or *infrastructures*, invoke interpretive scale and political vision as they shape landscapes and environments. Interpretive scales are associated with political, scientific or technical power and imagination; interpretative scales translate and represent observational categories – political and ecological languages speak one to the other (e.g. Zee 2017). Interpretive scales tell *stories*, embedded in models. Notwithstanding, such state, capitalist or scientific interpretative scales can be in sync, perversely in sync, or completely out of sync, with other lived and experienced temporalities.

As such, there is a problem if interpretive scales are thereby glossed *as* socio-ecological relations, full stop, in an aesthetic or *rhetorical* ecology of models and their narrative power. The lived and experienced rhythms of smallholders, sharecroppers, trees and fungi strictly speaking are not figurations of political power or form – their rhythms emerge as the structures of *everyday life* in ways that can diverge significantly with interpretive and political scales, capitalist scalability and frontier politics. This is distinct than posing a 'political logic' for certain plants or agricultural systems.[11] Indeed, this is because the Anthropocene situates human relations with nonhuman nature precisely at "the meeting point between the infinitely small and the very *longue durée*" (Braudel 1958: 747). it is not just that landscape forms *instance* scale as a language of the political landscape, but that the operational

[11] as suggested by James Scott and Michael Dove

moment of scale is especially germane to a longue durée of socio-ecological continuity.

Critically, not all actors or agents in a landscape engage all three moments of scale – operational, observational and interpretive – equally or directly. Surely, smallholders and sharecroppers are engaged in organizing their work and make decisions about their interactions in scale-sensitive manner. They are embedded in operational scales and participate in broader imaginations about scale and frontiers. But they inhabit these strange humid tropical places in ways that the 'scalable' and conjuring vision of a frontier or other state-scientific 'modelers of landscape form' do not. Smallholding and sharecropping cacao farmers obviously interpret and imagine the landscape in terms of scales. But they also have to *live* in it, contending, skillfully or awkwardly, with operational or embodied *experience*, observational or social *organization*, and interpretive or political *performance*. A better, less confusing and vague, phrase than 'scaling practices' might then be 'relational practices.' This is because smallholders and sharecroppers are unprivileged actors in state and scientific sectors and can rarely marshal their individual imaginations across broad swaths of the environment – hence, 'to scale' in the sense of constructing scale through narrative modeling of perception and landscape. That is, unless they opt for that frontier 'form' of burning down the forest to conjure it into speculative property.

Kenneth Olwig for example has offered a useful distinction between 'doing' landscape and 'performing' landscape (Olwig 2016). 'Doing' refers to living via the operational moment of scale; 'performing' to political landscape organization – the

interpretive moment of scale. Thus, in a Brazilian Amazon 'frontier', a *picada* forest trail, and extensive slash and burn deforestation are spectacular techniques that 'perform' property cadasters – often without any embodied attention to plants and soils outside of the hasty extraction of timber. On the other hand, work pruning trees – 4,000 qualitatively different individual trees – is operational 'doing' and consists of a grounded activity that is very difficult to 'scale' as a matter of performance. While *both* performance and material efforts are involved in either of these activities, the balance between performance utility and material utility changes.

In effect, this is to go beyond treating peasants as units that 'scale' into landscape forms, to show how smallholder peasant human ecologies *adapt to or resist multiple scales*. A smallholder agroforest involves all three moments of scale – development dreams, observational practices, and operational experiences – but it takes on a particular resonance in the operational moment. That is, in the structures of everyday life rather than through scientific or government *savoir*. From the last chapter, we may recall how Monteiro's folk experiments were viewed as crude and inapplicable by state scientists, notwithstanding their sophisticated and practical empiricism. We can also start to appreciate the chaotic and unstable character of peasantries in the Amazon.

Let's go back to the transformation in Medicilândia's landscape – the shift from state sugarcane to smallholder and sharecropper cacao, and the role of pruning witches' broom fungus. How did this socio-ecological change occur in terms of scale-sensitive factors? We can identify several patterns and processes. The *observational*

scale of 100 hectare lots, organized by the state, had been fixed in place via ongoing sugarcane production. This was because colonists involved in the sugarcane network tended not to accumulate land but kept sugarcane land use fixed at the 100-hectare size, similar to the way sugarcane plantations are structured to operate elsewhere in the world. Between state planners and colonists, the observational scale was in sync. Colonist development imagination was also attuned to the state's vision, or *interpretative scale* imposed on the landscape. Notwithstanding, the *operational scale* was out of sync with interpretative administration vision: the environment was too wet for the cane for the crop to accumulate sugar efficiently, the side roads were precarious, the property and accounts were administered from Brasilia, etc. After the collapse of sugarcane, while the observational scale or structural organization of interaction with the environment remained the same (100 hectare lots), the development dream had been broken. Capitalized colonists might continue to follow a frontier accumulation dream by deforesting land and managing it largely with four legged proxies (cattle). Yet, by the time of the sugarcane's collapse, this perception had already shifted to the north of the highway area, where new land was still available. And the size of the former sugarcane plantations in the highway zone was paradoxically too small for a scalability model of to function using cattle ranching.

As they were also forced into significant if not impossible debt, colonists started to imagine what they could produce largely with their bare hands. And with what was left of the state, namely hybrid cacao seeds distributed by CEPLAC for a token fee. There was a transformation in imagination and operations that went from

colonist plantation, to smallholding and sharecropping. The operational scale, or routine rhythms, of farming and biophysical processes shifted into a *less* intensive and more heterogeneously managed tree cropping and agroforestry. Such a configuration was out of place in terms of typical narrative of the frontier expansion and interpretive scales associated with this particular region and geography. It entails a fascinating type of ruin, a political and ecological adaptation emerging out of the cracks. Tree-based work did not conform either to frontier imagination, to the mechanics of capitalist plantations or forest conversion to ranch land. And while certainly having to do with state policy, this 'forest transition' was a local adaptation to a total political, social and ecological context: it involved self-ownership of labor, availability of hybrid cultivar seeds (germplasm), and a tree and a fungus that was best managed manually, among other factors.

CEPLAC's lingering ability to distribute productive hybrid seeds was fundamental in this transition. Yet CEPLAC's social and extension policy was a strange holdover from the twentieth century – out of sync with the scales of frontier expansion and political power. While cacao smallholders and sharecroppers have long contested with very limited state support, they have improvised new knowledges about cacao and formed new socio-ecological relations *in situ*. These resident farmers live and experience the processes and patterns that each scale – operational, observational and interpretative – have engendered over time and in space. But rather unlike state officials, foresters, scientists, or plantation and ranch owners, cacao smallholders and sharecroppers inhabit the multiple scales of the landscape.

Returning to Moran's argument about soil fertility and land use choices: Because of terra roxa's perceived development potential and peculiar mineral properties, landholders assigned to or acquiring terra roxa soil had been targeted by the state and had easy access to public finance, with little effort. This led to a distinct set of development ideas and aspirations. Terra roxa land holders had been subject to INCRA's sugarcane venture, and also to CEPLAC's ambitious PROCACAU program from the mid 1970s to the mid 1980s – in which CEPLAC acted as an automatic co-signatory on public loans. The issue was that with this peculiar connection to the state and to capital in this part of the Transamazon – terra roxa land use systems would get out of balance in 100 hectare lots, moving capital into cattle ranching elsewhere, or the system would get too weedy and would sit abandoned, a delight for monkeys. Alternatively, under the sugarcane design for terra roxa, and its abrupt and cruel demise, terra roxa holders were forced in the other direction – forced into severe debt with no hope for the state or banks to intervene.

Thus, state policy on the Transamazon – *paradoxically* – created a 'scalable' effect across the sugarcane zone in particular. This was driven by *debt*, rather than by capital. In this unusual case, land holders in the former sugarcane zone replanted with cacao, with sharecropping labor managing to sustain the holding. Cacao farming organized in smaller patches would be driven by complex interrelations of ecological conditions, social organization and development imagination. Thus, we have a) sharecroppers, b) colonists and c) true smallholders overlapping and trying to make a

living on the site of a former frontier gone to seed. These findings echoe Tsing's insight about peasants:

> *Contemporary advocates aestheticize the peasant forest as the planned result of traditional knowledge, creating nature and human needs in harmony. Yet many scholars suggest that these harmonious forms developed out of moments of deforestation and environmental destruction… Everyday peasant efforts are often responses to historical shifts far out of their control… small disturbance eddy within the currents of big disturbances… (Tsing 2015)*

In this contingent situation, working with trees provided an alternative way to think, of what to do, how to act. Sociologically and economically speaking, structures of households, land use and cultivation, and land tenure, would be shifting, breaking apart, being abandoned, reforming. Depending on the situation, trees died, or production faltered, or land was quickly deforested for brachiaria grass etc. Or without labor, cacao orchards became successional agroforests and turned back into forest.

Peasants, sharecroppers and smallholders do not have exhibit a uniform 'scale making project' in terms of land use processes and patch replication. With Robert Netting's work, for example, it is critical to recall that smallholding was anything but a stable form of relationships that could simply 'scale' around landscapes (Netting 1993: 272). Netting's interest was in ecological practical reason (cf. Sahlins' cultural practical reason) and innovation, arguing that every individual smallholding had its own domain and history – although rules and patterns could be found at the collective level, like the rules governing access and use of common lands in the Swiss village of

Törbel. And he could be legitimately criticized for his failure to attend to political injustices involving land. Yet, rules governing land use were not a product of the individual smallholding; rather, the smallholding pattern involved particular balances that depended on regional and demographic particulars. He compared the ecologies of sustainable agriculture worldwide, independently of any 'cultural' model of diffusion or symbols.

But as for the role of states, scalable design and policy – we might remember that these can help, depending on the context. 'Scalable' is an issue of models and ideas that travel. Plantations are a very notorious land use model, and not, strictly speaking, equivalent with modern state planning; the plantation is a horrid aesthetic tied up with the history of global capitalism starting the 16th century, with human and biological exploitation. Plantation history does not go parallel with the history of the state, even though similar claims have been made about agriculture in general (e.g. Scott 2015). On the other hand, governing rules and institutions are not destined to flounder simply because they emphasize modern planning and simplification (cf. Scott 1998). It depends on the particular situation – with *both* formal/imagined and non-formal/practical aspects. We might even consider how to institutionalize social reforestation in such marginalized places as the Brazilian Amazon, in spite of all odds. The tree, soil organized holdings and landscapes studied in this chapter, are derived from indigenous cultivars; they involve informally applied land use practices, but also the state and its contingent influence in this strange, ruinous and perpetual colony – Brazil.

Chapter four conclusion

This chapter has explored the deeper history of the cacao tree, and the phenomenology of labor, experience (ecology) and land system transformations that surround it. I have argued that the phenomenology and perception of the environment in these places is not something 'fused' with the politics and cultural organization of the landscape, but involves on the ground adjustments to contingencies and interruptions of scale. Rather than to suggest that smallholding peasants practice 'scaling' as a type of replication of traditional peasant units, smallholders have to improvise in order to be sustainable. This is part of the essence of smallholding, and I have argued that a culture of cacao on the Transamazon emerged in the cracks of a larger political currents and 'agency' of ecological processes involving the cacao tree and associated fungi and environments. The next chapter will further substantiate that, rather than being uniform processes, land use 'scales' are full of tensions across this geography, wherein smallholding farming itself suffers from a type of schizophrenia in outlooks on land. The insecurity and unstable position of peasantries in Brazil can help explain the unusual role of smallholders in a speculative politics of land tenure and cattle.

6. Chapter five – Going to Seed

By categorizing and comparing forms of smallholder land use, we see the specific factors that shape the sustainability – or lack thereof of – of cacao agriculture, and a 'schizophrenia' that affects land decisions.

This chapter will provide a comparative and quantitative view on the structures of smallholder land systems on the Transamazon and other colonized highway corridors in the Brazilian Amazon. I will work to categorize types of smallholder land systems, with a particular focus on how soils, holding sizes, incomes, and labor arrangements are patterned according to the type of farm. To put these structures in context, however, the chapter first outlines regional attitudes toward land tenure and the hegemony of cattle ranching. Second, I work to identify the different types of smallholdings that exist and how they are differentiated. Third, with respect to cacao land systems I will outline how it has consolidated in different ways and discuss imbalances in cacao farming as it was initially promoted by the state. Finally, the chapter discusses the emergence of a 'true' smallholding type, which has recently emerged as a more sustainable adaptation.

In areas settled through colonization programs – especially state organized – smallholdings historically tended to converge around 100 hectares. While this is a 'smallholding' in the context of the Brazilian Amazon, 100 hectares is very significant piece of land in most parts of the world. 100ha is too *big* for a single household to maintain in annual or perennial agriculture, unless using migratory

swidden farming, or alternatively mechanization, while it is too *small* for profitable ranching. It is an ideal size for sugarcane, however, if a surrounding disciplinary apparatus is maintained. Yet, over time, mosaics of different land systems have come to operate in parallel in the same landscape and on the same holding.

Tree cropping and agroforestry does not make up much more than thimbleful of the overall landscape in Transamazon municipalities stretching 1500 kilometers from Pacajá to Apuí, except in Medicilândia. While Emilio Moran's research group proposed that the presence of terra roxa (nitossolo Vermelho) soil explained this, I wasn't convinced. Ranches dominated terra roxa soils immediately outside of Altamira, and I had seen cacao growing on mixed fertility podzols, in Medicilândia and in Apuí – way out on the western extreme of the Transamazon. There were patches of cacao and açai and other trees being grown all over the region. I visited many nurseries and made many friends with university youth in Altamira and in rural schools, who were being educated as forest farmers. But we often felt like minnows in a wider sea of pasture and ongoing speculation on land.

Thinking from a rural development point of view, intensive agroforestry and perennial crops can allow for significantly more income per land area than other land use. To put this into perspective, on the Transamazon, 800kg of seeds is the average yield for one hectare. Based on my surveys, on a humble but typical smallholding of three hectares, with fluctuating market prices, this could bring a return of between 12,000 and 26,000 reais – roughly between 3,000 and 13,000 USD per year, depending on widely fluctuating exchange rates. In contrast, cattle ranching yields

about one tenth of this amount per land area, based on selling calves or fattening bulls on pasture (there is no castration to produce steers). Indeed, in combining development and conservation advantages, there have been numerous academic advocates for agroforestry and other agro-extractive economies over the years. In the 1980s and 1990s, researchers and the public were particularly keen on the role of agro-extractive reserves as a modality of social environmentalism.

But policy and academic enthusiasm for working tree landscapes has tempered over time. Scientists don't consider these as "serious" land use alternatives, when the enormous risks and challenges facing forest farmers are taken into account. Conservation and rural development scientist have argued that agroforestry and smallholders cannot compete with the scales at which cattle ranching and later mechanized agroindustry operate (Fearnside 1996, Pokorny et al. 2012). Indeed, aside from açai in the Amazon estuary near Belém – an area with extensive water transportation and with a significant regional and international market– 'agroextractive' economies in the Brazilian Amazon are faltering. Forests for Brazil nuts on the *Calha Norte* – the traditional areas on the north shore of the Amazon near Óbidos, for instance, are being cut down for pasture; the market for natural rubber in Acre relies on subsidies. The shores of the Tapajós river are lined with extensive rubber forests, but there is very little rubber gathered.

Some researchers have suggested that only the formation of tree plantations could be economically efficient enough to replace older forms of extractivism (e.g. Homma 2012). Yet the region has not seen the emergence of large-scale cacao or açai

plantations, with just a few exceptions. Not all agricultural intensification is about monocultures, and as Netting (1993) took smallholder intensification as an ecological economic process, intensification can be just as much about applying agroecological management. Blaikie (1999), similarly, wrote about agrodiversity – small farmers more broadly, who did not always intensify, but who notwithstanding worked with plant or animal commodities.

Still, if cacao or açai agroforestry yields so well, and if the smallholder form of production is considered so sustainable, why then wouldn't agroforestry simply take over across this region? While the livelihood benefits seem clear, the problem is that cattle are themselves an adaptation to the precarity and politics of rural development. Cattle can be just as much about risk taking as about risk aversion, and to get a better sense of the role of cattle in the peasant consciousness and expectations about development, it can help to try to think more explicitly about peasantries in Brazil.

In Brazil peasants' and smallholders' land tenure is arguably much less stable than in European contexts. Historically under feudalism, but also later in European history, land tenanted peasants in Europe have been able to hold on to parcels of land from one generation to the next; the emergence of the family as an institution in Europe is connected with the ability to inherit property and keep the Church at bay (Goody 1953). But peasant land tenure in Brazil has usually *not* involved a fixed situation or pattern. Here, peasants and smallholdings all have rather chaotic histories: occupying fringes, cracks and abandoned spaces in which more powerful interests

also exist, and often being expelled or run off the land. In limited situations, occasionally Brazilian peasants have found themselves supported by the state's ambitions, as with the dictatorship's short-lived 1970s Transamazon settlement plan. But state support for resettled peasants in the Brazilian Amazon was immediately overtaken by more capitalized and powerful interests.

Culturally speaking, Brazil's Amazonian hinterlands in some ways overlap with Brazil's backland northeast. To better understand peasant attitudes – and their relation to cattle – it helps to consider the *Sertanejo* – the backlander – in Brazil's history and consciousness. Being a sertanejo historically has meant a constant problem of dislocation and an insecurity in holding land. The following quote comes, from *O Povo Brasileiro* (the Brazilian People), by Brazilian anthropologist Darcy Ribeiro, characterizes peasant land tenure:

> *[Sertanejo peasants] are born, live and die confined to other people's lands, taking care of livestock, houses, pens and crops that have jealous owners. The very miserable ranch on which they live with their families, built by themselves with mud and straw from the countryside, does not belong to them. Nothing stimulates them ... As many years or generations that they remain on the land, the sertanejo is always a transitory aggregate, subject to being displaced at any time, without explanations or rights. For this reason, his house is the ranch on which he is only 'scratched'; his crop is precarious, only able to assure him a vital minimum so as not to die of hunger, and his attitude is one of reserve and distrust, which corresponds to those who live in a foreign world, apologizing for existing (Ribeiro 2015: 266-7)*

As much time or generations that he stays on the land, the *sertanejo* is always a transitory "agregado", subject to be dislocated by latifundiários, and ready to take up

arms in roving bands. And the northeast was one of two principal areas from which peasants migrated to the Amazon (the other was the south, especially Paraná). This is also the story of Rogério's family, related to us in chapter two.

With such subservience, flight and sometimes rebellion – the "culture" of land use both in the northeast and also in the Amazon comes into clearer focus. There is a *political* resonance of cattle, as they have been historically and culturally associated with wealth and power – and with the extreme political right, so notoriously expressed by the current Bolsonaro administrative fiasco, and previously, by the dictatorship. In contrast, small-scale agriculture has been undervalued – and sometimes associated with insecurity and poverty, rather than with continuity and sustainability on the land. In contrast, cattle are characterized by an extensive, roaming, connection with land. As the Brazilian interior in the northeast and center west the Brazilian *sertão* – are dominated by a culture of expansive land use, the recently colonized, Brazilian Amazon is in some sense an extension of the *sertão* or backlands. They are a place for cattle, as mobile symbols of respect, service and power, served by shiny white hi-lux pickup trucks with tinted window glass. Yet, in the Amazon, peasants are tied intimately into the regional cattle ranching complex, which will be outlined shortly.

The Brazilian Amazon has been characterized in terms of conflicting frontiers alternatively driven by popular agrarian or corporate interests (e.g. Browder and Godfrey 1987, Schmink and Wood 1993). Conflicting frontiers are anything but uniform processes and involve contentious and often violent spaces. Mosaics of

different socio-ecological land systems work in parallel across these landscape – and also on the same individual farm. Also, land systems are often interrupted and transformed in this region. For example, in chapter two, we saw how rice and sugarcane in turn failed, how these plans were awkwardly inserted into this environment as a classic agrarian and modernist plantation models, respectively. The former, rice, model, where colonist families were to dedicate themselves to a system that was so weedy, rife with toxic biting flies, and hordes of bird pests, so as to make this ambitious agrarian model a hell. And the latter, sugarcane, which ran aground on the environment's muddiness, thwarting the linking up of the system per a modernist plantation model.

Notwithstanding, contemporary types of smallholder peasant land use can be broadly differentiated into several types (Braga 2019, Serra 2020), which we will examine below. From here on, this chapter will attempt to unpack the peculiarities of land tenure in this region, the various types of smallholding land systems, how these systems mix on the same holding, how these overlap with cattle more generally. Then, it explores imbalances inherent in cacao agriculture and labor. This will give us a sense of the relations that factor in to overlapping processes, rather than to assume that a smallholding 'form' is replicating itself or 'scaling' as a stable form or infrastructure. In fact, a principal conclusion being made by this research is that state and otherwise outsider organized policies and finance are necessary *in ensuring the stabilization of agroforest landscapes and smallholdings in this region*.

Attitudes on Land Possession and Use

Before getting into identifying specific types of land systems, we need to outline this region's peculiarities in regard to land possession and property formation. In ongoing colonization of the Brazilian Amazon, often falsified, paper or electronic documents can be key elements in the performance of land ownership, especially in areas in which the state has not arrived first to organize settlement. Colonist land claims include the well-known phenomenon of *grilagem*, which literally means depositing falsified paper documents in a drawer with pissing and pooping grasshoppers (*grilo*) to make them appear old. However, in Brazil, documents by themselves, do not secure land tenure in perpetuity. With land use, claims to land can shift, based on physical activity, document inconsistencies, or violent conflict. But also, constitutional and civil codes articulate rules for the use and re-distribution of land for social purposes. Legal land tenure can be secured through squatting for five years. Sometimes, social movement organized squats occur on lands deemed to lack productive use, even though they may have an absentee owner.

Colonist land possession in the Brazilian Amazon – whether government authorized or informal squatting – involves practices shared by both larger and smaller actors. For example, a rancher or a logging consortium invades unclaimed or undistributed government land. Or logging consortiums or ranchers may simply pay colonists in government settlements to access their parcels. Or small colonists, without capital, determine to squat in unclaimed lands without government support, or in land already claimed by absent large holders. Small colonists may eventually

become clients (*laranjas*) of large holders who have capital and interests in the land in question or be confronted by an existing laranja or alternatively the hired gun of the large holder.

Whether for small or for large landowners, land tenure means sustaining material interaction with the land, politically speaking. But over time, whether for big or small actor – land tenure thus involves feedback from the environment. This varies from pasture degradation, through exposure to sun and soil compaction, to secondary regrowth, erosion, etc. The land is not an inert slate over which property frontiers scribble**.** For the Brazilian Amazônia, land and waterways' occupation and tenure are especially material practices, given deeper histories and overlap between indigenous, migratory, and extractive activities, both on water and land (Cleary 1993). Humans – indigenous and otherwise – all have a role in Amazonian environmental history (Raffles 2002, Balée 2013, etc).

For non-tribal communities, however, land tenure in the Brazilian Amazon takes on a size very distinct from other tropical forests. Here, the average "smallholding" is 57 hectares (141 acres) in size. This figure includes historical riverine or caboclo peasantries, quilombolas (descendants of maroon communities), and recent colonists, sometimes known as neopeasants (Brondizio et al 2009). Indigenous lands are not included in this figure. In the highway corridors, which have been colonized since the late 1960s, neopeasant colonist "smallholders" are settled onto larger holdings – tending toward 100 hectares (247 acres). In contrast, the

average size of a large holding in the colonized highway corridors is upwards of 1000 hectares (2,470 acres).

Consider the physical scale of human interaction with the forest in recent colonization. Upwards of 200 acres of towering trees. The opening of trails, extensive slash and burn, and eventual placement of cattle in such an environment are physically feasible for a few human bodies; they are also signifiers of land occupation. For both private and government settlement, the first step in land possession is to create picadas. Subsequently, a more demonstrative action is to remove at least part of any claim's forest, using extensive slash and burn to open up the area. Deforestation is a labor-intensive process, but of relatively short duration.

Since the late 1960s, colonist settlement in the Brazilian Amazon has been federally, state and privately organized, depending on the area. Settlement has involved both large land holders, and smallholders. In many frontier areas in the region, privately organized colonization pre-figures documentation of land title. However, the region also encompasses areas in which the state formally organized land distribution before the colonists arrived, such as on the TransAmazon highway (Moran 1981, Smith 1982). For government organized settlement like the TransAmazon highway, the National Institute for Colonization and Agrarian Reform (INCRA) historically directed colonists to clear at least half of their land to demonstrate productive use. Deforestation goes on to demonstrate tenure in addition to possession. This is a practice that occurs in <u>both</u> private and government organized settlement. The "fishbone" pattern of deforestation has thus an institutional character.

Deforestation was used to secure possession and tenure, and cattle used to combine extractive, productive and financial rents (Hecht 1993). When cattle are put out on the land, ongoing use is substantiated with minimal human work. Cattle are thus a dominant economic and institutional adaptation in the region, that assist with land tenure security. Commercially speaking, at small scales beef cattle make little sense. But they make sense *politically*. They are an instance of a 'scaling practice' as a network, like expansion of sugarcane plantations in the Caribbean. The animals help secure land as property and even more importantly as a financial instrument. As such, deforested land, and cattle, dominate land use in recently colonized uplands– for both large holder and smallholder (e.g. May 2009; Walker et al 2009). Cattle help to secure land holdings in the face of competing, extractive or small agricultural, land uses.

It is through these dynamics that deforestation and cattle contribute to an odd dynamic between the poverty of smallholder peasant ranching, which, notwithstanding, is linked with large holder, capitalized ranching. This link is a near universal phenomenon across the recently colonized Brazilian Amazon. It occurs through calf sales or through fattening operations on smallholdings, which link smallholders with large regional ranches. Smallholders use cattle in part to secure land tenure and savings, and to avoid market risk with agricultural crops. Yet moving the animals around facilitates accumulative land practices at larger scales with political access to finance. Within government settlements, paradoxically, ranchers

can accumulate multiple lots in an unauthorized land market (e.g. Ludewigs et al. 2009).

Given the above-described dynamics of land possession, deforestation and cattle-based rents, the upland highway corridors today have little intensification of small-scale agriculture (conventional or agroecological), let alone any significant extractive activity (e.g. Brazil nuts, rubber). Agriculture – i.e. the cultivation of plants or trees –is stagnant, existing only in fragments in most of the recently colonized highway corridors. On the other hand, on the fringes of the Cerrado biome, in Mato Grosso, Tocantins and Maranhão, mechanized grain agriculture increasingly dominates, with soybean farming and cattle the only areas of the Brazilian economy that have continued to grow, driven by exports, during the long covid-19 pandemic.

But smallholdings are nonetheless numerous, both in private and in government settlements. In the latter, alienation rights – rights to transfer ownership – are formally held by the state. Again, smallholder private and smallholder settlement holdings tend to be around 100 hectares (247 acres) in size. Whereas land tenure is politically organized around deforestation and cattle, smallholding is not disposed to practice migrating swidden agriculture in patches of about 1 hectare or less, as do riverine and indigenous communities (e.g. Posey 1985, etc). In contrast, land tenure in the colonized uplands is about trying to hold land encasing boundaries fixed (Tsing 2002), and land holders – both large and small – in colonized areas organize land use into dedicated areas – pasture and livestock, with much smaller areas dedicated to annuals and perennials (Pacheco 2009, Brondizio et al 2009,

Browder 1996, 2002). Yet, smallholder land use is "patchy," compared to large ranching and the mechanized soy farming of Mato Grosso and Argentina (Browder et al 1996, 2002). Cattle may be used to secure tenure – typical pasture size is about 30 hectares for smallholder colonists. But smallholders often struggle to cultivate annuals, perennials and agroforestry systems, and they shift land use through fallow periods more so than do large holders (Brondizio et al 2009).

But again, 100 hectares – a typical land holding size along the Transamazon – called a "lot" – is precisely that size too large to maintain in permanent annuals or perennial plots by individual households – unless through ambition of sugarcane or timber plantation – and too small to be profitable in a cattle system. Thus, land tenure and land use are placed in a **schizophrenic** relationship. Because land was – and still is – perceived as being abundant, deforestation is used to secure property; in the case of INCRA's state organized land cadaster, deforestation was institutionally required of colonists to symbolize "production."

However, in this *one* particular case – Medicilândia – land holdings were organized around *intensive* use. In the context of the Brazilian Amazon, this was a concentrated spatial arrangement for labor and land, which awkwardly interrupted typical patterns and processes associated with the frontier. In its wake, a new set of relations had been established. the highway landscape was reforested with cacao and other planted and spontaneously regenerating and remnant species.

Explaining the initial consolidation of cacao in Medicilândia

Cacao initially emerged on this part of the Transamazon in two ways, alternatively in tandem with state attention or with state abandonment. The first way involves CEPLAC technical assistance and credit programs from about 1976-1984, outside of the sugarcane zone, mostly to the west of the town on feeder roads km 105, 110, 115 and 120. The second way involves the spontaneous reconfiguration of land use when the state abruptly stopped buying sugarcane. Both of these formations relied significantly on family labor to establish themselves but have usually since been subdivided into sharecropped plots. Thus, labor is one of the key factors in their sustainability, because these are in fact the largest cacao farms in the world. On lots dedicated to cacao, they tend to have well over 50 hectares of land in cacao trees, compared to West Africa or Indonesia, where 3 hectares is considered an enormous cacao farm.

For the first way that involved technical assistance, CEPLAC acted as a co-signer on the loans in a streamlined credit application mechanism. CEPLAC knew how credit applications worked, with their rather flowery and formal language. A 'scale' was produced in terms of credit packages for 10,000 trees. Thus, CEPLAC directly empowered peasants with the Bank of Brazil, especially during the PROCACAU program from 1976-1986. In fact, at the time of cacao's early growth on the highway, migrant peasants were on their way to becoming small capitalist farmers, as with the plans for sugarcane. At this stage in the Transamazon's history,

cacao could be 'driving' the frontier and deforestation, in areas further from the highway. About 25 % of the original terra roxa lots – had invested capital generated from large cacao – outside of the INCRA designated sugarcane zone of course – into new lots in pasture as a means of re-investing in growth.

In recent years, however, credit no longer drives the expansion of cacao, and cacao has been uncoupled from deforestation at broader scales. In particular, in the ruined sugarcane zone, the shift to cacao was done in conditions of debt, through piecemeal replanting – effectively reforesting areas formerly occupied by sugarcane. These recuperating farms were almost never involved with cattle. Financially, cacao is thus not limited by access to capital – people can set out to cultivate it *conta própria* (out of pocket). And in terms of inputs, cacao seeds are fermented into a commodity using minimal technology – sacks and a tarp.

By its nature cacao can be decentralized in terms of labor and management – family/kin, day laborer, sharecropper, owner, managed crew. This work is spread out around the year, involves both women and men, and people of all ages, as owners and workers. Compared to sugarcane, this was a reconsolidation around *less intensive* cacao agriculture and dividing up the land amongst sharecroppers. Sugarcane is about twice as labor intensive than cacao agriculture – 150 men to cut 75 hectares. This need for labor however is concentrated around the harvest; if for sugar or ethanol production, the crop must be cut in large quantities, all at once, loaded onto trucks and tractor hauled immediately to a mill for processing. On the other hand, work with cacao involves about one person per hectare per year.

For example, considering what happened in the sugarcane zone, Rogério's family trajectory – from landless peasants in Brazil's northeast, to sugarcane plantation manager, to Amazonian cacao 'smallholder' – shows how land use was not a matter of a fixed social identity, but emerged in a process of migration and transformation. Rogério was from a family of landless peasants in the northeast of Brazil. They migrated to Altamira in Pará before the start of the TransAmazon project and were early adopters of cattle ranching. Absorbed into the TransAmazon project, Rogerio had wanted to continue with cattle, which he might have done, accumulating lots informally/illegally, as in any other part of the region. But the colonists in this particular area of the Transamazon were directed to plant sugarcane.

Rogério was not a classic smallholder type in the Netting or Dove sense of practicing intensified, diversified agriculture in a balance with extensive or rotating land use in more remote or commonly held areas. His lot was completely intensified, with management distributed amongst 18 sharecropping families. It was a situation that, ironically, resembled the paternalism of his native Ceará, which his family had fled in the 1950s. But here – these families were concentrated in a rainforest environment on 100 hectares (247 acres). Some might think this arrangement a type of plantation, involving a social hierarchy. But sharecroppers were sometimes also colonists, or smallholders themselves on other pieces of land – people in the community shifted roles in time or share these roles.

Thus, in a somewhat backhanded way, cacao perennial farming has flourished in Medicilândia because of the state's support for sugarcane, combined with specific

cacao programs oriented rigidly toward *one specific soil type – Nitossolo Vermelho or terra roxa*. With this history, in fact, folk thinking in the region tends to assume that cacao only does well only on terra roxa, because the state's imperative was transferred into daily practice and community understanding. But many farmers' experiences have borne out that cacao does just as well in mixed fertility soils, albeit with more attention to shade and soil moisture. In such *terra mista* areas, 'true' smallholders have developed niches to maintain a tree-based livelihood in the shadow of the dominant regional system – i.e. pasture and livestock. The latter system is relatively free of labor, relies on amassing brachiaria grass and Nelore breed herds, rather than manually tending to crops.

Differentiating and characterizing farm types

On to differentiating smallholding farm types. Simplifying, current smallholder farm system types of the Transamazon today consist of perhaps 4 types: the **cattle specialists**; **mixed smallholdings** that have a combination of cattle, cacao or other kinds of production, whether fish farms, annuals; large **cacao perennial specialists**; and **small perennial or annual chácaras, or 'true smallholders'**. The table below, based on surveys across Medicilândia and Apui municipalities, outlines cultivated area, income and labor arrangement characteristics.

Table 6.1: Characteristics of farm types across two Amazon municipalities (mean values)

Municipality and farmer type	Soil fertility	Distance from city	Land holding size	Area in production	Total net income	Net income / ha	Share-cropper contracts	Available family labor
Medicilândia – perennial	high	18.1	70	31.6*	139,028	4,855	3.2	4.8
Medicilândia – perennial chácara	medium	17.7	28	6.8*	31,451	4,387	0.1	4.4
Medicilândia – mixed	medium	20.7	122	58.3**	53,600	1,017	1.7	3
Medicilândia –cattle	medium / low	23	72	44	27,877	529	0	1.3
Apui – perennial	medium	43	79	6.2***	5,990	871	0.5	1.5
Apui –mixed	medium	68.2	99	25	15,693	1,778	0	1.7
Apui –cattle	medium / low	28.5	230	104.1	60,102	520	0	2.3

*Sometimes including açai; **Sometimes including fish farming ***Including coffee and guaraná

Referring to the table above, starting with the **large perennial specialist** farms located on high fertility soil in Medicilândia, we can see that on average they have 31.6 hectares dedicated to cacao, including both farms outside and inside the former sugarcane zone (map here). These are certainly some of the largest cacao farms in the world. While there is a great deal of variation in labor patterns, these farms on average have around 5 dedicated family members working on the lot, and 3 sharecropping families, which assuming are around 4/5 members each, means a total work force of around 17-20 people for the 31.6 hectares.

Mixed cattle-cacao smallholdings tend to exist in areas where there is less terra roxa soil, where farmers have been less apt to specialize, and have opted for combining cacao perennials with cattle on the same lot. Mixed or diversified farm types also involve fish farming, small livestock like goats, sheet, pigs, chicken raising, and some annual commercial agriculture, like tomatoes or watermelon. With

approximately 6ha of cacao and perhaps 40ha in pasture, a 100ha is this mixed system may still have primary forest reserve, although over time, tendency was to deforest from 50-80% of the lot. This configuration has been a sustainable livelihood adaptation for most colonists in Pará – albeit with its higher accumulated deforestation. This system allows for raising calves at the same time as balancing labor with a fairly large cacao system. The labor needed for this diversified or mixed type – referring to the table above – is about the same as required for a smaller perennial specialist on around one third of the land area. The advantage for families that overlap these two dominant economies is that the farmer is able to work an area 10 times as large, balancing the advantages of intensive and extensive land use.

This might be considered a successful, sustainable, adaptation per a Netting model for farming in an area where land is relatively abundant. Except that this system and its connections to larger scale ranching makes for one of the world's most significant social and ecological imbalances involving both underdevelopment and land use. The mixed system is in part a result of the way that the state and private interests distributed 100 hectare lots – and the schizophrenic relationship to such a holding, where little forest land is left standing, due to landowners' wishes to commercially exploit the lot. Most colonists, if they live on their lot, do not completely deforest their land and leave a forest reserve, usually located at the rear of the holding. There is an interest in holding on to a bit of forest, while not having an immediate commercial purpose. But this is if the family has lived on the lot.

Smallholders with up to 400 hectares – what is known as 4 fiscal modules in this region – are also often **smallholder cattle specialists**, especially if they hold more than one lot. Cattle specialists establish from 50% to 80% of their holdings in pasture of varying quality and have less interest in maintaining standing forest than do diversified/mixed farmers. While deforestation has been continuously monitored, expansion of forest conversion to pasture areas has continued in Transamazon and other recently colonized municipalities. Large ranching operations, as pointed out above, tend to be in a synergistic relationship with smallholding cattle specialists. In some sense, the continued drive to deforest, by making land claims and accumulating land in remote areas to the extent that enough open / pastureland can be amassed – is the goal – usually about 500hectares. But at the smallholder 'scale' of pasture/cattle, unless at least 60hectares of pasture is maintained in good quality, the system is economically precarious. Notwithstanding, smallholders, with the exception of cacao consolidated areas, today almost inevitably opt for credit for cattle and pasture, even if they don't have cattle to start with. 98% of all PRONAF credit goes to cattle, even though there are numerous other credit modalities, bank managers and locals have little knowledge of these, and do not know how to orchestrate these alternative land use financing mechanisms.

Large perennial specialists consist of immense jungle orchards. While these large cacao farms are half as labor intensive as sugarcane, this labor is spread throughout the year in cycles of harvest, pruning, occasional fertilizing and weeding. These cycles mean that work in cacao plots goes in ebbs and flows, with the most

demanding work during the harvest and even more so during the pruning season (October – December). There are perhaps three to five harvest cycles between May and October, of gradually diminishing volume, and one off-season harvest in around January. In terms of labor needs during the harvest, cacao pods need to be cut off the trees and amassed in piles, which involves about 10-15 person days per harvest per 3 hectares of cacao, which can be accomplished by one or just a few hands. Breaking up the pods however, as described in chapter one, is a group activity with 4 to 5 persons working in teams, in which a pair of workers break open the pods with blunted machetes that have been broken in half. The other two to three workers then scoop out pulp manually, gradually advancing on the pile. When all the seeds are out, forming a sweet, translucent white, mottled mass of pulp surrounding purplish brown seeds. These are then scooped into sacks on the horizontal, then tied up and left to ferment. Although fermentation is better accomplished in *coxas* or dedicated wooden fermentation boxes. Generally, because there are no price premiums paid for higher quality, carefully fermented product, the method is to leave the seeds fermenting in their pulp in the burlap sacks themselves, which removes the need for additional labor getting the mass into fermenting boxes.

The opened pod husks, which have been tossed into loose piles after opening them, quickly blacken and decompose in the humid, biotically active environment. Most of these agroforests have densely spaced cacao trees spaced about three to four meters apart, which, along with planted and favored species, make for a fully shaded agroforest floor, blanketed with foot long slowly decomposing cacao tree leaves,

which make a loud swishing and crunching sound as one pushes and steps their way through them. With approximately 1000 trees in each hectare – this means much effort and movement across the leafy understory. The *shade* however makes for a pleasant working environment – that is, if one is careful to avoid wasps and the occasional scorpion. Except for the off-season harvest in January, all harvest and pruning happens during the dry season. Many workers will work in flip flops, shorts and tshirts. Aside from tiny wooden benches, sacks, a tarp on which to amass the seeds, and dishwashing or cleaning gloves – which are helpful because the pulp is very acidic and material can wedge itself under one's fingernails, including bits of pod husks, so having at least one glove helps, to protect the hand scooping out the seeds and pulp from the pods.

While each of these harvests requires about 10 person days per hectare, or thus about 30 person days – or 5 people full time for one 6-day week – the harvest is usually spread over about a 10-day period with the larges harvest groups being organized for the final seed scooping and sacking effort. Thus, a family's overall dedication may be about 50% of working days in total, with other days during a month used for gardening, tending to animals, mending, canning/preserving, working for others, or exchanging labor with other kin members, neighbors or friends. The point here is that about 4-5 persons are needed to pitch in at harvest time – for each 3-4 hectares of cacao – although one or two persons can usually manage the rest.

A typical ‘large’ cacao system

Let’s now look at a typical layout of a lot dedicated to cacao, on terra roxa soil, outside of the sugarcane zone, on kilometer 115 south. This is the heart of the credit financed large cacao farm area, a typical terra roxa lot outside of the sugarcane zone, formed through ambitious development aspirations and the application of successive rounds of credit. Represented by the hand drawing below, the lot has roughly 65,000 cacao trees spread over 65 hectares with a 35-hectare primary forest at the back of the lot. This assumes a cacao tree spacing of roughly 3x3 meters. Thus, this is an immense jungle orchard/agroforest, which a single family cannot manage alone. Farms of this size are almost inevitably worked by sharecroppers. On the other hand, in regional comparison this is a smallholding, wherein 100 hectares is considered ‘small’ in the context of the Brazilian Amazon.

One can assume about one sharecropping family or individual for each five hectares, thus a total of 13 families ideally would be working this lot. In the drawing, however, we can see about five sharecropping houses. If we assume 4-5 persons per sharecropping household, with teenagers, this means that only 30 of the 65 hectares here can be attended to with care; the other 35 hectares will likely not be pruned effectively and will be worked only during harvests. However, as these cacao stands age, without more drastic pruning or a new graft onto rootstocks, the trees’ fruit pod production dwindles off, especially after about 25-30 years. We can see that 35-40,000 trees on this lot were planted in 1983 or prior, no doubt using the CEPLAC financing mechanism described above. This makes these trees between 34 and 38

years old at the time that this farmer was interviewed in 2017. In fact, this farmer had been bitter during our interview, telling me that in lieu of cacao he would rather deforest an entire virgin forest of 100 ha for pasture and cattle. He had come to resent the cacao trees and their weediness, even though he had been apportioned a lot full of fertile terra roxa soil!

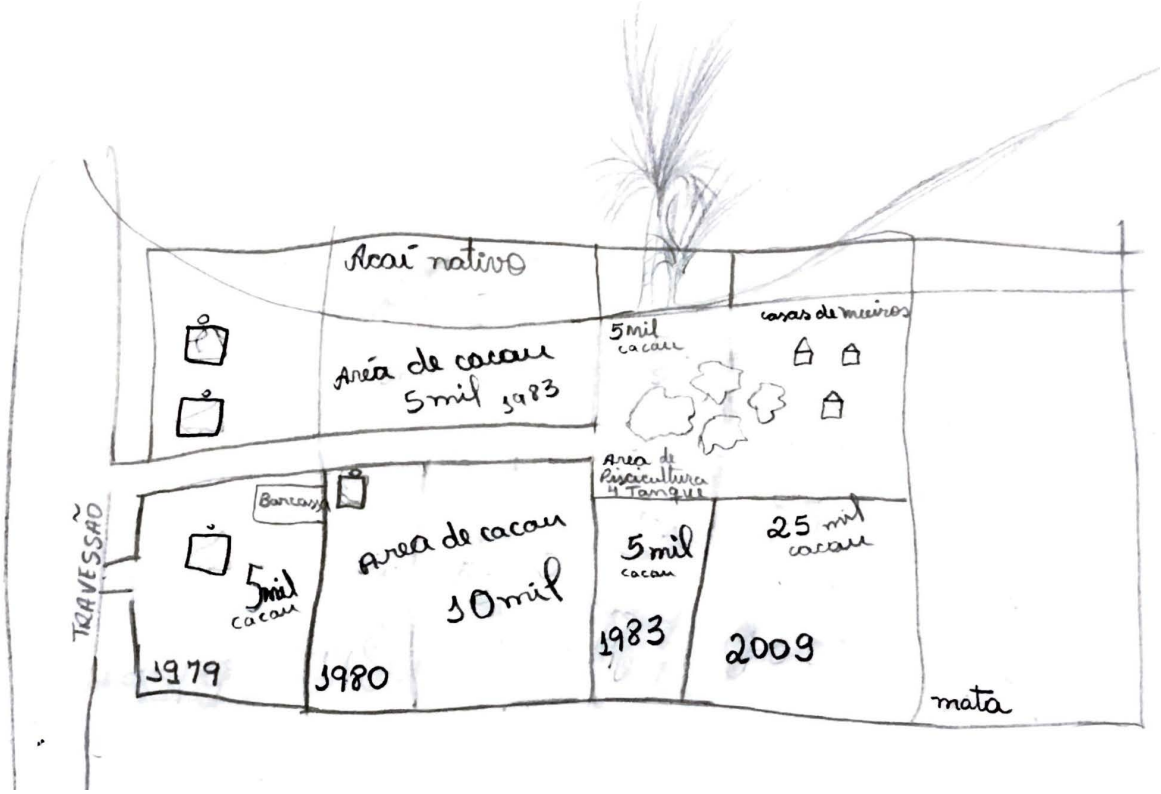

Figure 6.1: Hand drawn map of a lot on km 115 south, with waves of cacao being planted between 1979 and 2009. Cacao occupies about 3/4 of the lot, with remaining primary forest on the east ('mata')

For a lot closer to town, however, say within about 10-15 kilometers, sharecroppers and day labor is often easier to organize. Farm workers are often happier to be with about 30 minutes travel time of town, rather than to be isolated on unimproved and often steep side roads that can become nearly impassable during the

rainy season, and which involve two to three hours on a motorcycle just to get to town. And while sharecroppers' cabins were required by the state to have running water and usually had electricity, their upkeep is not always good, and may be little more than a shell of wooden planks, with a dirt floor and a leaky tin roof.

Conditions of poor housing and isolation from town often led to less motivated, depressed, work. Why would a sharecropper be motivated to prune five thousand trees, if his or her contract was for only one year? The joy of working one's own plot could thus flip into the *drudgery* of working as little as possible, not having enough hands or resources to change the situation. And thus, living as a sharecropper on a distant junglelike and muddy side road might become a dull waiting game, often involving alcoholic cachaça binging. In other cases, where contracts were for longer periods of time, sharecroppers felt a certain joy living deep in the jungle. We saw this with Andrei in chapter one, who had sharecropped a plot for a decade, where he himself had established the cacao from scratch. There the family had had rights to the bananas and produce that they had grown by themselves.

In contrast, Rogério's lot had become a relatively integrated situation, recuperated and replanted after sugarcane, planted with mahogany, full of families. But in this more distant situation on km 115 south, we had a cacao farm gone to seed. Getulio, on km 110 south, had also seen his cacao estate go to ruin without maintenance – indeed, it had become a successional agroforest of 40,000 or more trees, but with ever diminishing fruit over time. He hoped for a miracle sharecropper to emerge and rehabilitate the orchards. Like other large cacao farms gone to seed, his

large cacao farm had become practically a forest. This phenomenon might be compared to the *cabruca* systems of southern Bahia, except that in Bahia, cabruca meant planting into an existing advanced secondary or primary tract of forest, whereas on the Transamazon, the forest had been removed, but then had grown back in tandem with the densely planted cacao understory.

This biological exuberance matched with economic degradation did not always happen with more distant, large cacao farms, and on these side roads I saw many viable farms with contented owners. But because of the way that cacao requires cyclical labor in smaller areas, it is especially difficult to discipline human labor to produce 'to scale'. Instead, large cacao systems can only be sustained by managing and fostering social relations between landowners and *meeiros* (sharecroppers). Indeed, sharecroppers in Medicilândia and elsewhere in the Brazilian Amazon sometimes have more favorable contracts, lasting several years' duration, as we saw with Andrei in chapter one. This however guarantees little, as Andrei found himself on an underproducing, poorly cared for, farm, after his older contract expired. But in comparison to Bahia or in West Africa, where 30% contracts are the norm, and sharecropping is to be in poverty, on the Transamazon sharecroppers' contracts are usually for 50% or more of the crop, with sharecropping livelihoods in general holding above a minimum salary.

As we will see, meeiros and meeiras could accumulate enough to buy their own chácara, build a home and establish their own farms. This would often not be on *terra roxa*, but on *terra mista*. But cacao – and especially other tree crops – can be

just as viable economically on medium fertility soils as small scales, when well-managed, and because the producer has no outlays for labor. In this latter, 'true' smallholding type, often former sharecroppers, more closely approximate the sustainable smallholder type advocated by Netting as a successful adaptation. More critically, meeiros and meeiras, through their labor, came to know intimately how to work with cacao, and often better than many landowners. They did this without any technical assistance outside of access to hybrid cultivar seeds, which are increasingly being distributed to this emerging type of farmer. Yet, there is a serious shortage of hybrid cultivar seeds, which is now affecting the entire region.

The impasse of ageing cacao stands, where 'foot dragging' and depressed meeiros stand by expecting an ever more meagre harvest, characterizes one part of a larger dysfunctionality affecting this Transamazon landscape. This dysfunctionality will be unpacked in the next chapter, the Monkey Thanks You. The point here: rather than to view the consolidation of cacao as a 'scale making' imprint of sustainable peasant units (e.g. 'peasants make scales and peasants make landscapes'), much to the contrary it was the result of interruptions and confusions of scale, on this chaotic state and capitalist periphery.

'True' smallholding

Finally, with a '**true' smallholder or chacareiro**, the social organization of harvest often means that a nuclear family, teenage and young adult children, other kin, parents and an occasional day hire, can manage their farm independently.

Occasionally true smallholders however prefer to hire all labor, but this is the exception. As land use has reconsolidated itself to focus on balancing labor with diversity in production, and in lieu of credit and state attention, numerous 'true smallholdings' – or chácaras – have emerged roughly since 2000. In the map below we can see the distribution of these tiny – by regional standards – land holdings in green across the purple terra roxa zone and also outside. These green dots represent all holdings under 25 hectares in size. Interestingly, this is the largest concentration of chácaras anywhere in western Pará, except for urban market produce and chicken farmers near the city of Santarém.

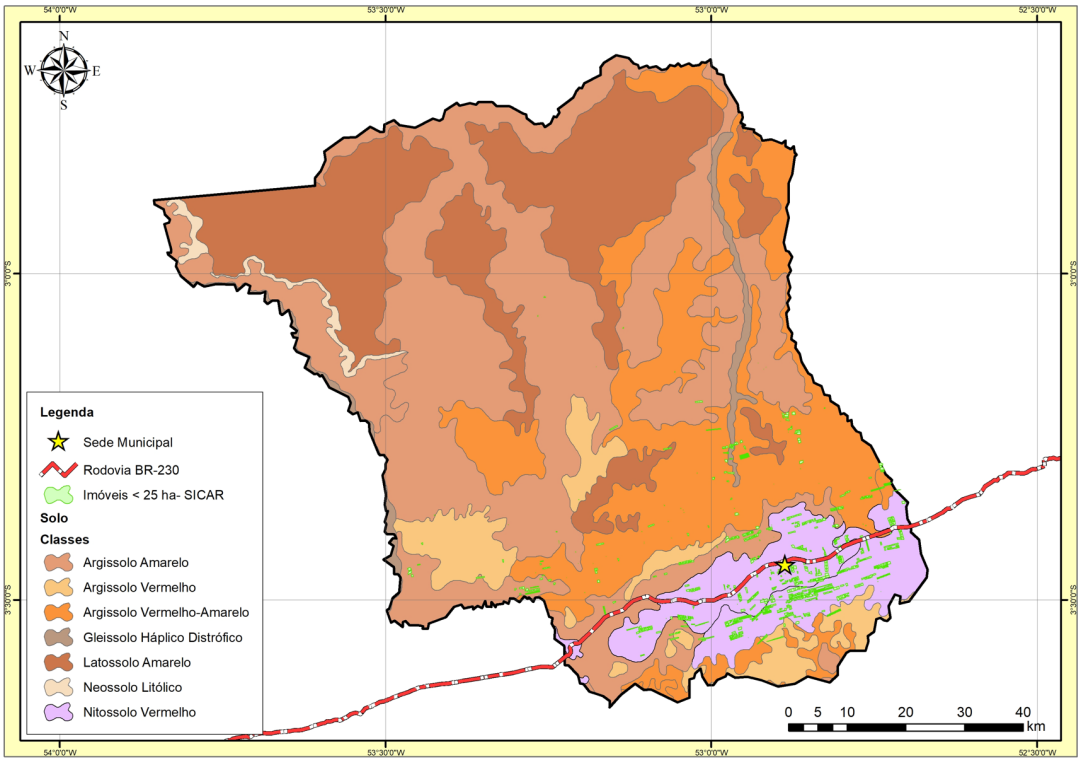

Figure 6.2 Identifying 'true' smallholdings (green dots) across soil types in Medicilândia

However, to date these true smallholdings have been *invisible* without either increasing the scale of observation or making a dedicated pull from the national land management registry (which has only been functional since around 2016). Such true smallholdings do not 'compete' with other land use in terms of impacting overall land use change in aggregate. What they do indicate however is the social character of cacao's consolidation, and of other real and potential perennial producing landscapes – how they come to be organized in smaller units over time, in situations favoring diverse tree cover. With the viability of true smallholdings, there is also a possibility for regional land use consolidation involving smaller properties. This however is a structural change that would require dedicated social policy – a 'true' agrarian-forest reform policy – unlike the modernist plans for sugarcane and cacao plantations that led to this accident of social reforestation that we see today.

'True' small holdings I found to have more diverse tree cover than sharecropped cacao estates. They would have açai, peach palm, Brazil nuts, andiroba, cumaru in taller agroforest stands, with lime and orange orchards adjacent to them. In the next chapter, we will explore the way that true smallholdings have managed to occupy the 'cracks' of the imagined development (and scientific) edifice – in how true smallholders work with diverse species in smaller areas, and in how more sensitive survey sampling and mapping can reveal these relations. Here, suffice it to say that my surveys showed that labor on land led enhanced agrobiodiversity; agricultural choices were not 'caused' by soil fertility types.

In this chapter, I have tried to provide an account of the chaos and also consolidated forms of land use in the recently colonized Brazilian Amazon. This is a characterization that builds on decades of quantitative attempts to model land use responses, which sought relentlessly to construct statistical coherence on the basis of individual household data. But ecology, geography, culture and history all matter, and it is impossible to understand these places without attention to a range of 'scales' – political, social and ecological – that influence the organization of land use systems. State interaction, credit interaction, extension interaction – their collapses, as well as emerging folk knowledges and experience – and not to mention, the imprint of thousands of years of indigenous semi-domestication of crops, retooled by the state, came to bear on this Transamazonian world. In the next chapter, I will explore cases of how these development dreams play out in the landscape, and how and where land use plans are concocted. Farmers plans and development dreams are often interrupted, whether by social, political or ecological factors. The purpose will be to show the unexpected, non-scalable and yet patterned, effects of development expectations, in friction with surrounding ecological dynamics.

7. Chapter six – The Monkey Thanks You

Forest ecological succession accompanies the ruins of frontier development imagination.

Many informal, unwritten practices govern land use in the Brazilian Amazon. And as I pointed out in the last chapter, decision pathways that lead a farmer to cattle or to cacao or some other mixture of land use activities can be rather **schizophrenic**, with smallholders pulled toward extensive cattle ranching, even if their land would not sustain such land use. The other side to this informal land use rules situation is that bureaucracies for the most part disempower smallholder and peasant cultivators. Smallholder peasants can have an especially hard time availing themselves of the state. Bureaucratic impasse is a significant factor affecting small-scale farmers, in parallel with other institutional synergies that do exist and function well, involving land speculation, deforestation and cattle ranching.

How labor is organized, how a farmer goes about applying for credit from a bank or interacts with environmental policy, are not so straightforward such that the rules framing the decision can be aptly identified without a closer look at the individual situation. What a farmer aims to do can work out, or not, depending on multiple factors, including the efforts and costs (i.e. transaction costs) involved in engaging various social or bureaucratic situations. In Brazil, for example, many institutional 'options' are simply not realistic for small farmers, given the time and

effort needed to sort out bureaucratic complexity, bottlenecks and impasse. And farmers may not have the social 'power' needed to get such relations to move.

This chapter will argue that popular expectations about sustainable development are often thwarted or frozen by speculative outlooks, bureaucratic impasse and land systems that disempower smallholders, and which have created significant mistrust for cooperatives. And simultaneously, how the natural world sometimes exults in response to this fractured character of development. Especially in more isolated areas in the Brazilian Amazon, labor is harder to organize, and this, combined with bureaucratic impasse, means that establishing, maintaining and diversifying land use becomes a significant challenge. In contrast, pasture and cattle function quite well in isolated areas, and leverage speculative, extractive and productive rents all at once, largely without the need for labor (Hecht 1993), and with much easier access to credit.

The consolidation of cacao farming – whether at large or small scales – has certainly involved the state, but it has also involved popular adaptation to state ruin, and the particular characteristics of this tree that 'interrupt' the scales of cattle ranching. Thus, this cacao 'empowered' area centers on the Transmazon highway, on soils for which The Executive Commission for the Planning of Cacao Agriculture (CEPLAC) historically credited farmers, but also encompassing the areas on which sugarcane was formerly grown.

To help illustrate what I mean about the aloofness of the state in Brazil, let me try to put this bureaucratic situation into regional contrast. In Mexico, for example,

officially sanctioned community forestry is significant, extending across relatively large territories that are collectively managed. Community forestry however involves and is substantiated in communicative performances that tie or link state bureaucratic behavior with and within local communities. Whatever the literal content of such communication, this attempts to legitimize the power of the state (Mathews 2011), in terms of authority and expertise on forests. In the Brazilian Amazon, however, bureaucracy and land/forest knowledges are entwined in an arguably more chaotic and violent manner: the norm is unsanctioned timbering and deforestation, with bursts of violent environmental policing. Very high transaction costs in engaging state bureaucracies to try to legalize forestry encourage this perverse institutional situation. Thus, the state's power works in a backhanded way: illegal timber is made into lumber in remote sawmills, transformed into a 'legal' commodity through the false emission of *notas fiscais* (fiscal receipts) in Altamira, and trucked to southern, more developed, Brazil – São Paulo, etc. The environmental state enters in when environmental police (IBAMA) seize logging equipment and burn sawmills to the ground. Thus, even though illegal, unsanctioned timbering and speculation on land is linked to the state and to development dreams, expressed however through disjunctive practices of property and accumulation strategies (see Campbell 2015).

Even though documents are also important for them, many small-scale cultivators in the Brazilian Amazon have no patience for engaging the state – the only time they may visit town will be to obtain state issued pensions or seeds. Cacao production in Medicilândia but also all across Pará, operates largely without

bureaucratic transactions – except for when producers opt to establish nurseries with hybrid seed stock from CEPLAC. While obtaining seeds is a very simple transaction, the state stops there as a tangible presence. 2,500 producers in Medicilândia, and perhaps an additional 20,000 across the state of Pará, today exchange slightly fermented seeds with middleman merchants. These transactions are strictly commercial, on the spot; they are categorically *not* bureaucratic – they involve weighing sacks, making cash payment, or issuing credit to the sharecropper or small farmer on a middleman-maintained paper ledger. As in ancient Mesoamerica, cacao seeds operate as a currency.

The legacy of state planning and programs, including the collapse of the sugarcane system, has also installed significant social mistrust for cooperatives. The sugarcane enterprise was operated as a cooperative, and yet, when it collapsed the state left all its members in severe debt. More recent state credit programs, such as FNO in the 1990s, further fomented popular mistrust for cooperatives. This, even though FNO was ostensibly designed to stimulate more diversified, sustainable farming. The reason for this was, that in colonists' desperation, much of the credit issued through FNO went into buying cattle, and many credited farmers went into default, even thought they had entered collective credit arrangements. This meant that defaults pulled all the other co-signers into arrears.

With this breakdown of trust in collective organization, today only approximately 2% of the municipalities' cacao producers (around 50 out of 2,500) are involved in cooperative niche markets and a small chocolate factory. All other cacao

production is transacted through middlemen who then sell to multinational distributors with warehouses in Altamira (Barry Callebaut, Cargill, Olam). Cacao farming is overwhelmingly managed by individual landowners and sharecroppers, who make spot transactions with middleman merchants, and thus avoid the state in terms of the traceability of their production. Further, the cacao production is made sustainable through the mobility of labor and the cacao market itself. Long distances or lack of transport does not thwart selling cacao in this market articulated area, as middlemen merchants will send heavy duty 4-wheel drive trucks to the farm gate, when there is sufficient volume, at distances of up to 70 kilometers.

In contrast to the attentions of middlemen, state bureaucracies in the Brazilian Amazon – especially involving agrarian policy and extension – are especially aloof or just absent. Jaded bureaucratic inaction is the norm. The state's mandates may be imagined or vaguely known, with actors appealing to or at least assuming the state's view of legitimacy of claim, but via differing mandates. This situation has produced, historically, deforestation and conflicts over land. Just one example is the famous murder of Sister Dorothy Stang in 2006 in Anapu – about 200 kilometers to the east of Medicilândia – which was facilitated by the lack of INCRA action and intervention in land disputes between ranchers and peasants.

In the 1970s, however, landless peasants from Brazil's northeast relied on the government to produce documents without bureaucratic acrobatics. Rogério obtained land simply by appearing at INCRA's offices in Altamira with his identity card. At that time, INCRA had a staff set up to support the process, with the land cadaster

already mapped out. Unlike most other land titling projects in this region, the population that settled on the early TransAmazon were handed mapped, signed and stamped tenure documents, which survive to this day. Colonists did not have to maneuver networks to receive them. But after the 1970s, gradually it became impossible to resolve land tenure issues through INCRA, which became more of a vote mobilizing agency. But the early days were oddly different.

Put the former situation in contrast with ongoing expansion of cattle and *grilagem* (land grabbing) since the 1990s, such as described by Campbell (2015). Speculation and accumulation of land, cattle and capital, over time became the default bureaucratically 'savvy' figuration of property in the colonized Amazon. Cacao, on the other hand, in this region, in which the extent of the surrounding rainforest remains so large, is viewed as the work of little people. In Brazil, cacao's commodity price does not appear on Globo TV or in other media, unlike soy, sugar, or 24-hour televised cattle auctions. And the land areas occupied by cacao's cultivation are minuscule by Brazilian Amazon standards.

Thus, cacao's emergence after the fall of sugarcane on the Transamazon cannot be explained as an artifact or residual of bureaucratic power, skill and savvy – in engaging political connections or networks. The state had been involved in a social policy for settling the landless. But, nearly fifty years later, what had emerged was the dogged spirit of socio-ecological relations and labor on the land. The TransAmazon's was a migrant population, entirely dependent on the state to physically enter the area. But this population was forced to adapt to a slow and sure removal of active, attentive

bureaucracy – at the moment in which it would have expected to continue to appeal to the government for their own survival.

Thus, the community here – in the ruined sugarcane zone – did not 'parasitize' the industrial infrastructure of the state. They did not abscond with the tractors and trucks. They did not scale the gates of the sugarcane mill as wily and clever peasants, to refit the machinery for, say, making artisanal rum. Rather, they saw the government lock the gates, and retain a full-time watchman to stand over a rusting heap of scrap. Inside the gates were perhaps a dozen or more working vehicles. Thus, the community waited, for over a decade, hoping that their debt to the Bank of Brazil might be forgiven. But it was yet another refrain, of being ignored in a malignant manner. In earlier days, they had hoped that the roads might remain passable. But as the state withdrew, the roads started to seriously deteriorate, starting in the 1980s, dragging on into the 1990s. Those who stayed on the TransAmazon "highway" struggled to remain in place, in jaded silence, and gathering resentment. Would they simply sell their land, and move on to more recent frontiers, follow the imagined quick returns on new lands? No, we will go to Brasilia, travel thousands of kilometers, since the state will not come to us. And the social movement for the survival of the TransAmazon emerged – "live produce and preserve nature" was the slogan.

Here, colonists, squatters, sharecroppers – women and men – Afro- and Euro-Brazilian – managed to adapt livelihoods and concentrate cultivation practices despite a perverse institutional and political economic context. Planting cacao did not mean

bureaucratic skill. Cacao agriculture emerged, where sugarcane had once stood, largely in the absence of any state infrastructure outside of the legal recognition of property and CEPLAC's limited ability to provide seeds for home grown nurseries. After the 1990s, there was essentially no functional agricultural extension. Cattle ranching, on the other hand, became that parasitic practice attuned to bureaucratic power and impasse, deliberately precarious road conditions, the accumulation of new land and new credit – ranching has the political character of 'scaling' across the landscape as a replicable model of power, oligarchic collusion and ignorance within the state.

While this chapter does not describe social movements and collective economic organization, the chapter ethnographically recounts how three farmers have attempted to sustain livelihoods on the land. The chapter also includes a description of one of two last remaining CEPLAC technicians in Medicilândia, to better show the character of 'officialdom' and farmer struggles trying to finance projects in the present. I show how attempts at official transactions do not always work out, even when involving those who supposedly represent the state. The farm cases vary from a one-time sharecropper that gave up on tree cropping and shifted to cattle; a female head of household attempting to develop a lot in an INCRA settlement at the northern extreme of the municipality; a Navy veteran from Bahia trying to manage his family's semi abandoned cacao estate.

My methods involve a combination of participant observation, walking and driving the land with these farmers and their families, interviews and oral histories,

surveys, ethnobotanical notes, and remote sensing analysis of satellite data. Below I present the three farmers and seven factors in both a map and a comparative table.

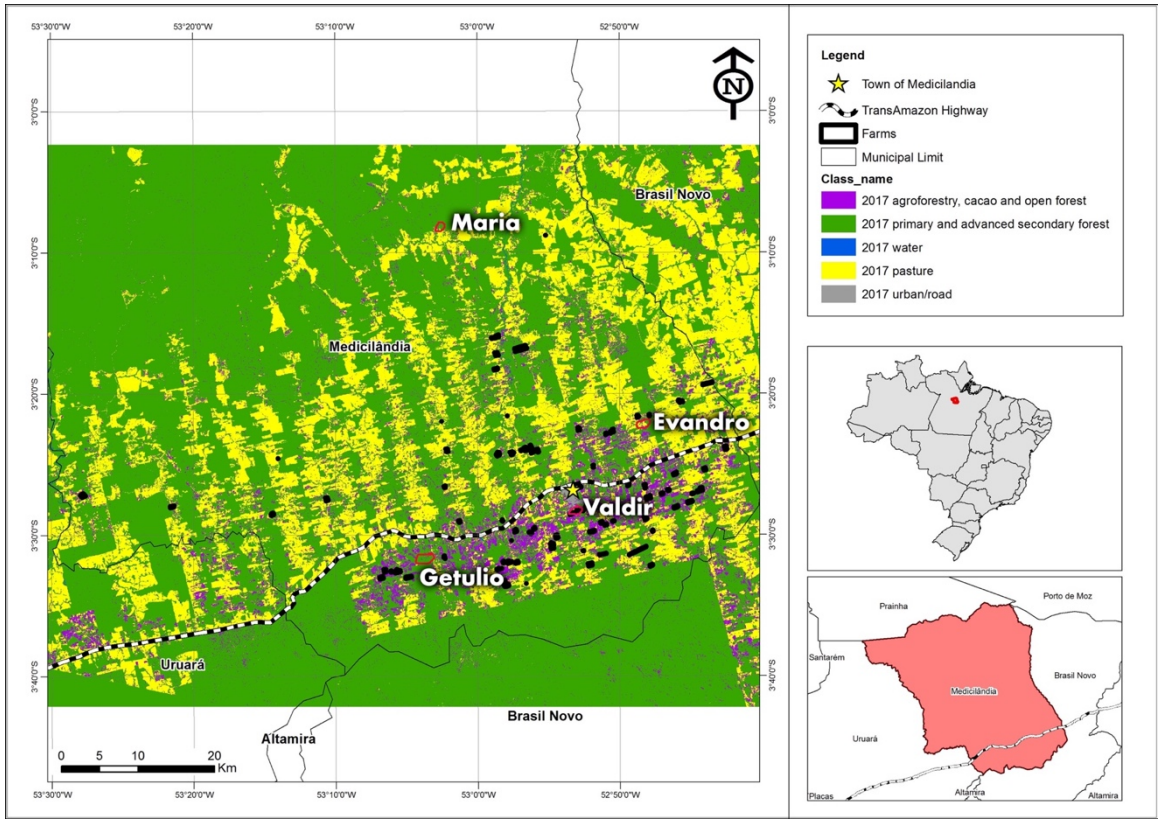

Figure 7.1: Land cover map of Medicilândia with small (<25ha) farms indicated by black dots, and location of farm cases in white text, with red ovals indicating the location of 100ha lots. Note clear border with Arara indigenous territory on the southern end of the municipality, and this indigenous territory's location coming right up to the edge of the highway between km 120 and 140.

Table 7.1: comparative table of factors affecting the three farm cases described in this chapter. Listed in order of appearance in the text.

Case	*Distance to to town on unimproved roads (km)*	*Labor arrangement*	*Historical access to technical assistance (since start of tenure)*	*Historical access to credit programs*	*Soil fertility*	*Scale of operation, relative to primary land use*	*Historical price volatility*	*Primary use of land (system outcome)*
Evandro	18	family	n/a (self-taught; he himself had been the municipal secretary of agriculture)	good	mixed	medium (~132ha pasture on two adjacent 100ha lots)	high	Pasture, used for fattening bulls. Some areas previously used for coffee and black pepper. 6ha of abandoned cacao.
Maria	60	family	poor	poor	low (sandy)	small (20ha pasture on one 100ha lot)	n/a (no production)	Abandoned pasture; small home garden
Getulio	25	sharecropper (1)	good in the past; poor today	good in the past; poor today	high (terra roxa)	large (40ha cacao on one 100ha lot)	high	Poorly managed/abandoned cacao ("technified" cacao planted in the 1980s, outside of the sugarcane zone)

Sivuca – a relic of the agrarian state

Before I had even arrived in Medicilândia, I had visited CEPLAC in Belém. There, the agencies research head graciously received me. He made a phone call to the CEPLAC office in Medicilândia. “Take this man around, show him producers,” etc. A major favor from the head of the agency. When I got to Medicilândia I went to look up the technician who had taken that call. Sivuca is his nickname, for when he kept his hair long and resembled a Brazilian 70s musician with a hair like that boxing announcer. Sivuca is from Maranhão. He has curly hair and green eyes. The CEPLAC office in Medicilândia occupies the hill just to the southeast of the highway center. It’s just down the hill from the community radio station, where Rogério works. One steps in through a glass sliding door, with cardboard laid out to wipe your feet. Air conditioning. Sivuca’s office is there on the right, in front of a bench of three seats for people to wait. On meeting Sivuca, he tells me the story of his time getting here.

It’s Maranhão in 1984, he tells me. He had attended a two-year agro-technical school in São Luis. He opted, like many Brazilians, to work in the public sector, applying for a *concurso* – a guaranteed government salary, with CEPLAC. He was married at twenty one and had a friend in Brasil Novo on the TransAmazon. He relates how he received a telegraph, that he had been offered the job. He imitates the telegraphy on the desk – beep de beep de de beep beep – and constantly scribbles on a random sheaf of paper. Telegraphy was the most secure form of communication in the region as late as the 1980s.

He traveled to Belém and then to Altamira during the Pro-Cacau project (1976-1986) – a program to encourage cacao in the Amazon (in Pará and in Rondônia, the other government frontier to succeed the TransAmazon in the 1980s). In 1976, when INCRA was staffed out of Brasil Novo, it set up an arrangement with CEPLAC to act as the primary extension arm of the state. EMATER at this time (1975-1980) was administered from within CEPLAC? The Pro-Cacau program would extend the TransAmazon from Pacaja to Placas – a distance of approximately 300 miles.

For four years (’84-’89), he worked for CEPLAC in Ururará, the next municipality to the west of Medicilândia. At that time, the functionaries had vehicles and travel time paid by the kilometer. CEPLAC operated as a business – it survived based on “*tributário monetário*”, which meant that CEPLAC was partially funded by a fee applied to cacao exports. While part of the budget came out of the Ministry of Agriculture, the agency was self-sustaining in this private cooperation with the cacao sector. Thus, the agency was incentivized to set up as many projects with farmers as possible. CEPLAC approved auditors entered the project with farmers such that all financial calculations and documents were taken care of. There had been a fleet of 500 VW bugs to take around the functionaries. VW bugs were relatively better off in the mud, with the engine sitting atop the rear wheel drive. The PROCACAU program however ended in 1986.

Sivuca told me about a tragic accident with his neighbor – a gasoline fire, which killed his neighbor’s daughter, in 1989. While the accident had not been

Sivuca's fault, he had asked CEPLAC to be transferred to Tucumã. He spent twelve years in Tucumã ('89-'01), separated from his first wife, then went to Placas in 2001. In December of 2003, he arrived in Medicilânida.

My audience with Sivuca continues as various farmers come into the building to 'hold court'. Sivuca tells me about the hybrids – CEPLAC has 22 varieties. All were developed in Bahia, but tested at the biological station that is at kilometer 100 south. They were going to start developing a graft/clone program there but the research program stopped. The biological station plans to produce clones however has been stalled since the 1980s. The national development bank was going to pay 75% of the cost of setting up the biological station to produce clones and include irrigation systems. But somehow the entire project was rejected.

Due to rash decision of one of the agency's directors in the late 1980s, CEPLAC also stopped being paid a fee from cacao exports. The lack of foresight of that decision meant that the agency was now entirely dependent on federal funding and would start to suffer a drastic funding shortfall. There was always a problem involving any chain of command. For cacao farmers, with this bureaucratic impasse, imagine the implications. Farmers' might opt to start nurseries using seeds that were second or third generations after the initial hybrid cross – this meant that the tree's fruit producing characteristics were no longer controlled as a phenotype in the plant breeding process. Farmers might spend significant effort planting thousands of trees, with seeds that they had amassed themselves, and end up baffled and bitter when they

didn't produce fruit. Few understood cacao like the agency did, but extension work had come to be almost nonexistent, except for furnishing hybrid bred cultivar seeds.

Later that day, we are riding in Sivuca's dusty cramped and ancient Fiat, blasting sertanejo music from the pen drive. We drive down to the market area on the highway, where he buys some big fronds of lettuce, and a watermelon. Back up the semi-paved town, over the gullies and past the small stores selling toilet paper, soft drinks, crackers and beer. At the top of the hill, the PACAL sugarcane mill emerges in the hazy distance, over the motley former government land full of squats and shacks and small orchards. The road turns to dirt and road dust is in the air – that iron like smell of pulverized terra roxa. We hit over rounded basalt stones. We skirt motley trees and orchard forests of the former sugarcane area near the PACAL mill. But before we get to PACAL, we pull to the left into the PACAL village, which surrounds the weedy plaza next to the abandoned Bank of Brazil buidling. The village hosts several of the characters in this ethnography: Rogerio, Sivuca, Carlos Alberto.

Sivuca was classified as a technician, rather than as a research extension employee. But as a longstanding, lifelong government employee, his job security was phenomenal. Earning over ten minimum salaries per month, he supported several families. He had just had a child with his fourth wife. Well into his sixties, he was a well-paid minion of the state. Sivuca today was the one individual in town who wrote projects for credit, who had some knowledge of how to produce bureaucratic documents, and which documents were required. And he cut himself a commission to do it. Except that now, Sivuca was the sole, individual representative of the state.

Thus he came into work, semi-retired, to write projects, to get a cut of the proceeds. He was a relic of active federal government.

In the building's back yard sit two government pickup trucks in relatively good condition, with flat tires. These haven't been moved or used in years. Too hard to get the government to liberate the funds to repair them. This was a commonly used word: *liberar*. The act of the state in liberating funds – almost like a sanctified act. Sivuca was sympathetic with farmers' bureaucratic headaches. For example, to obtain bank financing, small farmers had to identify themselves with a document that certified that they were 'family farm' producers (agricultura familiar), called the DAP. He said that farmers can't manage any bureaucratic transaction without the DAP document. But to get the document they have to have a certain level of production. But they can't get to that level of production without credit. But they can't obtain credit without the DAP; so catch 22.

Figure 7.2: Financial assistance. a small farmer has ridden his motorcycle 80 kilometers – 3 hours each way – on dirt roads for help consolidating his farm.

Such bureaucratic impasse and procedural unknowns were a significant factor affecting the population. Most mornings I would stop by the rural workers' union to see the greeting hall thronged with men, women and children. all nervously seeking information. The primary function of the rural workers' union was to help poor rural people figure out how to accomplish anything involving officialdom. The rural workers' union functioned through members' paying dues, and they were supposed to assist all farmers' confusing document and state interaction needs, from bank accounts to identity documents. The state paid pensions, and there were programs for families under the *bolsa família*, a federal program that paid grants to support children. Where did one start to procure the right documents? Which documents were needed? What do I do when I go to the bank? Using the internet in this area was a

significant challenge, and the rural workers' union staff took time to serve the population by looking up citizens in the state's byzantine record systems. I had been to banks myself, an experience to make one shudder. It happens all across Brazil – the poor lining up to make appeals to the financial "court" – after all, Brazil had been a European monarchy in exile in the new world. In one of these depressing moments at a bank, I had seen myself how cattle ranchers would be whisked in to talk to the bank manager, without even having to wait in line.

Case 1: Evandro

Reading the land, soils and plants was something that some farmers did better than others. They taught themselves. One of the first farmers that I interviewed – based on random sampling of the original INCRA lots – was the interesting Evandro, now about 75 years of age. He had migrated to the TransAmazon in 1975, after the INCRA distribution of land. Previously, Evandro had lived in Paraná – one of Brazil's other agricultural frontiers. In Paraná coffee agriculture had expanded from the 1940s to the 1960s, but the frontier closed, mechanization and land accumulation set in, and sharecroppers like Evandro saw no way to acquire land. Thus, the family migrated to new land frontier – this time, Pará in the Amazon.

Evandro had told me that when he arrived in the mid 1970s in Pará, INCRA was still giving full technical assistance to land beneficiaries, including the facilitation of credit. They had had a health post maintained in the agrovilas. But INCRA – due to shifts in regional development policy (see Browder and Godfrey 1987 and others) had abandoned these policies by the 1980s, and the agrovilas

remained – technically squatting, but with socially recognized ownership. in this 'second wave' of migration – of which Evandro and Israel had been a part – families tended to know a bit more about working land. At this point, INCRA had stopped its active policy of technical assistance, remaining in the background as the formal authority on land settlement for the poor. But the people continued coming, Evandro had told me. They marked out their own land to make sure it conformed to lot boundaries. But also in the 1980s many more exploitative interests started to arrive, who came to grab land, to kill people, ranchers that went inside the INCRA settlements and created their own, sometimes clandestine, roads.

The original 12km of settlement to each side of the TransAmazon however is one of the few places in colonized Brazilian Amazon where many land documents are authentic government products, rather than involving a labor of politically savvy speculation.[12] Keep in mind, Evandro told me, that INCRA was responsible for initial deforestation of the TransAmazon. At that time, INCRA was afraid of losing hold of the landscape. As a land beneficiary you were obliged to deforest at least half of the lot – or about 50 hectares. If you didn't, you lost your government granted right to the land. The military dictator government had brought people here and had given them technical assistance. But when it became clear to the public that the land was good for livestock, that's when people started to show up to accumulate land by other means.

[12] See Campbell (2015) on grilagem, forgery or speculation of various kinds, for more recent frontiers in Pará like Castelo dos Sonhos on the BR-163 highway.

And then, even though the region was still full of agrarian settlements, INCRA stopped providing technical assistance.

When Evandro arrived, he had enough money saved to purchase a lot of land on km 75 south. The lot had sandy soil however and was unfertile. His neighbor however saw that his entire family worked together, so the neighbor asked him to sharecrop his cacao trees. Evandro's family took on 32,000 of them – a tremendous task, even though the price was only 20 cents a kilo. As he told me:

> *I didn't know how to work with cacao, only with coffee, because in Paraná and São Paulo I worked with coffee. Because my land was fraco [unfertile/sandy], I decided to take on the cacao [as a sharecropper]. I believe in God, and I think that he had a plan for me, even with the price of cacao being low, at 20 cents per kilo I took on 34,000 trees. In that year, 1984, the price of cacao went up, from 20 cents to 1 cruzeiro.*

The price for cacao had gone in 1984 due to a crisis with cacao production in the Ivory Coast. With that windfall, in 1985 he was able to buy a two lots on km 80 north. These lots had been partially deforested but abandoned – a typical land use history. One owner had died; the other owner had disappeared. INCRA almost was going to take back the land. Evandro bought the land, presumably from INCRA, with the money he had earned as a sharecropper. He continued to sharecrop the cacao farm on km 75 south until 1989.

> *When I moved here, I cut down the forest there below [at the back of the lot]. There [at the back of the lot] the soil is terra roxa. I planted 12 thousand cacao trees, 6 thousand black pepper [vines] and I organized the pastures and then I went to work with the juquira (secondary regrowth scrub). (Interview 2016)*

He told me that he continued to work with black pepper vines, and eventually reached about 20,000 plants. One year he harvested 15 tons of black pepper seeds. But then the fungal disease arrived, wiping out the crop entirely. During the success of cacao in the 1980s, the family had also bought two more lots of land on which they had run cattle – for a total of 400 hectares of land. Evandro's original idea was to stick with cacao, using the land and cattle as a savings mechanism. But the cacao market suffered a crisis between 1989 and 1992 – the price plummeted. So instead, they determined to plant coffee, and they set up a bank project to do it. Coffee's price had been quite high – about 1 cruzeiro a kilo. In this, Evandro had essentially tried to sustain a small agricultural corporation, with 36 laboring hands on the farm in the early1990s – 6 family members, 10 permanent salaried workers and 20 temporary workers. And no sharecroppers.

> *My intention was to plant cacao but between 1989 and 1992 cacao suffered a crisis, and the price went down. So, we financed a project for coffee… When we financed the project a kilogram of coffee was 1 real per kilogram, which was a lot of money. By the time we had our first coffee harvest it was worth 20 cents / kilogram… We had developed a PRONAF project to plant that coffee. We had known that the price was high, but we had no knowledge of what would later happen. We thought that coffee would continue with a good price. In the three years that we harvested coffee, it continued at 20 cents a kilogram. At that time, we sold the coffee to Izmar (Trevisan) [to mill]. The next year it gave a price of 20 cents, we sold to Izmar again, because he was in a better financial situation. Then, my son tore out all the coffee with a tractor. (Interview 2016)*

To pay the debt for planting coffee, they were forced to sell off the two cattle lots. Evandro's story was not unique, he knew as well as I how this was a typical story of volatility on the frontier – with bank financing leading to near ruin. Evandro told me about another financing program – FNO – that emerged in the 1990s, long after the initial heyday of active technical assistance and bank management located in the PACAL village. FNO stipulated particular production packages and grouped beneficiaries together – loans would be paid back collectively. What happened, however was that farmers used the money to increase cattle herds, rather than diversifying or intensifying cultivation. Many of the parties to the collective loans did not pay back the money – leaving their partners in arrears.

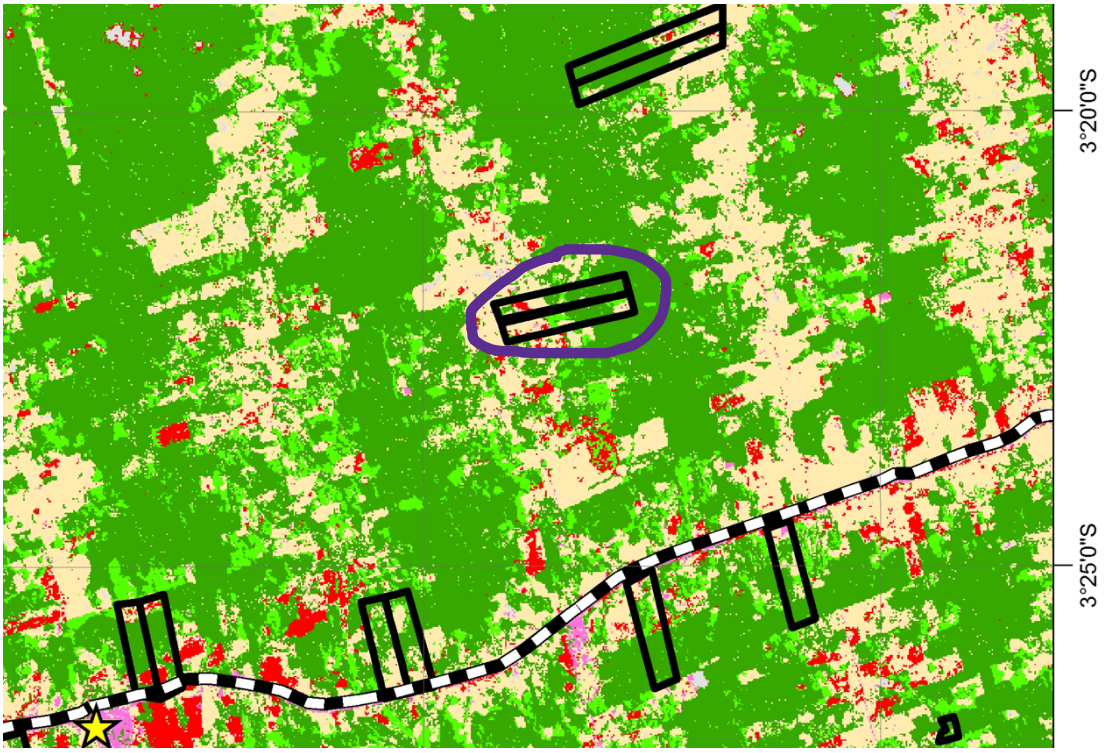

Figure 7.3: 1992 land cover. In the center of the frame: the two lots acquired by Evandro after his windfall as a cacao sharecropper in the mid 1980s. 35, 000 coffee

trees have not yet been planted in the center of the lot to the south. Remote sensing land class analysis by author; map created by Felipe Martenexen.

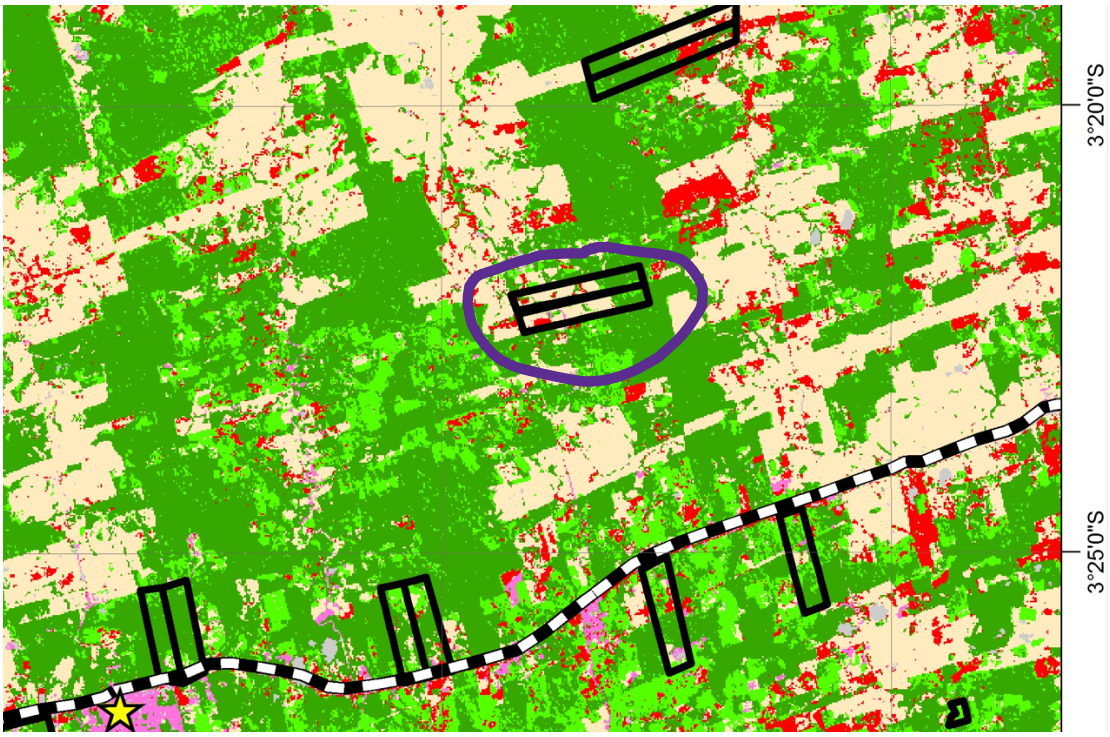

Figure 7.4: 2014 land cover of Evandro's land. In the center of the frame: the two lots acquired by Evandro, after the failure of coffee, the two lots have been largely transformed into pastureland. Remote sensing land class analysis by author; map created by Felipe Martenexen.

Without specific technical assistance or credit programs from either INCRA or CEPLAC, the regional land use system evolved to be dominated by pasture and livestock. But, Evandro told me, poor single-family colonists, on a single lot of terra mista, working with pasture, can't get up to sufficient level of income. Thus, on the lands opened up by the state for settlement and social use, in 100 hectare lots like the early program – the land quickly changes hands, paradoxically resulting in land accumulation by wealthy non-resident ranchers, the very issue that social land settlement was instituted to reform (Ludewigs et al. 2009). Evandro told me that,

close by, about 10km further north on the travessão inside the INCRA settlement, there were landowners with 4 or 5 lots held together. This was illegal under INCRA's rules, but there was always the *jeitinho* in Brazil – making an informal way past formal irregularities.

Notwithstanding the disaster with coffee, which had forced him to sell 200 hectares of cattle pasturing lots that he had acquired within the Surubim INCRA settlement to the north, Evandro was passionate about work with the land and his agricultural activities impressed the community. He was tapped to be municipal secretary of agriculture in 1996, with mayor Lani Trevisan. She was reputed by the community to have been the best mayor that the municipality had ever known. As secretary, he started nurseries, taught five hundred persons grafting techniques for fruit trees. Evandro's self-taught knowledge essentially involved experience:

> *We keep working, we keep gaining experience and we do research. The first extension technicians dictated to us, they didn't like us doing things differently, but colonists through their experience proved that the technicians were wrong. For example, for black pepper, they only allowed credit financing to go to terra roxa — it's a good soil, but when it gets dry the soil splits and it tears up the roots. And when it gets wet the soil gets water saturated and the vines die. Terra mista doesn't split up or soak up like that and the black pepper doesn't die. (Interview 2016)*

Yet, his own family gradually moved away from labor intensive tree cropping and horticulture into managing pasture and a timber plantation on the two remaining land lots. By 2019 there was only two family workers on the farm. A tree plantation of native mahogany – 4,500 trees spaced 4 by 4 meters – surrounded by Mombasa

grass, was now located on the area in which the coffee had stood. Evandro now raised goats. White Nelore bulls with dull black eyes roamed the remaining land in a share pasture arrangement with a local rancher. The holding had gone from labor intensive to labor de-intensive, eventually landing in a land use system roughly 10 times less productive per land area, but also requiring roughly 10 times less manual labor. They had just enough land to share pasture about 80 head of share bulls with very little overhead and labor.

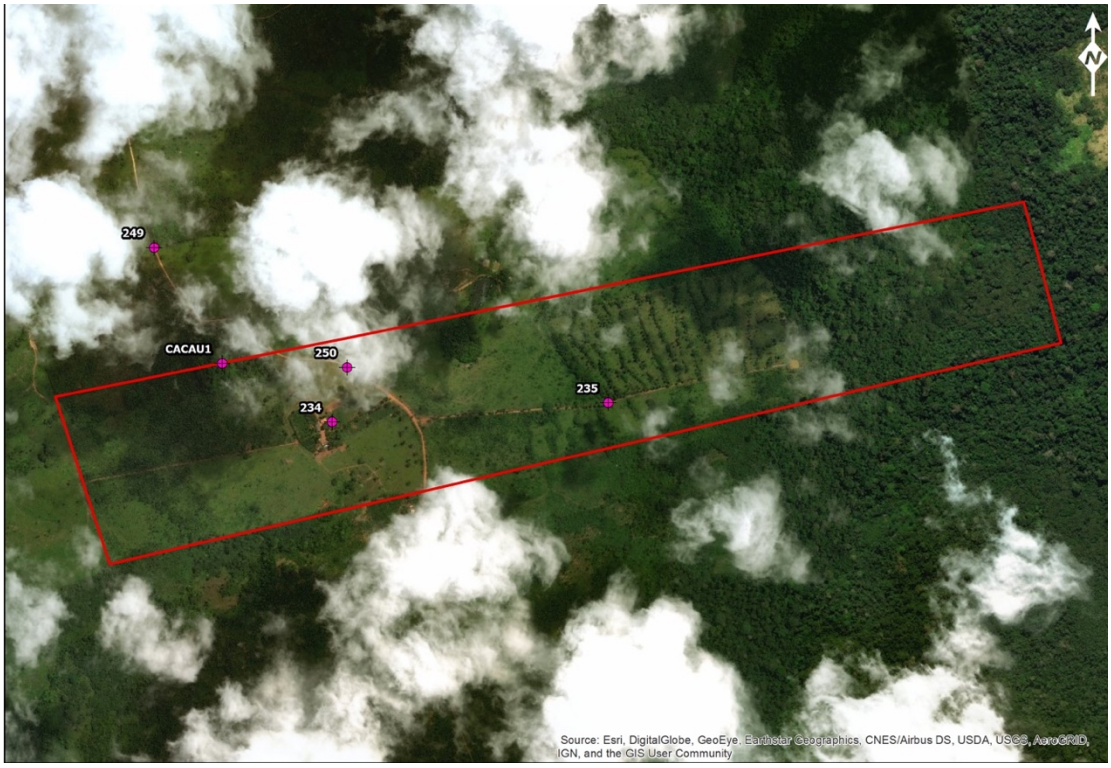

Figure 7.5: Recent image of lot #78, which formerly harbored 35,000 coffee trees. Abandoned successional cacao at the east side, with mahogany trees planted into Mombasa grass at GPS point 235 of the lot. The home site is at GPS point 234.

The home compound was an island of shade, shaped by Evandro's experience and knowledge with cultivation. There, Evandro continued with all kinds of

cultivation and experiments, with pitaya fruit and jabuticaba, also maintaining many other fruit trees. He maintained many other fruit trees. But cacao was abandoned, at the back of the lot, and had essentially become a successional agroforest through which monkeys were grateful to roam at will.

Figure 7.6: Evandro's home garden

We walked to the back of the lot one day and saw the abandoned cacao. Evandro in his conversation about the land would stop to use his machete to pull up a soil sample every now and then to show us how the soil was changing. He showed me the relative sandy or clayey ness, and the soil's color: red meant more fertility. There was even indigenous black earth on the land – Evandro said that there had been an Arara village nearby. There was a babaçu tree, which was being embraced by an Apuí tree – which starts off as a parasitic vine before smothering the host tree and replacing the original tree. Evandro likened the process in terms of sin: the sinner was the

babaçu tree that was being caressed by the evil vine, unconcerned about continued sin, until it was too late – the sin had devoured his soul. While Evandro viewed nature sometimes as Christian allegory, however, he was incredibly attentive to the ecology. He told me about the 'native' cacao trees, which were actually a different species, Theobroma speciosum, see the figure above on page 19. The difference between the cacaui trees and the hybrid bred cacao trees was that the native tree only had fruit along its trunk, and fewer later branches. The native cacaui tree was never found on terra roxa, said Evandro, but only on terra mista.

Figure 7.7: Evandro's abandoned cacao, now indistinguishable from primary forest in a satellite image.

Similar to Rogério's story from chapter two, we can think of Evandro's 'peasant' identity as a case of transformation, involving small-scale cultivation and

interaction with wider markets and political and economic spheres of control. He had migrated, done well as a sharecropper, bought additional land and had become a diversified horticulturalist. But he had then retreated into managing pasture due to credit and market fiascos. His lot was not particularly distant from the town (18km), and he had planted cacao on both terra roxa and terra mista. He was attentive to nature and was passionate about cultivation. But his experience becoming a more capitalist type of farmer, involving coffee, had been a disaster. The imbalance and failure of the land system can be compared to Rogério's experience with sugarcane. While Evandro had been blessed early in his career, it had not worked out in the long run.

What concerned me was that here was a place in which diversified horticulture could have, should have, continued. The livelihood strategy had not worked as planned, due to the lack of cooperative organization to stabilize prices, the risks of opting for bank financing at a large scale (30,000 coffee trees), and the buying and selling of land to pay accounts. It was classic boom and bust on a capitalist periphery, with little support from the state. In fact, Evandro had essentially become the state himself, as secretary of agriculture. But he told me, as Brazilian municipal administrations make radical political shifts every four years, the community outreach and education he had suffered to build around horticulture vanished.

Today, horticulture was concentrated in his house garden, where there was delicious pitaya and jabuticaba fruit, açai trees, a turtle pond, very verbal red macaws,

a parrot, a miniscule monkey. But there had been a rupture between the father's generation, who had secured a fortune with labor, and the son's experience. Adilson the son, who had come up in life as a heavy machinery, tractor and bulldozer operator, had gone through the entire coffee area at the age of 25, uprooting the trees. Adilson would become a heavy machinery operator, renting out services in the municipality for clearing forest. His son was a fan of planting eucalyptus and became the main supplier of eucalyptus seedlings across the area. He hoped that we could design a project to get money from international financiers. At first, he kept asking me about how to set up carbon financing for reduced deforestation, involving claims to regional forests. Later, he started to ask me in earnest about getting money for reforestation, assuming I had some way into the business. I indulged his conversation – it was all rather facetious. He told me he wanted to be free like an angel, and rich. The obsession with money as a sign of blessedness was not atypical, I supposed, for evangelicals.

But the son's aspirations were to try to get rich with land and development in ways that didn't involve labor. In the 1990s, as a heavy machinery operator he had re-opened a road leading to informally settled areas in what was protected as the northern side of the Arara indigenous reserve. There had been confusion about this area due to the state formerly granting a large land concession to a gaucho land syndicate from Rio Grande do Sul. Smallholding families settled there in irregular circumstances and that they had difficult access to the area. In 1992 there was a picada leading into the reserve and colonists were opening the forest. FUNAI then

formerly registered the land as pertaining to the Arara indigenous nation. But without knowing the formal status of the area, the settlement had started. The state produced the formal documentation of the area, and the colonists had pulled out after a bit of drama. The forest regrew.

Later, the son had invested in real estate in São Paulo. And he had lost his shirt. But as the demand for large machinery and tractor work was so great on the Transamazon, and so few had the operational expertise – he was able to get back on his feet. He took pills for anxiety and depressive mood swings. He was not a cynical or corrupt person. But I did think of him as a bit daft and representative of an Evangelical attitude about money. Others in the region took speculative accumulation to a serious level of violence, however, disposed to get their way by murdering land squatters and indigenous people.

Case 2: Maria

At the union hall, Milton tells me about a family that needs a ride up km95 north – a couple that has asked about the state's plans to extend electricity to that area. About 60 kilometers away, it takes about two and a half hours to get there if road conditions are favorable. Sure, I'll take them. We meet on Friday morning: Dona Maria, João, and their grandson Gabriel. We all have a jolly ride north. We pull out of town to the west, ride to the end of the asphalt. From here the Transamazon remains an unimproved road, except for a few stretches near Placas, for hundreds of miles. We pass the "gaucho" ranch – the only ranch/pasture area immediately on the highway between kilometers 75 and 115. We turn north onto the km 95 travessão – up and down hills, boulders in the unimproved dirt, dust pouring up from the impact of the tires, climbing and descending hills, crossing wooden plank bridges. The first few kilometers are full of trees and cacao, then there is less of it. We pass the 'agrovila' – the state planned, but abandoned rural village, in which all the houses are owned informally. Recently, after 40 years, INCRA has started to distribute title. We pass the abandoned airstrip, on which bureaucrats and officials would arrive direct from Brasilia in the 1970s, and then, pasture and secondary scrub, tall Brazil nut trees isolated, slowly dying, in the pastures. We come down a hill to a larger bridge and a river – dark reddish water, dark basalt boulders. We pass mid size ranches and eventually some larger ranch land with degraded pasture, then a hamlet with a a saw mill. Finally, we enter an area with much original standing forest, reaching Maria's homesite.

The couple are from Maranhão. Her husband had worked for the sugarcane mill. Dona Maria's lot is in one of three INCRA settlements in the municipality – PA Surubim – that starts about 10 km north of the highway. It goes on for 50km in extent, and Maria's land is at the northern edge of it. Just past Maria's land, another INCRA settlement starts – called Ademir Frederice. This is a sustainable development settlement (PDS modality) that was set up on paper, but the lands were never distributed.

Figure 7.8: Arriving at Dona Maria's lot, two and a half hours' drive from Medicilândia. Note species in her home garden: Mango, Peach Palm, Avocado, Cupuaçu, Oranges. No electricity or water.

Maria, like many poor colonists, was trying to develop her land for pasture and cattle but was having difficulties. She had not yet secured a bank loan, and an attempt at deforestation of about 20 hectares to form pasture had instead produced a vibrant stand of secondary regrowth, visible in this photograph:

Figure 7.9: Dona Maria's lot. Approximately 20 hectares were burned here to form pasture, but this ‘pasture’ is already up in secondary regeneration with Cecropia. Contrast with the home garden in the previous figure.

Dona Maria’s view had been that establishing pasture as her best economic option going forward. Yet, when applying to the bank for PRONAF *mais alimento*

program, she was told that she would not be approved, because she would be deforesting. Yet just 5km from where her land stands, there is a completely illegal ranch, visible in the next photograph below.

Figure 7.10: Illegal, unauthorized ranch within the PDS government settlement about 5km north of Maria's lot. Non-native green grasses; drastic ecological change.

This ranch, in the photograph above with the cow skull, is an illegal land claim in an INCRA area for social land distribution. From a formal government perspective, this land claim in the PDS is illegal, But because INCRA will do nothing, the rancher, who runs a store in Medicilândia and owns land on km 80 south, has entered government land and set up a 500-hectare (1200 acre) ranch. Notwithstanding its formal illegality, this land has been registered in the national

databased to monitor land use. It thus has a CAR document, but with no land title. This is one type of way that ranchers occupy 'unclaimed' land with aggressive deforestation and cattle. Even though the individual (who I knew) might have to confront the existence of fines attached to his national financial identity number, it didn't matter. Having a registered "environmental" claim on nearly 1000 ha was a way of performing land possession without being granted land title. The rancher expected that the settlement would eventually be dissolved, at which point his land would be formally his own.

Note the differences between the last two pictures. The first is Dona Maria's lot – it has been cleared once, using fire, but the forest is coming back with a vengeance, with the Cecropia trees dominating at this stage of pioneer species succession. This also means that the regrowth will continue vigorously, as Cecropia help in attracting other reseeding birds and bats. In the second picture, we see an ecological shift – the grass now dominates. has been While this latter deforestation is completely unauthorized and illegal; Maria's was legal – she did have the legal right to deforest 20% of her land. The point here is that the 'legal' pathway toward forming pasture and holding cattle has been made nearly impossible for the smallholder peasant family, while the 'illegal' mode of aggressive deforestation functions quite well. Also the smallholder peasant family, in opting for cattle, will almost certainly remain poor.

A few months later, I am sitting on the porch of Dona Maria's humble bungalow back in the town of Medicilândia – her other residence. While the family

spends weeks at a time out on the property, they also keep this residence in town, where their children and grandchildren live. I'm talking with Maria's grandson Gabriel, sitting on the porch. He helps me list the factors that most affect the sustainability of farming. The first, not surprisingly, was water. Then, in order: the distance on a precarious unimproved road (60km). Then, the issue of labor and temporary residence on the land. Fourth, the lack of technical assistance. And so on, like this:

1. Water
2. Distance on unimproved, precarious dirt road
3. Labor – non-permanent residence at site
4. Technical assistance
5. Lack of credit, which is tied to the technical assistance issue
6. No electricity
7. Soil fertility
8. No health services
9. No public transportation

Interestingly, soil was not at the top of the list, but rather water, distance, labor and technical assistance. Water was less of an issue in the area of the municipality nearer the highway; here, the land was traversed by multiple rivers and streams. But there, in the northern part of the municipality, the land was a porous plateau through which water filtered through sandy soils into an aquifer – there was little surface water.

Based on my experience with Maria and Gabriel, I saw how the isolation, the lack of labor and lack of technical assistance or knowledge about alternative land use, drastically limited the viability of any livelihood on Maria's land, as much as she had dreamt about obtaining cattle. Cattle and pasture seemed to be the only way to

develop the land, for Maria and so many others who did not have labor to sustain alternatives. Indeed, just up the road from Dona Maria's, an almost fully deforested area, five times as large was illegally maintained, with a part time resident manager.

Case 3: Getulio

Getulio had served in the Brazilian Navy. AfroBrazilian, from Bahia, he had been stationed in Rio de Janeiro in the 1970s. He practiced tenor saxophone and appreciated that golden musical age. I had roomed with him for a couple of months in late 2016 and early 2017. The music around here on the TransAmazon – horrible! I agreed. It was a wood house with a tin roof, leaky. But it had a place for Getulio to park the truck that he drove for Jorge, mentioned in chapter two. I slept on a cot in a small wood planked room with a mosquito net. We swept up *baratas* (cockroaches). Getulio had come back to Amazonia to see if he could manage his family's old cacao estate. There he was, showing me his CAR documents to the two lots.

He had appealed to Carlos – the second CEPLAC technician – to visit his farm. The estate had not been maintained and now produced so little fruit. Getulio had contracted a sharecropper to live on the property and maintain and harvest the cacao. These were typical agreements in which the sharecropper had a right to half of the spot value of the cacao harvest, whose prices could significantly change during a season. The cacao on Getulio's land had been planted, I assumed, with CEPLAC credit from the early 1980s. Without dedicated management, the orchards had gone to seed. Maybe concentrate on a small area, I suggested? See if you can apply for a

small loan to get that small area back into fruit. And maybe there is some type of ecological or carbon program to which you could appeal for funding – from space, your lot looks like primary forest.

We went out to his lot on a Sunday morning. It's muddy on the highway. It's the twentieth of November, 2016. The terra roxa soil is gobbing up on the truck tires. This part of the road is particularly hilly, and tractor-trailers have slipped in the mud and have gotten stuck on the shoulders of the road. We get to kilometer 110, twenty km west of the town, and turn south. Cross a wooden plank bridge, go about 4km. The land is on the right. There is a wooden house with a cement floored veranda; a *barcaça* cacao sun drying platform, and a small cleared area. We have our machetes and walk behind the house onto the lot, 2 kilometers deep, past some 40-year-old cacao trees near the house, down into a *baixão* or low-lying area crossing a stream, then up on to firm ground after about 400 meters.

There are 40,000 cacao trees on this farm, but they produce very little fruit. The surrounding landscape is very forested here, and the orchards that remained were havens for monkeys feasting on the fruit pulp. It's an orchard one step from returning to anthropogenic forest. There are tall, twenty, thirty-year-old babaçu palms and other trees in the mix. The cacao is seriously affected by the *vassoura de bruxa* (witches' broom) fungus, with stems curling up like a strange form of pasta, and the fruits biologically mummified. There are many wasp nests clinging to the branches. Most of these trees have sent up shoots from the root level or on the lateral stems.

This puts the trees energy into growing upward, increasing biomass, rather than using energy to produce fruit pods.

As we saw in chapter three (Invisible Transamazônia), with its accumulated biomass and photosynthetic chemical composition, from a satellite photograph, this area appears as a primary forest. But what was there to do in terms of a livelihood? He couldn't sell the land because hiring the service to do the financial assessment was prohibitively expensive. He lamented sharecropping, because it wasn't going to change anything on a one-year contract. He didn't have the money to pay for fertilizer or labor to do an aggressive pruning of the trees to get them back into production. Rather than to offer any practical options. Carlos from CEPLAC told Getulio: *o macao te agradece*. **The monkey thanks you!**

Figure 7.11: Cacao tree tilted to embrace another tree in Getulio's semi-abandoned cacao farm

Figure 7.12: Getulio holding a stem with witches' broom disease

It's a long walk over the dry cacao leaves to the back of the lot. And hilly. Yet, we aren't in the sun, so it's a pleasant and humid. This lot had good terra roxa soil. It was 24 km from town, even if on the unimproved dirt highway and side road. But there were too many trees to take care of. The entire lot might generate 4,000 kg of cacao, and thus about 15,000 reais ($5,000 US) would go to Getulio. It kept him interested in what to do about it. While the rest of his family was back in Bahia, working in a growing tech hardware sector, he was out here in the middle of nowhere.

A year later, I'm back in Medicilândia, and look up Getulio. He has moved out of the bungalow to a humble residential hotel by the highway. He doesn't cook, but he has a veteran's pension so he can manage. He is proud of his shiny white VW bug, with chrome rims, parked in blazing sun in the service lane in front of the

roadside businesses. We sit at Moises' middleman shop on the corner, which has a big scale sitting on the concrete to weigh sacks of cacao.

"I'm going to apply for a credit at the bank," Getulio tells me. "Since we can't afford to do the inventory, my mother and I have produced a document consigning 10 hectares or 10,000 trees to me." It took about two months for the document to be produced in Bahia, officiated by a notary, and arrive in Medicilândia. There was also getting the Declaration of being a Family Farmer document, that identifies rural producers in terms of specific credit lines (Pronaf). There was the Cadastro Rural Ambiental (CAR), for which he had paid 400 reais – a geotechnician has to be paid to come out the lot and mark a few points, and produce an extremely basic map, which is uploaded into a national database. There was the declaration of the neighbors, to attest that Getulio was in fact the individual with land tenure. There was the soil analysis, for which he paid 110 reais. In total – about six documents, it has taken Getulio about six months and about 1,000 reais to put it all together.

And Sivuca had written the project, and the project had been presented at the bank. In October. Then, the following year, I get a call from Getulio. He is still waiting it out. While all the documents are in order, the bank manager keeps putting him off. Why? I ask. Did you check with Sivuca? No explanation, he says. *Sacanagem* – a massacre, says Getulio. Getulio's family owns two lots of land – about 500 acres – out here. And yet, the bank doesn't want to budge.

With Getulio, I saw how the administration of carbon payments simply failed to work. It was now early December, and I was going to go out to Getulio's lot again.

We had talked about planting hundreds of açai palms along the road that he was going to build with the loan. He would have a good road to get through the low-lying land and a good bridge across the three streams that pass through that area. His land was blessed with water. The açai could be collected right from the road, a long line of beautiful palms. The tree is named for Euterpe and grapes, as the fronds of fruit look like dark grapes gracefully gathered under the delicate palm fronds. The açai grows well in those low-lying areas, and the soil is fertile. And the cacao itself – would be pruned aggressively, to get the trees going with fruit again. If only the credit would come through, we could start. The municipality ran a nursery at which one could opt for açai seedlings, otherwise, I could get some from Israel and Ideflor in Altamira, who distribute seedlings all over the region.

And we were optimistic about yet another possibility – of getting paid for restorative land use, via a project from the international funders – who had a project in the region for biomass intensive agroforestry, for carbon. I had stopped at the union hall, to see Milton, and was surprised to see a set of laptops and calculators spread out on the table in Milton's office. I was instantly suspicious. Milton wasn't there, he was sick with some intestinal problem, but the room is occupied by a crew of carbon consultants. They use the word "technologies" as a way of referring to planting trees. I ask to see the public announcement about the project. The project is about restoring land to productive status, and/or a greater degree of biomass (trees). The project had interviewed eighty farmers in the municipality. Those farmers approved would be granted a lump sum payment and two technical visits over the course of six months to

establish agroforestry technologies. They ask me if I am French – the French have technical interventions across the region, and the Amazon has been something of a French cultural entity (Levi-Strauss).

Ok, this all seems to apply to Getulio's case. He has a degraded cacao orchard, and this payment could help. I go back to the residential hotel to pick him up, and we head back to the union hall. We're going to speak to the project manager, a nice man named Agnalto, to see what is happening. Getulio's case seems apropos because he has already applied for financing to restore productivity of his cacao stands, to be funded by PRONAF. Yes, the lot fits the requirements, says Agnalto. It has a CAR. There is a formal concession for 10 hectares, owned by Getulio, contained within the lot. "Can you go out and get me some geo-referenced points," asks Agnalto. Yes, absolutely.

So off Getulio and I go in the truck, back out to his lot. We go back out past the low-lying stream area and up the hill into the weedy cacao, and I take a few necessary points with the GPS. I keep stopping and attending to the trees with a machete – cutting vertical shoots that divert water and energy, and stems affected by witches' broom fungus. One could spend months doing this – it needs to be done. We get back to Getulio's house, in which he does not reside, because it is lonely to be all the way out here by oneself. But the sharecropping family, who live in his house, has cooked some lunch – some delicious *galinha caipira* (country hen), white rice, syrupy beans. I drape the meal with oily pepper sauce. Hot food, hot climate. After lunch we rest in hammocks on the cement floored verandah, watch birds flit by, and

motorcycles with parent couples and babies without helmets. We have açai! It has been recently strained, and cold, kept in a refrigerator (electricity reaches Getulio's lot). There is sugar and *puba* – that very coarse manioc flour – to stir in with the dark purple. We muse about starting a *balneário açai* – a bathing house serving açai, there, on the property, where the igarape drifts through the bottomland forest.

We drive back to Medicilândia in the truck, rolling up and down the twenty kilometers of red terra roxa hills. We get back to the union hall, all set to sign and seal this thing. It's perfect. We talk to one of the consultants, but she has not been informed about Getulio's case. And the deadline to enroll in the program is today. And cacao, she says – it doesn't apply. Why not? I ask. Because the area has to be degraded. But it is, I suggest. Looking at the public announcement, it articulates degradation in terms of productivity OR vegetation/biomass. And Getulio's is a degraded cacao orchard. No, no she says – you don't understand. She starts to get defensive – without ever referring to a set of rules. Why can't degraded trees also be included in the project, I ask – cacao trees are agriculture, the program is for degraded agriculture and to enhance carbon in the landscape, to mitigate climate change. What could be better than cacao?

The consultant doesn't have a response, other than, here in Medicilândia there are producers of grass, of corn and rice. Rice? But no one has planted rice in this area for at least fifteen years. Why doesn't this program have a look at the crop that actually sustains this municipality – cacao trees? Or, should we just deforest the Amazon because then we'd be better able to apply the carbon credits? You are telling

me that this program doesn't support locating an agroforestry system in an area that isn't already degraded pasture? But the cacao is degraded in terms of productivity.

Then another carbon program techie from the team gets involved. No, you just aren't understanding, and the logic isn't ours – it's the funder's logic. I get it, I say. I read out from the public announcement: "*Recuperar uma área degradada significa revertê-la de uma condição degradada para uma condição produtiva, independente do estado em que estava originalmente e de sua destinação futura.*" But the first consultant seems intent on introducing obstacles. Getulio doesn't have land title! But yes, he does – it's a formal concession of an area – fully legalized. But the CAR isn't in his name! It doesn't matter, if the land is registered. But where is his indication of income? Here it is. Oh, so if he makes 60,000 then he is actually in the second category and he will need 2 hectares of forest reserve in order to implement the system. But he already has 40 ha of reserve on the lot, I say. Why can't you just include the 2 ha within the 10 ha concession? But the document says 10,000 trees, not 10 hectares, she says. And on and on….

To think, we went out to the lot, spent the day getting a new legitimate candidate into the system. The program has interviewed perhaps 80 farmers, but only 10 have been able to enter the program. All the rest were deemed ineligible due to fines – unknown to the farmers – attached to their national identity number. The satellite monitoring program set up through the CAR had spotted fires on their farms – small areas burned – often one or two acres. And the majority of the farmers in the municipality were now out of compliance, and therefore couldn't subscribe to a

program designed to recuperate vegetation. Without any communication from the state.

But Getulio's CAR is clean – no fires. Getulio is perplexed about how all of this is supposed to work. In the morning, I'm back at the union hall. The program manager, who wasn't around during yesterday's frustrating discussion, agrees – yes, Getulio qualifies for the program, he is eligible according to the definitions. We'll try to get him in. Questioning how the national system for environmental governance works, I pull up on my laptop a CAR map from a smallholder on a tiny plot – his CAR indicates his land is completely deforested. To the contrary, I say, I've been there, and it is covered with trees – it's one of the most species diverse chácaras I've seen. But these are farmed trees, so it isn't native forest, according to the geo-techinicans who produced the document. It has to be "natural" regeneration for it to approach a native forest? Agnalto agrees – it is a problem. And I relate this to Rogério later that week –the environmental state valued abandoned regrowth more so than productive trees.

And so, with recent environmental laws, tree farmers can't legally manage fallow forest, because after 5 years of satellite monitored regrowth it becomes extremely costly and time consuming to get the proper documents to reuse secondary regrowth areas. For the environmental state, secondary forests are in a state of ecological succession to valuable primary forests, and should be left untouched after they have reached a certain age. So much for swidden agriculture, which as an indigenous mode of land use has maintained and enriched the agrobiodiversity of

Amazon forests. Even though each of the INCRA lots (100 hectares or 247 acres) could easily be managed as swidden migratory farms, with more than enough room to farm through the forest instead of deforesting it permanently. But there it was – the environmental state – creating carbon and biodiversity property as areas fixed on a map. And the cynicism of state power in relation to humble producers. It was the big ranchers who would be profiting off of environmental governance, not the little people, not the cacao producers. I had seen it – the CAR, paradoxically, was being used to develop lands inside unsettled INCRA territory in the northern extreme of the municipality. I was enmeshed in a state and scientific clusterfuck. But at least the monkeys were grateful.

Bugue has just called – a sharecropper with whom I am staying on Rogério's lot. They are installing a pump to take water up to the center of the lot. Water is getting short; the dry season lasts much longer than twenty years ago. The cacao is suffering, close to dying. I tell him I will get there tonight. I still have to get to Adalto's lot north on km 95 – a farmer who has grown cacao on terra mista without any assistance from the state. I pick up a tin of sardines at the store and get on the road.

Chapter six conclusion

In this chapter, I have attempted to concretely interweave how labor, ecology and development schemes interact and interrupt each other in the landscape. I did this by describing and comparing three farm cases, and the story of the last remaining federal level bureaucrat in Medicilândia (Carlos, the other remaining CEPLAC

technician, no longer came in to work). I explored these farmers' development dreams, and how their experiences with bureaucracies and commodity markets influenced their land use decisions. I have attempted to show that while state programs and markets influence land use decisions, when small-scale cultivators attempt to come to the table, they often opt for systems that are unsustainable, or encounter a slew of bureaucratic obstacles. Rather than empowering small-scale productive horticulture, the subversion of state power undergirds illegal land speculation and the expansion of cattle ranching in a backhanded manner. As such, while Campbell (2015) has documented how land speculation functions, and functions well; here I have attempted to document the dysfunctional relations between different institutions, land use and livelihoods.

The first case explored – Sivuca's – showed the decadence of a state extension agency that, while certainly having a role in shaping the cacao landscape on terra roxa soils, did not allow cacao farming to consolidate outside of a limited *terroir*. This, notwithstanding that soil fertility does not limit cacao's cultivation in medium fertility areas. Thus, while the municipality of Medicilândia today produces more cacao than any other in Brazil, bureaucratic rules stall many possibilities involving alternative land use and cooperatively organized value chains. For example, strict rules about taxes and public budgets have in effect prevented cacao's wonderful fruit pulp from entering a nationally funded school lunch program. For individual farmers, a too complex practice of drawing up elaborate fiscal receipts, have made it impossible for the municipal government to purchase cacao fruit pulp – which is more valuable than

dried seeds. In institutional dysfunction like the former, cooperatives and collective enterprises in this region have a very weak presence, in part because of the bitter history of collectively organized farmer interactions with the state and including how the state organized farmers into the sugarcane production network.

Evandro's case showed how land holdings shifted through time, how later arriving colonists might enter as sharecroppers, become smallholder horticulturalists, and end up as medium size ranchers. Evandro's case also showed how working with the land brought ecological knowledge, but how commodity markets and credit can cause shifts to economically and politically less risky land use – inevitably pasture and cattle in this region.

Maria's case showed how holding large areas of land could confuse the politics of property with the sustainability of management. Her case shows how development dreams easily break down even when turning to cattle ranching. Dona Maria's home garden was full of poultry, food and fruit, fed by rain. But in attempting to develop capital, however, she made an attempt to establish pasture involving bank financing. The land use result however was not pasture or cattle. Rather, it was a significant stand of pioneer Cecropia regrowth in a once burned 20-hectare area located near her house and home garden. Her case also shows us the effect of bureaucratic discrimination against peasants. And her grandson gave us an outline to better appreciate the experience of ecological and cultural limiting factors in attending to land.

Getulio's case showed us the unsustainability of bureaucratically formed large scale cacao outside of the sugarcane zone, dating from the 1980s. I showed his contemporary, attempt to reenlist bureaucratic finance was unsuccessful. Finally, his case indicated environmental discrimination, and scientific bureaucratic approaches to enhancing carbon and biodiversity by 'freezing' natural ecological succession in place on a map. While environmental / carbon governance programs have started to enter these landscapes, those rules systems have further alienated the 'environmental state' from an ostensible aim of sustainability. While Getulio's land resembled a forest, it would be blocked from receiving a credit for carbon sequestration. While this carbon program interviewed 80 farmers in Medicilândia, only 10 could enter the program due to fines – which were unknown to the farmers – attached to them through state satellite monitoring of small fires set on their holdings.

Below I repeat the map that I used in the introduction to this chapter. This map represents a randomly selected distribution of 100 'true' smallholdings under 25 hectares – the black dots in the map – across the entire municipal landscape. Also, one can see the cacao consolidated area, represented in purple, which signifies both secondary regrowth and tree cropping/agroforestry. Note the clear border between the colonist and indigenous Arara landscape to the south of the highway, and also how Arara indigenous territory is adjacent to the highway itself between km 120 and 140 at the western edge. The three farm cases – all roughly 100-hectare holdings in this chapter– are roughly sketched on the map. I provide this map because the initial

research methodology was to focus on the original state distributed size of land tenure, or 100 hectares. However, with the national CAR database, it is possible to locate smaller land holdings. This is to change the unit of observation from the large INCRA distributed lot of 100 hectares, to a 'true' smallholding *chácara*.

There are several observations to be made here. First, one can see a concentration of 'true' smallholdings under 25 hectares – the black dots in the map – roughly commensurate with the distribution of cacao. Second, one can see the emergence of new smallholdings outside of the CEPLAC/terra roxa 'terroir,' especially on km 95 north. Third, one can see that these areas with black dots have good distribution of rivers and streams thus good if not excellent availability of water. Fourth, there is easier access to the town – most of these new smallholdings are within 30 to 45 minutes' travel time, and at most 2 hours during the rainy season, assuming that roads are still passable by motorcycle. Fifth, it means that tree cropping is occurring in these new areas with minimal state involvement. The farmers perhaps obtain some hybrid seeds from CEPLAC, but there is no technical assistance for soil management, and no credit.

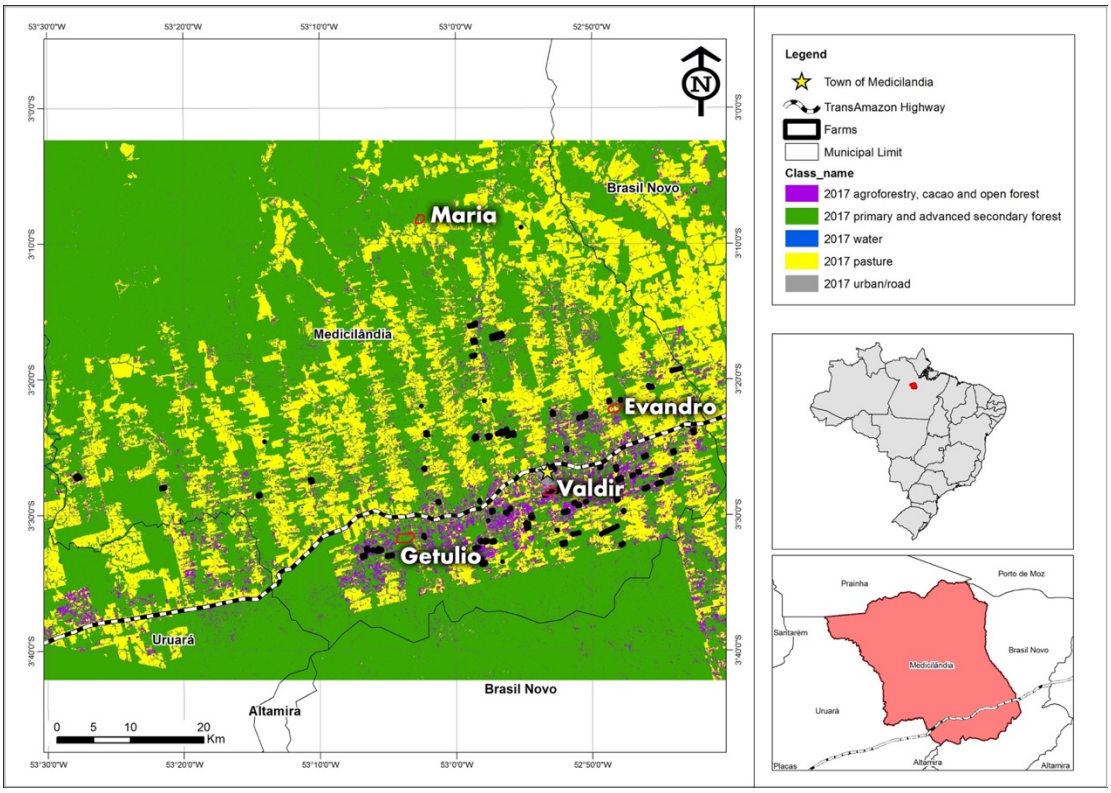

Figure 7.13: Land cover map of Medicilândia with small (<20ha) farms indicated by black dots and location of farm cases in white text, with tiny red ovals indicating the location of 100ha lots. Also note clear border with Arara indigenous territory on the southern end of the municipality, and this indigenous territory's location coming right up to the edge of the highway between km 120 and 140.

Lastly, these small farms are also located on medium fertility soils. This final observation is perhaps the most relevant for a revamped socio-ecology of this region. The map suggests that farmer adaptations have transcended the historically and bureaucratically determined 'terroir'. Cacao consolidated near the town as a reorganization of the socio-ecological system after sugarcane system collapse. But seeing cacao outside of this zone also means that land use and governance research for this region is in urgent need of revision.

If human mobility, water access, and seed distribution are viable, smallholders are able to cultivate trees successfully on medium fertility soils. Interestingly, that human mobility involving informal urban markets has helped sustain tree and forest cover has been documented by Padoch and Brondizio (2008) and Vogt et al. (2015) for the Amazon estuary's forest farming of açai. But on the other hand, while the municipality of Medicilândia today produces more cacao than any other in Brazil, bureaucratic rules thwart many possibilities involving alternative land use and cooperatively organized value chains. For example, strict rules about taxes and public budgets have in effect prevented cacao's wonderful fruit pulp from entering a nationally funded school lunch program. For individual farmers, a too complex practice of drawing up elaborate fiscal receipts, have made it impossible for the municipal government to purchase cacao fruit pulp – which is more valuable than dried seeds. In institutional dysfunction like the former, cooperatives and collective enterprises have a very weak presence in the region, in part because of the bitter

history of collectively organized farmer interactions with the state and including how the state organized farmers into the sugarcane production network.

The next chapter will explore in detail the emergence of the ‘true’ smallholder type of farmer, and relevance for a revamped socio-ecology of land systems in this region involving medium or degraded fertility soils.

8. Chapter seven – Terra Mista (Mixed Earth)

Sustainable smallholder farms emerge out of the ongoing chaos and poverty of a post-frontier.

It is nearing the end of the rainy season in Altamira in May of 2019. The sky to the west above the city outskirts is swimming with dark mottled clouds. Hot, late afternoon sunlight streams down onto the developed and yet ruined city. I look out on steep and rutted dirt lanes, a cheaply built Evangelical church, bricks and an assortment of construction projects careening down into a low-lying swampy area. This house that I am housesitting, encased within a cement wall, is a product of the rush to build properties during the corrupt national mobilization around the Belo Monte Dam. Skirting the concrete wall and a rough platform outside the wall's metal gate, there is a thicket of tropical Black Eyed Susans, hardy wild grasses. There is a four-inch long green and red grasshopper perched on one stem. An embauba (crecropia) tree is coming up through a crack in the cement patio. The soil upon which Altamira sits is highly fertile, *terra roxa*, described in this dissertation's first chapter on cacao livelihood attitudes and outlooks. Before the Belo Monte Dam, Altamira had once contained numerous commercial urban produce gardens. Yet all of these have disappeared. Today, I dread vegetables and beans for being laced with agrotoxins, trucked here over thousands of kilometers from Bahia or São Paulo.

So it is, at the end of my field work, staying in Altamira I oddly feel far away from soil *practices*. Yet soil has accumulated in the concrete patio. It spills along the jagged and broken asphalt on the steep street, outside the metal gate that encloses this house as if it were a bunker. The military dictatorship in Brazil had used the 1970s Transamazon highway project strategically, to defuse popular unrest and create a national framework for Amazonian settlement and development. While similar to land reform projects internationally at that time in terms of anti-communist strategy, the Transamazon was unusual in terms of scale. In this context, Emilio Moran, a U.S. trained anthropologist, had lived in a government settled village at km 23 on the Transamazon to conduct fieldwork for his dissertation, once, in 1973. Others, like geographer Nigel Smith and ecologist Phillip Fearnside, also came here to analyze variation in the agroecological consistency of land use and crops, with a decidedly apolitical framing of the situation. But with expanded scientific and public interest about the Brazilian Amazon and deforestation in the 1970s and 1980s, soil fertility began to inform a Malthusian narrative about population and poverty driven frontier expansion. This was countered decisively by Susanna Hecht's political ecological work in the 1980s, which outlined the peculiar institutional and financial character of regional speculation on land, juxtaposed with empirical documentation of soil fertility (Hecht 1985).

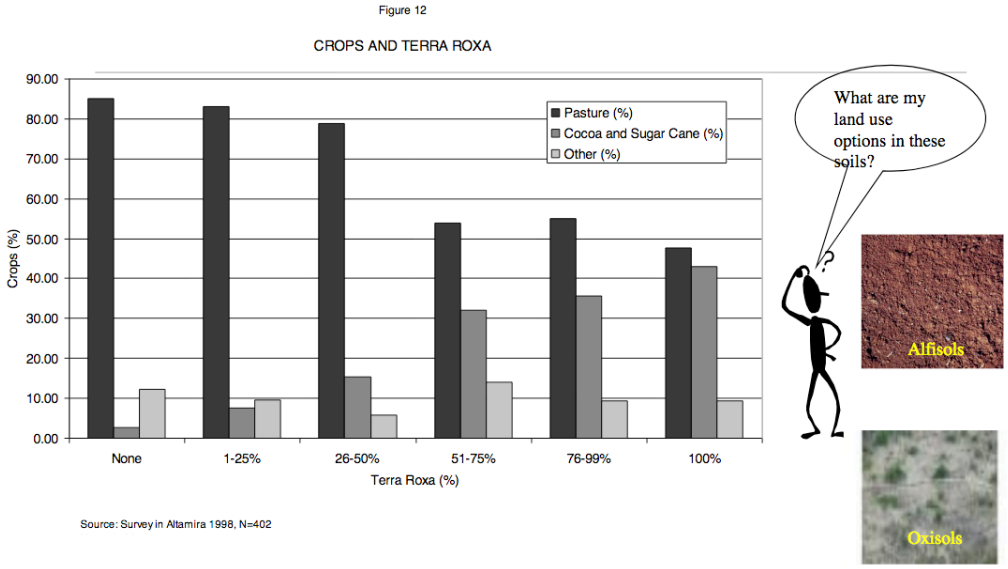

Figure 8.1: Slide from a power point presentation given at USP in São Paulo, Brazil in 2017. Emilio Moran's research findings posit that land use is in an organic, adaptive relationship with soil environmental conditions.

For Moran, however, the cultural ecological argument never turned to politics. Thus, if a 100-hectare lot on the Transamazon had more high fertility terra roxa (nitossolo vermelho) soil, his data produced the following correlation: with more terra roxa, there was a higher % of land on the lot being used for cacao and sugarcane. Such observations led Emilio Moran's research group to emphasize the relationship of soil fertility with the landscape pattern of development well up into the twenty first century. Moran wasn't the only one who was convinced. State extension officials and community members, upon casual reflection, often referred to the landscape in terms of soil. Terra roxa was where cacao grew and was most bankable. Yet, immediately outside Altamira, I saw that the soil was also terra roxa. And here, the land is organized in large ranches of 500, 1000ha or larger.

Strikingly red, with brownish purple tones, terra roxa soil was *nitossolo vermelho* classified by Brazilian soil scientists for its peculiar mineral properties being based on basalt parent material, I describe this soil in chapter one of this dissertation. But *terra roxa* was also a folk category. Like *terra mista* (mixed fertility soil), and *terra preta* (black fertile soil, anthropogenic). Most edaphic (soil) types that are *terra mista* are Argissolos (or podzols) in the Brazilian scientific terminology, or Ultisols in the American. Terra mista soils are particularly 'weathered', much more so than terra roxa but not extremely so. Terra mista is thus more acidic because of age and the humid/rainy climate that drains base cations out from soils over time. But acidic soils can be managed, for example, because acidic aluminum and iron fused clays do not bind to organic matter, but only to unattached nutrient molecules. I saw in my fieldwork that people called a soil 'mista' mainly by considering color and clay, sandiness and rockiness. Usually mista soil was an orangish color. Meaning the presence of iron oxides. Too yellow, or too sandy, meant *fraco* (weak) soil – which could usually be characterized as a Latosol (or Oxisol in the U.S. terminology) with less iron, and with an extremely weathered, highly acidic soil profile with nutrient-freezing aluminum.

In my fieldwork I became interested in the structural conditions and experience of former sharecroppers or other landless farmers that took up holdings on terra mista soil. This often meant difficult movement on rocky and boggy semi-improved roads. These migrant colonists arrived on the Transamazon in later waves of migrations from the late 1970s onward. I was interested in what allowed these

emerging ‘true’ smallholders – opting for smaller holdings without government assistance – to be successful, in spite of being on ‘terra mista’, and without any significant interaction with the state except in terms of access to hybrid cacao seeds or to açai palm seedlings. In contrast to financing for pasture – on mixed soils cultivation of crops had never been pro-actively supported by state policy or credit. And only for the past 15 years or so has CEPLAC – Brazil’s Executive Commission for the Planning of Cacao Agriculture – a nearly extinct agency in terms of technical assistance/credit provision – has allowed hybrid seeds to go to farmers on mixed soils. CEPLAC had no maps of what was happening in the region, only excel spreadsheets with brute numbers of registered cacao producers and aggregate production per municipality.

Yet more experienced farmers, and even CEPLAC officials, knew that cacao on mixed soils did well. So, what if we were to look at what occurs below frontier development fantasies or scientific models, on the ground in out of the way places? I thus use *terra mista* or mixed earth as a way to focus on the structure, experience and diversity of human ecologies that are unnoticed and inconsequential under state, scientific or mainstream development scrutiny. These out of the way landscapes however are vital signposts of alternative socio-ecologial land systems, and of the experiences and understandings of smallholders and peasants on a ruined post frontier on the TransAmazon highway. My questions were, how did the organization of labor and livelihood allow for the sustainable cultivation and management of cacao and other trees on less fertile soil? What were the motivations for doing what was often

thought impractical or impossible? How was soil, livelihood, labor, tree cover and ethno-biodiversity interrelated? And how did the state and markets affect these conditions?

Theoretical orientation

Here I briefly repeat my theoretical orientation. I am drawing on four principal areas: political ecology, human ecology of agriculture and tropical livelihoods, the phenomenology of landscapes, and 'non-scalability' as a theory and method. Combining these theoretical frameworks, I am interested in refocusing models of understanding, with sensitivity to methods of observations and to diversity.

In terms of political ecology, I am taking cues from Fairhead and Leach (1996) and Hecht et al. (2014), among others. Approaching the material, biological landscape as a historical record, interestingly, became a method to interrogate authoritative knowledge, with Fairhead and Leach's classic work (1996) on false forest history and the narratives of environmental decline in West Africa. Fairhead and Leach's approach was to analyze the history of vegetation, viewed through older aerial photos, maps and in the context of interviews with residents. They observed how socio-economic change translated into landscape enrichment. Using the vegetation and the landscape themselves as key interlocutors, they thus allowed for closer examination of conservation and development narratives. In a similar critical vein, market dynamics, institutional analysis and historical ecology forms the research programmatic foundations for "The Social Lives of Forests: Past, Present and Future of Woodland Resurgence" (2014) edited by Hecht, Morrison and Padoch.

The editors of this volume articulated a broad research program that would seek to dispel popular conceptions of the nature culture divide, by indicating real practices and knowledges in the world attesting to "the creation of a society of nature" (Hecht et al. 2014: 1). This involves the re-consideration of institutions and policies as models for state-locality relations, land tenure and territorial arrangements.

Secondly, in terms of human ecology, Robert Netting's (e.g. Netting 1993) longstanding attention to the structure of land use and land tenure at the household level is empirically and comparatively useful as a methodological guide to structural problems affecting agriculture. Netting was able to demonstrate relationships between farming systems, households and labor, energy, productivity, population density and markets – across farming systems worldwide. While a cultural ecologist, Netting was clear that smallholding and sustainable intensified agriculture were not environmentally determined (Netting 1993: 275). To Netting's structural approach I also bring in approaches to tropical forest livelihoods, taking empirical and comparative inspiration from applied Amazonian literatures in economic botany (e.g. Padoch and Denevan 1987) and human ecology (e.g. Hecht and Posey, Steward 2013) that catalog and compare indigenous and riverine community soil and plant use and forest livelihoods. With the exception of Smith et al. 1996 there are very few contributions on the cultivation decisions of upland interior (*terra firme*) Amazon colonists.

Thirdly, I am also trying to explore ecological experiences and learning processes and as they happen on site. Here, the phenomenological work of Tim

Ingold is useful (2000, 2011), not because he shows us how to approach the political or the longue durée, but because he attends to how human cognition works in process, in relation to the environment. This is useful in situations in which narratives and models do not form the *essence* of the land use relationships under consideration.

Fourthly, I will engage the method of non-scalability (Tsing 2012, 2015) – i.e. historical contingency – in walking and participatory observation, to weave through multiple relations and processes in the landscape. A longstanding challenge for socio- and political ecological research involves weaving environmental concerns together with multi-scale problems of the global environment, politics, the state, capitalism and human migration (e.g. Tsing 2000, 2005, 2012, 2015; Hecht 2015). These are often longue durée historical and geographical issues.

Narrating Mapping, Methods and Findings

In this chapter I explore how lower mixed fertility soil is worked and experienced on different kinds of land holdings, with different spatial and temporal characteristics. I combine remote sensing, surveys, walking and mapping, and drawing – to look at how soils, livelihoods, labor and land use interrelated in practice. To gauge these changes as processes and patterns over varied geographies I used remote sensing analysis to interpret and measure land cover changes, combined with ground truthing. Thus, I juxtapose remote sensing images, photographs of the landscapes being described, hand drawn maps and drawings of land holdings and landscape characteristics. These observations were further substantiated by applying

surveys that captured historical changes in residence, labor, production and land use, and preferences for planted and valued tree and other species.

So, I had to figure out a way to develop controlled comparison, with limited ability to move across such a challenging geography, which would account for what was going on accurately and empirically. I went to an online copy of "Mr. Methods" – Russel Bernard's – 9th edition on research design in anthropology. I had also determined to enroll in classes in remote sensing at Earth and Marine Sciences at UCSC and in soil science at UC Berkeley. Let's look at land use maps generated during this process. Two maps below show my classification of land cover done at UCSC in 2015, combined with my initial survey of colonist lots in 2016 and 2017. The first map is for the year 1992; the second is for the year 2014. The areas in red represent recently burned or bare soil areas. One can see a concentration of larger red areas in the 1992 map. These are areas upwards of 40 to well over 100 hectares and are concentrated around the PACAL sugarcane refinery. This satellite image is from the month of July, when cloud cover allows for a rare clear view of Amazon land cover, and which is also a month in which sugarcane is burned for harvest.

With these colors (light green for agroforestry/secondary) our impression of a land use transition is not particularly dramatic. Yet scrutinizing the maps one can see a definite shift in the landscape from sugarcane to post-sugarcane. One way to read this transition is in the size and distribution of the red, burned areas. In the 1992 map, one can see these burned areas for sugarcane and for deforestation – either

concentrated in the sugarcane zone or on a few of the travessões to deforest, for example on km 80 north.

In the 2014 map, burning patterns change, now representing the two dominant land use processes: pasture/cattle and cacao. 40-80ha patches of burning are concentrated next to the Arara indigenous reserve, to the north of the BR-230 (transamazon) highway, and the areas are increasingly larger toward the eastern edge of the map. These are areas in which cattle ranching is expanding. In contrast, much smaller patches of burning/opening follow the extent of the cacao production area. The smaller patches largely correspond with the cacao land use area. Of the colonist lots surveyed – i.e. the black rectangles – located close to the sugarcane refinery, the majority are with significantly more tree/forest cover in 2014 than in 1992.

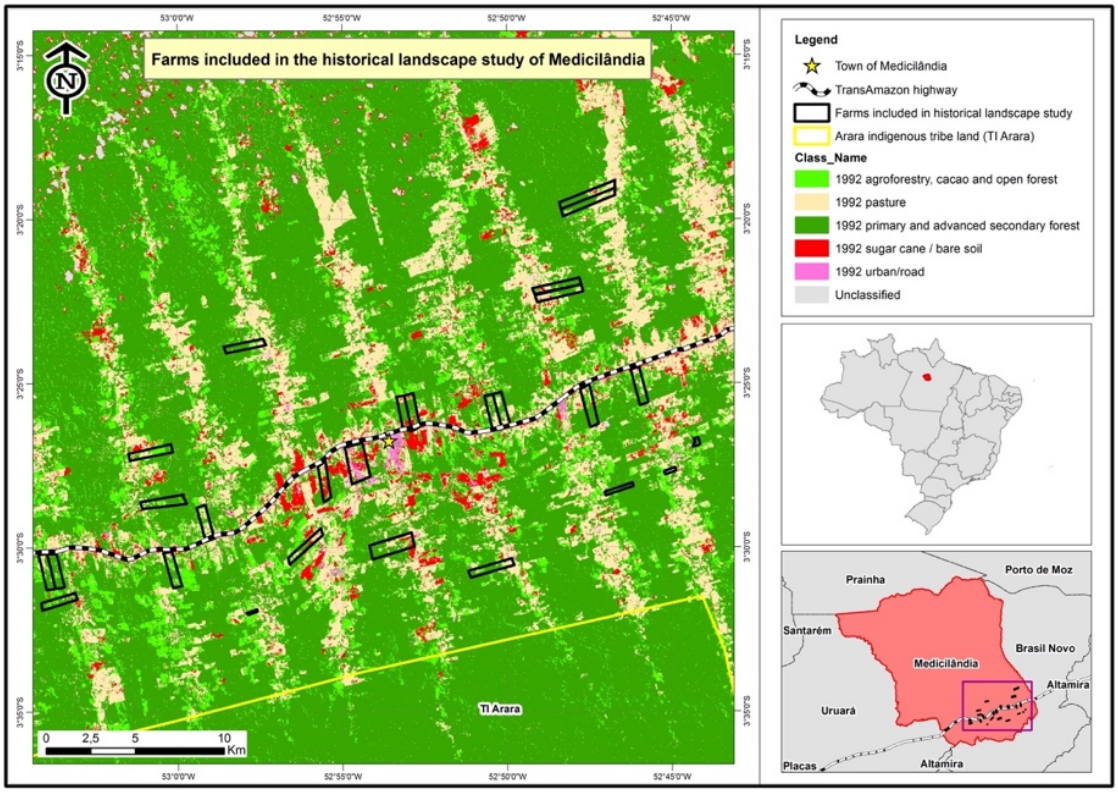

Figure 8.2: Medicilândia land cover in 1992. Georeferenced property markers of the original sample of colonist lots studied in 2016 and 2017. Land cover classification in ENVI by the author; map composed by Felipe Martenexem.

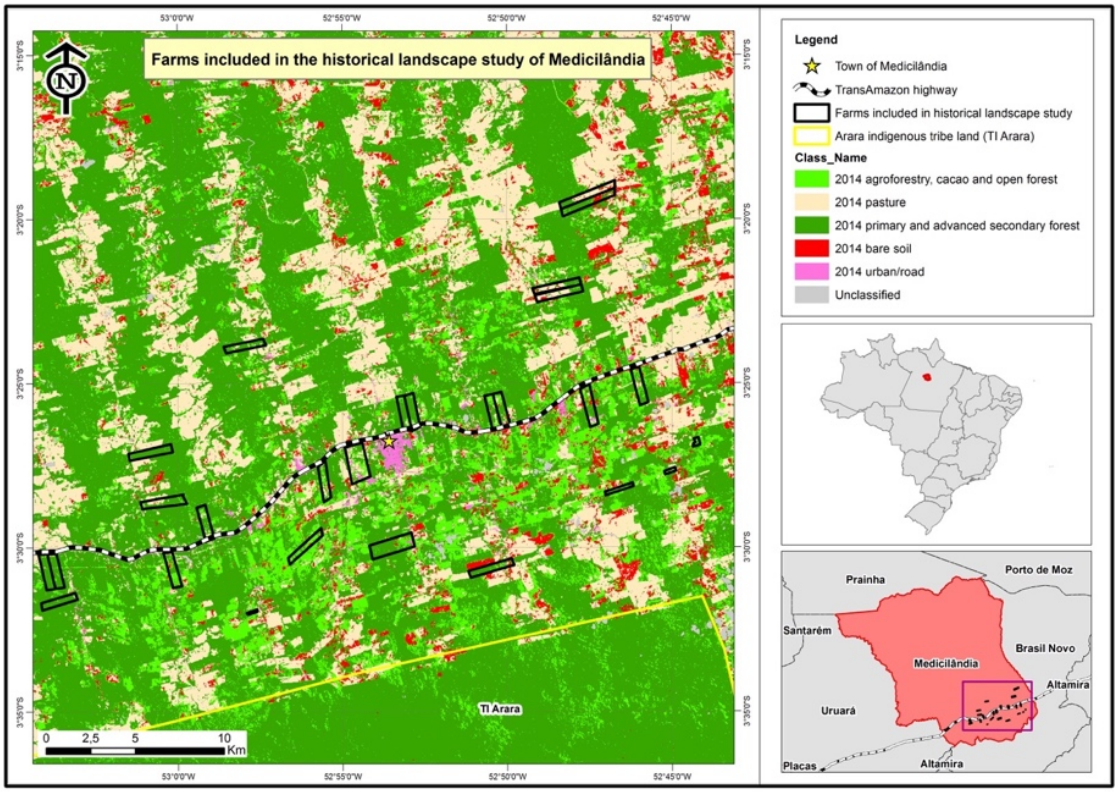

Figure 8.3: Medicilândia land cover in 2014. Georeferenced property markers of the original sample of colonist lots studied in 2016 and 2017. Land cover classification by the author; credit to Felipe Martenexem for the map.

In the 2014 map (figure 2), there is a significant increase in agroforestry/tree crops (or secondary forest?) as a percentage of land cover on the overall landscape, represented by the light green color. I was able to quantify some of the dynamics. When considering a landscape centered on the Transamazon highway itself, for the period 1992 to 2014, agroforestry and secondary forest land use increased by 54%, pasture decreased by 7%, and the net tree cover loss was -0.7% (Davenport 2015). There is a slight overall loss of tree cover, but this is when one is also considering the expansion of cattle ranching in terra mista areas in which cacao has not consolidated.

Land use to the east, also in terra roxa, displays increase of tree cover, especially along highway. In contrast, shifting the focus to the north 20km off the highway center, at the same geographical extent, there is an 85% increase in land area devoted to pasture and a -15.1% net forest loss for the same 1992 to 2014 period. Thus, outside of the sugarcane and cacao areas, there is an increase in deforestation/pasture.

Was this bifurcation a function of adaptation to soil fertility, as Moran's group had suggested? Again, here I was asking how soil fertility, the type of land holding, and distance (or travel times) influenced livelihood and outlooks on land use and nature. But I would have to dig deeper than these remote sensing studies and my original sample of 20 lots to look at relations over time. By the time I started my fieldwork, the *Cadastro Ambiental Rural* (CAR) or rural land use registry, had been rolled out as an instrument for land use governance in the Brazilian Amazon. This had been accomplished in cooperation with Brazilian states (e.g. Pará, Mato Grosso) and by local municipalities at different levels of effort and sophistication. The CAR's actual impact on land use given political and cultural expectations are complex, and even more so in the current political climate. Yet, most privately held land in the region has opted for registering in the system to avoid government fines, or, alternatively and perversely, to consolidate speculative land claims. The system works in odd ways. Yet, comparing the outcomes of policy instrument perceptions was not what I was trying to, so much as to see what was under or left unexamined by the modeling or governing framework.

I was interested in surprising relations, processes and change in interactions *across* scales and diversity, or across different ways of seeing, experiencing and knowing. I was especially interested in processes that went unrepresented. For example, I saw that in the CAR system many agroforestry holdings – completely in tree cover – were represented as deforested. The method for creating CAR documents in Medicilândia was lax. One paid an overworked, barely equipped technician to arrive somehow at the holding and mark perhaps 2 GPS points along the road. Then that technician, for whom this would be the one site visit, would estimate a square in GIS, and the land holding would be represented in terms of a binary: deforested areas versus primary forest remaining. The CAR system was designed to monitor forest cover but has been much less tractable in terms of encouraging reforestation, ostensibly what the system was designed to support.

But there it was, one had much of the land grossly represented in terms of management units, even if they lacked land tenure documents or were themselves land grabs. However, as an entirely public database (CAR), accessible on the internet, this database could be used in a different way: I could surmise that the system gave coordinates for all different sorts of land holdings, legal and illegal, formerly titled, land grab, and small scale squatting – allowing for a rich sample design.

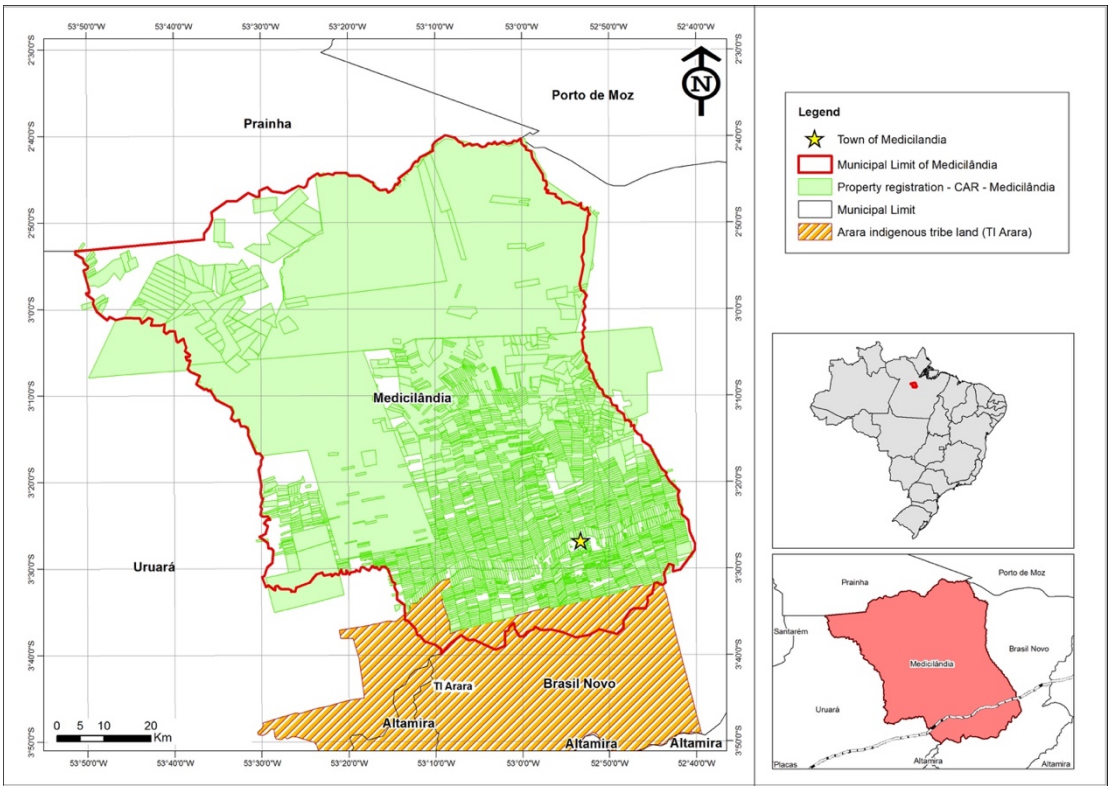

Figure 8.4: CAR registered land holdings in 2019. Credit to Felipe Martenexen for the map.

I had surmised that smaller land holdings brought with them different expectations about land use. If soil type wasn't determinative of land use change, could one find a different pattern to evince distinct relations? Upon returning to Santa Cruz in early 2017 and in early 2018 I found that it was impossible to find a sustainable living situation, or any relevant conversation about these questions or the methodological and practical challenges of carrying out a project in the field. Offering extensive labor on an unrelated project in order to access ENVI software, was the best offer I could find. It had been two years since I had first done the remote sensing analysis at Earth and Marine Sciences, and my instructor Eli Silver had

retired. And social studies of reforestation did not yet have that rather provincial American appeal of being ‘science’.

So, in attempting to combine lab and field methods, theory and practice, I went back to Brazil. I would live off rent from a collectively owned but ruined, small stone house in rural Virginia, which I had repaired over several months involving my own labor for simple carpentry and painting, a rather large loan to work with a contractor for more technical repairs, and significant help from my Mother. Back in the field however I had no infrastructure outside of a borrowed table and a spotty internet connection at the federal university in Altamira. I had to seek help – on making maps and applying the remote sensing approaches I had previously developed at UCSC. I had made friends with Felipe at IPAM (Amazon Environmental Research Institute), before this NGO lost its grip on running projects in the region and shuttered its office. Its principal coordinator, always good on the political and administrative, but not on the local and regenerative, moved to her new job at the same NGO, in far off Brasilia. Felipe had been let go, and I went to Felipe’s house in Altamira to make maps. I was able to find a more accurate local soil ‘shapefile’. A shapefile is simply a digital representation of areas with georeferenced information. Soil maps for the Brazilian Amazon were originally based on an ambitious radar remote sensing project in the 1960s, matched with field surveys along the highway. The issue with RADAM soil maps was that they did not represent soil variation at smaller scales; however, the shapefile I had obtained was reputed – at least at the Federal University in Altamira – to be more accurate.

With this shapefile I asked Felipe to download CAR data for several municipalities, and to overlay the land registry with this soil map. This would show us a rough picture of how land holding sizes correlated with soil types. This allowed for a clear identification of where the terra roxa lot size cacao holdings were being split up into 'true' smallholdings, or maintained as lots, with sharecropping labor. The map below was first presented in chapter 4, to show the presence of this true smallholding type in the landscape. Mapping with Felipe, we could see that most smallholdings under 25 hectares were indeed located on terra roxa, as one can see in the map. But what was interesting was their being located *also* on terra mista and in local agglomerations (see map figure 8.5 below). For example, I could see a distribution going up the travessão (side road) km 95 north. Who were these green dots and what were they doing on these smallholdings?

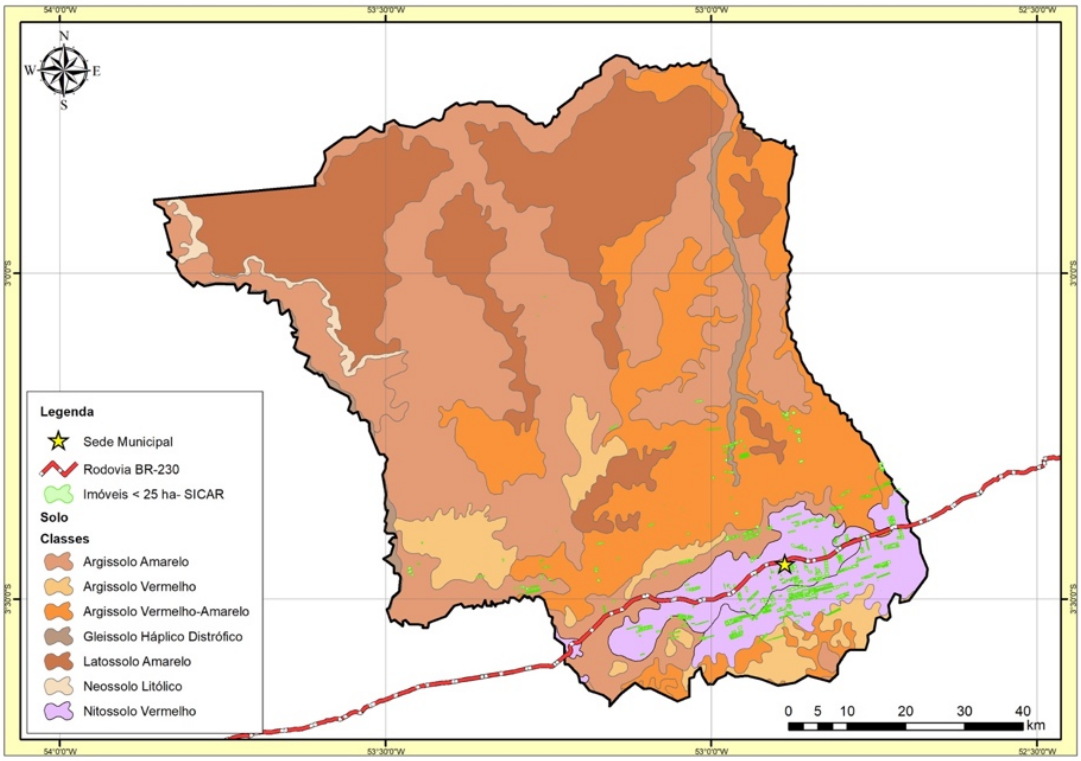

Figure 8.5: Soil map of Medicilândia with the green dots representing smallholdings <25 hectares. The purple color represents terra roxa (Nitossolo Vermelho). The three Argissolo types and the Gelissolo roughly speaking are 'terras mistas'. At smaller scales, soil variation and heterogeneity increases. Credit to Felipe Martenexen for the map.

The next step would be to build a (stratified?) sample that would include smallholdings as well as originally sized colonist lots. I built the survey sample drawing directly from the CAR database because the latter covers land holdings of all sizes for the overwhelming majority of the land in the southern half of the municipality. The aim was to 'stratify' the sample to account for true smallholders <25 ha as well as the original colonist lots. This is to ensure that the key subpopulation of the true smallholder would be included in a study on income, land use aspirations and species choices, and to analyze how these varied in relation with

(if not a function of) the size of the holding. While there were less registered smallholdings relative to lots in Medicilândia, their presence was growing, and looking at maps for other Amazonian municipalities (e.g. Altamira, Apui, Tucumã) Indeed, the geographical concentration of true smallholdings relative to the cacao economy was striking.

The advantage of having the CAR database was that, for the first time, one had a way of visualizing both kinds of management units – both <25ha and >25ha. Most in the latter category tended to be closer to 100 ha, because of the history of land distribution. The other part of this was that here we could perform a 'natural experiment' on how 3 key independent variables – soil, holding size, time to access/distance – combined to correlate or not with dependent variables like income, labor arrangements, land use aspirations, and species preferences.

To make the stratified sample, I took a random selection of 50 smallholdings from the CAR, from an overall total of about 250. Parallel to this, I took a random selection of 50 'medium' size holdings from the CAR for the more common colonist lot size – roughly 100 hectares, out of a total of about 2,000. In this sampling strategy, therefore, I was making a deliberate effort to capture how variables interrelated with true smallholdings.

The research design is thus characterized as 'factorial' to test for the effects and interrelationships of three independent variables, while stratifying the sample to maximize variation amongst them. Again, the three independent variables to be tested were: a) holding size (lot vs. chácara); b) soil type (terra roxa – terra mista); and c)

time from town (30 minutes or less vs. more than 30 minutes, in the dry season). The dependent variables would be, among others, net incomes, labor arrangements, area in tree cultivation, species choices, and how much forest would they hypothetically expect to cut down on a 100-hectare patch.

The research design is characterized as 'factorial' to test for the effects and interrelationships of these three independent variables, with each farm case fitting into one of eight independent variable conditions, based on the 2 x 2 x 2 possible combinations of the three independent variables:

1. terra roxa smallholdings (<25ha), 30 minutes or less to reach the farm (near)
2. terra roxa smallholdings, more than 30 minutes to reach the farm (far)
3. terra roxa lots (>25ha), 30 minutes or less (near)
4. terra roxa lots, more than 30 minutes (far)
5. terra roxa smallholdings, 30 minutes or less (near)
6. terra mista smallholdings, more than 30 minutes (far)
7. terra mista lots, 30 minutes or less (near)
8. terra mista lots, more than 30 minutes (far)

Structuring the sample this way maximizes variation in the sample while controlling for the independent variables' influences. I remind the reader that the goal was also to critically test Moran's research hypothesis i.e. that land use development is an adaptive process to soil conditions. Moran's group have long posited a correlation of sugarcane and cacao with terra roxa soils – see the figure below. But by controlling for soil, size and travel time, my research design, in contrast, allowed for gauging how terra mista or mixed earth livelihoods were actually composed across the landscape, at a different scale of observation. Moran's mechanical illustration of land decisions based on soil type uses the U.S. soil terminology, which is not particularly apt for tropical soils. Moran indicates Alfisols

for terra roxa, and Oxisols for terra mista. And yet, Oxisols, considered to be unfertile in the North American soils literature, are more complex. They have good physicl properties and can often be managed. That is – they are *terra mista*.

In contrast to Moran's mechanical adaptation, I was thereby controlling for how three variables (soil, size, distance) correlated with the land use and makeup of the farm. And also, I was accounting for institutional context, such as the fact that sugarcane had been mandated by the government and then had been abandoned by the government. Or the fact that CEPLAC had had an ambitious credit program to develop cacao on the Transamazon in the 1970s and 1980s, and continued as a significant, if woefully underfunded and staffed presence, into the early twenty-first century.

For each of the three independent variables, about half of the n=100 sample is in one category – for each of the three variables – with the other half in the opposed position (high/medium soil fertility; lot size/smallholding size; near/far). I determined not to compare holdings at the extreme western edge of the municipality on say km 135 north, as just getting out to these areas takes half a day from the town of Medicilândia. Instead, to capture for holdings that take over 30 minutes to reach the town of Medicilândia, I selected smallholdings on km 95 north – for example, # 37 through #41 in the map below. The map below is the survey sample.

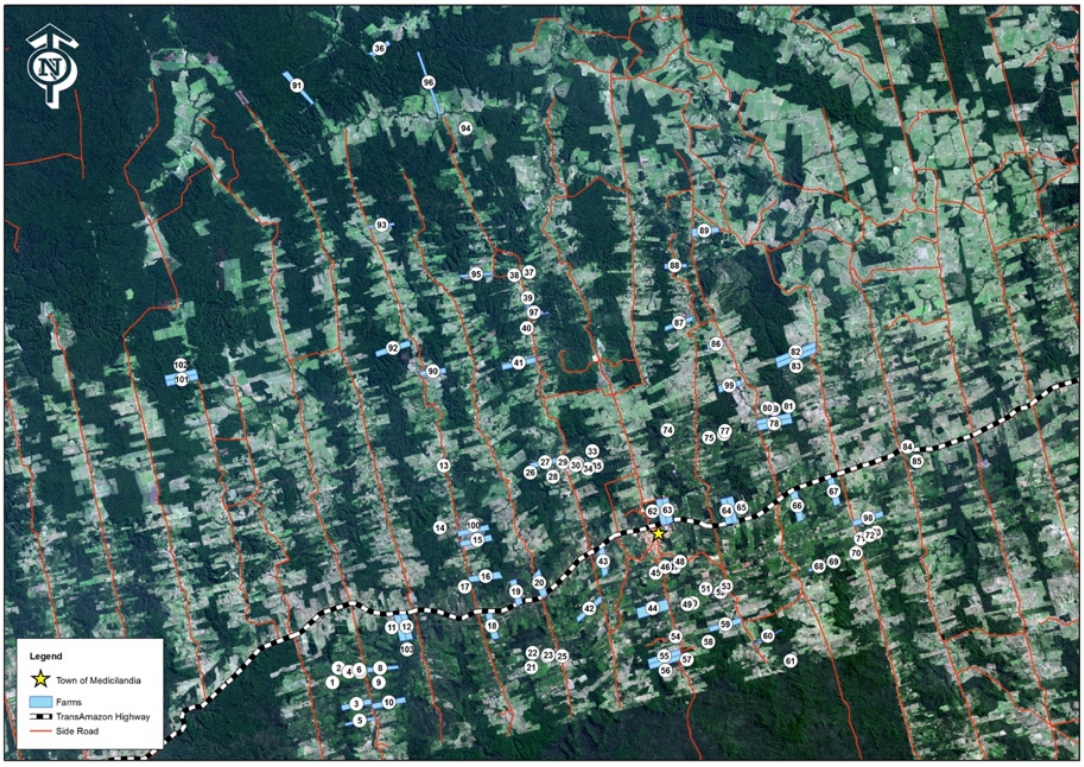

Figure 8.6: Random, stratified sample of 100 lots and smallholdings. The two cases studied in this chapter are the two true smallholdings (or chácaras) # 61 and #34. Side roads are spaced 5 km apart. Credit to Felipe Martenexem for the map.

In the end, I surveyed, walk-interviewed and occasionally worked with 32 farmers, distributed across all eight factorial groups in the factorial design. I included a few additional outlier cases, such that the total sample universe came to 103. But not all of the sample farms were surveyed. Yet, by working within this sample universe, the observations could still maximize variation in the relations amongst the variables, as long as I kept the groups relatively even. Remarkably, the two cases that I discuss ethnographically, below, were all picked up in this random sampling method, *after* I had spontaneously come to know these people on their farms (#34 and #61 in the figure above and below). In fact, I would never have understood patterns

on the map – *where to look* – without these face-to-face experiences. For example, case #34 and nearby cases were on a side road that blends into the general noisiness of the image. At the same time, however, the sampling technique served as a check or control on any personal bias – for example, that my interest in agroecology would overshadow being able to appreciate the overall composition of livelihoods and land use across the municipality. In all of this, I do not presume that there is a God's eye view – but rather that methods are embedded and iterative, while maps are not objective so much as subjective, embodied representations. Rather to provincialize 'science', I seek to refocus technical observations in a critical manner.

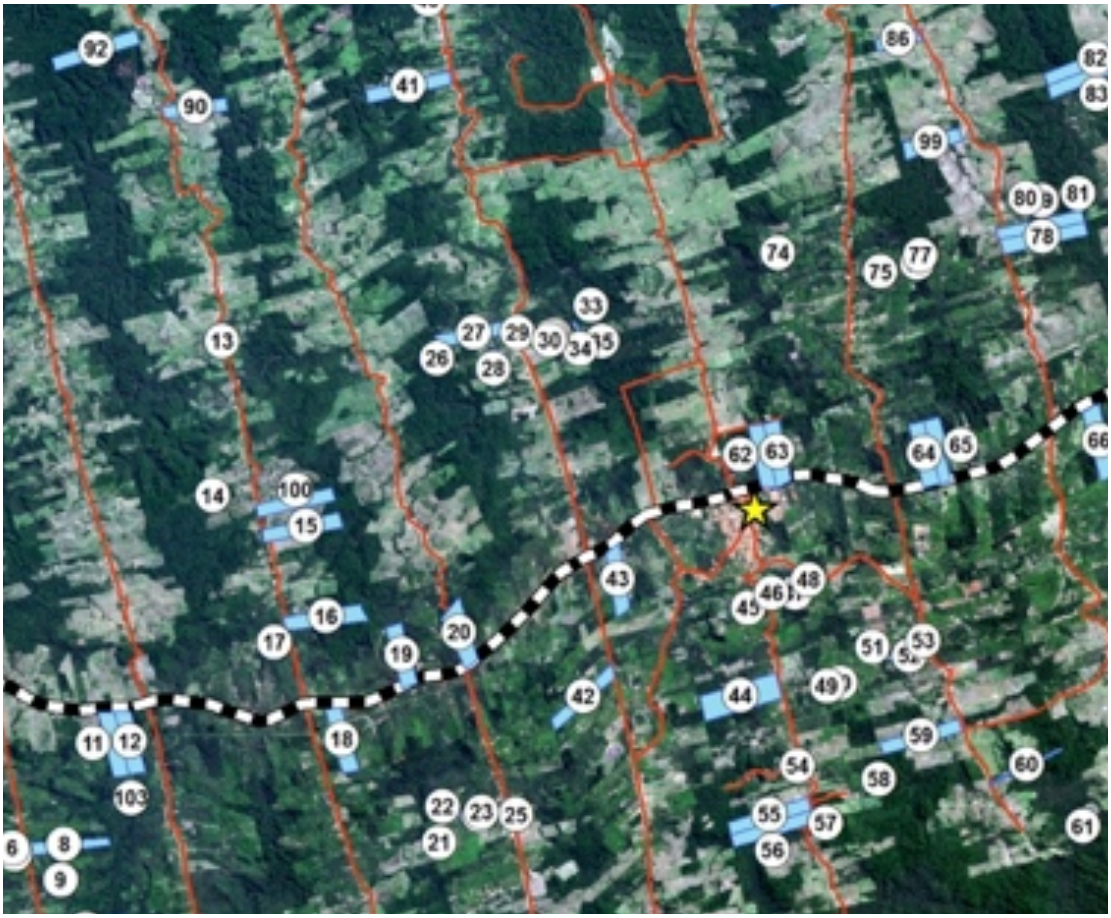

Figure 8.7: Closer view of the sampling map. We visit farms #61 (lower right) and #34 (center) below.

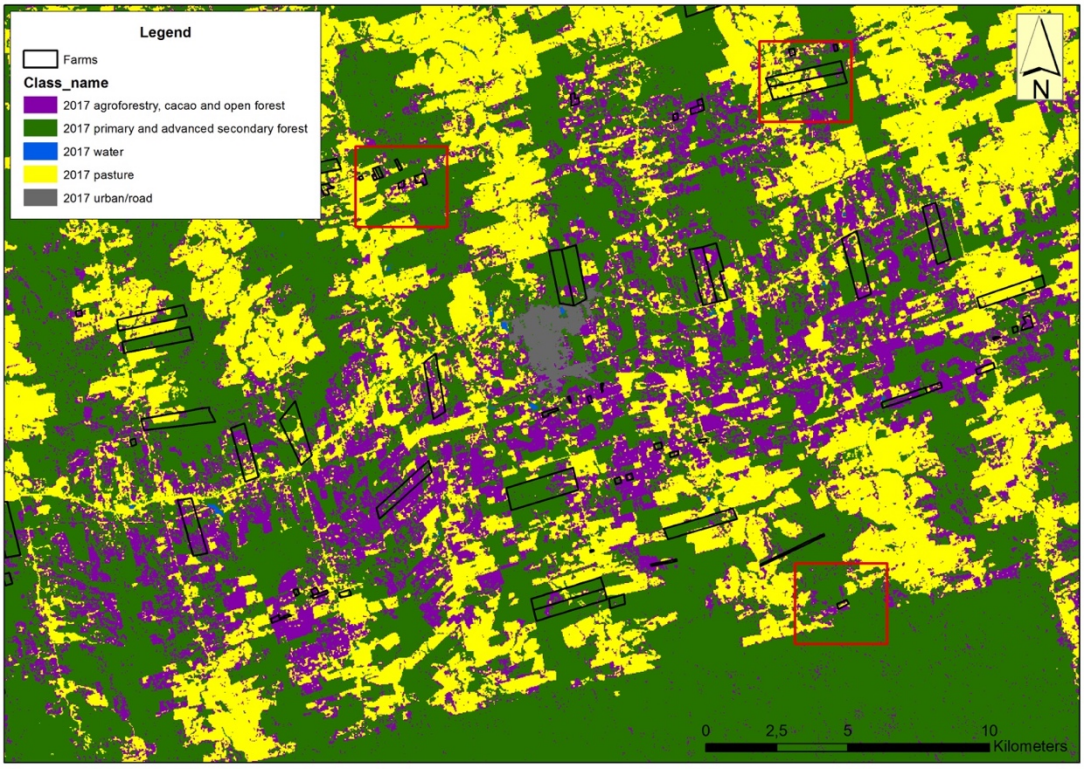

Figure 8.8: Mapping the three landscape cases of terra mista under consideration in this chapter. The red square at the south represents the landscape of Israel's chácara, just at the edge of the Arara indigenous reserve (#61 in the previous map); the square to the northwest with multiple chácaras is Edileia's (#34 in the previous map). The red square to the northeast containing two adjacent lots is Evandro/Adilson's land, which were discussed in the previous chapter (#78 in the previous map). Land classification by the author; map credit to Felipe Martenexen.

I gradually worked to survey the terra mista smallholding cases in late 2017 and the first half of 2019. Something interesting started to emerge. In contrast to Moran –and against the grain of development & extension rhetoric. I found that there was *no statistical quantitative difference* in net incomes per hectare, comparing cacao farms on terra mista, with cacao farms on terra roxa. This could be partially explained by the fact that many terra roxa holding were managed through sharecropping, and thus, their income was being discounted by 50%. But I was *also* comparing for true

smallholders across terra mista and terra roxa, who used their own labor. Here was an interesting supposition about structural differences in land use systems, expectations and perceptions. In addition to higher net income, terra mista holders said they would deforest less land, and cultivated trees matched to the labor and management ability of the household. See the table below.

Table 8.1: key results from survey research, mean values

Soil fertility type	Average area in tree cultivation (hectares)	Avg. net income / hectare (reais = .25 to .33 USD)	Avg. deforestation outlook: how many hectares would you cut down if you held a 100-ha patch entirely of forest?
Terra mista	6.8	4387	38
Terra roxa	31.6	4855	53

All of the land managers with whom I interacted during this process had their particular histories. Here I have outlined the process of geographical and sampling studies, not because these sampling approaches revealed much about what was going on in and of themselves, but because they were connected to lines of movement in the landscape, pointing at or suggesting relations. Tim Ingold has written on how as Westerners we must negotiate extremes between what he has called the "dwelling and commodity" perspectives (Ingold 2000: 329). The first, dwelling, about situated social experience; the second, commodity perspective about dislocated time and space – something similar to what GPS and GIS aptly perform in cartography, in disembodied map representations. Similarly, Ingold also has made pointed

distinctions between how maps can be conceived of as, one, practiced movements and narratives, versus, two, cartesian objectivity representing disembodied objects in empty space.

Using structured observations, however I was trying to sketch out in an iterative way phenomena and relations rarely registered in statistical and geographical modeling approaches to land use change in this region. Scanning across these different observations, both in this field improvised 'lab' and on the ground, I was hoping to get a better idea about these relationships in terms of soils, distances, working practices and exchange relationships. Land decisions each involve their own gamut of relations across multiple scales, both political and ecological. However, all of this effort to slice across an abstract landscape is much ado about nothing without experiencing situated reality in accompanying humans and nonhumans on the land. In this chapter, I compare human cases. The first that I follow here was previously a sharecropper, part of a secondary wave of migration to the Transamazon from Paraná, like Evandro in the last chapter. The second, Edileia is younger woman from an even more recent wave of migration from Maranhão.

I will now write as if we were walking or driving along the side roads or travessões that take us there. Leaving Medicilândia to the southeast, one goes up and down several hills with prominent speed bumps. The road is full of motorcycles. Sometimes people are carrying umbrellas while riding along. Small stores proffer a plastic bag for every single transaction, involving toxin laden beans, tomatoes, rice, all imported from other regions in Brazil. Food had been produced for local markets

in this area in the past, but rarely now. It was a city and a landscape driven by cacao and cattle. It was a struggle to get to a point of relative economic security here – much life here was hand to mouth, motorcycles often stacked with people.

Getting to the edge of town, we climb a steep hill, shacks lining the side streets. There is the cemetery on the left, then the compound for the county's heavy machinery –rarely put to use – on the right. There is a fork to the left and the road flattens out and there are 'dirty' pastures, meter high clumps of brachiaria grass. Trees accumulate in fencerows. Then, cacao farming starts to dominate – the concentration of orchards on the former sugarcane estates, with banana and African palm and *embauba* (cecropia) interspersed with cacao trees. The road is full of large stones and puddles and climbs and descends small hills. In the midafternoon – the sun is out, and the air is very hot and humid albeit with a small breeze rustling the fronds of açai palms.

This is the kilometer 85 south *travessão*, or side road. It starts in the post-sugar smallholder or sharecropped cacao area, then transitions into pasture estates when the soil changes from terra roxa to terra mista. At the end of the line, it ends with the first case under consideration in this chapter and an abandoned amethyst mine, next to the Arara reserve. So, let me take you to the *chácara* (smallholding) of Israel – who, as an illiterate teenager had arrived on the transamazon in the 1980s, long after the formal land distribution had ended.

End of the line

After about 7 kilometers, the landscape switches back into pasture, dotted with fire resistant babaçu palms – the road becomes less well maintained, more of a rocky track. It climbs another hill, traversing pasture. Here we see land system for pasture/cattle, which functions at sizes of hundreds to thousands of hectares. Previously, we had just seen a land system for trees, functioning at a much smaller size. This contrast between land systems could be seen across much of the Medicilândia landscape. The concentration of cacao tree farming and agroforestry was much higher on terra roxa soils. But in the terra mista landscape, which we were now entering, we first see pasture and cattle.

In the cattle landscape in Amazônia, fire is intended to discipline and transform the ecology into a different system --- usually dominated today by *brachiaria* grass. In contrast in the Amazon, general, vigorous secondary regeneration follows fire, but each repeated use of fire reduces biodiversity except for fire resistant species like babaçu palms. Fire was the 'traditional' cheap way to manage land or *symbolically* manage it for purposes of securing property. Oddly, one of extensive deforestation's hallmarks throughout the past twenty years, given strict environmental regulations, was, notwithstanding fines for deforestation, to leave Brazil nut trees isolated in the midst of the pasture, where they would eventually succumb to fire (the species is not at all adapted to fire (picture).

Figure 8.9: Fire resistant Babaçu palm in the foreground with dead Brazil nut tree in the background.

Figure 8.10: Nelore breed cattle with Babaçu palms

There is now a forested cliff in the distance, and the road/track turns to pure sand, then back to sandy yellow clay, then forks and forks again passing through secondary forest. Then, we start to descend into a valley – on the other side is a primary forest containing many palms, on the descending slop in the foreground there are clearings in cacao orchards and other clearings, some corn. The cacao orchards are interspersed with many tree species. While there were grasses in the sunlit areas next to the road track, the ecology quickly transitioned to forest in front of you, leading from the grasses, into cacao trees with babaçu and other palms, then rather quickly, to the full tropical forest assemblage with fully grown Ipê and Brazil nut trees.

Figure 8.11: Road area just before Israel's chácara transitioning to cacao and eventually to primary forest

I liked going here, to Israel's place, because it was next to the Arara indigenous reserve, even though their village was now located 50 kilometers to the south, on the shores of the Iriri river. It was illegal to go to the indigenous reserve without bureaucratic authorization, which was almost impossible to obtain. Israel's site was unique in that many histories converged here – state planned colonization, the sugarcane, pasture for cattle, the indigenous land. Colonist settlement is today usually associated with encroachment on indigenous territories and violence against members of these communities. Here, however, was a settler smallholder in peace, who after two decades of laboring as a sharecropper had managed to secure a holding. He had recuperated land that had been wasted in a failed sugarcane at the outskirts of that production zone. No longer a sharecropping peasant, he had transitioned to a 'true' smallholder, with labor was his most valuable asset.

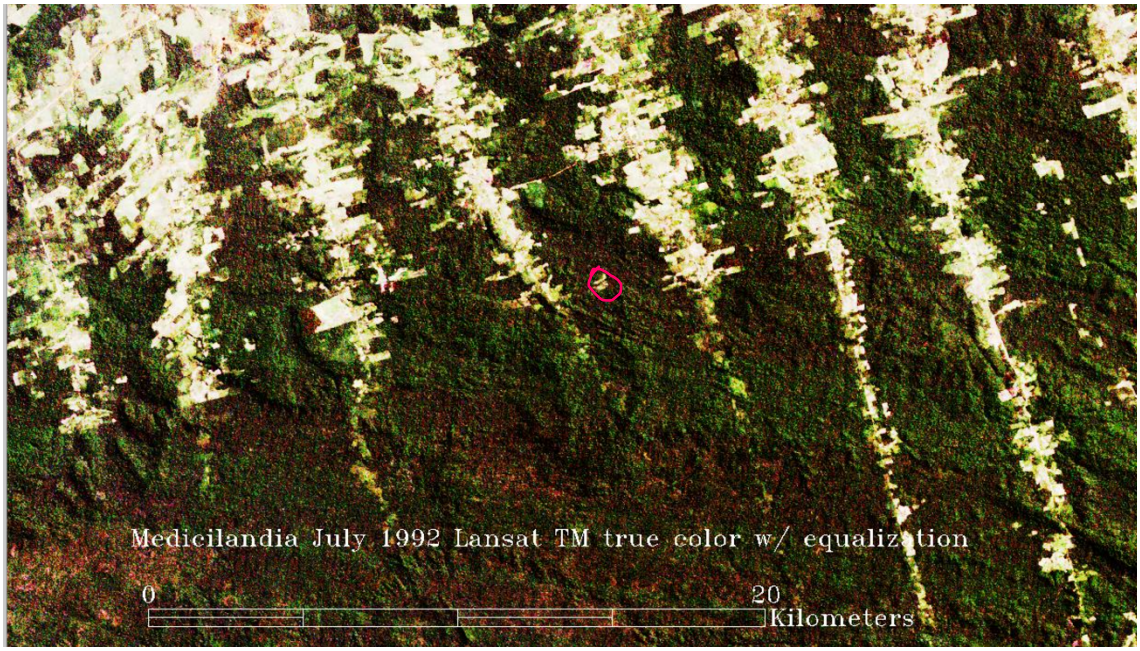

Figure 8.12: 1992 satellite image in true color with the land that Israel would eventually acquire circled in red

Figure 8.13: 2014 satellite image in true color with the same land circled the consolidated cacao area post sugarcane is now visible to the naked eye and is circled – the area to the northwest of the map

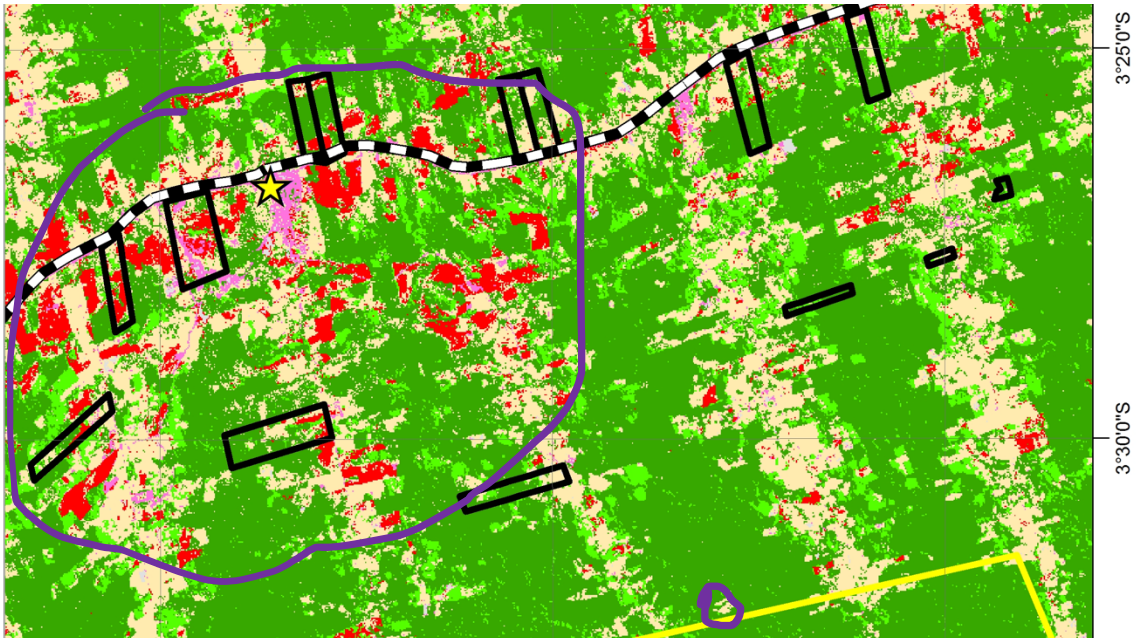

Figure 8.14: 1992 classification of land cover in the smaller area in which Israel lives. A larger purple circle around the sugarcane concentrated land. Israel's chácara is the small purple circle to the southeast.

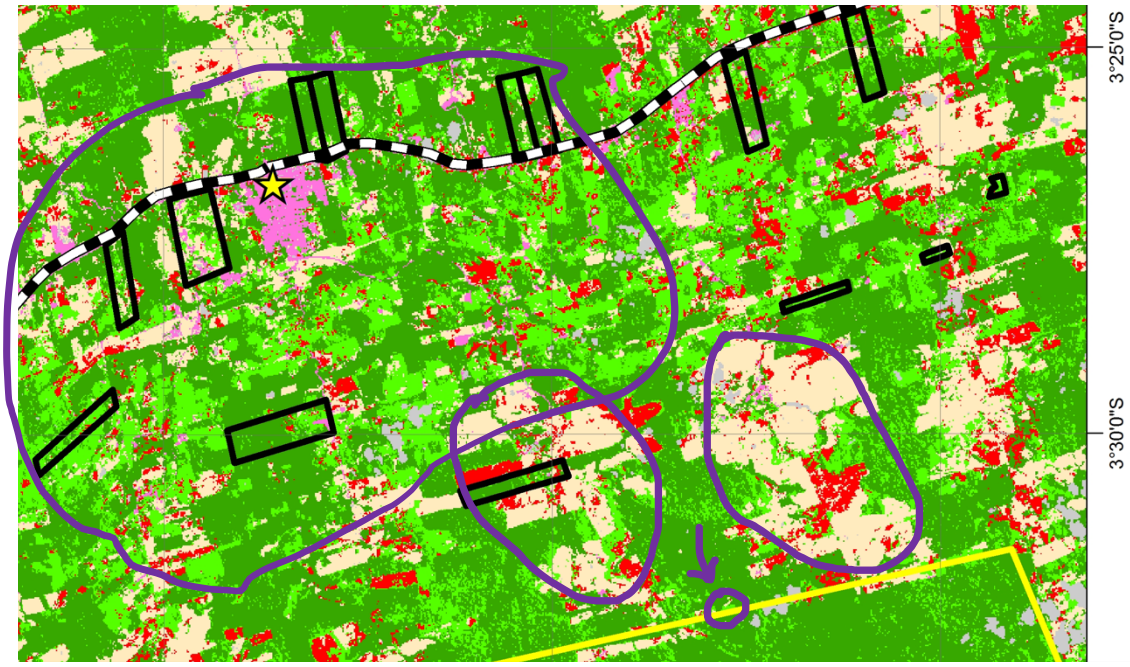

Figure 8.15: 2014 classification of the same region. In 2014, this has been replaced by the cacao landscape (large purple circle), large-scale cattle landscape (two circles) and Israel's chácara (the smallest circle with the arrow pointing to it). The yellow line

representing the border of the Arara indigenous reserve is incorrectly represented as it overlaps legitimate holdings located at that border. Also note that all the sampled (black rectangle) colonist lots in the sugarcane area are now with significantly more tree cover than in 1992.

Figure 8.16: Zoom in on the 2014 satellite image. At this resolution, it is very difficult to make out the land use, and as such, coupling satellite image analysis with on the groundwork is critical.

The soil on Israel's holding was reddish yellow with much clay. Argissolo Vermelho-Amarelo. A rocky dirt road that descends to the house, and a small river that crosses the lower, eastern part of the holding at a diagonal. Land use consists of cacao, corn, lime trees, *pupunha* (peach palm – wonderful for heart of palm and also for the starchy, nutritious, fruit) & açai, a house and *estufa* (a covered platform for drying cacao seeds after in-sack fermentation) are here along with secondary forest. The holding contains 10000 planted cacao trees, spaced 3.5 x 3.5 meters, along with many planted and favored species, see the table below. So, about 10 hectares in

species diverse tree cropping and the rest of the holding is about 15 hectares of secondary forest.

The area had been in sugarcane or pasture, had been abandoned, and had become a thicket. “Nothing to eat” Israel had told me. Israel started to clear the vegetation in 2007, riding the roughly 30-40 minutes down to the area from where he still worked as a sharecropper. They would then burn these areas in order to space and plant cacao trees along with other species. His partner and he started with an area of 2 ½ hectares to plant 2.500 cacao trees. They thus re-established productive land use gradually, over the next seven years – just the two of them at first. First, they planted seedlings along the river that had been bordered by sugarcane, then moved up the hill to the northwest. They allowed natural regeneration of Brazil nut and other seedlings to occur in the midst of the planted trees. By 2019 there were 10,000 cacao trees, they had planted many other fruit and timber trees, and hoped to expand açai plantings. See the table below in which planted and favored species in the two cases under consideration in this chapter.

Table 8.2: Trees planted, favored and in production, and net income from cacao and other trees, across the two ethnographic cases in this chapter

	#61 ISRAEL			#34 EDILEIA		
Common species name	Number of trees	Production in 2018	Net income (reais)	Number of trees	Production in 2018	Net income (reais)
Cacao	10,000	8,000 kg	57,000	3,800	2,100 kg	12,930
Planted trees inside cacao agroforestry system						
	African Mahogany 35 in 2017, 100 in 2019					
				Native mahogany 25		
				Açai 200 Home consumption		

				Ipê amaerlo e roxo (6)		
				Cedro Cheroso (timber) 25		
				Maranhoto 6		
				Eucaplyptus 3		
Planted trees (outside of cacao agroforestry system)						
	Açai 100	Home consumption				
	Banana maça, prata	400	2,000			
	Pupunha (peach palm) 100	140	490			
	Limão tati enxerta (grafted) 170	34	1,360			
	Laranja enxerta (grafted) 30			Laranja		
	Cedro Cheroso (timber) 15					
	Eucaplyptus 14					
	Maranhoto					
				Murici		
				Abacate (avocado)		
				Urucum		
				Buriti (7)		
Annual food crops and animals (outside of cacao system)						
	Manioc			Manioc		
	Corn 1.75 ha					
	Peanuts 2.5 ha					
	Chickens			Chickens		
	Pigs					
	Garden vegetables					
Naturally occurring species inside cacao agroforestry system						
	Açai					
	Castanheira (Brazil nut) 100			Castanheira (Brazil nut) 10-20		
	Bacaba					
	Camaru fero (Cumaru?)					
	Laranja comum					
	Jabacatía (espirito santo) Jaracatiá?					
	Abacate					
	Jatobá					
	Tatajuba					
	Sapucaia					
	Cajá (Tapereba)					
	Genipapo					
	Pitomba					
	Ipê Amarelo			Ipê Amarelo (6)		

	Sumaúma (Ceiba Pentandra)	
	Peroba branca	
	Tuturuba?	
	Papareba?	
	Mamão (papaya)	
Secondary forest valued species		
	Abacaba	
	Ipê Amarelo	
	Ipê Roxo	
	Manga (Mango)	
	Tatajuba	

The land had been eventually titled and marked through the Terra Legal program, which was set up to secure land tenure for undocumented properties (see Campbell 2015), but which has since been deconstructed/defunded. The farm now had a net income of over 5,000 reais/hectare per year. Or approximately US 2,000 / hectare per year. About 7% of gross spent on expenses (chemical fertilizer spread by hand). So over U.S. 20,000 liquid income in total – a decent living for a small farmer in a peripheral area in the Brazilian Amazon. In comparison, a smallholder using the land for cattle would bring in about one tenth of this amount, or roughly U.S. 200 for each hectare in dedicated to cattle. The middleman merchant cacao buyer would send a F4000 truck all the way out to his holding for each of the multiple cacao harvests. However, his family and neighbors here had grouped together to themselves dig the holes for the cement posts that would eventually bring them electricity and access to unfortunate Brazilian broadcast television. On my last visit, the cement power post had fallen across the travessão and I had to walk down, about a kilometer, to the holding. Israel did not expect that the state would be back to reset the pole anytime soon.

He used an off-road motorcycle to move around, dipping around the downed electrical pole and across streams that crossed eroded rocky portions of the road across the intermediate cattle landscape. It had taken decades of labor to get to this point. His chácara (smallholding) was just close enough to work on it gradually while commuting out from the town. Today, there were 6 hands helping, which included his sons and a 24 year old sharecropper who lived in a shack with electricity, next to the river.

Israel contrasted different practical outlooks for land, between smallholder cultivators and cattle ranchers:

> *Someone gets a lot (100 hectares) to work with cacao. He works for 30 years to form that area into productive agriculture — cacao, açai… Now, with pasture, with a lot of 150 hectares of land you just do away with it all at once. 150 hectares of pasture. And cacao no, you plant it bit by bit, now with pasture it is easy, you cut down trees without having to cut up the vegetation, then burn it. With cacao it is different, if you [eventually over decades] clear 50 hectares with cacao you clear 500 with pasture [in a relatively short period of time]. (Interview 2019)*

Israel had come up from Paraná in Brazil's south in the early 1980s as a young teenager, with 6 brothers. This migrant population wasn't the one that had harvested sugarcane for the most part – the latter labor force was sourced by the sugarcane company in a credit system from Maranhão, through which sugarcane farmers paid a lump sum paid on a debt from their production. In contrast, this incoming group of landless farmers that actually lived in Medicilândia full time, worked for the already established colonists as sharecroppers, often with coffee in the

early days. Israel had worked for twenty years as a sharecropper, roughly from the age of 17 to the age of 37. At times he had managed up to eight thousand coffee trees at a time. His work had been constant, he told me, dawn to dusk, seven days a week. Before cacao had become dominant, many colonists had tried to get coffee (arábica?) to work as a crop. In part, I suppose, because they were from coffee producing regions in Paraná, or Espirito Santo.

But coffee did not work out in the region. Commodity prices were so low that in the mid 90s some producers took it to tearing out the trees, in woeful resentment of so much wasted work. Israel grew to love cacao as a crop, and after 2000 prices for cacao started to make the crop significantly more valuable than coffee. So while they had tried with coffee, it was cacao that had provided livelihood security. Cacao was not something that he and his kin had done in the past in Paraná. He had learned to manage and love the crop through working with it over the past twenty years. Years of experience had developed within Israel love and knowledge for the plant, and for the rhythms of harvest, pruning, managing other plants and trees and fertilizing the soil. His life with cacao had blended into days of relative peace. And without making enemies, although Israel complained about all the rancher fire and impulses to form more and more pasture – he called the latter misery without shade!

His enthusiasm was contagious as he spryly led me on paths through what he called a cacao "forest" … his words and depiction of his condition went along with continuous movement and physical activity. He punctuated talk with his machete clinging off a stem infected with vassoura de bruxa (witches' broom fungus). "This is

the bane of cacao in Brazil… there is a lot of it here." Such pruning action with the machete was a constant attitude, whenever standing and talking near the trees. It was as if pruning was in conversation, not as a matter of ideal tree form or an aesthetic disposition of how a cacao tree should look, but in terms of the simple urgency of the human ecological and livelihood relationship and the understood need to clear off the fungus. Pruning was the cacao farmer's primary interaction with his or her trees, other than planting them, grafting them, or harvesting fruit pods.

But this was not an English garden, and there was much work to do. Socio-ecological relations here involved constant movement and learned work methods. I saw that amongst laboring smallholders, work practices and pruning decisions are made ad hoc – while farmers may understand tree 'form' – the exigencies of manual work mean attending to messy fungal infections, and also to stem shoots and termite nests, in all sorts of ways. One is careful to avoid wasp nests. One often has to scramble up into the trees to prune, either using the machete or a podão. The trees tend to be larger and more complex than, say, peach or apple trees in a temperate climate. Most pruning for temperate orchards can be done from the ground, but in these systems, there is often so much pruning to do that one needs to get up into the tree with a machete to get it done. Here, I am trying to engage how and why work with trees transforms human perception and knowledge.

For example, of what does a tree graft consist? Grafting is a practice that one learns by doing. Cultivating and also grafting trees on the Transamazon was a livelihood concern. Many colonists and smallholders on the TransAmazon /

Medicilândia take to using grafting cloned trees in concentrated areas, and nearer the home, as a way to get more cacao fruit pods out of a limited number of trees – say, a few score to a few hundred – as opposed to using hybrid cultivar seed – provided by CEPLAC –in which each tree will grow into a different genetic individual. Just outside his house, Israel shows me several 'cloned' cacao trees. Even though less than a year old, some are already with fruit pods. They will grow into very short trees, about 2 meters tall. He has interspersed these cloned cacao trees with the 170 limão tati trees, which are slightly taller. He tells me about the different methods to make a graft. The faster way is 'galvaz' or to make a V notch in the root stock, using a machete, then to make a V point for the grafted stem. Then you drop the grafted stem into the notch, wrap the joint with plastic? and also cover the plant. In about 15 days, the graft has been made, the root stock has accepted the stem and a new individual starts to grow. Using the latter method, you can do about thirty trees in a day. The more difficult (but biologically surer?) way to graft is called 'enxerta'.

We then start circling around the holding. We start below the *estufa* or covered drying platform, in a low lying, occasionally flooded area recently planted in açai palm and *pupunha* peach palm trees. There are 100 of each type, alternating in rows. Then we skirt back into another slightly more elevated area, through grown cacao trees about 3-4 meters tall, interspersed with juvenile Brazil nut trees that have sprouted naturally, and which are already 15 meters tall. We come to a log bridge across a river. He calls it the *ponte de amizade* – bridge of friendship.

On the other side, on land that slopes down to the river, he showed me grafts onto 12-year-old cacao trees – those trees he first planted in 2007. He was taking cloned vegetative material – known as the scion – and grafting it onto the rootstock. He had taught himself how to graft through experimentation, using the machete and different bonds to see what would happen. Smallholders were experimenting with the practice, and grafting had not been taught by the cacao extension agency – which already have seen was a relic of state planning, and without a new hire in thirty years. The agency had not made field visits in Medicilândia since the 1990s.

Figure 8.17: Graft on older tree. The graft is at the ground/soil level, with the scion the thinner trunk parallel to the main trunk. Note the difference of the fruit color between the scion (red fruit pods) and the older tree (green fruit pods.

On another day, after a simple lunch of beans and greasy chunks of pork, warmed over the elevated clay stove holding a wood fire, we decided to go out walking again. That day I had brought pens and paper hoping to draw his chácara. But given the energy, rather than to insist that he draw on paper – I left the pencils

and paper in a sack. And we went out again across his land on foot. It starts to rain heavily, and we take shelter at his sharecropper's shack next to the river facing south. Before us is the start of advanced secondary and then primary rainforest. The indigenous Arara reserve is there, half a kilometer away. In the foreground are numerous young Brazil nut trees, bacaba palms, that overshadow cacao on the other side of the river.

Figure 8.18: Looking to the south across the river. Cacao system with juvenile Brazil nut tree at the left

While the rain patters on the tin above us, he starts to draw a map with his machete in the ground. Gracefully he cuts into the packed sandy clay – making broad lines by pulling the machete laterally, and fine lines by pulling it along its edge. He made circles by twisting the metal. And so, we mapped out and walked out and talked out the relations of his chácara. There are two areas of cacao formed on either side of

the entrance, a long stretch of *capoeira* or *juquira* (secondary forest) running down one edge of the holding, new cacao skirts a river at the southern edge, and he has planted açai and pupunha in a *baixão* (bottom ground, sometimes floods).

Figure 8.19: Mapping in the environment

The rain eventually slowed to a drizzle, and we set off walking again. We come out of the mixed cacao stand, Israel has recently cleared this area of about 3 hectares, with a chain saw and then burned it – to plant corn and peanuts along with cacao trees. It was a mixture between an agricultural swidden designed for food crops and the commercial cacao agroforestry that was to come, the latter a mess of cacao trees interspersed mostly with seed sprouting trees, especially Brazil nut trees. Through pruning the cacao, the system could be maintained productively for thirty years or more.

Figure 8.20: The edge of Israel's holding. He has just started a roça with corn and peanuts, to be grown into a cacao system

Israel could only write his name – he was illiterate. The cacao seeds Israel obtained from the CEPLAC agency in town, from Carlos. Israel told me that he had not registered with the agency, that Carlos had just given him the seeds. And Israel had not laid out this new cultivated area with careful distribution of species – the mode of agroforestry and permaculture imagined by urban Brazilians in the southeast who aspire to ecological lifestyles. The latter tend to rely on the knowledge and landscape design of Ernst Götz – a Swiss land use innovator who designed an intricate spatial aesthetic for 'scientific' agroforests in Bahia. Here on the Transamazon, agroforestry was rather a broad-brush word for work with multiple tree species but often without deliberate spatial planning aside from the main productive crops. Israel's productive açai, pupunha, cacao corn and peanuts were all indigenous

semi-domesticates or domesticates of the Americas (Miller and Nair 2006), now grown in the ruined shadow of the state. Meanwhile, Brazil nut, papaya, babaçu palm, sapucaia, jenipapo (all native) were all trees Israel liked to eat; they were casually planted and sprouted up with the corn, peanuts and cacao. Then we come to the road, where Israel points out a juvenile castanheira across the road in the messy orchard.

Figure 8.21: A cacao seedling in the corn swidden

If the local price were higher, Israel might someday opt for collecting Brazil nuts on his agroforestry chácara. But the local price was only about 2 real / kilo of nuts with shell – not worth making the exchange in Medicilândia, even though the price was four times higher in Altamira. He tells me he has 500 kilos of shucked nuts in their shells sitting as his house. He tells me he'll sell them if the price were 4 reais. Opening up the wooden seed balls of Brazil nut trees with machetes is hard manual

work, exponentially harder than opening up cacao fruit pods – in the natural world only Macaws had the technical means to get to Brazil nuts.

We make our way up the dirt road to the property dividing line, then duck again into the cacao trees on the other, northern side… So we see how the relations flowed, and at what scales. It turns out, that Israel could certainly draw and had often done so to imagine his chácara. While we walked, he was keen that I get the details correct, as if the drawing that I would produce would have authority. But I leave this world at the end of the line facing the indigenous reserve I leave my sketch, a testament to the particular sort of value and relationships Israel had managed to create and balance, at this very particular point in time and space.

Figure 8.22: Drawing of the mature agroforestry system

Israel's holding, I stress, was unusual in that he had worked with his partner with few labor exchanges involving kin. This notwithstanding his 6 brothers, he had formed the cacao largely himself. Kin based exchanges I saw were the means in which families further away from town tended to sustain themselves, as they could not rely on many sharecroppers to reside in extremely isolated places.

The point here however is that the labor was the determining factor in the land holding, livelihood and agroecological relations. Also, the determination to risk that labor into the formation of a productive income generating system. This was not that 'peasant' per the James Scott Southeast Asian – or European peasant – model of a risk averse food cultivator in densely settled areas in exploitative relationships with state or feudal landlords. This was a former peasant sharecropper, transformed into something else. The organization of his labor and livelihood had changed his ability to manage his environment in an ongoing improvised way, and to take pleasure in the natural world and possibilities that surrounded them.

A 10,000-tree system however was about the extreme limit of what one couple could manage and sustain as their main livelihoods. He now had a young resident sharecropper helping him. His children had been young when they had started, and it was only now with the cacao fully grown that his sons (all sons? check) were involved. I wasn't sure how he split cacao earnings with them. Yet at 49 years, he told me, he had few years left to work like this. Also, there was no guarantee that this property would continue as a perennial productive agroforest. His sons, if other

fortunes presented themselves – labor on a dam project, gold mining camps – might opt to migrate to regional cities like Altamira, to try their luck in urban areas or in other speculative options. They might even sell the place. Maintaining continuity of land holdings between generations was a significant problem in Medicilândia, especially for large families.

For example, I had seen that Clovis' family plot on km 75 south (#70) was quickly sold off in parcels; his brothers and sisters all moved to Altamira and Brasil Novo. Clovis had remained woefully in a shack as the last of eight chidren, on a 10? hectare plot at the front of the lot. He told me he was hopeful to grow açai, as he had good water running through his parcel. But his determination was to risk a larger landholding elsewhere, starting on a new piece in the Assurini settlement across the Iriri river, where he told me he heard the growls of jaguars. When I went back to visit him in 2019, two years later, I found a new resident at his shack – he had sold and moved to the town of Brasil Novo.

Yet, risk seeking is a common attitude in migratory and livelihood dispositions in the Brazilian Amazon (Cleary 1993). There is also a tension between smallholding (agroforestry) – which is risk seeking because it depends on commodity prices – with cattle ranching and the fire and deforestation it involves as an accumulative strategy across much larger areas. Smallholding here was not about subsistence, of being averse to market relations. It was rather a question of trying to sustain a livelihood – involving commodity money – on small areas of land without capital, technical assistance, credit or machinery, or even wages on the side.

Smallholders on mixed soils – Israel included – certainly used chemical fertilizers, and many would gladly opt for cattle on a larger holding. But going back to one of the three key findings from the sample study: mixed soil small cultivators seemed to be more satisfied with their accomplishments and responded that they would deforest 38 hectares on a lot of primary forest, in contrast to 53 hectares on average for land holders on terra roxa (see table 1).

Why would this be? Many smallholders on terra mista would tell me that 20 or 25 hectares was plenty of land with which to work at the level of a 100-ha lot. This I took as being based on their experience, about the balance they had managed to achieve in a labor framing of relationships – at their outer limit involving about 10,000 trees and perhaps 15 hectares of secondary forest or other land cover.

Living balanced

The 95 north travessão was so poorly maintained by the county that moving 30km meant a hard and uncomfortable ride, with a motorcycle usually the better way to manage the distance/time. This was the road on which I accompanied Dona Maria in the institutional chapter to her far-off lot, without water and without electricity, where they were trying to form, and failed to form, pasture. HiLux pickup trucks would occasionally appear, but these machines were attending to land perhaps 60 km or more to the north, a capitalized invasion of public INCRA land where illegal timbering and ranching were becoming more prevalent – making that area dangerous for researchers. (show map).

Yet 95 north had a diversity of holdings large and small for most of the first 35km, which was unlike most the travessões where small properties were less common after about 10-15km. Indeed, in our sampling work, Felipe and I had found that 80% of all registered chácaras under 20ha were located within a 20km radius of the city. The side road 95n however had a rich distribution of the true smallholding chácaras up to about 35 kilometers – those mysterious small green dots in the soil map on page X. After that, smallholdings became very scarce, if they existed at all. So, Unlike the 85 south travessão where Israel was located *after* the ranching land, 95n had different types of land use along most of its length, and also unlike neighboring 90n, which led directly out of the center of town, and on which the land had been consolidated into the more typical regional pattern of large ranches (about 2000 ha).

On 95 north, more humble producers – sharecroppers, often migrants from Maranhão – had tried to re-settle, trying – and often failing – at different types of cattle arrangements (mostly small calf cow, pasture fattening) black pepper, fish farming, chickens and prize rooster rearing, açai, cupuaçu and of course cacao. There was even a traditional rice husking and manioc mill about 20km in. Starting a few kilometers from town, it thus combined near and distant holdings on soils for the most part of medium fertility. Therefore, one could consider how smallholdings might be established regardless of soil fertility and the state's historical development mandate with sugarcane.

There was an *agrovila* (state agrarian village), located 10km up, which had been part of the original state settlement plan. This agrovila was also the site of a government airplane landing strip, which had served to shuttle in officials and important persons to the PACAL sugarcane refinery complex up until about 2000. The landing strip was now abandoned,now in 2 meter tall weeds. The land here was thus a bit flatter than south of the Transamazon. Agrovilas in the original settlement planning scheme were located on each side road 10km. Originally containing state health clinics, and ecumenical chapels – they had persisted as unusual small residential villages, as interesting relics of the 1970s. The residence pattern had remained, there had been much buying and selling of structures over the generations without formal title. The land in the agrovilas still belonged to the federal government, if one might be able to find the document in the woefully understaffed superintendency office in Altamira.[13] In the agrovila, there were a few small businesses, churches and people looking out their windows at passers-by on their motorcycles or on foot – people walked around agrovilas. The agrovila allowed for modest livelihoods and for labor's mobility out to lots or chácaras in tree crops.

Here I met Edileia, who ran a small store and snooker bar, lived behind the bar, but who had secured title to a chácara about 3 km away. Her chácara was located on what had also been INCRA (National Institute for Colonization and Agrarian

[13] This situation had recently changed, however as national and regional policy has been to try to issue private title for INCRA land and remove of the role of the agency as an administrator for social purpose of land. Title documents were being handed out in the region by the Fundação Viver, Produzir e Preservar (FVPP).

Reform) land. They had built a road themselves to go in, on the 'vai quem quer' *ramal* (road track, a bit more developed than a *pique*) or 'go whoever wishes' secondary side road. She was getting ready to move out of the agrovila to the chácara. This entire INCRA lot – like those at km 92 just outside of the main town – had been squatted upon. Hence the name. Squatting on an unproductive large landholding or ranch in other parts of the Amazon usually brought significant risks, if an 'owner' with a cynical heart might opt to destroy squatting settlements and / or murder *posseiros* (small land holders without formal title). But here on the vai quem quer ramal, posseiros eventually secured title and property markers through the terra legal program, as had Israel. The land tenure pattern was now small properties of ~4 hectares each. On the maps below, we can see the small-scale settlement of the vai quem quer ramal indicated by the purple arrow, with sustainable smallholding agroforestry.

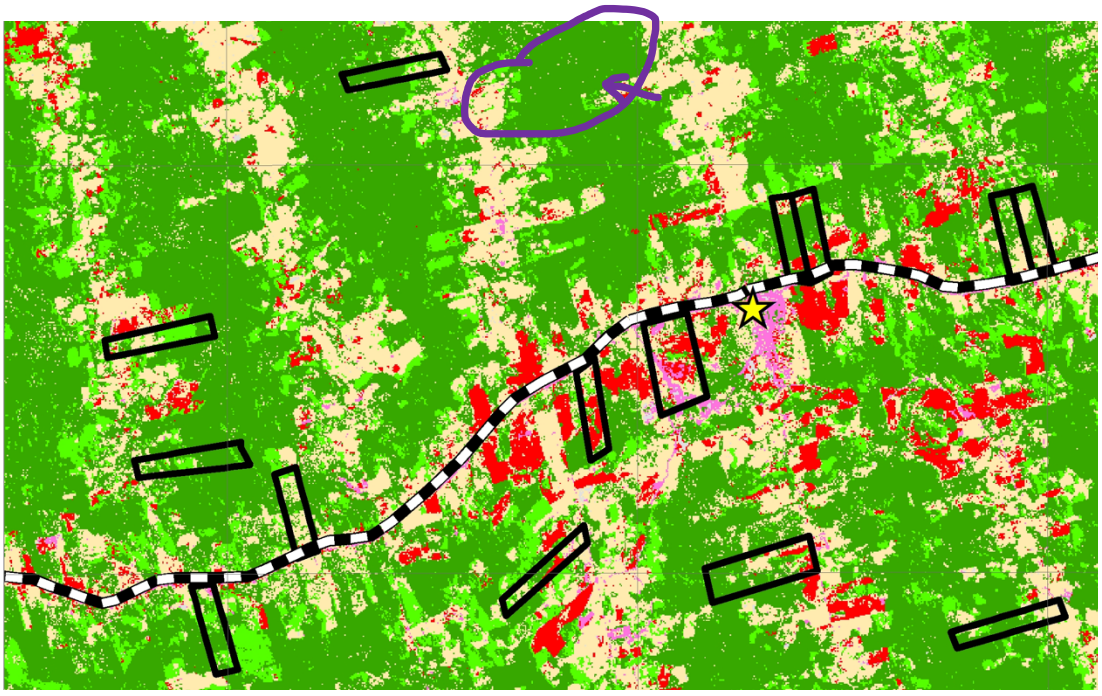

Figure 8.23: The land cover classification map of 95 north in 1992 before the opening of the Vai Quem Quer road, indicated by the circle / purple arrow

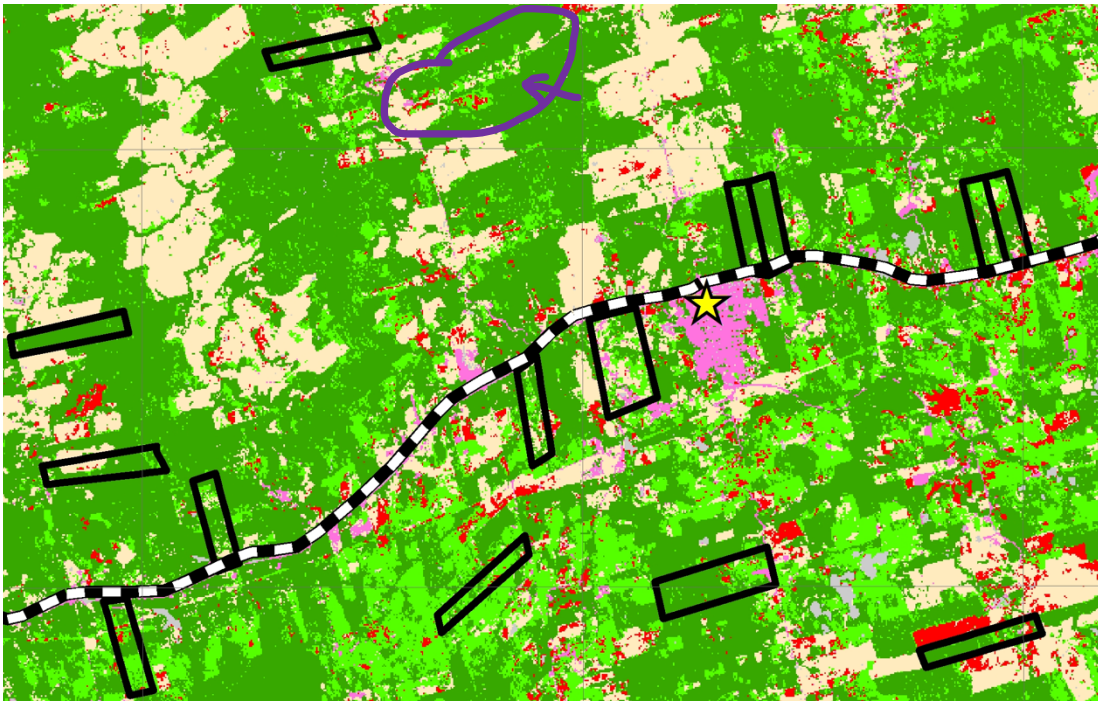

Figure 8.24: The Vai Quem Quer road in 2014. The newly established squat smallholdings on former INCRA forested land, indicated by the circle / purple arrow

Figure 8.25: Open sun poly-cultural orchard on Edileia's chácara smallholding

Figure 8.26: Urucum on Edileia's chácara

Figure 8.27: Edileia’s home with cacao spread out on a tarp to dry

Figure 8.28: Turning over the cacao seeds

She loved to walk around her land, a machete handy at her waist. We walked through her eclectic set of plantings – cacao, açai, pupunha, beans and pineapple, urucum and banana, as represented in the drawing of her holding, see figure 28 on page 58 below. We reached the small stream or igarape at the back of the holding, where she had a *mina de agua* (artesian well) that supplied her house (picture). While we walked, we talked about how she organized her holding and the work it took. For

example, about 3 people were involved in pruning the 3,800 trees, herself, her partner and some day labor, over the course of about 21 days. With the store income, she had cash on hand.

But to cut down on the labor for weeding her holding, or cutting down unneeded secondary vegetation, she used glyphosate herbicide. While her holding was also species diverse, like Israel's, her holding was not so dense with tree-cover, such that where there were gaps between the trees, secondary regrowth would start. Rather than to address the weeds with physical effort using a mechanical weed whacker, she had determined that herbicide was part of the solution. She or her partner could apply the herbicide themselves, and then, combined with the weed whacker, they would work for about 15 half days each in both February and September – much less onerous. The motive was not to work as little as possible, but to economize labor across multiple tasks. Roçando or work with a mechanical weed whacker was dull, but weeding was a necessary kind of work, in order to prune cacao trees and organize harvests in these humid tropical polycultural orchards. If she could close the system's 'canopy' or if the system were to be managed more as a successional swidden, this work would not be so needed because the system would prevent solar energy from reaching the soil level. This was one of the sticking points of cacao – it could be left to become a successional agroforest – but to produce well it had to maintained – pruned, harvested, weeded, occasionally fertilized – with labor, to control witches' broom and also to encourage the trees to make more fruit.

But the problem was that much of the ground lay bare without residual organic matter, such that the equatorial sun was beating down on the soil. This, and no fertilizer, was probably the reason why her chácara was not producing very well – about 677 grams of cacao seeds per tree on average amongst her 3,100 producing trees, although she had just planted 700 more. For cacao systems with well managed shade trees – about 40% closed canopy – on similar, medium fertility soils, the average was 1000 grams. Notwithstanding it was easily sustainable at this small scale in terms of labor and cash outlay, the latter about 8% of her gross intake. The market was very easy to manage. Like many other very small holders and sharecroppers of cacao, Ediliea didn't have access to a formal drying platform or a barcaça rolling roof drying platform. She just laid cacao out to dry in the open, on a tarp. "Viver equilibrada" or lived in a balanced way – was the way she put it. With the exception of using Glyphosate, this was possibly the most sustainable residential/productive situation of all three cases. It was easy to access. There were no biting black flies. It was 20 minutes from town. And she loved her place and the individual trees, based on the feeling one gets from the following drawing.

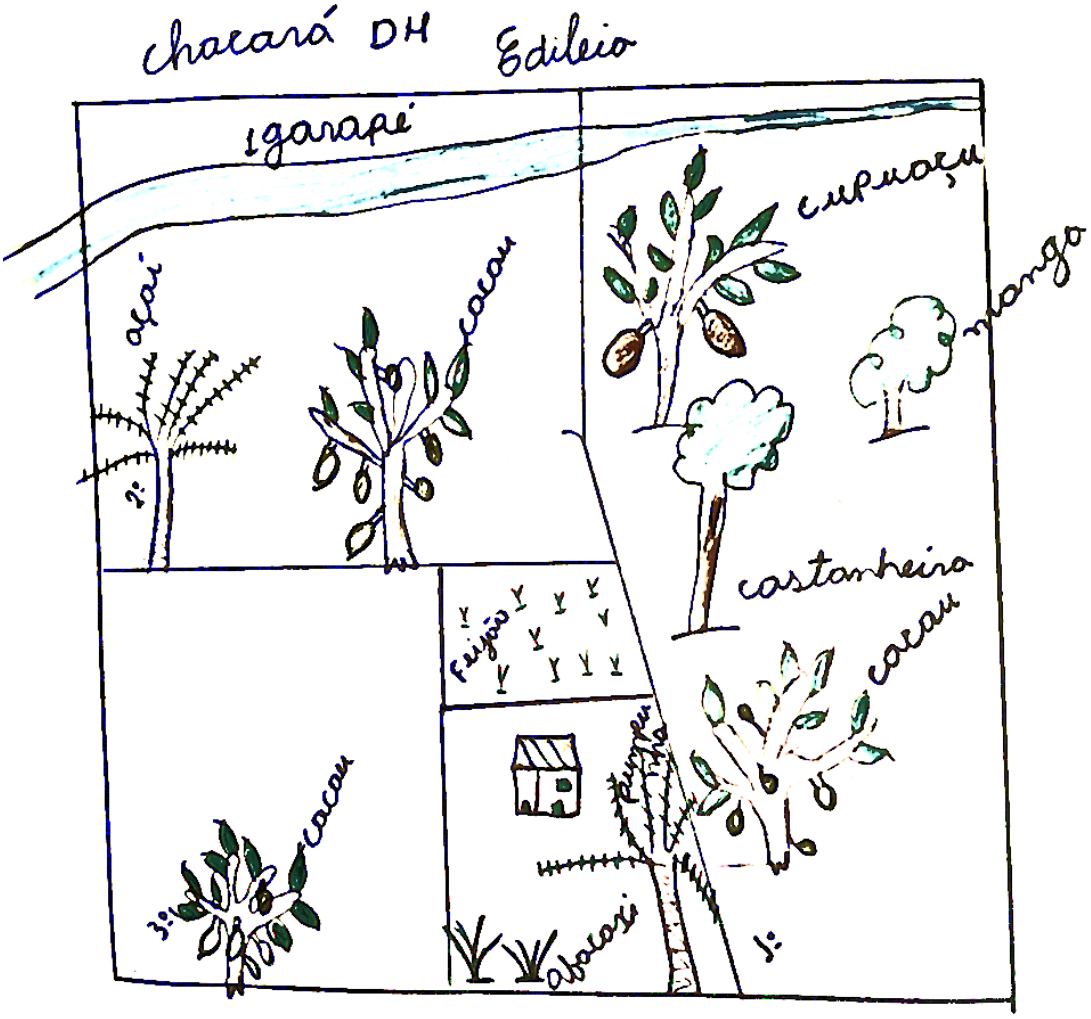

Figure 8.29: Edileia's drawing of her chácara

Here, I consider the issue of soil fertility and the issue of weeding. Over several hectares of land, and in areas of low population density, one can't count on household garbage/middens or human feces or dead animal or fish bones making much of an impact outside of the home garden. (or terrace / raking leaf litter) So, lacking the former sources of nutrients areas further away from home sites, limited

fire and swiddens has been the traditional technology to manage Amazonian soil fertility, for both indigenous and smallholder. Setting fires after cutting up trees and vegetation in 1-2 hectares to make a roça (swidden) worked well for rotating food production for perhaps the first two years. For example, like Israel's corn and peanuts, into which he had planted cacao trees for the long term. But by the third year the temporarily enriched system would rebound into acidity, tying up plant available nutrients.

In perennial management of cacao fruit over 30 or more years, however, trees have to be maintained and pruned. In the livelihood systems on the Transamazon it isn't a matter of picking at a diversity of fruits in a piecemeal manner but organizing labor effective harvests across several hectares at once. One has to be able to move around in the understory, the fruits have to be physically accessible while on foot, cut down and amassed into piles to be broken up by hand. Cacao poly-cultural orchards could be viewed in a kind of continuum with enriched swiddens, but what we typically had on the Transamazon was a hybrid between natural regeneration and deliberate or technical spacing of trees. Cacao was a native species, but it had transitioned from being a semi-domesticate forest food, into a managed cultivar for a global commodity market.

Smallholders have to make improvised decisions involving the scarcity of labor. Edileia used herbicide; Israel used chemical fertilizer. What we had here on Edileia's chácara was a perhaps odd mongrel of a diverse species orchard and home garden, but this was not that pattern of the Boro Indians practicing swidden

agriculture, studied by Denevan and Padoch near Iquitos in Peru in the 1980s, or Darryl Posey's study of the Kayapó. This was not a swidden, it was a poly-cultural orchard. For example, without a collectively organized alternative, over 10 hectares it would be difficult for Israel to manage cacao using traditional swidden methods – these were permanent cacao plots designed to produce for over 30 years. 10 hectares is a very large area of land indeed, compared to the few hectares managed by traditional indigenous-peasant families studied by Padoch and others in Peru. Israel's holding was rich in clay, but perhaps just a touch too acidic, which would make nutrients difficult for cacao trees to absorb without a little help. So, he used sacks of lime amended fertilizer and spread it out by hand on top of the leaf litter inside his orchards. This material had cost him a few thousand reais – about $1000 U.S. – about 7% of his gross income.

If there were biological assemblages that could solve the issue of soil nutrients for cacao, like mycorrhizal symbiotic associations – I needed to do more work to find out. On the other hand, I did know about *terra preto do índio* (Anthropogenic Dark Earths), which had been a sophisticated indigenous innovation, creating centuries long persistence of soil organic matter. This was because of the remarkable *nanoscopic* physical texture of organic soil carbon in ADE, making it such that microorganisms can only eat the carbon extremely slowly (Glaser et al. 2003). Patches of ADE were scattered all over Amazonia, including in upland Medicilândia. But ADE had been created collectively, in areas of dense population, over decades and centuries, using garbage, feces, bones, made into a kind of magical charcoal.

Considering these longer histories, the challenge for a sustainable socio-ecological system (or process) it seemed did not lie in a permaculture model of nature, but in the work effort and available technology in situations in which locally available fertilizers – outside of fire generated ashes – were too scarce to distribute over 10 hectares. In a *chacareiro* livelihood, smallholders had to use what was feasible and practicable, lacking collectively organized technological and labor alternatives. What was interesting was that successful livelihoods on mixed soils further out on the 95 north travessão involved collective work parties or *mutirões* for harvest, pruning, weeding – and no chemical fertilizer was being used (check surveys).

Chapter seven conclusion

The viability of farming fruit bearing trees in agroforestry systems on the TransAmazon is more closely tied to *labor* than to soil fertility, considering land use organization and experience on terra mista. Yet, the state has never financed cacao on mixed soils, nor has it actively connected smaller-scale land use and tenure with more sustainable livelihoods. Thus, cacao farming on mixed soils, such as for ambitious and relatively young farm families like Israel's – *rarely* reaches around 10,000 trees or 10 cultivated hectares per family. The average for the study was 7 hectares. As such, these farmers, even if more sustainable, are only visible at a radically different scale of observation than that that involves pasture/cattle ranching, and land use change at large, which occurs over hundreds of hectares. Cacao production on the

other hand is clearly visible on terra roxa, but hard to observe and measure on terra mista. For example, I would never had noticed the Vai Quem Quer side road, where Edileia's chácara is located, on the land cover map, because its details were blending into the general noisiness of the image.

Returning to Moran's argument about soil fertility and land use choices: Because of terra roxa's perceived development potential and peculiar mineral properties, landholders assigned to or acquiring terra roxa soil had been targeted by the state and had easy access to public finance, with little effort. This led to a distinct set of development ideas and aspirations. The issue was that with this peculiar connection to the state and to capital in this part of the Transamazon – terra roxa land use systems would get out of balance in 100 hectare lots, moving capital into cattle ranching elsewhere, or the system would get too weedy and would sit abandoned, a delight for monkeys.

Alternatively, under the sugarcane design for terra roxa, and its abrupt and cruel demise, terra roxa holders were forced in the other direction – forced into severe debt with no hope for the state or banks to intervene. Thus, state policy on the Transamazon – *paradoxically* – created a 'scalable' reverse effect across the sugarcane zone, driven by debt, rather than by capital. In this unusual case, land holders in the former sugarcane zone replanted with cacao, with sharecropping labor managing to sustain the holding, and often with the cacao slowly degrading in terms of production, but not ecologically. The tendency in this situation: maintain the system in a semi-feudal sharecropping community on the lot of the benign Rogério,

or split up the property into self-sustaining holdings. The latter increasingly happened during generational turnover.

The former set of relations explain the higher concentration of chácaras on terra roxa. In contrast, in terra mista areas smallholders did not 'scale' across the landscape, as much as they developed niches to try to maintain a tree-based livelihood in the shadow of the dominant regional system – i.e. pasture and livestock. The latter system is relatively free of labor, relies on amassing brachiaria grass and Nelore breed herds, rather than manually tending to crops.

This chapter focused on relations on terra mista mixed earth soils. In this, we should keep in mind that Medicilândia's torrid, changing landscape is an utter mess. There is much variation and outright chaos in institutional experiences, land use decisions, family migration histories, farms/household trajectories, land tenure and organization of labor, ecological conditions and agricultural techniques. Looking at the town – literally a state planned agrarian city or 'agropolis'– it is full of craters, steep muddy ravines, bottom land rife with mosquitos. Improvised buildings, corrupted county leadership/maintenance, and 'screw you' driving attitudes (also common to Brazil at large). Families with newborn children buzzing around on motorcycles without helmets. Some houses are made of wood, built on stilts. But there are more well to do citizens who can afford tile floors and to build walls around their houses. A city of sharecropping peasants and smallholders commuting out to their land, and larger landowner ranchers who often did not reside in the county but in

Altamira, but moved around in hermetically sealed, window shaded, white HiLux trucks.

In the overall county, one had to learn to read the landscape for multiple frameworks of relations, and messy land use histories and patterns. Contemporary and continuous ruin and regrowth made the landscape and its patterns unsettled – quickly moving in and out of formation. Sugarcane plantation agriculture had required ongoing government/ political work – because, in this regional geography land use and tenure came to be more often dominated by *non-cultivation* – timber extraction, ranching, etc. given the perceived abundance of land. In the recently colonized Brazilian Amazon it is almost as if land is ruined as soon as it is touched.

9. Conclusion

The nature culture divide as it shapes discourse on the Brazilian Amazon

For eight months out of the year, drizzling misty rains suffuse the landscape in the western state of Pará in the Brazilian Amazon. A short dry season starts in July and lasts until early November. But what if I were to tell you that during my fieldwork, a popular refrain was that this pattern had *reversed itself*. In the second decade of the twenty first century, hard pounding rains now begin in late January and persist until May. Then, eight months of dry months – June through January – permeate the landscape with equatorial sun. During the dry season, the *vassoura de bruxa* fungus sits dormant inside cacao trees, and cupuaçu trees. The dust kicks up on the dirt roads, accumulate on anything using the roads, making the vegetation beside the road red, orange or yellow, depending on the type of soil.

The forest feeds rainfall through evapotranspiration, and with almost half a century of deforestation and the fragmentation, the rainfall patterns have certainly shifted. A recent scientific paper in the *International Journal of Climatology* concludes: "In conjunction with the increasing trend in the annual range of rainfall in some localities, [climatological data for the Brazilian Legal Amazon] suggest a tendency of wetter wet seasons and/or drier dry seasons." (Almeida et al. 2017: 2024). The latter is not a resounding corroboration of regional climatic changes, but it was clear from talking to migrant colonists to this area that precipitation patterns had changed, dramatically, over the course of a few decades. Before, it had been eight

months of rain, and four months of dry weather; now it was four months of rain, and eight months of dry weather. In the 1970s the rain came down like a mist; whereas now, when it rained, it was a torrent. This local knowledge of climate change was simply about the sensory fact of having seen and heard, felt and smelt, the new patterns. So that while climate change was directly relevant / felt by colonists — folk observations were not present or counted in technical-scientific observations.

Dramatic environmental changes were part of migrant colonists' experience throughout their lives, from deforestation and the hard labor that it had required without chainsaws or tractors in their early days, to attempts farming commodity crops like rice while being swarmed by biting, toxic gnats, with these new gaps in the forest coming up again in forest so quickly that areas would be fifteen meters high within three to five years. But, seeing all these processes, notwithstanding, most urban and NGO Brazilians understood these livelihoods and existence on the frontier as a simple extension of capitalism… and a violent encroachment on indigenous worlds. The diversity of migrant colonist life and their experiments with agroecologies over decades were also invisible; it was not recognized. The scale of observation was that of regional change, broad quantifications of deforestation along that singular dimension, with secondary regrowth interpreted as abandonment.

Medicilândia, at least during the time I conducted my fieldwork from 2016-2019, had long stopped expanding colonist land use into the Arara Indigenous territory to the south. Also, people like Rogério had told me that, decades ago, the Arara were often on the Transamazon itself. They would have walked out of the

forest, and ten to twenty or so kilometers along the travessões… usually in groups with children. Sometimes they carried a domesticated pig or even a peccary wild pig to exchange in town. More often, they carried mahogany seeds to trade with the colonists, many of whom had been interested in planting this valuable tree, decades ago. Indeed, Mahogany is one of the favored trees planted directly into cacao agroforests. Mahogany seeds are light on the air and literally winged vessels – dispersed by wind in the ecology. But, like any tree, they can be directly established as a seedling.

Shifting forward thirty years, any interaction with Indigenous lands required bureaucratic authorization, which itself was impossible to obtain. Further, the principal village of the Arara was located beyond 30km of forest, on the Iriri river. Any formal work – not to mention collaboration – with tribal indigenous areas was bureaucratically stunted, while casual exchanges with Indigenous communities still took place. I had heard that local actors made 'deals' with the Arara and other groups – but destructively, for timber, trading cachaça…. These were also illegal of course, but the Brazilian federal state is very slow to move, even based on its own ostensible aims. The FUNAI apparatus was in fact sometimes tied to criminality and to the Bolsonaro government itself, while it might be used to facilitate mining and missionary activity in Indigenous territory.

Altamira, the larger regional city 90km to the east of Medicilândia, was once a hard to access river outpost trading in jaguar hides and Brazil nuts, but today is a rapidly growing regional city, surrounded by ranches. But a few miles up the Xingu,

the territory changes, turning to river communities and, two days journey by speedboat, indigenous villages. The land to the west, after about 75km of patchy ranches and smallholding cattle, switches dramatically into a tree covered landscape, and remains so until about km 140, in the cacao forests of Medicilândia.

But while the region is diverse, sociality across human groups is increasingly less so today. Interviewing and interacting with a broader university and NGO community in Altamira, I could see how riverine peasant and indigenous worlds were 'lorded over' by the National Foundation for the Protection of Indians (FUNAI – indigenous peoples are referred to as 'indios' in Brazil), while the Socio-Environmental Insitute (ISA) were the key organization with regard to riverine peoples' affairs (see, for example, Fisher 2015). ISA was concerned with the image and identity of the forest – for outsiders and donor audiences. Yet, the lives and livelihoods of the diversity of forest peoples, which based on my fieldwork was tribal indigenous, riverine peasant, quilombola, and even migrant colonist. Meanwhile, cities and 'modern' ways of life were signals of progress and development for more recent residents of larger regional cities like Altamira.

The point here is that while indigenous and traditionally identified peoples were seen by the ISA community as legitimate forest stewards, most agrarian actors were well outside of the 'framing' of 'forest defense'. This, notwithstanding that the history of the *Terra do Meio* (Land in the Middle) – the world's largest conservation mosaic, was rooted in the history of agrarian social movements (Schwartzman et al 2010; Campos and Nepstad 2006). This history seemed to be lost on ISA

collaborators. Amazônia was now an essentially binary image – dividing the legitimate forest peoples from the agrarian peasants and anything else involving farming. In Altamira I felt strange around the urban expat, tattoo toting, NGO visitors, none of whom knew how the preservation of the Terra do Meio had resulted from the assassination of the American nun Dorothy Stang in 2006. It had involved the mobilization of the federal government, the connection of the Catholic Church with peasant smallholders in conflict with latifundiários. The failure of the state to do anything – to map or properly administer cases – had been argued to be the cause of Sister Dorothy's assassination.

In this dissertation I have pointed out this invisibility of agroecological alternatives to the frontier or 'common sense' approach to deforestation *as* development. I have also argued that to counter such invisibility and show how an emergent alternative land system works, one needs to employ mixed methods across different scales of observations and relationships: land cover change, labor phenomenology, sensory ethnobotany, botanical history, ideological and development aspirations. I mention all this because of the difficulty of bridging binary divides in how the Amazon continues to be identified and 'promoted', by NGO and media outlets appealing to global publics. The reality on the ground across most of the region is messy and complex – situations that do not fit the idea of an Indigenous 'ontology' confronted by the West – but where the latter strangely serves to recast a nature culture divide. The reality of social life was that it often involved detribalized peoples, smallholders, rapidly growing towns and cities with disastrous planning,

urban dwelling Indigenous peoples, across a mess of development and associated conflicts across the larger Transamazon / Xingu subregion. For example, the Belo Monte dam project – successfully blocked in 1989 based on Kayapó Indigenous mobilization tied to international attention – was finally cemented into place in 2015, based on the same planning, and involving the same chief engineer. The aftermath of Belo Monte had morphed into a horridly bureaucratic set of impact mitigation plans combined with ongoing industrial ambitions, in the form of the mining giant Belo Sun, which plans to excavate the entire *volta grande* (big bend) area of the Xingu. Brazilian local political interests swoon toward dreams of large-scale industrial development, shiny pickup trucks, hermetically sealed houses blasting air conditioning, with the whine of commercially styled Sertanejo Universitário music.

But everywhere there were cracks in this drive toward almost 'millenarian' development regime of *boi, bala e biblia* (cattle, bullets and bibles). Agrarian worlds, I have argued in this dissertation, could also be 'forest' – could also be connected with nature, given a system of labor and a scale of interaction that could draw people into contact with the land. But in 'developed' Altamira, it was hard to approach. Asphalted roads lead out across vast pasture to the north, west and east – these pastures scoured landscapes still had the scrub of remaining 'living dead' Brazil nut trees, babaçu palms, and thickets here and there… A few *igarapes* – slow moving streams, in bottomlands rife with açai palms. But, if one found one's way out along the Transamazon, there were hundreds, thousands, of waterways and forest patches snaking through the landscape. If one determined to plant trees and stand by them

commercially, to have the patience – because one had to wait four years for fruit to produce – there a logic came in, a task. The commercial orientation of cacao was tied to a global commodity market, but because in this region it occupies such small areas compared to cattle ranching — nowhere was cacao farming impinging on indigenous territory. At this scale, it was not a frontier, but 'social', focused on 'living balanced' – which seemed to be a shared attitude amongst many of the farmers I got to know, such as for Edileia and Israel in chapter seven. If they were planting trees on medium fertility soils, this attitude seemed to flourish. But if they were on the high fertility soil, connected to the state's original credit incentive plans for cacao – cacao sometimes got out of balance, as I have described in chapter five.

But while alternative agrarian systems to the frontier existed, they were strangely criminalized by the state, for small scale deforestation and fire events. The state emits fines for burning areas of, say, one to ten hectares, intended for establishing cacao agroforests. This is dwarfed by the scales at which regional cattle ranching operations get consolidated, at hundreds to thousands of hectares. But while the former system could support livelihood connected regrowth and restoration; the latter did not. Notwithstanding, any deforestation, any use of fire, was identical, no matter the scale.

Similarly, the Ministry of Labor was challenged in understanding or placing the phenomenon of sharecropping in Medicilândia. For months, before I had first met him, I had heard about Rogério – radio announcer and savant, Godless anarchist, rebel soul and so on--had come into conflict with the state. I heard the story at Jorge's

general store, where the walls and posts adorned with images of *Nossa Senhora Nazaré*, the account managed by ink pen on paper, where anything could be procured: from tree oils, to tools, to plastic sacks for seedlings. Here, I return to accompany Rogério in his soft spoken but clear confrontation with the state's framing of rural relations.

When I had first arrived at Rogério's lot, I was struck by the images on the wall, pictures of painted jaguars next to a framed picture of Karl Marx. Marx? Here? Rogério it turned out had been targeted by the federal Ministry of Labor for 'slave labor' on his land. With modern day slavery still existing in the region, federal agents around 2012 had been combing databases and records looking for abuses – these could sometimes be found on larger cattle operations in the region. At Rogério's lot on km 95 south, the visiting agent had been flabbergasted – you have 18 families living on this lot. Just in this small area?

Rogério, who celebrated Black identity, had fled landholder oppression in Ceará, migrated thousands of kilometers by water and land, and now worked with sharecropping families using 5-year duration contracts, with housing provided. But the state had told him he was now an agent of 'slavery', because their agents could not understand the lack of wage receipts and taxes paid, combined with numerous humans residing on the lot. After the fiasco of being forced into the sugarcane system, and then abruptly thrown into debt by the state –- here again was another fiasco… So, what is this? Rogério asked the state agent. Well, sir, you appear to be holding slaves here on your property. Slaves?

At once, Rogério rented a bus – if there were to be any way to confront the state on its bureaucratic identification of this situation, they would have to go, collectively to the Ministry of Labor to get them to see. Members from eighteen sharecropping families got on, and they drove the 90 kilometers into Altamira. There, at the Ministry of Labor, Rogério and the families piled in, and were granted an audience. Families provided testimonials on their livelihood and their rights –- no, they were no obligated to stay on the property and could cancel their contract at any time. Their homes had electricity and running water. They were not in debt to the landowner, there were no 'company stores' throwing them into hopeless arrears. They transacted cacao with a middleman merchant in town, the scales were legible and fair, and they received 50% of the market price.

Rogério addressed the magistrate: "*Doutor*, if I am doing something wrong here, I ask then that you divide up this land with these families." Here was a challenge to the state, and on the state's own ostensible terms. Show me the injustice, said Rogério. This situation did lead to significant change. The complex phenomenon of sharecropping in Medicilândia was recognized by the state; clear regulations were then established for sharecropper housing and other conditions. While the institution could involve exploitative or absent landlords, many sharecropping situations that I saw were part of the social fabric of the community, a way of 'holding on', and could allow for combined livelihoods (such as for Avani). Many former sharecroppers, like Bugue and Israel, transitioned into smallholding. While, as argued by Andrei in chapter one, splitting up land would be 'real' agrarian reform, many rural actors like

Rogério thought deeply about the ethics of these relationships, and were in solidarity with the families with which they worked. Sharecropping is a complex topic – and a potential source of injustice. But it could also be seen as the one feasible option that remained for land holders who had been led astray by the state with sugarcane and thrown into significant debt.

Social change, ecological phenomena and systems questions

While we have come up on a difficult planetary time, the question is hardly ever asked: what is the role of labor in cooling the planet, and in saving us from ourselves? Labor, work and production – with their Marxist connotations – have long been dissonant with the cosmological or ontological framing of indigenous worlds, or with the ethnobiological / ethnoecological exploration of biodiversity, or, more recently, even with the issue of the Anthropocene. But how could labor processes have anything to do with the environment at the 'scale' of global environmental change? Indeed, what is the relationship of political ecology (and political economy) with a phenomenology of the environment? How does agrarian change become a question of forest (or other system) relations?

Debates about 'peasantries' in the twentieth century involved the recognition of the social, cultural and economic position of vast numbers of humans in world history (e.g. Wolf 1966, Paige 1975). And yet, one of the principal questions involved what this broad social category had to say about societal *change*, how agrarian communities were variously organized and interacted within broader political

economies and through class struggles within the state. But on the other hand – for scholars like Mintz – peasants were a way to conceive of the history of communities *after* plantations and *after* slavery. Peasants were thus a category – not of the *pre-modern* – but of the reconstituted character of human survival and autonomy after the breakdown of Caribbean systems of exploitation. "When we speak of Afro-American cultures, we are speaking of disturbed pasts, but those pasts were carried by successive generations, each dealing with the daily challenges of oppression… the glory of Afro-Americana inheres in the durable fiber of humanity, in the face of what surely must have been the most repressive epoch in modern world history." (Mintz 1989: 14). Villages on Jamaica and in Haiti were never peripheral figurations of state or economic domination, as they are manifestations of cultures that have emerged in the wake of slavery. The point is that for Mintz the 'peasant' did not live in a moral economic universe, defined by expectation of traditional balances between landlords and tenants – but a restructuring of agrarian relations altogether. For Mintz, the peasant was not a category defined in terms of being 'pre' to the modern or to capitalism, but in terms of reemergence beyond the colonial state and *after* capitalist plantations.

With four centuries of slavery in the Americas, the word plantation invokes race on landscapes (or urbanscapes). So, when plantations and patches are treated as an ecological metaphor for social relations in the contemporary – what are the risks? First, the contemporary 'plantation' in its ecological disturbances – i.e. the issue of large scale land acquisitions, mechanized agriculture – are an entirely different matter

than that of human enslavement. But further, if we treat agrarian relations surrounding landlords and peasants in capitalist peripheries as one of 'moral economies', I suggest, we lose the profound political economic and social change framings that informed Mintz (and others') work on Caribbean transformations, Fairhead and Leach's uncovering of ethnobiologies, or Carney's work on gendered agrarian change (Carney 1993), as transformative cultures.

What is the role of alternative smallholder land use in a context of global environmental change? For the anthropology of the environment, crossovers between human with more than human agency have been proposed as an alternative way of looking at socio-ecological heterogeneity and how pockets of sustainability manage to exist, for example, in the work of Anna Tsing. Let's consider how Tsing and colleagues' work on 'patchiness' is in resistance to plantation capitalist uniformity. Perfecto (2009), for example, in thinking about the situation of global land use and agriculture in the tropics, show how a critical landscape ecology and patchiness is good to think with. This is because many if not most inhabited landscapes – especially in the tropics – are mixtures between pure simplification and late successional ecologies. A critical landscape ecology is concerned with the sustaining role of landscape patches – a spatial model of comparison in analyzing ecological heterogeneity and the overall habitat affordances of geographical areas.

While the ecological concept of patch is one thing, the term 'patch' has been brought in as a heuristic for describing diversities of life, cosmologies and 'systems' (Tsing et al. 2019). For Tsing, for example, the idea of the 'patch' serves as a

landscape structural model for looking at forms of analytical unity, and in terms of thinking with the diversity of these forms. But on the other hand, there is, inevitably a 'patchiness' to plantations themselves, and to their environs, which allow for zones of escape, for uncontrollability and nonconformity. The idea of patch challenges capitalist histories through cultural contingency and contention (Tsing 2015: 134). Thus, thinking through patches, we can see messiness and transcendence of the dominant utilitarian models of capitalism. In conversation with an ecological model of patchiness, we can appreciate both human and nonhuman heterogeneity in landscapes and the resilience of organisms, and life connectedness.

But while critical 'patch ecology' study of landscapes reveals ecological heterogeneity, when the 'patch' becomes a model for social systems on landscapes – we are confronted by the nexus of scalability (capitalism) with nonscalability, but where capitalism is left more or less ongoing. Viewing the capitalist center through the unruly periphery, we risk setting up a fuzzy dichotomy, akin to James Scott's model of the evolution of states on landscapes in tension with traditional ways of land use, such as swiddens in upland Southeast Asia. This is narrative brilliance; but it can be analytically limited.

Somewhat as Tsing's model of patchiness is in tension with global processes of capitalist accumulation, the household moral economy of peasants casts rural residents as peripherals to state centers. While Tsing's model relies on a *spatial* metaphor of patchiness, with Nature agency that upends Man history, the moral economic idea about agrarian tradition, involves a *temporal* dichotomy about the

'pre-modern' in resistance to the modern (Roseberry 1989). James Scott's narrative model poses the social illegibility of hinterlands; Tsing's narrative model poses the riotous ferality of Nature. However, if Nature is to transcend human history, however, we are left wondering about the implications for politics and society, notwithstanding calls for ontological anarchism (Tsing et al. 2019).

If patches are a unit of analysis in systems thinking, we need to ask – what are the relationship across scales, and where are the structural differences in change pathways? Here we risk getting lost in the weeds. For example, plantations are also patches. Coal fired power plants – also patches; suburban developments –- also patches; swidden agroforests --- patches; satoyama forests –- patches; in other words, the usefulness of the landscape heterogeneity as a larger environmental – and political economic – method of analysis can get out of focus. Patches relating with other patches. Plantations butting up against smallholdings, except that the planation and the smallholding contract farming are in synergy. Capitalist supply chains butting up again the exchange of gifts – yet one cannot operate without the other. A patch of a power plant emitting greenhouse gases –- diffusing into the uniformity of the global atmosphere. Patches of cattle ranching of radically different sizes throughout the Brazilian Amazon, filtering into a regional slaughterhouse supply chain reaching global markets. Patchiness and uniformity. Nonscalabiliy and scalability —-- they come in and out of focus. "The farther we stray into the peripheries of capitalist production, the more coordination between polyphonic assemblages and industrial processes becomes central to making a profit." (Tsing 2015: 24). Here, socio-

ecological systems – landscape structures – are not posed in terms of alternatives; rather, plantations – as landscape structures for capitalism – act in concert with smallholder patches and more than human labor. One is left asking, is this actually socio-ecological system change? Is identifying other than human agency in a patchy Anthropocene transcendent in itself?

Therapy for my inner James Scott

The story arch of this dissertation, notwithstanding, seems to have a similar narrative construction of 'plantation and patch', ruin and resurgence, moral economic resistance, with collaboration across ecological and human spheres. Indeed, I have been accused of having an 'inner James Scott'. But the household model of peasant economics and politics, upon which Scott developed his theory of a moral economy, can be an ideological problem, leading to a framing of quotidian resistance that is 'anti-state', but which can serve to reinforce a bourgeoise politics in terms of urban rural relations (Petras and Veltmayer 2002: 45). This is precisely what I seek to avoid. While Rogério's resurgence as a rural actor was recast as 'slavery' for the modern state, his move was to try to reshape the state through an audience with the agrarian. A more nuanced view of agrarian questions and social change confronts the state on its own ostensible terms, in rural livelihood and conservation struggles – and in the relevance of humble human labor for global environmental change.

If we, for example, see the variation of land tenure and state relations, ecological conditions, and working, subjective experiences in contact with the environment, we are trying to work across scales, not to pose a dichotomy of pre-modern with modern, periphery with center, Nature with 'Man history'. Instead, we can see that have never been modern, at the same time as we are all *Naturvolken* (Orr et al. 2015). We are trying to work through issues of social change, politics, ecologies and experience. We are trying to engage how human systems couple with natural systems, and the institutional conflicts and reconfigurations that result. Rather than a

peasant seeking moral economic redress, Rogério confronted the state. The state's knowledge was itself the challenge, whereas labor and ecological relations became a matter of social change. On one hand, we have the politics of land tenure and land use; on the other, we can appreciate how labor connects with natural ecologies.

But further, if we move from landscape structures and patches to agrarian politics, the 'pre-modern' moral economy – one of Scott's principal contributions to politics – is essentially grounded on a concept of primitive households' economic preferences. It took profound influence from Chayanov, one of anthropology's key influences on 'pre-modern' substantive modes of life and livelihood. In Chayanov's model of neoclassical utility, labor is understood as 'drudgery' – something to be engaged as efficiently as possible, but which can get out of balance, switching into self-exploitation. Sahlins' *Stone Age Economics* (1972), along with Scott's use of the moral economy concept, derived from Chayanov's ideas about the decreasing utility of labor in peasant households. This concept has now been a staple in the field of agrarian studies for decades.

A confusion in contemporary peasant and agroecological studies literatures has been to reassert the Chayanov model of household balances and labor drudgery, when the model has nothing to do with agroecological interactions per se. It doesn't matter, for a moral economy, what soils are like, or how to engage/learn/change in interaction with an environment; what matters is conserving traditional entitlements – a full belly. Notwithstanding, the moral economy infuses contemporary discussions of

agrarian livelihoods, claiming a 'reinvigoration' of political economy (e.g. Besky 2014).

What is the specific consistency of smallholder agroecologies as socio-ecological systems? In anthropology, we have to go back to the twentieth century to rethink this. In Robert Netting's work on smallholders, the ecological economic organization of agriculture was posed in an entirely different matter than that of a 'patch' or a periphery, but in terms of the internal social and ecological coherence and function of land management – and how this could manage to sustain itself. Further, it was not an attempt to model 'peasants' as an occupation of the fringes of state landscapes / peripheries, but as a practical logic of human subsistence and economy, whether for the Kofyar in northern Nigeria, or for the mountain Swiss. When labor was connected to the land, agriculture could be either intensive or extensive, or could be combined. Agriculture, when attuned to labor and available sources of energy and nutrients, was sustainable, even if taking a variety of forms and involving much flux across landscapes and generations.

The problem, however, is that Netting's cultural ecology could only identify change in terms of 'adaptation': Netting's theory was based on Boserup's concept of population induced intensification. If we are interested in working across systems theory, political ecological, and phenomenological/cognitive questions, we need to take the time to work through relations within and between units of analysis. As such, in the introduction, I pointed out the challenge of methodologically connecting political, ecological and phenomenological views on the environment – these are very

different framings of the world. But while we already know that any epistemology is based on the ontological framework, the greater challenge is to take scale seriously as a matter of relations and transformations *across* systems – different realms of practice, organization and meaning – but in entering those relations and measuring how they work. Throughout this dissertation I have tried to work through how a migrant colonist world of labor and ecologies underpinned transformations of the organization of land use. In this dissertation, observational scales, social changes, and labor experiences, all needed to be brought into conversation in order to see an emergent reality.

Smallholders on the Transamazon post-frontier should not be understood as pre-modern peasants, in terms of a resisting, traditional type of life. In fact, the position of 'peasants' and a necessity of creativity in livelihood is where most human beings in the world stand today in relation to capital. Just considering the 'developed' West, we see the breakdown of wage-based employment, increasing feudalism of politics and knowledges, heightened migration pressures, and late capitalist chaos in which the coffers of the state – and currencies based on debt liquidity – are handed over to oligarchs with futuristic masturbatory dreams in space. With all this, we also have global environmental change. Work – and livelihood – is something that so many of us desperately seek, as well as the meaning and value of labor, i.e. the value theory of labor; rather than the labor theory of value (Narotzky 2018). Engaging labor, work, and production can be a manner of engaging diversity in the act. For far

too long, it has been downgraded to being some oppression of 'biopower' where production is thought to be a type of disciplinary apparatus.

But much anthropological analysis over the past 30 years has deliberately removed themselves from work and production as a mode of engagement. Harris observes that: "The shift in anthropological attention away from work and production to what is produced and how it circulates, to objects– 'things' in Appadurai's (1986) formulation – and to exchange, was consonant with broader shifts in the global political economy away from productivism of the socialist bloc to the dominance of neoliberalism, and away from labour to post-Fordism and consumption" (Harris 2007: 156).[14] It may be time to start to move back to work and production, which can certainly include cosmological and observational diversity. But it should deemphasize the enchanting materiality of things, return us to the diversity of experience, to the appropriate and ethical use of the sciences as tools, and the potentialities of system transformation.

Notwithstanding earlier framings of the region that focused on socio-biodiversity, scholars and policy institutions have come to ignore peasants, their internal diversity, and implications for biodiversity and climate adaptation, and especially in the Brazilian Amazon (de Toledo et al 2017). Social change in agrarian contexts in Brazil has often meant confronting the state on its own ostensible terms; this goes beyond framing the issue in terms of misunderstandings or bureaucratic

[14] This framing of the problem is adapted from Howard (2017)

knowledges that don't 'get' peasants; but to the reconfiguration of landscapes in adaptation that is both ecological and political in character.

The calling of a feminist or intersectional political ecology – concerned with what gets recognized in research – means that cultural anthropologists need to engage with socio-ecological systems in ways that are not simply descriptive, but participatory and which engage observational precision. Anthropologists need to learn how to measure and compare ecological interactions – not by following around scientists and other trained observers upon which they can pin narratives, but in learning for themselves. Ecological models are useful for looking at biodiversity; when used as a metaphor for social systems on landscapes, we need to work toward the resonance of *relations* within/inside/across patches. This can be resolved to some extent using through environmental history, but anthropologists can also measure relations amongst more than human and participate in actual environment making using tools that are wielded, rather than concepts/models that are 'afforded'.

Human labor can connect with more than human labor in creative ways – not as feral and unplanned outcomes of modern planning and Man history – but in terms of regenerative socio-ecologies. The role of human labor in the continental scale potential of reforestation and alternative livelihoods in the Brazilian Amazon has not been taken seriously by contemporary scholars or policy institutions. What is striking is the inability of policy institutions and conservation scientists to think with the archaeological record of anthropogenic dark earths, socio-biodiversity and agroecological intensification. For example, in a longue durée approach to Amazônia

archaeology and the phenomenon of Anthropogenic Dark Earths show vast inhabited landscapes along the rivers, which vanished after European contact. In the few areas in which mounds and other landscape artefacts remain (e.g. rock paintings) show complexity – not a rainforest soil 'limited' culture / civilization. In other words, if we take seriously the archaeological record of certain civilizations in the Americas - Teotihuacán, Amazônia – we see agriculture leading, not to irrigation despotism as in Mesopotamia – but to the fluidity of trade, craft, soil making through cool fires, forest shaping through mobility through forests and along rivers … we imagine the role of women, children, other genders, men – human diversity and labor in shaping / sustaining these lifeworlds, and, in some instances, with cacao as an indigenous commodity.

The role of human labor in everyday application of carbon to soil could be enormous, but the Brazilian Amazon has been increasingly framed as a nature-culture binary, on the one hand. On the other hand, a 'patchy Anthropocene' (Tsing et a. 2019) take on things has not been particularly serious about institutional change or human system transformations to adapt to or even mitigate global environmental change. More work needs to be done on the character of coupled natural human systems, where relations (on land, at sea) themselves are questioned, put into play over time and space, across scales. The risk – for a patchy Anthropocene approach – is that even a focus on ecological assemblages as narratives reasserts a nature culture divide, by setting world land- and water- scapes in terms of feral phenomena

that accompany frontiers, and which upend the West's (or Man's) conception of itself. Again, this is narrative and aesthetic brilliance, but it is analytically limited.

What I propose is to refocus our attention onto the overlooked multitudes of flotsam human – and more than human – worlds and their struggle for survival across both rural and urban geographies. I propose that we focus in on how human labor and connect with more than human labor – to how cultural systems of organization and practice compare and connect to large scales of global environmental change. Surely, agroecological relations in land systems involve human labor crossed with more than human labor. But to envision change in political economies that would bring about regenerative dynamics connected to the global environment, humans need to be brought back in. By bringing humans back in, and in focusing on human experience and land management – we go beyond a politics of identity or an aesthetics of the environment, to the immanence of environmental experience crossed with political economic and ecological relations. Cultural anthropologists – and especially in the U.S. – have unfortunately rooted ethnographic discourse on the aesthetic niceties of pre-modern pasts or of cosmological or biological 'others'. Such an approach, unfortunately, serves to feed bourgeois democratic imagination and a cultural elitism that accompanies late capitalism.

What I am suggesting, therefore, is that current 'narrative' impulse in contemporary ethnographic discourse weakens any concerted focus on social/agrarian change and on socio-ecological relations within forests or other ecosystems. For example, we cannot simply tell a story about how modernity and capitalism are

flawed, that states and capital variously attempt to impose discipline, or go absent – resulting in 'lively' landscapes that are bureaucratically corruptible or ecologically feral. Again, contemporary cultural anthropology – at least in the U.S. – has relied heavily on a moral economic framing for traditional agriculture that 'resists' the state, or alternatively, on peripheral nonhumans and humans that are creative in occupying 'gaps' and patches under capitalism. Neither of these essentially narrative models concern themselves with socio-ecological systems or change per se. In contrast, for example, we should ask: what is the specific consistency of human labor in coupled human natural systems? Of more than human labor? How do these function in concert, or relate one to the other? How do these relations evolve over time and in space – and how do cultures of land use emerge through political and ecological change? How we view relationships between agriculture, livelihood and nature, can consider: soils, species, foods, goods/commodities, processes, trade and value exchanges, urban-rural crossovers – in specific regions and particular social organizational contexts. Such relations involve institutions, justice questions, and ecological agency – and brings these together in a larger anthropology of the environment.

10. Appendix: Survey Instrument

SURVEY (PART 1)

LOCALIZAÇÃO DA PROPRIEDADE

Data (dia, mês, ano)
|____/__
__/____|
Entrevistador
_____
_____
Vila ou comunidade
_____ ☐ Família mais antiga ☐ Nova Família
_____
Vicinal/Travessão **ID.Propriedade** |__|__|__|
_____ GPS da Casa |__|__|__|__|__|
_____ UTM X |__|__|__|__|__|__|__|
Gleba UTM Y |__|__|__|__|__|__|__|
_____ _____
_____
Lote
_____
_____
Distância do centro urbano
_____km
Distância da estrada principal
_____km

FAMILIA E HISTORIA

1. Nome do produtor/a _____

Sexo: |__|
Estado Civil: |__|

Quantidade de membro da família (núcleo familiar e parentes)
_____

Idade da mãe _____

Número de filhas mulheres menores/= de 16 anos _____

Número de filhas mulheres maiores de 16 anos _____

Idade do pai _____

Número de filhos homens menores/= de 16 anos _____

Número de filhos homens maiores de 16 anos _____

2. Irmãos _____ na região local _____ ; Primos _____ na região local _____; Netos _____ na região local _____

3. Nascimento (estado) _____ e procedência (estado) _____

4. No seu lugar de procedência você morava em um lugar

   Rural ☐
   Urbano ☐
   Periferia urbana ☐

5. Antes de <u>trabalhar neste lote</u>, tinha que tipo de posse ou relação com terra ou propriedade:

   Meeiro ☐
   Posseiro ☐
   Lote próprio ☐
   Outra propriedade (especifique) _____
   ☐
   Sem terra ou propriedade ☐

6. Você chegou no Pará/Amazonas em que ano? _____ E a este lote, chegou que ano? _____

7. <u>Antes de trabalhar neste lote</u>, trabalhava com quais produtos & atividades? Favor de marcar todas que aplica <u>e os anos</u>:

Agricultura (lavoura branca) ☐

Quais?

Auto-consumo (sem ingresso monetário) ☐

Especifique (mandioca, feijão, arroz, produtos da lavoura branca que também são vendidos para programa de merenda escolar etc.)

Pecuária ☐

Comercializa leite/queijo ☐

Galinhas/ovos ☐

Porco ☐

Carneiro ☐

Cabra ☐

Peixe ☐

Abelhas/mel ☐

Café ☐

Cacau ☐

Guaraná ☐

Pimenta ☐

Açaí ☐

Outro produto perene (qual_____) ☐

Madeira ☐

Extrativismo (castanha ou outras frutas da mata) ☐

Caça ou pesca? ☐

Garimpagem ☐

Industria da casa / valor agregado (p.e. produtos comestíveis, costura) ☐

Rural: Comércio ☐

Rural: Emprego Público ☐

Rural: Assalariado ☐

Rural: Diarista ☐

Rural: Meeiro ☐

Rural: Autônomo ☐

Rural: Atravessador ☐

Urbano: Comércio ☐

Urbano: Empresa ☐

Urbano: Serviço Público *(p.e. professor/a)* ☐

Urbano: Assalariado ☐

Urbano: Autônomo ☐

Urbano: Atravessador ☐

Urbano: Profissional *(médico, advogado, etc.)* ☐

Benefícios sociais / bolsas ☐

Aposentado ☐

Outros (qual_____) ☐

RESIDENCE / LOCAL MOVEMENT

8. No total quantas pessoas moram o dependem economicamente do lote (inclui família, meeiros, empregados, inquilinos, filhos, outro parente, outros)

	1977	1987	1997	2007	2017
Número total de pessoas que moram/dependam do lote					

9. Quantos meses por ano mora em cada um (média/ano)?
   1. Neste lote |__|__| meses
   2. Na cidade (Qual? _____) |__|__| meses
   3. Na vila (Qual? _____) |__|__| meses
   4. Em outra propriedade/lote rural |__|__| meses

10. Se mora maior parte do ano na Propriedade Rural ou Vila
    Vai para qual cidade? (Nome da cidade)

Com que frequência você vai para a CIDADE?

☐ diária ☐ semanal

☐ quinzenal ☐ mensal ☐ anual

Meio de transporte?_____

Tempo VERAO por viagem? (só ida) _____ Tempo INVERNO (só ida) _____

Custo por viagem? (Só ida) _____

Quais são suas principais atividades na cidade? *(por exemplo: receber pensão, cuidar dos negócios, vender produtos, etc.)?*

_____,_____,

_____,_____

11. Se mora maior parte do ano na Cidade OU VILA

Com que frequência você vai para a propriedade rural? (Marque a resposta mais apropriada)

☐ diária ☐ semanal

☐ quinzenal ☐ mensal ☐ anual

Meio de transporte? _____

Tempo VERAO por viagem? (só ida)_____ Tempo INVERNO (só ida)_____

Custo por viagem *(só ida)*? _____

Quais as principais razões para a viagem (*por exemplo: cuidar do lote, abastecer a casa, visitar alguém, etc.*)?

_____, _____,

_____,_____

12. Você visita cidades maiores na região (p.e. Altamira, Santarém, Manaus, Humaitá, Porto Velho)? _____ Quantas veces por ano? ____ Quanto tempo você passa na cidade durante o ano? _____

Quais as principais razões para a viagem?

_____, _____, _____,_____

LAND CHARACTERISTICS / DOCUMENTS

13. Área dos lotes que possui atualmente (juntos)

	___ha	___ha	___ha	___ha	___ha
Datas (quais anos) com posse ou contrato para cada área					
Indicações geográficas:					
Acesso a água (1,2,3,4)**					
Qualidade da terra (1,2,3,4,5)*					
Fertilidade geral (1,2,3,4)**					

**1-Amarelo 2-Latossolo vermelho amarelo 3-Podzólico vermelho amarelo 4-Terra roxa estruturada 5-Outro*

*****1-Ruim 2-Meia 3-Boa 4- Muita Boa***

14. Quantas propriedades rurais o senhor possui dentro dos limites de Projetos de Assentamento? _____ E fora?_____

15. Como o Sr./Sra. obteve seu(s) lote(s)? (Coloca o número do lote da pergunta 20)

Recebeu ou comprou (projeto PIN) do INCRA ☐
Comprou ☐
Herança ☐
Outro (especifique) _____ ☐

16. Qual é a situação fundiária do(s) lote(s)? (Coloca o número do lote da pergunta 20)

Titulo definitivo ☐
Titulo provisório ☐
Concessão de uso (CCU) ☐
Contrato de compra ☐
Não tem documento ☐

17. Tem CAR? ☐ Não ☐ Sim. Para quais lotes? (Coloca o número do lote da pergunta 20)

18. Você dividiu ☐ ou acrescentou ☐ a área **deste lote**? *Não* ☐
Se sim, por que dividiu ou acrescentou a área do lote
_____

19. O dono/a atual tem sido o único dono/a do lote desde o início? Sim ☐ Não ☐

20. Com relação a esta propriedade rural e a outras que eventualmente possua ou venha a possuir, o senhor/a pretende *(assinale todas que se aplicam)*:

☐ Ampliar esta propriedade
☐ Comprar/Ampliar outra(s) propriedade(s) separada(s)
☐ Vender esta propriedade → ☐ mudar para a cidade/vila ☐ mudar para outra propr. rural
☐ Doar/Deixar esta propriedade para filho(s) |__| → Especifique _____
☐ Doar/Deixar outras propriedades para filho(s) |__| → Especifique _____
☐ Outros → especifique _____

Códigos para opções Doar/Deixar: 1 = dividir entre todos os filhos e filhas; 2 = dividir entre todos os filhos; 3. dividir entre todas as filhas; 4. dar para apenas um ou para alguns filhos e/ou filhas (especifique: mais novo, mais velho, solteiros, casados, etc.)

LIVEILHOODS / LABOR ARRANGEMENTS

21. Favor marcar todos os produtos/atividades que se aplicam, em ordem do tempo dedicado a eles, incluindo atividades voltadas para o auto-consumo *(principal=1, secundária=2, terceira=3, quarta = 4, quinta = 5, etc.)*

Nota: Lembrar de confirmar se praticam ou não as atividades em negrito abaixo

	Quais membros da família dedicam tempo a essa atividade/produto	Renda / ano ($R) (Se aplicável)
Agricultura (lavoura branca) ☐ Quais?		
Sell to school lunch program?		
Auto-consumo (sem ingresso monetário) ☐ Especifique (mandioca, feijão, arroz, produtos da lavoura branca que também são vendidos para programa de merenda escolar etc.)		**X**
Pecuária ☐		
Comercializa leite/queijo ☐		

Galinhas/ovos ☐		
Porco ☐		
Carneiro ☐		
Cabra ☐		
Peixe ☐		
Abelhas/mel ☐		
Café ☐		
Cacau ☐		
Guaraná ☐		
Pimenta ☐		
Açaí ☐		
Outro produto perene (qual_____) ☐		
Madeira ☐		
Extrativismo (castanha ou outras frutas da mata) ☐		
Caça ou pesca? ☐		
Garimpagem ☐		
Industria da casa / valor agregado (p.e. produtos comestíveis, costura) ☐		
Rural: Comércio ☐		
Rural: Emprego Público ☐		
Rural: Assalariado ☐		
Rural: Diarista ☐		
Rural: Meeiro ☐		
Rural: Autônomo ☐		
Rural: Atravessador ☐		
Urbano: Comércio☐		
Urbano: Empresa ☐		
Urbano: Serviço Público *(p.e. professor/a)* ☐		

Urbano: Assalariado ☐		
Urbano: Autônomo ☐		
Urbano: Atravessador ☐		
Urbano: Profissional *(médico, advogado, etc.)* ☐		
Benefícios sociais / bolsas ☐		
Aposentado ☐		
Outros (qual_____) ☐		
Alugo de casa ☐		
Alugo de terra ☐		

22. Qual o tipo e a forma de transporte mais utilizado quando vende seu produtos?

Transporte de Produtos Agrícolas: Tipo? _____Forma: |__|

Qual a unidade e o preço pago no ano de 2017? _____

Transporte de Produtos Animais: Tipo? _____

Forma: |__|

Qual a unidade e o preço pago no ano de 2017?_____

Exemplos p/ tipo de Transporte: carro, caminhão, ônibus, etc.

Códigos p/ Forma de Transporte: 1. Próprio; 2. Comprador apanha na propriedade; 3. O senhor paga o transporte; 4. Outro (qual?)

23. **Você poderia prover as seguintes informações sobre o café e o outro produto mais rentável que você comercializa? Está tudo bem se você não se lembra dos preços/quantidades exatos(as) em cada período, uma estimativa grosseira é suficiente.** *(se o entrevistado tiver muita dificuldade em estimar, deixe a célula em branco)*

Café ou outro perene (Cacau) SAF/Mono Ano em que iniciou:	**~10 anos atrás 2007**	**~5 anos atrás 2012**	**~2 anos atrás 2015**	**Agora (este ano) 2017**
Preço/unidade				Já falou acima?
Unidades produzidas/ano				
Custo dos insumos (fertilizantes, pesticidas, equipamentos, etc.)				
Mão de obra terceirizada (não a familiar)				
Como é vendido?				

(atravessador, beneficiador, mercado direto, etc.)				
DIFICULDADE RELATIVA DA LOGISTICA/ TRANSPORTAÇAO/ DISTANCIA "1" MUITO/NEGATIVO até "10" POUCO/POSITIVO				
Outro produto Ano em que iniciou:	**~10 anos atrás 2007**	**~5 anos atrás 2012**	**~2 anos atrás 2015**	**Agora (este ano) 2017**
Preço/unidade				Já falou acima?
Unidades produzidas/ano				
Custo dos insumos (fertilizantes, pesticidas, equipamentos, etc.)				
Mão de obra terceirizada (não a familiar)				
Como é vendido? (atravessador, beneficiador, mercado direto, etc.)				
DIFICULDADE RELATIVA DA LOGISTICA/ TRANSPORTAÇAO/ DISTANCIA "1" MUITO/NEGATIVO até "10" POUCO/POSITIVO				

24. O senhor/a tem se empregado para outros e foi renumerado (ganhou salários)?
    ☐ sim → quantos dias por ano? |__|__|__| Que atividades?_____
    ☐ Não

25. Tem em meia ATUALMENTE? Quais atividades?
    _____

26. Gostaríamos de saber quantas pessoas/ano trabalharam no lote (em média) ao longo dos últimos anos (família + outras pessoas). Perguntas que possam ajudar: Teve alguma época que vocês trabalhavam somente com mão de obra familiar? Em que época vocês tiveram o maior/menor número de pessoas trabalhando junto com a sua família? Anotar o número de pessoas.

	1977	1987	1997	2007	2017
Só o dono/a trabalhando no lote					
Só mão-de-obra familiar					

Meeiros					
Contratados permanentes					
Contratados temporários					

27. O senhor/a tem trabalhado em mutirão? ☐ Não ☐ Sim *Se sim,*

Quantas vezes vocês trabalharam para outros no último ano? |__|__| vezes

Quantas vezes receberam trabalho no último ano? |__|__| vezes

Para quais atividades geralmente fazem mutirão?

_____

Quanto teria pago pelo mesmo tipo de trabalho recebido em mutirão? R$ ___ pessoa/dia.

MANAGEMENT / TECHNOLOGY / OUTLOOKS

28. Como era/é a composição dos lotes (total de todos os lotes juntos) (ha)

	1977	1987	1997	2007	2017
Lavoura branca (p.e. cana)					
Perene (café) **ha / # pê / espaçamento**					
Perene (cacau) **ha / # pê / espaçamento**					
Perene (outro _____) **ha / # pê / espaçamento**					
Perene (outro _____) **ha / # pê / espaçamento**					
Pastagem útil					
Juquira					
Plantações de árvores					
Mata virgem					
TOTAL IGUAL A AREA LOTES	Suma=	Suma=	Suma=	Suma=	Suma=

29. Você implanta as novas áreas de lavouras sobre

Juquira baixa (<5 anos) ☐

Juquira media (5-15 anos) ☐
Juquira alta (>15 anos) ☐
Mata virgem ☐

30. O senhor usou/usa que tipo de tecnologia?

Passado	*Atualmente*		*há quantos anos usa?*
☐	☐	Faz uso de fogo	|__|__| A cada |__|__| anos
☐	☐	Tração animal grade	|__|__| *Próprio* ? ☐ Sim ☐ Não
☐	☐	Tração animal arado	|__|__| *Próprio* ? ☐ Sim ☐ Não
☐	☐	Tração animal carreta	|__|__| *Próprio* ? ☐ Sim ☐ Não
☐	☐	Caminhão	|__|__| *Próprio* ? ☐ Sim ☐ Não
☐	☐	Trator	|__|__| *Próprio* ? ☐ Sim ☐ Não
☐	☐	Grade	|__|__| *Próprio* ? ☐ Sim ☐ Não
☐	☐	Arado	|__|__| *Próprio* ? ☐ Sim ☐ Não
☐	☐	Carreta	|__|__| *Próprio* ? ☐ Sim ☐ Não
☐	☐	Motosserra	|__|__| *Próprio* ? ☐ Sim ☐ Não
☐	☐	Motor	|__|__| *Próprio* ? ☐ Sim ☐ Não
☐	☐	Gerador	|__|__| *Próprio* ? ☐ Sim ☐ Não
☐	☐	Foice e machado	|__|__| *Próprio* ? ☐ Sim ☐ Não
☐	☐	Roçadeira	|__|__| *Próprio* ? ☐ Sim ☐ Não
☐	☐	Plantadeira manual	|__|__| *Próprio* ? ☐ Sim ☐ Não
☐	☐	Inseticida	|__|__| Vezes ao ano: |__| Qtde? _____ Onde? _____
☐	☐	Fungicida	|__|__| Vezes ao ano: |__| Qtde? _____ Onde? _____
☐	☐	Herbicida	|__|__| Vezes ao ano: |__| Qtde? _____ Onde? _____
☐	☐	Adubo químico	|__|__| Cada |__| anos Qtde? _____ Onde? _____
☐	☐	Adubo orgânico	|__|__| Cada |__| anos Qtde? _____ Onde? _____
☐	☐	Sal mineral	|__|__| Vezes ao ano: |__| Qtde? _____ Onde? _____
☐	☐	Remédios/vacinas p/ gado	|__|__| Vezes ao ano: |__| Qtde? _____ Onde? _____
☐	☐	Faz roçagem manual	|__|__|
☐	☐	Faz roçagem mecânica	|__|__|
☐	☐	Cercas	|__|__| Quantos metros? _____
☐	☐	Pratica a pastagem rotativa	|__|__|
☐	☐	Faz replantio de capim?	|__|__|

Que tipo?_____

Traz algum beneficio (produtividade e/ou manutenção)?_____

☐ ☐ Outros _____ |__|__|
_____
_____

31. **O senhor já plantou árvore/árvores em um de seus lotes <u>fora</u> do SAF (p.e. madeira)?**

☐ Sim ☐ não
Se sim, preencher de acordo abaixo
Espécie/Nome comum; área (ha); quantidade; espaçamento
_____;_____;_____;_____
_____;_____;_____;_____
_____;_____;_____;_____
_____;_____;_____;_____

32. **Tem alguma *área* ou *espécie de árvore* de sua propriedade que o senhor tem protegido <u>fora</u> do SAF (p.e. numa área de capoeira)?**
(Diferencie se foi crescimento espontâneo ou se a árvore já estava lá quando o produtor chegou)

☐ Sim → quais/quantos? _____
Por quê? _____
☐ Não

33. **O senhor já plantou árvore/árvores em um de seus lotes <u>dentro</u> do SAF?**

☐ Sim ☐ não
Se sim, preencher de acordo abaixo
Espécie/Nome comum; área (ha); quantidade; espaçamento
_____;_____;_____;_____
_____;_____;_____;_____
_____;_____;_____;_____
_____;_____;_____;_____

34. **Tem alguma *área* ou *espécie de árvore* de sua propriedade que o senhor tem protegido <u>dentro</u> do SAF?**
(Diferencie se foi crescimento espontâneo ou se a árvore já estava lá antes do SAF)

☐ Sim → quais/quantos? _____
Por quê? _____
☐ Não

35. Expectativas

	Pastagem	Gado	Juquira	L. Brancas	Perenes	Mata
Continuar						
Aumentar						
Diminuir*						

*se não tem e não quer ter coloca diminuir

36. Se você adquirisse um dinheiro para fazer um investimento, o que você faria?

Novas terras ☐ Pecuária ☐ Agricultura / Perenes ☐ especifique _____

Benfeitorias no lote/propriedade ☐ Viver melhor ☐

37. Se agora você teria um lote de 100 há de mata na mesma zona, quanto acha que você precisaria desmatar? ___ ha Por que?

38. O que você acha determina o NÃO uso de sistemas perenes/SAFs/produção com árvores? Marca todos que aplique.

- ☐ Falta de mão de obra
- ☐ Falta de documentos ou burocracia
- ☐ Falta de assistência técnica
- ☐ Falta de acesso ao crédito / capital
- ☐ Falta de mercado
- ☐ Distancia / custo do frete
- ☐ Tempo requerido esperar para a produção (tem que assegurar)
- ☐ Qualidade de solos

INSTITUTIONAL / FINANCIAL CONTEXT

39. Participa do sindicato de trabalhadores rurais
☐ Não ☐ Sim. Qual _____
Qualidade da participação/comunicação (1-ruim 10-ótimo) _____

40. Participa de alguma associação ou cooperativa de produtores
☐ Não ☐ Sim. Qual _____
Qualidade da participação/comunicação (1-ruim 10-ótimo) _____

41. Participa ativamente em um partido público?
☐ Não ☐ Sim. Qual _____
Qualidade da participação/comunicação (1-ruim 10-ótimo) _____

42. Você recebeu/recebe assistência técnica?
☐ Não ☐ Sim. Qual _____
Qualidade da participação/comunicação (1-ruim 10-ótimo) _____

43. Você recebeu fomento do INCRA?
☐ Não ☐ Sim. Qual _____
Qualidade da participação/comunicação (1-ruim 10-ótimo) _____

44. Você recebeu fomento sobre **marco regulatório ambiental**?

☐ Não ☐ Sim. Qual _____
Qualidade da participação/comunicação (1-ruim 10-ótimo) _____

45. Você/alguém do lote teve acesso a financiamento bancário/empréstimos?

Financiamento (FNO, Pronaf, etc.)	Ano	Quantidade (R$)	Objetivo	Devolução*

*1 = nada; 2 = <10%; 3= <50%; 4= >50%

O que aconteceu com o que você fez com os financiamentos? Prestou?
_____
_____
_____

Qualidade da participação/comunicação com o banco ou entidade prestativa
(1-ruim 10-ótimo) _____

SIT DOWN INTERVIEW (PART II)

LAND USE HISTORICAL PARTICIPATORY MAPPING SURVEY

~1987						
Mata	Lavoura/roça 1	Lavoura/roça 2	Pasto	SAFs / arvores 1	SAFs / arvores 2	Juquira

~1987						
Mata	Lavoura/roça 1	Lavoura/roça 2	Pasto	SAFs / arvores 1	SAFs / arvores 2	Juquira

~1997						
Mata	Lavoura/roça 1	Lavoura/roça 2	Pasto	SAFs / arvores 1	SAFs / arvores 2	Juquira

~1997						
Mata	Lavoura/roça 1	Lavoura/roça 2	Pasto	SAFs / arvores 1	SAFs / arvores 2	Juquira

~2007						
Mata	Lavoura/roça 1	Lavoura/roça 2	Pasto	SAFs / arvores 1	SAFs / arvores 2	Juquira

~2007						
Mata	Lavoura/roça 1	Lavoura/roça 2	Pasto	SAFs / arvores 1	SAFs / arvores 2	Juquira

~2017						
Mata	Lavoura/roça 1	Lavoura/roça 2	Pasto	SAFs / arvores 1	SAFs / arvores 2	Juquira

~2017						
Mata	Lavoura/roça 1	Lavoura/roça 2	Pasto	SAFs / arvores 1	SAFs / arvores 2	Juquira

PARTICIPATORY GRAPHING OF LABOR AND TECHNICAL

	Dias totais / ano:
dias	Colhendo
	JANEIRO DEZEMBRO
	Técnica (manual/facão, mecanizada)
	Quantas pessoas
	Mulheres
	Crianças

	Dias totais / ano:
days	Podando
	JANEIRO DEZEMBRO
	Técnica (manual/facão, mecanizada)
	Quantas pessoas
	Mulheres
	Crianças

	Dias totais / ano:
Dias mensais	Roçando
	JANEIRO DEZEMBRO
	Técnica (manual/facão, mecanizada)
	Quantas pessoas
	Mulheres
	Crianças

	Dias totais / ano:
dias	Adubando
	JANEIRO DEZEMBRO
	Técnica (manual/facão, mecanizada)
	Quantas pessoas
	Mulheres
	Crianças

	Dias totais / ano:
dias	Veneno
	JANEIRO DEZEMBRO
	Técnica (manual/facão, mecanizada)
	Quantas pessoas
	Mulheres
	Crianças

	Dias totais / ano:
dias	Trator
	JANEIRO DEZEMBRO
	Técnica (manual/facão, mecanizada)
	Quantas pessoas
	Mulheres
	Crianças

	Dias totais / ano:
dias	Corte e Queima
	JANEIRO DEZEMBRO
	Técnica (manual/facão, mecanizada)
	Quantas pessoas
	Mulheres
	Crianças

ETC incluindo outras atividades: madeira, pecuária...

11. Bibliography

Adams, Cristina, Rui Murrieta, Walter Neves, and Mark Harris, eds. 2009. *Amazon Peasant Societies in a Changing Environment*. Dordrecht: Springer Netherlands. http://link.springer.com/10.1007/978-1-4020-9283-1.

Almeida, C. T., J. F. Oliveira-Júnior, R. C. Delgado, P. Cubo, and M. C. Ramos. 2017. "Spatiotemporal Rainfall and Temperature Trends throughout the Brazilian Legal Amazon, 1973–2013." *International Journal of Climatology* 37 (4): 2013–26. https://doi.org/10.1002/joc.4831.

Almeida C. T., Oliveira-Júnior J. F., Delgado R. C., Cubo P., and Ramos M. C. 2017. "Spatiotemporal Rainfall and Temperature Trends throughout the Brazilian Legal Amazon, 1973–2013." *International Journal of Climatology* 37 (4): 2013–26. https://doi.org/10.1002/joc.4831.

Anderson, Anthony B., Peter Herman May, and Michael J. Balick. 1991. *The Subsidy from Nature: Palm Forests, Peasantry, and Development on an Amazon Frontier*. New York: Columbia University Press.

Angelsen, Arild, and David Kaimowitz. 2004. "Is Agroforestry Likely to Reduce Deforestation." *Agroforestry and Biodiversity Conservation in Tropical Landscapes. Island Press, Washington, DC*, 87–106.

Araújo Santos, Roberto, and Philippe Léna. 2010. *Desenvolvimento sustentável e sociedades na Amazônia*. Coleção Eduardo Galvão. Belém: Museu Paraense Emilio Goeldi.

Armstrong, Chelsey Geralda, Anna C. Shoemaker, Iain McKechnie, Anneli Ekblom, Péter Szabó, Paul J. Lane, Alex C. McAlvay, et al. 2017. "Anthropological Contributions to Historical Ecology: 50 Questions, Infinite Prospects." *PLOS ONE* 12 (2): e0171883. https://doi.org/10.1371/journal.pone.0171883.

Azevedo, Andrea A., Raoni Rajão, Marcelo A. Costa, Marcelo C. C. Stabile, Marcia N. Macedo, Tiago N. P. dos Reis, Ane Alencar, Britaldo S. Soares-Filho, and Rayane Pacheco. 2017. "Limits of Brazil's Forest Code as a Means to End Illegal Deforestation." *Proceedings of the National Academy of Sciences* 114 (29): 7653–58. https://doi.org/10.1073/pnas.1604768114.

Balée, W. 1994. "Footprints of the Forest: Ka'apor Ethnobotany. The Historical Ecology of Plant Utilization by an Amazonian People." *Biology and Resource Management in the Tropics Series - Columbia University Press (USA)*, 419 pp.

Balée, William. 2006. "The Research Program of Historical Ecology." *Annual Review of Anthropology* 35 (1): 75–98. https://doi.org/10.1146/annurev.anthro.35.081705.123231.

———. 2013. *Cultural Forests of the Amazon : A Historical Ecology of People and Their Landscapes*. Tuscaloosa: University of Alabama Press.

Balée, William, and Clark Erickson. 2006. *Time and Complexity in Historical Ecology: Studies in the Neotropical Lowlands*. Columbia University Press.

Barrau, Jacques. 1979. "Sur l'origine du cacaoyer, Theobroma cacao Linné, Sterculiacées." *Journal d'agriculture traditionnelle et de botanique appliquée* 26 (3): 171–80. https://doi.org/10.3406/jatba.1979.3799.

Bartley, B. G. D. 2005. *The Genetic Diversity of Cacao and Its Utilization*. Wallingford: CABI.

Batista, Evandro, Britaldo Soares-Filho, Fabiano Barbosa, Frank Merry, Juliana Davis, Richard van der Hoff, and Raoni G. Rajão. 2019. "Large-Scale Pasture Restoration May Not Be the Best Option to Reduce Greenhouse Gas Emissions in Brazil." *Environmental Research Letters* 14 (12): 125009. https://doi.org/10.1088/1748-9326/ab5139.

Batistella, Mateus, Édson Luis Bolfe, and Emilio F. Moran. 2013. "Agroforestry in Tomé-Açu: An Alternative to Pasture in the Amazon." In *Human-Environment Interactions: Current and Future Directions*, edited by Eduardo S. Brondízio and Emilio F. Moran, 321–42. Human-Environment Interactions. Dordrecht: Springer Netherlands. https://doi.org/10.1007/978-94-007-4780-7_14.

Berg, C. C., Pilar Franco Rosselli, and Diane W. Davidson. 2005. *Cecropia*. Flora Neotropica, monograph no. 94. Bronx, New York: The New York Botanical Garden.

Bernstein, Henry, and Terence J. Byres. 2001. "From Peasant Studies to Agrarian Change." *Journal of Agrarian Change* 1 (1): 1–56. https://doi.org/10.1111/1471-0366.00002.

Besky, Sarah. 2014. *The Darjeeling Distinction: Labor and Justice on Fair-Trade Tea Plantations in India*. California Studies in Food and Culture 47. Berkeley: University of California Press.

Betty J Meggers. 1971. *Amazonia: Man and Culture in a Counterfeit Paradise ,: Pbk*. Worlds of Man : Studies in Cultural Ecology. Aldine, Atherton.

Bhattarai, Anil. 2019. "Seeing Like a Farmer: Socioecological Complexity of Constructing and Maintaining Ecologically Integrated Smallholder Family Farms." Thesis. http://tspace.library.utoronto.ca/handle/1807/97328.

Blok, Anders. 2014. "Articulating Social Science in the Wild of Global Natures? On Economics and Anthropology in Transnational Environmental Politics Social Science in the Wild of Global Natures? On Economics and Anthropology in Transnational Environmental Politics." *Environment and Planning A: Economy and Space* 46 (9): 2125–42. https://doi.org/10.1068/a469.

Borem, Aluízio, M. T. G. Lopes, C. R. Clement, and H. Noda. 2012. "Domestication and Breeding: Amazonian Species."

Borras Jr, Saturnino M. Borras. 2009. "Agrarian Change and Peasant Studies: Changes, Continuities and Challenges – an Introduction." *The Journal of Peasant Studies* 36 (1): 5–31. https://doi.org/10.1080/03066150902820297.

Boserup, Ester. 1993. *The Conditions of Agricultural Growth: The Economics of Agrarian Change under Population Pressure*. London: Earthscan.

Bosma, Ulbe, Juan A. Giusti-Cordero, and G. Roger Knight. 2007. *Sugarlandia Revisited: Sugar and Colonialism in Asia and the Americas, 1800-1940*. Berghahn Books.

Botengan, Mary Ann Pollisco. 1990. "Organization of Household Labor in Agroforestry Systems: Philippine Cases." https://repository.arizona.edu/handle/10150/185236.

Braga, Daniel P. P., Frederico Domene, and Flávio B. Gandara. 2018. "Shade Trees Composition and Diversity in Cacao Agroforestry Systems of Southern Pará, Brazilian Amazon." *Agroforestry Systems*, May. https://doi.org/10.1007/s10457-018-0250-6.

Braga, Daniel Palma Perez. 2019. "How Well Can Smallholders in the Amazon Live: An Analysis of Livelihoods and Forest Conservation in Cacao- and Cattle-Based Farms in the Eastern Amazon, Brazil." Text, Universidade de São Paulo. https://doi.org/10.11606/T.11.2019.tde-22082019-101655.

Braudel, Fernand. 1958. "Histoire et Sciences Sociales: La Longue Durée." *Annales. Histoire, Sciences Sociales* 13 (4): 725–53. https://doi.org/10.3406/ahess.1958.2781.

Brenner, Neil. 2001. "The Limits to Scale? Methodological Reflections on Scalar Structuration." *Progress in Human Geography* 25 (4): 591–614.

Brondizio, Eduardo S. 2004. "Agriculture Intensification, Economic Identity, and Shared Invisibility in Amazonian Peasantry: Caboclos and Colonists in Comparative Perspective." *Culture & Agriculture* 26 (1–2): 1–24.

———. 2006. "Landscapes of the Past, Footprints of the Future: Historical Ecology and the Analysis of Land Use Change in the Amazon." In *Time and Complexity in Historical Ecology: Studies in the Neotropical Lowlands*, 365–405.

Brondízio, Eduardo S. 2008. *The Amazonian Caboclo and the Açaí Palm: Forest Farmers in the Global Market*. Advances in Economic Botany, v. 16. Bronx, N.Y: The New York Botanical Garden Press.

Brondízio, Eduardo S., Anthony Cak, Marcellus M. Caldas, Carlos Mena, Richard Bilsborrow, Celia T. Futemma, Thomas Ludewigs, Emilio F. Moran, and Mateus Batistella. 2013. "Small Farmers and Deforestation in Amazonia." In *Amazonia and Global Change*, 117–43. American Geophysical Union. http://onlinelibrary.wiley.com.oca.ucsc.edu/doi/10.1029/2008GM000737/pdf.

Brondizio, Eduardo S., and Emilio F. Moran. 2012. "Level-Dependent Deforestation Trajectories in the Brazilian Amazon from 1970 to 2001." *Population and Environment* 34 (1): 69–85. https://doi.org/10.1007/s11111-011-0159-8.

Browder, John O. 1996. "Reading Colonist Landscapes: Social Interpretations of Tropical Forest Patches in an Amazonian Agricultural Frontier." *Forest Patches in Tropical Landscapes*, 285–99.

Browder, John O., and Brian J. Godfrey. 1997. *Rainforest Cities: Urbanization, Development, and Globalization of the Brazilian Amazon*. New York: Columbia University Press.

Browder, John O., Marcos A. Pedlowski, Robert Walker, Randolph H. Wynne, Percy M. Summers, Ana Abad, Nancy Becerra-Cordoba, and Joao Mil-Homens. 2008. "Revisiting Theories of Frontier Expansion in the Brazilian Amazon: A Survey of the Colonist Farming Population in Rondônia's Post-Frontier, 1992–2002." *World Development* 36 (8): 1469–92. https://doi.org/10.1016/j.worlddev.2007.08.008.

Bunker, Stephen G. 1985. *Underdeveloping the Amazon: Extraction, Unequal Exchange, and the Failure of the Modern State*. Urbana: University of Illinois Press.

Caldas, Marcellus, Robert Walker, Eugenio Arima, Stephen Perz, Stephen Aldrich, and Cynthia Simmons. 2007. "Theorizing Land Cover and Land Use Change: The Peasant Economy of Amazonian Deforestation." *Annals of the Association of American Geographers* 97 (1): 86–110. https://doi.org/10.1111/j.1467-8306.2007.00525.x.

Calvi, Miquéias, Sebastião Augusto, and Ailton Araújo. 2010. *Diagnóstico Do Arranjo Produtivo Local Da Cultura Do Cacau No Território Da Transamazônica - Pará*. https://doi.org/10.13140/RG.2.2.19337.95847.

Campbell, Jeremy M. 2015. *Conjuring Property: Speculation and Environmental Futures in the Brazilian Amazon*. Culture, Place, and Nature. Seattle: University of Washington Press.

Carney, Judith. 1993. "Converting the Wetlands, Engendering the Environment: The Intersection of Gender with Agrarian Change in the Gambia." *Economic Geography* 69 (4): 329–48. https://doi.org/10.2307/143593.

Cassino, Mariana Franco, Rubana Palhares Alves, Carolina Levis, Jennifer Watling, André Braga Junqueira, Myrtle P. Shock, Maria Julia Ferreira, et al. 2019. "Ethnobotany and Ethnoecology Applied to Historical Ecology." In *Methods and Techniques in Ethnobiology and Ethnoecology*, edited by Ulysses Paulino Albuquerque, Reinaldo Farias Paiva de Lucena, Luiz Vital Fernandes Cruz da Cunha, and Rômulo Romeu Nóbrega Alves, 187–208. Springer Protocols Handbooks. New York, NY: Springer New York. https://doi.org/10.1007/978-1-4939-8919-5_13.

Castro, Eduardo Viveiros de. 1996. "Images of Nature and Society in Amazonian Ethnology." *Annual Review of Anthropology* 25 (January): 179–200.

Castro, Eduardo Viveiros de. 1998. “Cosmological Deixis and Amerindian Perspectivism.” *The Journal of the Royal Anthropological Institute* 4 (3): 469–88. https://doi.org/10.2307/3034157.

Chakrabarty, Dipesh. 2009. “The Climate of History: Four Theses.” *Critical Inquiry* 35 (January): 197–222. https://doi.org/10.1086/596640.

———. 2012. “Postcolonial Studies and the Challenge of Climate Change.” *New Literary History* 43 (1): 1–18. https://doi.org/10.1353/nlh.2012.0007.

Chapman, R. K., and S. de J. Soria. 1983. “Comparative Forcipomyia (Diptera, Ceratopogonidae) Pollination of Cacao in Central America and Southern Mexico.” *Revista Theobroma (Brasil) v. 13 (2) p. 129-139*.

Chayanov, A. V. 1986. *The Theory of Peasant Economy*. 1 edition. Madison, Wis: University of Wisconsin Press.

Chazdon, Robin L. 2008. “Beyond Deforestation: Restoring Forests and Ecosystem Services on Degraded Lands.” *Science* 320 (5882): 1458–60. https://doi.org/10.1126/science.1155365.

Cheesman, E. E. 1944. *Notes on the Nomenclature, Classification and Possible Relationships of Cacao Populations*. IPC Science and Technology Press {.

Cisneros, Elías, Sophie Lian Zhou, and Jan Börner. 2015. “Naming and Shaming for Conservation: Evidence from the Brazilian Amazon.” *PLOS ONE* 10 (9): e0136402. https://doi.org/10.1371/journal.pone.0136402.

Cleary, David. 1990. *Anatomy of the Amazon Gold Rush*. Basingstoke: Macmillan in association with St. Antony’s College, Oxford.

———. 1993. “After the Frontier: Problems with Political Economy in the Modern Brazilian Amazon.” *Journal of Latin American Studies* 25 (02): 331–49. https://doi.org/10.1017/S0022216X00004685.

———. 1999. *Race, Nationalism and Social Theory in Brazil: Rethinking Gilberto Freyre*. University of Oxford. Transnational Communities Programme. http://www.transcomm.ox.ac.uk/working%20papers/cleary.pdf.

———. 2001. “Towards an Environmental History of the Amazon: From Prehistory to the Nineteenth Century.” *Latin American Research Review* 36 (2): 65–96.

Clement, Charles R. 1999. “1492 and the Loss of Amazonian Crop Genetic Resources. I. The Relation between Domestication and Human Population Decline.” *Economic Botany* 53 (2): 188–202. https://doi.org/10.1007/BF02866498.

Clement, Charles R., Michelly De Cristo-Araújo, Geo Coppens D’Eeckenbrugge, Alessandro Alves Pereira, and Doriane Picanço-Rodrigues. 2010. “Origin and Domestication of Native Amazonian Crops.” *Diversity* 2 (1): 72–106. https://doi.org/10.3390/d2010072.

Clement, Charles R., William M. Denevan, Michael J. Heckenberger, André Braga Junqueira, Eduardo G. Neves, Wenceslau G. Teixeira, and William I. Woods. 2015. "The Domestication of Amazonia before European Conquest." *Proceedings of the Royal Society B: Biological Sciences* 282 (1812): 20150813. https://doi.org/10.1098/rspb.2015.0813.

CONKLIN, H. C. 1957. "Hanunoo agriculture. A report on an integral system of shifting cultivation in the Philippines. Vol. 2.," 209 pp.

Coomes, O. T., and G. J. Burt. 1997. "Indigenous Market-Oriented Agroforestry: Dissecting Local Diversity in Western Amazonia." *Agroforestry Systems* 37 (1): 27–44. https://doi.org/10.1023/A:1005834816188.

Coomes, Oliver T., and Natalie Ban. 2004. "Cultivated Plant Species Diversity in Home Gardens of an Amazonian Peasant Village in Northeastern Peru." *Economic Botany* 58 (3): 420–34. https://doi.org/10.1663/0013-0001(2004)058[0420:CPSDIH]2.0.CO;2.

Coomes, Oliver T., and Bradford L. Barham. 1997. "Rain Forest Extraction and Conservation in Amazonia." *The Geographical Journal* 163 (2): 180–88. https://doi.org/10.2307/3060181.

Coomes, Oliver T., Yoshito Takasaki, and Jeanine M. Rhemtulla. 2016. "Forests as Landscapes of Social Inequality: Tropical Forest Cover and Land Distribution among Shifting Cultivators." *Ecology and Society* 21 (3): art20. https://doi.org/10.5751/ES-08684-210320.

———. 2017. "What Fate for Swidden Agriculture under Land Constraint in Tropical Forests? Lessons from a Long-Term Study in an Amazonian Peasant Community." *Journal of Rural Studies* 54 (August): 39–51. https://doi.org/10.1016/j.jrurstud.2017.06.002.

Coq-Huelva, Daniel, Bolier Torres-Navarrete, and Carlos Bueno-Suárez. 2018. "Indigenous Worldviews and Western Conventions: Sumak Kawsay and Cocoa Production in Ecuadorian Amazonia." *Agriculture and Human Values* 35 (1): 163–79. https://doi.org/10.1007/s10460-017-9812-x.

Cosgrove, Denis. 2017. "Prospect, Perspective and the Evolution of the Landscape Idea." Environment. October 24, 2017. https://doi.org/10.4324/9781315256351-6.

Cosgrove, Denis E. 1998. *Social Formation and Symbolic Landscape*. Univ of Wisconsin Press.

Crosby, Alfred W. 2003. *The Columbian Exchange: Biological and Cultural Consequences of 1492*. Thirtieth anniversary edition. Westport, Conn: Praeger.

Cuatrecasas, José. 1964. *Cacao and Its Allies: A Taxonomic Revision of the Genus Theobroma*. Vol. 35. Smithsonian Institution.

Culic, Irina. 2016. “THE MUSHROOM AT THE END OF THE WORLD. ON THE POSSIBILITY OF LIFE IN CAPITALIST RUINS, BY ANNA LOWENHAUPT TSING, PRINCETON AND OXFORD: PRINCETON UNIVERSITY PRESS, 2015, 331 PAGES INCL. NOTES AND INDEX.” *Studia Universitatis Babes-Bolyai - Sociologia* 61 (2): 175–78.

Daly, Lewis, Katherine French, Theresa L. Miller, and Luíseach Nic Eoin. 2016. “Integrating Ontology into Ethnobotanical Research.” *Journal of Ethnobiology* 36 (1): 1–9. https://doi.org/10.2993/0278-0771-36.1.1.

Davenport, Robert Brooks, Jorge Luiz Vivan, Peter Herman May, Paulo César Nunes, Lucila Nunes de Vargas, William Leles Souza Costa, Amanda Ribeiro Oliveira, and Raoni Lucas Rajão. 2017. “Adaptive Forest Governance in Northwestern Mato Grosso, Brazil: Pilot Project Outcomes across Agrarian Reform Landscapes.” *Environmental Policy and Governance* 27 (5): 453–71. https://doi.org/10.1002/eet.1772.

Dawson, Ian K., Manuel R. Guariguata, Judy Loo, John C. Weber, Ard Lengkeek, David Bush, Jonathan Cornelius, et al. 2013. “What Is the Relevance of Smallholders’ Agroforestry Systems for Conserving Tropical Tree Species and Genetic Diversity in circa Situm, in Situ and Ex Situ Settings? A Review.” *Biodiversity and Conservation* 22 (2): 301–24. https://doi.org/10.1007/s10531-012-0429-5.

Denevan, William M. 1992. “The Pristine Myth: The Landscape of the Americas in 1492.” *Annals of the Association of American Geographers* 82 (3): 369–85. https://doi.org/10.1111/j.1467-8306.1992.tb01965.x.

Denevan, W.M., and J. M. Padoch, Christine, eds. 1987. “Swidden-Fallow Agroforestry in the Peruvian Amazon.” 5: 107 pp.

Der Coelen, Peter van, Friso Lammertse, and Lynne Richards. 2019. “Bosch to Bruegel: Uncovering Everyday Life.” *JHNA* 11 (1): 1. https://doi.org/10.5092/jhna.2019.11.1.4.

Dias, Luiz Antônio dos Santos, Júlio Pontes Barriga, Paulo Yoshio Kageyama, and Caio Márcio Vasconcellos Cordeiro de Almeida. 2003. “Variation and Its Distribution in Wild Cacao Populations from the Brazilian Amazon.” *Brazilian Archives of Biology and Technology* 46 (4): 507–14. https://doi.org/10.1590/S1516-89132003000400003.

Dove, Michael. 2011. *The Banana Tree at the Gate: A History of Marginal Peoples and Global Markets in Borneo*. Yale Agrarian Studies Series. New Haven [Conn.]: Yale University Press.

Dove, Michael R. 1983. “Theories of Swidden Agriculture, and the Political Economy of Ignorance.” *Agroforestry Systems* 1 (2): 85–99. https://doi.org/10.1007/BF00596351.

Edy, N, E K Zakaria, I Lakani, and Hasriyanti. 2019. “Forest Conversion into Cacao Agroforestry and Cacao Plantation Change the Diversity of Arbuscular Mycorrhizal Fungi.” *IOP Conference Series: Earth and Environmental Science* 270 (May): 012015. https://doi.org/10.1088/1755-1315/270/1/012015.

Engels, Friedrich. 2010. *The Origin of the Family, Private Property and the State*. Penguin UK.

Entwisle, Barbara, Paul C. Stern, National Research Council (U.S.), and National Research Council (U.S.), eds. 2005. *Population, Land Use, and Environment: Research Directions*. Washington, D.C: National Academies Press.

Erickson, Clark L. 2006. "Intensification, Political Economy, and the Farming Community; in Defense of a Bottom-up Perspective of the Past." http://repository.upenn.edu/cgi/viewcontent.cgi?article=1005&context=anthro_papers.

Evans-Pritchard, E. E. 1960. *The Nuer, a Description of the Modes of Livelihood and Political Institutions of a Nilotic People*. Oxford: At the Clarendon press.

Fairhead, James. 1996. *Misreading the African Landscape: Society and Ecology Ina Forest-Savanna Mosaic*. African Studies Series 90. Cambridge ; New York: Cambridge University Press.

Fearnside, Philip M. 1986. *Human Carrying Capacity of the Brazilian Rain-Forest*. New York: Columbia University Press.

———. 2003. "Conservation Policy in Brazilian Amazonia: Understanding the Dilemmas." *World Development* 31 (5): 757–79. https://doi.org/10.1016/S0305-750X(03)00011-1.

———. 2008. "The Roles and Movements of Actors in the Deforestation of Brazilian Amazonia." *Ecology and Society* 13 (1): art23. https://doi.org/10.5751/ES-02451-130123.

———. n.d. "Projetos de Colonização Na Amazônia Brasileira: Objetivos Conflitantes e Capacidade de Suporte Humano." Accessed March 2, 2020. https://www.academia.edu/1191191/Projetos_de_coloniza%C3%A7%C3%A3o_na_Amaz%C3%B4nia_brasileira_objetivos_conflitantes_e_capacidade_de_suporte_humano.

Fearnside, Philip Martin. 1979. "Cattle Yield Prediction for the Transamazon Highway of Brazil."

Fisher, William H. 2015. "Victims Of The Economic Miracle Forty Years Later: Brazil's Indigenous Lands In The Post-Earth Summit Era." *Urban Anthropology and Studies of Cultural Systems and World Economic Development* 44 (3/4): 197–260.

Fitzhugh, Ben, Virginia L. Butler, Kristine M. Bovy, and Michael A. Etnier. 2018. "Human Ecodynamics: A Perspective for the Study of Long-Term Change in Socioecological Systems." *Journal of Archaeological Science: Reports*, April. https://doi.org/10.1016/j.jasrep.2018.03.016.

Folke, Carl. 2006. "Resilience: The Emergence of a Perspective for Social–Ecological Systems Analyses." *Global Environmental Change*, Resilience, Vulnerability, and Adaptation: A Cross-Cutting Theme of the International Human Dimensions

Programme on Global Environmental Change, 16 (3): 253–67. https://doi.org/10.1016/j.gloenvcha.2006.04.002.

Forman, Shepard. 1975. *The Brazilian Peasantry*. New York: Columbia University Press.

Foweraker, Joe. 1981. *The Struggle for Land: A Political Economy of the Pioneer Frontier in Brazil from 1930 to the Present Day*. Cambridge Latin American Studies 39. Cambridge [Eng.] ; New York: Cambridge University Press.

Fraser, James Angus, Thiago Cardoso, Angela Steward, and Luke Parry. 2018. "Amazonian Peasant Livelihood Differentiation as Mutuality-Market Dialectics." *The Journal of Peasant Studies* 45 (7): 1382–1409. https://doi.org/10.1080/03066150.2017.1296833.

Gardner Toby A., Ferreira Joice, Barlow Jos, Lees Alexander C., Parry Luke, Vieira Ima Célia Guimarães, Berenguer Erika, et al. 2013. "A Social and Ecological Assessment of Tropical Land Uses at Multiple Scales: The Sustainable Amazon Network." *Philosophical Transactions of the Royal Society B: Biological Sciences* 368 (1619): 20120166. https://doi.org/10.1098/rstb.2012.0166.

Garrett, R. D., I. Koh, E. F. Lambin, Y. le Polain de Waroux, J. H. Kastens, and J. C. Brown. 2018. "Intensification in Agriculture-Forest Frontiers: Land Use Responses to Development and Conservation Policies in Brazil." *Global Environmental Change* 53 (November): 233–43. https://doi.org/10.1016/j.gloenvcha.2018.09.011.

Garrett, Rachael D., Toby A. Gardner, Thiago Fonseca Morello, Sebastien Marchand, Jos Barlow, Driss Ezzine de Blas, Joice Ferreira, Alexander C. Lees, and Luke Parry. 2017. "Explaining the Persistence of Low Income and Environmentally Degrading Land Uses in the Brazilian Amazon." *Ecology and Society* 22 (3). https://doi.org/10.5751/ES-09364-220327.

Geertz, Clifford. 1963. *Agricultural Involution: The Process of Ecological Change in Indonesia*. Monographs and Papers / Association of Asian Studies 11. Berkeley, Calif: Published for the Association of AsianStudies by University of California Press.

Giraldo, Omar Felipe. 2019. "Agroecology in Post-Development." In *Political Ecology of Agriculture: Agroecology and Post-Development*, edited by Omar Felipe Giraldo, 75–95. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-11824-2_5.

Godar, Javier, Emilio Jorge Tizado, and Benno Pokorny. 2012. "Who Is Responsible for Deforestation in the Amazon? A Spatially Explicit Analysis along the Transamazon Highway in Brazil." *Forest Ecology and Management* 267 (March): 58–73. https://doi.org/10.1016/j.foreco.2011.11.046.

Goody, Jack. 1958. *The Developmental Cycle in Domestic Groups*. Cambridge Papers in Social Anthropology, no. 1. Cambridge, [England]: Published for the Department of Archaeology and Anthropology at the University Press.

Gordon, Robert. 1990. “Number Eight Is False.” *National Review* 42 (6): 47–48.

Grandin, Greg. 2009. *Fordlandia: The Rise and Fall of Henry Ford’s Forgotten Jungle City*. 1st ed. New York: Metropolitan Books/Henry Holt and Co.

Greenleaf, Maron. 2019. “The Value of the Untenured Forest: Land Rights, Green Labor, and Forest Carbon in the Brazilian Amazon.” *The Journal of Peasant Studies* 0 (0): 1–20. https://doi.org/10.1080/03066150.2019.1579197.

Gregory, Gillian, and Oliver T. Coomes. 2019. “Protected Areas Fund Rural Household Dispersal to Urban Areas in Riverine Amazonia.” *Human Ecology* 47 (2): 291–301. https://doi.org/10.1007/s10745-019-0060-0.

Guariguata, Manuel R., Peter Cronkleton, Amy E. Duchelle, and Pieter A. Zuidema. 2017. “Revisiting the ‘Cornerstone of Amazonian Conservation’: A Socioecological Assessment of Brazil Nut Exploitation.” *Biodiversity and Conservation* 26 (9): 2007–27. https://doi.org/10.1007/s10531-017-1355-3.

Guedes, Gilvan R., Leah K. VanWey, James R. Hull, Mariangela Antigo, and Alisson F. Barbieri. 2014. “Poverty Dynamics, Ecological Endowments, and Land Use among Smallholders in the Brazilian Amazon.” *Social Science Research* 43 (January): 74–91. https://doi.org/10.1016/j.ssresearch.2013.09.002.

Gunderson, Lance H., and C. S. Holling, eds. 2002. *Panarchy: Understanding Transformations in Human and Natural Systems*. Washington, DC: Island Press.

Gupta, Aarti, Eva Lövbrand, Esther Turnhout, and Marjanneke J Vijge. 2012. “In Pursuit of Carbon Accountability: The Politics of REDD+ Measuring, Reporting and Verification Systems.” *Current Opinion in Environmental Sustainability*, 4/6 Climate systems, 4 (6): 726–31. https://doi.org/10.1016/j.cosust.2012.10.004.

Haraway, Donna. 2015. “Anthropocene, Capitalocene, Plantationocene, Chthulucene: Making Kin.” *Environmental Humanities* 6 (1): 159–65. https://doi.org/10.1215/22011919-3615934.

Harris, Mark, and Stephen Nugent, eds. 2004. *Some Other Amazonians: Perspectives on Modern Amazonia*. London: Institute for the Study of the Americas.

Harris, O. 2007. “What makes people work?”. in Astuti, R., Parry, J., and Stafford, C. (eds.), *Questions of Anthropology*, pp. 137-165. Oxford: Berg.

Harvey, Celia A., Oliver Komar, Robin Chazdon, Bruce G. Ferguson, Bryan Finegan, Daniel M. Griffith, MIGUEL MARTÍNEZ-RAMOS, Helda Morales, Ronald Nigh, and LORENA SOTO-PINTO. 2008. “Integrating Agricultural Landscapes with Biodiversity Conservation in the Mesoamerican Hotspot.” *Conservation Biology* 22 (1): 8–15.

Hébette, Jean. 2004. *Cruzando a fronteira: 30 anos de estudo do campesinato na Amazônia*. Editora Universitária UFPA.

Hebinck, Paul. 2018. “De-/Re-Agrarianisation: Global Perspectives.” *Journal of Rural Studies* 61 (July): 227–35. https://doi.org/10.1016/j.jrurstud.2018.04.010.

Hecht, SB. 2009. “Kayapó Savanna Management: Fire, Soils, and Forest Islands in a Threatened Biome.” In *Amazonian Dark Earths: Wim Sombroek’s Vision*, edited by William I. Woods, Wenceslau G. Teixeira, Johannes Lehmann, Christoph Steiner, Antoinette WinklerPrins, and Lilian Rebellato, 143–62. Dordrecht: Springer Netherlands. https://doi.org/10.1007/978-1-4020-9031-8_7.

Hecht, Susanna. 2010. “The New Rurality: Globalization, Peasants and the Paradoxes of Landscapes.” *Land Use Policy*, Forest transitions, 27 (2): 161–69. https://doi.org/10.1016/j.landusepol.2009.08.010.

———. 2012. “Q&A: Susanna Hecht,” October. https://escholarship.org/uc/item/4m49j56q.

Hecht, Susanna B. 1985. “Environment, Development and Politics: Capital Accumulation and the Livestock Sector in Eastern Amazonia.” *World Development* 13 (6): 663–84.

———. 1990. “‘The Fate of the Forest.’” *New York Times*, 1990, sec. Book Review.

———. 1993. “The Logic of Livestock and Deforestation in Amazonia.” *BioScience* 43 (10): 687–95. https://doi.org/10.2307/1312340.

———. 2003. “Indigenous Soil Management and the Creation of Amazonian Dark Earths: Implications of Kayapó Practice.” In *Amazonian Dark Earths: Origin Properties Management*, edited by Johannes Lehmann, Dirse C. Kern, Brund Glaser, and William I. Wodos, 355–72. Dordrecht: Springer Netherlands. https://doi.org/10.1007/1-4020-2597-1_18.

———. 2005. “Soybeans, Development and Conservation on the Amazon Frontier.” *Development & Change* 36 (2): 375–404. https://doi.org/10.1111/j.0012-155X.2005.00415.x.

———. 2014. “Forests Lost and Found in Tropical Latin America: The Woodland ‘Green Revolution.’” *The Journal of Peasant Studies* 41 (5): 877–909. https://doi.org/10.1080/03066150.2014.917371.

Hecht, Susanna B., Anthony B. Anderson, and Peter May. 1988. “The Subsidy from Nature: Shifting Cultivation, Successional Palm Forests, and Rural Development.” *Human Organization* 47 (1): 25–35.

Hecht, Susanna B., and Alexander Cockburn. 1989. *The Fate of the Forest: Developers, Destroyers, and Defenders of the Amazon*. London ; New York: Verso.

Hecht, Susanna B., Kathleen D. Morrison, and Christine Padoch, eds. 2014. *The Social Lives of Forests: Past, Present, and Future of Woodland Resurgence*. Chicago ; London: The University of Chicago Press.

Hecht, Susanna, and Alexander Cockburn. 2011. *The Fate of the Forest: Developers, Destroyers, and Defenders of the Amazon, Updated Edition*. Updated edition. Chicago ; London: The University of Chicago Press.

Hobsbawm, E. J. 1985. *Bandits*. Second edition. A Pelican Book. Harmondsworth: Penguin.

Hoelle, Jeffrey. 2014. "Cattle Culture in the Brazilian Amazon." *Human Organization* 73 (December): 363–74. https://doi.org/10.17730/humo.73.4.u61u675428341165.

———. 2015. *Rainforest Cowboys: The Rise of Ranching and Cattle Culture in Western Amazonia*. Austin, TX: University of Texas Press.

Holling, Crawford S. 1973. "Resilience and Stability of Ecological Systems." *Annual Review of Ecology and Systematics* 4 (1): 1–23.

Howard, Penny McCall. 2017. *Environment, Labour and Capitalism at Sea: "working the Ground" in Scotland*. New Ethnographies. Manchester: University Press.

Iglesias, Luis, Eduardo Salas, Humberto A. Leblanc, and Pekka Nygren. 2011. "Response of Theobroma Cacao and Inga Edulis Seedlings to Cross-Inoculated Populations of Arbuscular Mycorrhizal Fungi." *Agroforestry Systems* 83 (1): 63. https://doi.org/10.1007/s10457-011-9400-9.

Ingold, Tim. 1993. "The Temporality of the Landscape." *World Archaeology* 25 (2): 152–74. https://doi.org/10.1080/00438243.1993.9980235.

———. 2011a. *The Perception of the Environment: Essays on Livelihood, Dwelling and Skill*. Reissue edition. London ; New York: Routledge.

———. 2011b. *Being Alive: Essays on Movement, Knowledge and Description*. London ; New York: Routledge.

———. 2012. "Toward an Ecology of Materials." *Annual Review of Anthropology* 41 (1): 427–42. https://doi.org/10.1146/annurev-anthro-081309-145920.

Ingold, Tim, and Jo Lee Vergunst, eds. 2008. *Ways of Walking: Ethnography and Practice on Foot*. Anthropological Studies of Creativity and Perception. Aldershot, England ; Burlington, VT: Ashgate.

Isendahl, Christian. 2016. "Historical Ecology Coming of Age." *Reviews in Anthropology* 45 (3–4): 127–47. https://doi.org/10.1080/00938157.2016.1210962.

Jackson, Rowan C., Andrew J. Dugmore, and Felix Riede. 2018. "Rediscovering Lessons of Adaptation from the Past." *Global Environmental Change* 52 (September): 58–65. https://doi.org/10.1016/j.gloenvcha.2018.05.006.

Johnson, Allen W. 1972. "Individuality and Experimentation in Traditional Agriculture." *Human Ecology* 1 (2): 149–59. https://doi.org/10.1007/BF01531352.

Kaartinen, Timo. 2018. “Interview with Tim Ingold.” *Suomen Antropologi: Journal of the Finnish Anthropological Society* 43 (1): 51–61. https://doi.org/10.30676/jfas.v43i1.74075.

Knapp, Gregory. 1994. Review of *Review of Smallholders, Householders: Farm Families and the Ecology of Intensive, Sustainable Agriculture*, by Robert McC. Netting. *Annals of the Association of American Geographers* 84 (2): 314–17.

Kohn, Eduardo. 2013. *How Forests Think: Toward an Anthropology Beyond the Human*. 1 edition. University of California Press.

Kremen, Claire. 2015. “Reframing the Land-Sparing/Land-Sharing Debate for Biodiversity Conservation: Reframing the Land-Sparing/Land-Sharing Debate.” *Annals of the New York Academy of Sciences* 1355 (1): 52–76. https://doi.org/10.1111/nyas.12845.

Lachenaud, Philippe, and Dapeng Zhang. 2008. “Genetic Diversity and Population Structure in Wild Stands of Cacao Trees (*Theobroma Cacao* L.) in French Guiana.” *Annals of Forest Science* 65 (3): 310. https://doi.org/10.1051/forest:2008011.

Lambin, Eric F., and Patrick Meyfroidt. 2010. “Land Use Transitions: Socio-Ecological Feedback versus Socio-Economic Change.” *Land Use Policy* 27 (2): 108–18. https://doi.org/10.1016/j.landusepol.2009.09.003.

Larkin, Brian. 2013. “The Politics and Poetics of Infrastructure.” *Annual Review of Anthropology* 42 (1): 327–43. https://doi.org/10.1146/annurev-anthro-092412-155522.

Laurance, William F., José L. C. Camargo, Regina C. C. Luizão, Susan G. Laurance, Stuart L. Pimm, Emilio M. Bruna, Philip C. Stouffer, et al. 2011. “The Fate of Amazonian Forest Fragments: A 32-Year Investigation.” *Biological Conservation* 144 (1): 56–67. https://doi.org/10.1016/j.biocon.2010.09.021.

Lawrence, Anna, ed. 2000. *Forestry, Forest Users and Research: New Ways of Learning*. Wageningen, The Netherlands: ETFRN, European Tropical Forest Research Network.

Lawrence, Ted J., Richard C. Stedman, Stephen J. Morreale, and Sarah R. Taylor. 2019. “Rethinking Landscape Conservation: Linking Globalized Agriculture to Changes to Indigenous Community-Managed Landscapes.” *Tropical Conservation Science* 12 (January): 1940082919889503. https://doi.org/10.1177/1940082919889503.

Levien, Michael, Michael Watts, and Yan Hairong. 2018. “Agrarian Marxism.” *The Journal of Peasant Studies* 45 (5–6): 853–83. https://doi.org/10.1080/03066150.2018.1534101.

Li, Tania Murray. 2005. “Beyond ‘the State’ and Failed Schemes.” *American Anthropologist* 107 (3): 383–94. https://doi.org/10.1525/aa.2005.107.3.383.

———. 2014. *Land’s End: Capitalist Relations on an Indigenous Frontier*. Duke University Press Books.

Liu, Jianguo, Thomas Dietz, Stephen R. Carpenter, Marina Alberti, Carl Folke, Emilio Moran, Alice N. Pell, et al. 2007. "Complexity of Coupled Human and Natural Systems." *Science* 317 (5844): 1513–16. https://doi.org/10.1126/science.1144004.

Liverman, Diana M. and National Research Council (US) Committee on the Human Dimensions of Global Change. 1998. *People and Pixels Linking Remote Sensing and Social Science*. Washington, D.C: National Academy Press.

López-García, Daniel, Verónica García-García, Yolanda Sampedro-Ortega, Ariadna Pomar-León, Guillem Tendero-Acin, Annaïs Sastre-Morató, and Ana Correro-Humanes. 2019a. "Exploring the Contradictions of Scaling: Action Plans for Agroecological Transition in Metropolitan Environments." *Agroecology and Sustainable Food Systems*, August. http://www.tandfonline.com/doi/abs/10.1080/21683565.2019.1649783.

———. 2019b. "Exploring the Contradictions of Scaling: Action Plans for Agroecological Transition in Metropolitan Environments." *Agroecology and Sustainable Food Systems* 0 (0): 1–23. https://doi.org/10.1080/21683565.2019.1649783.

Ludewigs, Thomas. 2016. "LAND-USE DECISION MAKING, UNCERTAINTY AND EFFECTIVENESS OF LAND REFORM IN ACRE, BRAZILIAN AMAZON." *Amazônica - Revista de Antropologia* 1 (1). https://periodicos.ufpa.br/index.php/amazonica/article/view/162.

Ludewigs, Thomas, Alvaro de Oliveira D'antona, Eduardo Sonnewend Brondízio, and Scott Hetrick. 2009. "Agrarian Structure and Land-Cover Change Along the Lifespan of Three Colonization Areas in the Brazilian Amazon." *World Development* 37 (8): 1348–59. https://doi.org/10.1016/j.worlddev.2008.08.018.

Lyons, Kristina Marie. 2013. "Soil Practitioners and Vital Spaces: Agricultural Ethics and Life Processes in the Colombian Amazon." UNIVERSITY OF CALIFORNIA, DAVIS. http://gradworks.umi.com.oca.ucsc.edu/35/96/3596917.html.

———. 2014. "Soil Science, Development, and the 'Elusive Nature' of Colombia's Amazonian Plains." *The Journal of Latin American and Caribbean Anthropology* 19 (2): 212–36. https://doi.org/10.1111/jlca.12097.

———. 2016. "Decomposition as Life Politics: Soils, Selva, and Small Farmers under the Gun of the U.S.–Colombia War on Drugs." *Cultural Anthropology* 31 (1): 56–81. https://doi.org/10.14506/ca31.1.04.

MacKinnon, Danny. 2011. "Reconstructing Scale: Towards a New Scalar Politics." *Progress in Human Geography* 35 (1): 21–36. https://doi.org/10.1177/0309132510367841.

Markelova, Helen, and Ruth Meinzen-Dick. 2006. "Collective Action and Market Access for Smallholders: A Summary of Findings," January.

Mart′inez-Alier, Juan. 2002. *The Environmentalism of the Poor: A Study of Ecological Conflicts and Valuation*. Northhampton, MA: Edward Elgar Pub.

Martinez-Alier, J. 1995. “In Praise of Smallholders.” *The Journal of Peasant Studies* 23 (1): 140–48. https://doi.org/10.1080/03066159508438603.

Mathews, Andrew S. 2005. “Power/Knowledge, Power/Ignorance: Forest Fires and the State in Mexico.” *Human Ecology* 33 (6): 795–820. https://doi.org/10.1007/s10745-005-8211-x.

———. 2011. *Instituting Nature: Authority, Expertise, and Power in Mexican Forests*. Politics, Science, and the Environment Series. Cambridge, Mass: MIT Press.

———. 2018. “Landscapes and Throughscapes in Italian Forest Worlds: Thinking Dramatically about the Anthropocene.” *Cultural Anthropology* 33 (3): 386–414. https://doi.org/10.14506/ca33.3.05.

Mayer, Enrique. 2002. *The Articulated Peasant: Household Economies in the Andes*. Boulder, Colo: Westview Press.

McCracken, Stephen D., Andrea D. Siqueira, Emilio F. Moran, and Eduardo S. Brondízio. 2002. “Land Use Patterns on an Agricultural Frontier in Brazil.” *Deforestation and Land Use in the Amazon. Gainesville: University Press of Florida*, 162–92.

McCune, Nils, and Marlen Sánchez. 2019. “Teaching the Territory: Agroecological Pedagogy and Popular Movements.” *Agriculture and Human Values* 36 (3): 595–610. https://doi.org/10.1007/s10460-018-9853-9.

Melo, Jairo Baquero. 2015. “The Intersection of Race, Class, and Ethnicity in Agrarian Inequalities, Identities, and the Social Resistance of Peasants in Colombia.” *Current Sociology* 63 (7): 1017–36. https://doi.org/10.1177/0011392115586801.

Meyfroidt, P., R. Roy Chowdhury, A. de Bremond, E. C. Ellis, K. -H. Erb, T. Filatova, R. D. Garrett, et al. 2018. “Middle-Range Theories of Land System Change.” *Global Environmental Change* 53 (November): 52–67. https://doi.org/10.1016/j.gloenvcha.2018.08.006.

Miller, Robert Pritchard, and P. K. R. Nair. 2006. “Indigenous Agroforestry Systems in Amazonia: From Prehistory to Today.” *Agroforestry Systems* 66 (2): 151–64. https://doi.org/10.1007/s10457-005-6074-1.

Mintz, Sidney W. 1960. *Worker in the Cane: A Puerto Rican Life History*. Caribbean Series, 2. New Haven: Yale University Press.

———. 1973. “A Note on the Definition of Peasantries.” *The Journal of Peasant Studies* 1 (1): 91–106. https://doi.org/10.1080/03066157308437874.

———. 1985. *Sweetness and Power: The Place of Sugar in Modern History*. New York: Penguin Books.

Mintz, Sidney Wilfred. 1974. *Caribbean Transformations*. Chicago: Aldine Pub. Co.

Moore, Jason W. 2017. “The Capitalocene, Part I: On the Nature and Origins of Our Ecological Crisis.” *The Journal of Peasant Studies* 44 (3): 594–630. https://doi.org/10.1080/03066150.2016.1235036.

———. 2018. “The Capitalocene Part II: Accumulation by Appropriation and the Centrality of Unpaid Work/Energy.” *The Journal of Peasant Studies* 45 (2): 237–79. https://doi.org/10.1080/03066150.2016.1272587.

Moran, E F, E S Brondizio, J Tucker, M C Silva-Forsberg, I C Falesi, and S McCracken. n.d. “Strategies for Amazonian Forest Restoration: Evidence for Afforestation in Five Regions of the Brazilian Amazon,” 13.

Moran, Emilio F. 1981. *Developing the Amazon*. Bloomington: Indiana University Press.

Moran, Emilio F., Eduardo S. Brondizio, and S. McCracken. 2002. “Trajectories of Land Use: Soils, Succession, and Crop Choice.” *Deforestation and Land Use in the Amazon*, 193–217.

Moran, Emilio F., and Elinor Ostrom, eds. 2005a. “New Directions in Human-Environment Interactions and Land-Use/Land-Cover Research.” In *Seeing the Forest and the Trees*. The MIT Press. https://doi.org/10.7551/mitpress/6140.003.0021.

———, eds. 2005b. “Theories Underlying the Study of Human-Environment Interactions.” In *Seeing the Forest and the Trees*. The MIT Press. https://doi.org/10.7551/mitpress/6140.003.0005.

Moran, Emilio F., Elinor Ostrom, and ebrary, Inc, eds. 2005. *Seeing the Forest and the Trees: Human-Environment Interactions in Forest Ecosystems*. Cambridge, Mass: Mit Press.

Morgan, Lewis Henry. 1909. *Ancient Society; or, Researches in the Lines of Human Progress from Savagery, through Barbarism to Civilization.* Chicago: Kerr.

Muilerman, Sander, and Sietze Vellema. 2017. “Scaling Service Delivery in a Failed State: Cocoa Smallholders, Farmer Field Schools, Persistent Bureaucrats and Institutional Work in Côte d’Ivoire.” *International Journal of Agricultural Sustainability* 15 (1): 83–98. https://doi.org/10.1080/14735903.2016.1246274.

Muilerman, Sander, Seerp Wigboldus, and Cees Leeuwis. 2018. “Scaling and Institutionalization within Agricultural Innovation Systems: The Case of Cocoa Farmer Field Schools in Cameroon.” *International Journal of Agricultural Sustainability* 16 (2): 167–86. https://doi.org/10.1080/14735903.2018.1440469.

Nair, PK Ramachandran. 1993. *An Introduction to Agroforestry*. Springer Science & Business Media.

Narotzky, Susana. 2016. “Where Have All the Peasants Gone?” *Annual Review of Anthropology* 45 (1): 301–18. https://doi.org/10.1146/annurev-anthro-102215-100240.

———. 2018. “Rethinking the Concept of Labour.” *Journal of the Royal Anthropological Institute* 24 (S1): 29–43. https://doi.org/10.1111/1467-9655.12797.

Nepstad, Daniel C., William Boyd, Claudia M. Stickler, Tathiana Bezerra, and Andrea A. Azevedo. 2013. “Responding to Climate Change and the Global Land Crisis: REDD+, Market Transformation and Low-Emissions Rural Development.” *Philosophical Transactions of the Royal Society B: Biological Sciences* 368 (1619): 20120167. https://doi.org/10.1098/rstb.2012.0167.

Netting, Robert. 1993. *Smallholders, Householders: Farm Families and the Ecology of Intensive, Sustainable Agriculture*. 1 edition. Stanford, Calif: Stanford University Press.

Netting, Robert McC. 1982. “Territory, Property, and Tenure.” *Behavioral and Social Science Research: A National Resource, Part II*, 446–502.

Neves, Eduardo G., and Michael J. Heckenberger. 2019. “The Call of the Wild: Rethinking Food Production in Ancient Amazonia.” *Annual Review of Anthropology* 48 (1): null. https://doi.org/10.1146/annurev-anthro-102218-011057.

Nugent, Stephen. 1981. “Amazonia: Ecosystem and Social System.” *Man*, New Series, 16 (1): 62–74. https://doi.org/10.2307/2801975.

———. 1993. *Amazonian Caboclo Society: An Essay on Invisibility and Peasant Economy*. Explorations in Anthropology. Providence, RI: Berg.

———. 1997. “The Coordinates of Identity in Amazonia At Play in the Fields of Culture.” *Critique of Anthropology* 17 (1): 33–51. https://doi.org/10.1177/0308275X9701700103.

———. 2002. “Whither *O Campesinato* ? Historical Peasantries of Brazilian Amazonia.” *Journal of Peasant Studies* 29 (3–4): 162–89. https://doi.org/10.1080/03066150412331311059.

Nyerges, A. Endre, and Glen Martin Green. 2000. “The Ethnography of Landscape: GIS and Remote Sensing in the Study of Forest Change in West African Guinea Savanna.” *American Anthropologist* 102 (2): 271–89. https://doi.org/10.1525/aa.2000.102.2.271.

Olwig, Kenneth R. 1996. “Recovering the Substantive Nature of Landscape.” *Annals of the Association of American Geographers* 86 (4): 630–53. https://doi.org/10.1111/j.1467-8306.1996.tb01770.x.

———. 2013. “Globalism and the Enclosure of the Landscape Commons.” In *Cultural Severance and the Environment: The Ending of Traditional and Customary Practice on Commons and Landscapes Managed in Common*, edited by Ian D. Rotherham, 31–46. Environmental History. Dordrecht: Springer Netherlands. https://doi.org/10.1007/978-94-007-6159-9_3.

———. 2016. “Performing on the Landscape versus Doing Landscape: Perambulatory Practice, Sight and the Sense of Belonging.” Ways of Walking. December 5, 2016. https://doi.org/10.4324/9781315234250-13.

Orr, Yancey, J. Stephen Lansing, and Michael R. Dove. 2015. “Environmental Anthropology: Systemic Perspectives.” *Annual Review of Anthropology* 44 (1): 153–68. https://doi.org/10.1146/annurev-anthro-102214-014159.

Ostrom, E. 2009. “A General Framework for Analyzing Sustainability of Social-Ecological Systems.” *Science* 325 (5939): 419–22. https://doi.org/10.1126/science.1172133.

Pacheco, Pablo. 2009. “Smallholder Livelihoods, Wealth and Deforestation in the Eastern Amazon.” *Human Ecology* 37 (1): 27–41. https://doi.org/10.1007/s10745-009-9220-y.

Pacheco, Pablo, and Rene Poccard-Chapuis. 2012. “The Complex Evolution of Cattle Ranching Development Amid Market Integration and Policy Shifts in the Brazilian Amazon.” *Annals of the Association of American Geographers* 102 (6): 1366–90. https://doi.org/10.1080/00045608.2012.678040.

Padoch, C., A. Stewart, M. Pinedo-Vasquez, L. Putzel, and M. M. Ruiz. 2014. *Urban Residence, Rural Employment, and the Future of Amazonian Forests*. Chicago University Press,. http://www.cifor.org/library/5440/urban-residence-rural-employment-and-the-future-of-amazonian-forests/.

Padoch, Christine, Eduardo Brondizio, Sandra Costa, Miguel Pinedo-Vasquez, Robin R. Sears, Andrea Siqueira, and others. 2008. “Urban Forest and Rural Cities: Multi-Sited Households, Consumption Patterns, and Forest Resources in Amazonia.” *Ecology and Society* 13 (2): 2.

Paige, Jeffery M. 1978. *Agrarian Revolution: Social Movements and Export Agriculture in the Underdeveloped World*. 1st Free Press pbk. ed. 1978. New York: Free Press.

Patiño, Victor Manuel. 2002. *Historia y Dispersión de Los Frutales Nativos Del Neotrópico*. CIAT.

Pensky, Max. n.d. “THREE KINDS OF RUIN: HEIDEGGER, BENJAMIN, SEBALD,” 26.

Perfecto, Ivette. 2019. *Nature’s Matrix: Linking Agriculture, Biodiversity Conservation and Food Sovereignty*. Second edition. Milton Park, Abingdon, Oxon ; Routledge.

Perz, Stephen G., and David L. Skole. 2003. “Social Determinants of Secondary Forests in the Brazilian Amazon.” *Social Science Research* 32 (1): 25–60.

Perz, Stephen G., and Robert T. Walker. 2002. “Household Life Cycles and Secondary Forest Cover among Small Farm Colonists in the Amazon.” *World Development* 30 (6): 1009–27.

Petras, James, and Henry Veltmeyer. 2002. "The Peasantry and the State in Latin America: A Troubled Past, an Uncertain Future." *Journal of Peasant Studies* 29 (3–4): 41–82. https://doi.org/10.1080/03066150412331311029.

Ploeg, Jan Douwe van der. 2010. "The Peasantries of the Twenty-First Century: The Commoditisation Debate Revisited." *The Journal of Peasant Studies* 37 (1): 1–30. https://doi.org/10.1080/03066150903498721.

———. 2020. "Farmers' Upheaval, Climate Crisis and Populism." *The Journal of Peasant Studies* 0 (0): 1–17. https://doi.org/10.1080/03066150.2020.1725490.

Pokorny, B., and W. De Jong. 2015. "Smallholders and Forest Landscape Transitions: Locally Devised Development Strategies of the Tropical Americas." *International Forestry Review* 17 (1): 1–19. https://doi.org/10.1505/146554815814668981.

Pokorny, Benno, Wil de Jong, Javier Godar, Pablo Pacheco, and James Johnson. 2013. "From Large to Small: Reorienting Rural Development Policies in Response to Climate Change, Food Security and Poverty." *Forest Policy and Economics* 36 (November): 52–59. https://doi.org/10.1016/j.forpol.2013.02.009.

Polanyi, Karl. 1944. *The Great Transformation*. Boston: Beacon Press.

Porro, R., N.s.m. Porro, M.c. Menezes, and Ö. Bartholdson. 2015. "Collective Action and Forest Management: Institutional Challenges for the Environmental Agrarian Reform in Anapu, Brazilian Amazon." *International Forestry Review* 17 (s1): 20–37. https://doi.org/10.1505/146554815814668990.

Porro, Roberto. 2005. "Palms, Pastures, and Swidden Fields: The Grounded Political Ecology of 'Agro-Extractive/Shifting-Cultivator Peasants' in Maranhão, Brazil." *Human Ecology* 33 (1): 17–56. https://doi.org/10.1007/s10745-005-1654-2.

Porro, Roberto, Robert P. Miller, Marcos R. Tito, Jason A. Donovan, Jorge L. Vivan, Ralph Trancoso, Rudi F. Van Kanten, Jorge E. Grijalva, Bertha L. Ramirez, and André L. Gonçalves. 2012. "Agroforestry in the Amazon Region: A Pathway for Balancing Conservation and Development." In *Agroforestry - The Future of Global Land Use*, edited by P.K. Ramachandran Nair and Dennis Garrity, 391–428. Advances in Agroforestry. Dordrecht: Springer Netherlands. https://doi.org/10.1007/978-94-007-4676-3_20.

Posey, Darrell A., and Michael J. Balick, eds. 2006. *Human Impacts on Amazonia: The Role of Traditional Ecological Knowledge in Conservation and Development*. 1st edition. New York: Columbia University Press.

POSEY, DARRELL A., JOHN FRECHIONE, JOHN EDDINS, LUIZ FRANCELINO DA SILVA, DEBBIE MYERS, DIANE CASE, and PETER MACBEATH. 1984. "Ethnoecology as Applied Anthropology in Amazonian Development." *Human Organization* 43 (2): 95–107.

Posey, Darrell Addison. 1985. “Indigenous Management of Tropical Forest Ecosystems: The Case of the Kayapó Indians of the Brazilian Amazon.” *Agroforestry Systems* 3 (2): 139–58. https://doi.org/10.1007/BF00122640.

Posey, Darrell Addison, and William L. Balee. 1989. “Resource Management in Amazonia: Indigenous and Folk Strategies.” *Advances in Economic Botany (USA)*. http://agris.fao.org/agris-search/search.do?recordID=US9037910.

Pound, F. J. 1943. *Cacao and Witches’ Broom Disease (Marasmius Perniciosus).* AL Rhodes.

Prieto-Benavides, Oscar Oswaldo, Carlos Eulogio Belezaca-Pinargote, Washington Fernando Mora-Silva, Felipe Rafael Garcés-Fiallos, Freddy Agustín Sabando-Ávila, and Pedro Emilio Cedeño-Loja. 2012. “Identification of Arbuscular Mycorrhizal Fungi in Cocoa Agroforestry Systems in the Ecuadorian Humid Tropics.” *Agronomía Mesoamericana* 23 (2): 233–39.

Primavesi, A. 1982. *The Ecological Soil Management: Agriculture in Tropical Regions*. Nobel, São Paulo.

Radel, Claudia, Brad D. Jokisch, Birgit Schmook, Lindsey Carte, Mariel Aguilar-Støen, Kathleen Hermans, Karl Zimmerer, and Stephen Aldrich. 2019. “Migration as a Feature of Land System Transitions.” *Current Opinion in Environmental Sustainability*, Sustainability governance and transformation, 38 (June): 103–10. https://doi.org/10.1016/j.cosust.2019.05.007.

Raffles, Hugh. 2002. *In Amazonia: A Natural History*. Princeton, N.J: Princeton University Press.

Rangan, Haripriya, and Christian A. Kull. 2009. “What Makes Ecology `political’?: Rethinking `scale’ in Political Ecology.” *Progress in Human Geography* 33 (1): 28–45. https://doi.org/10.1177/0309132508090215.

Reed, James, Josh van Vianen, Jos Barlow, and Terry Sunderland. 2017. “Have Integrated Landscape Approaches Reconciled Societal and Environmental Issues in the Tropics?” *Land Use Policy* 63 (April): 481–92. https://doi.org/10.1016/j.landusepol.2017.02.021.

Rice, Robert A., and Russell Greenberg. 2000. “Cacao Cultivation and the Conservation of Biological Diversity.” *AMBIO: A Journal of the Human Environment* 29 (3): 167–73. https://doi.org/10.1579/0044-7447-29.3.167.

Richards, M. 1997. “Missing a Moving Target? Colonist Technology Development on the Amazon Frontier.” *ODI Research Study*, 110 pp.

Robbins, Paul. 2001. “Tracking Invasive Land Covers in India, or Why Our Landscapes Have Never Been Modern.” *Annals of the Association of American Geographers* 91 (4): 637–59. https://doi.org/10.1111/0004-5608.00263.

———. 2003. “Beyond Ground Truth: GIS and the Environmental Knowledge of Herders, Professional Foresters, and Other Traditional Communities.” *Human Ecology* 31 (2): 233–53.

Robbins, Paul, Ashwini Chhatre, and Krithi Karanth. 2015. “Political Ecology of Commodity Agroforests and Tropical Biodiversity.” *Conservation Letters* 8 (2): 77–85. https://doi.org/10.1111/conl.12169.

Rocheleau, Dianne. 1995. “Maps, Numbers, Text, and Context: Mixing Methods in Feminist Political Ecology.” *The Professional Geographer* 47 (4): 458–66. https://doi.org/10.1111/j.0033-0124.1995.458_h.x.

Rocheleau, Dianne, and David Edmunds. 1997. “Women, Men and Trees: Gender, Power and Property in Forest and Agrarian Landscapes.” *World Development* 25 (8): 1351–71. https://doi.org/10.1016/S0305-750X(97)00036-3.

Rojas, David. 2016. “Climate Politics in the Anthropocene and Environmentalism Beyond Nature and Culture in Brazilian Amazonia.” *PoLAR: Political and Legal Anthropology Review* 39 (1): 16–32.

Roosevelt, Anna Curtenius, ed. 1994. *Amazonian Indians from Prehistory to the Present: Anthropological Perspectives*. Tucson: University of Arizona Press.

Roseberry, William. 1983. *Coffee and Capitalism in the Venezuelan Andes*. Latin American Monographs, no. 59. Austin: University of Texas Press.

———. 1986. “The Ideology of Domestic Production.” *Labour, Capital and Society/Travail, Capital et Société*, 70–93.

———. 1989. *Anthropologies and Histories: Essays in Culture, History,and Political Economy*. New Brunswick: Rutgers University Press.

Ruf, Francois, and Goetz Schroth. 2004. “Chocolate Forests and Monocultures: A Historical Review of Cocoa Growing and Its Conflicting Role in Tropical Deforestation and Forest Conservation.” *Agroforestry and Biodiversity Conservation in Tropical Landscapes. Island Press, Washington*, 107–34.

Sahlins, Marshall. 1972. *Stone Age Economics*. Chicago: Aldine-Atherton.

Sawyer, Stephen W. 2015. “Time after Time: Narratives of the Longue Durée in the Anthropocene.” *Transatlantica. Revue d’études Américaines. American Studies Journal*, no. 1 (April). https://transatlantica.revues.org/7344?lang=en.

Sayre, Nathan F. 2005. “Ecological and Geographical Scale: Parallels and Potential for Integration , Ecolog ical and Geographical Scale: Parallels and Potential for Integration.” *Progress in Human Geography* 29 (3): 276–90. https://doi.org/10.1191/0309132505ph546oa.

Schielein, Johannes, and Jan Börner. 2018. "Recent Transformations of Land-Use and Land-Cover Dynamics across Different Deforestation Frontiers in the Brazilian Amazon." *Land Use Policy* 76 (July): 81–94. https://doi.org/10.1016/j.landusepol.2018.04.052.

Schmink, Marianne, Jeffrey Hoelle, Carlos Valério A. Gomes, and Gregory M. Thaler. 2019. "From Contested to 'Green' Frontiers in the Amazon? A Long-Term Analysis of São Félix Do Xingu, Brazil." *The Journal of Peasant Studies* 46 (2): 377–99. https://doi.org/10.1080/03066150.2017.1381841.

Schmink, Marianne, and Charles H. Wood. 1992. *Contested Frontiers in Amazonia*. New York: Columbia University Press.

Schroth, Götz. 2004. *Agroforestry and Biodiversity Conservation in Tropical Landscapes*. Island Press.

Schroth, Götz, Deborah Faria, Marcelo Araujo, Lucio Bede, Sunshine A. Van Bael, Camila R. Cassano, Leonardo C. Oliveira, and Jacques H. C. Delabie. 2011. "Conservation in Tropical Landscape Mosaics: The Case of the Cacao Landscape of Southern Bahia, Brazil." *Biodiversity and Conservation* 20 (8): 1635–54. https://doi.org/10.1007/s10531-011-0052-x.

Schroth, Götz, Gustavo A. B. da Fonseca, Celia A. Harvey, Claude Gascon, Heraldo L. Vasconcelos, and Anne-Marie N. Izac, eds. 2004. *Agroforestry and Biodiversity Conservation in Tropical Landscapes*. 1 edition. Washington: Island Press.

Schroth, Götz, Edenise Garcia, Bronson Winthrop Griscom, Wenceslau Geraldes Teixeira, and Lucyana Pereira Barros. 2016. "Commodity Production as Restoration Driver in the Brazilian Amazon? Pasture Re-Agro-Forestation with Cocoa (<Emphasis Type="Italic">Theobroma Cacao</Emphasis>) in Southern Pará." *Sustainability Science* 11 (2): 277–93. https://doi.org/10.1007/s11625-015-0330-8.

Schroth, Götz, and Celia A. Harvey. 2007. "Biodiversity Conservation in Cocoa Production Landscapes: An Overview." *Biodiversity and Conservation* 16 (8): 2237–44. https://doi.org/10.1007/s10531-007-9195-1.

Schroth, Götz, Arzhvaël Jeusset, Andrea da Silva Gomes, Ciro Tavares Florence, Núbia Aparecida Pinto Coelho, Deborah Faria, and Peter Läderach. 2016. "Climate Friendliness of Cocoa Agroforests Is Compatible with Productivity Increase." *Mitigation and Adaptation Strategies for Global Change* 21 (1): 67–80. https://doi.org/10.1007/s11027-014-9570-7.

Schwartzman, Stephan, Ane Alencar, Hilary Zarin, and Ana Paula Santos Souza. 2010. "Social Movements and Large-Scale Tropical Forest Protection on the Amazon Frontier: Conservation From Chaos." *The Journal of Environment & Development* 19 (3): 274–99. https://doi.org/10.1177/1070496510367627.

Schwartzman, Stephan, André Villas Boas, Katia Yukari Ono, Marisa Gesteira Fonseca, Juan Doblas, Barbara Zimmerman, Paulo Junqueira, et al. 2013. "The Natural and Social

History of the Indigenous Lands and Protected Areas Corridor of the Xingu River Basin." *Philosophical Transactions of the Royal Society B: Biological Sciences* 368 (1619): 20120164. https://doi.org/10.1098/rstb.2012.0164.

Scoones, Ian. 2009. "Livelihoods Perspectives and Rural Development." *The Journal of Peasant Studies* 36 (1): 171–96. https://doi.org/10.1080/03066150902820503.

Scott, James C. 1977. *The Moral Economy of the Peasant: Rebellion and Subsistence in Southeast Asia*. 8.11.1977 edition. New Haven: Yale University Press.

———. 1999. *Seeing like a State: How Certain Schemes to Improve the Human Condition Have Failed*. New Haven: Yale University Press.

———. 2009. *The Art of Not Being Governed: An Anarchist History of Upland Southeast Asia*. Yale Agrarian Studies Series. New Haven: Yale University Press.

———. 2017. *Against the Grain: A Deep History of the Earliest States*. Yale Agrarian Studies. New Haven: Yale University Press.

Serra, Anderson Borges. n.d. "PROJETO ROÇA SEM QUEIMAR: UMA EXPERIÊNCIA À LUZ DOS PRINCÍPIOS DA AGROECOLOGIA DESENVOLVIDA NA TRANSAMAZÔNICA, OESTE DO PARÁ," 4.

Seshia Galvin, Shaila. 2018. "Interspecies Relations and Agrarian Worlds." *Annual Review of Anthropology* 47 (1): 233–49. https://doi.org/10.1146/annurev-anthro-102317-050232.

Simmons, Cynthia, Robert Walker, Stephen Perz, Eugenio Arima, Stephen Aldrich, and Marcellus Caldas. 2016. "Spatial Patterns of Frontier Settlement: Balancing Conservation and Development." *Journal of Latin American Geography* 15 (1): 33–58. https://doi.org/10.1353/lag.2016.0011.

Smith, N., J. Dubois, D. Current, E. Lutz, and C. Clement. 1998. "Agroforestry Experiences in the Brazilian Amazon: Constraints and Opportunities." *Conservation and Development of Brazil's Tropical Forest Regions*, xiv + 67 pp.

Smith, Nigel J. H. 1982. *Rainforest Corridors: The Transamazon Colonization Scheme*. Berkeley: University of California Press.

———. 1999. *The Amazon River Forest: A Natural History of Plants, Animals, and People*. New York: Oxford University Press.

Smith, Nigel JH. 1978. "Agricultural Productivity along Brazil's Transamazon Highway." *Agro-Ecosystems* 4 (4): 415–32.

———. 1982. *Rainforest Corridors: The Transamazon Colonization Scheme*. Univ of California Press.

Smith, Nigel J.H., Italo C. Falesi, Paulo de T. Alvim, and Emmanuel Adilson S. Serrão. 1996. "Agroforestry Trajectories among Smallholders in the Brazilian Amazon: Innovation

and Resiliency in Pioneer and Older Settled Areas." *Ecological Economics* 18 (1): 15–27. https://doi.org/10.1016/0921-8009(95)00057-7.

Soares-Filho, Britaldo, Paulo Moutinho, Daniel Nepstad, Anthony Anderson, Hermann Rodrigues, Ricardo Garcia, Laura Dietzsch, et al. 2010. "Role of Brazilian Amazon Protected Areas in Climate Change Mitigation." *Proceedings of the National Academy of Sciences* 107 (24): 10821–26. https://doi.org/10.1073/pnas.0913048107.

Somarriba, Eduardo, and Philippe Lachenaud. 2013. "Successional Cocoa Agroforests of the Amazon–Orinoco–Guiana Shield." *Forests, Trees and Livelihoods* 22 (1): 51–59. https://doi.org/10.1080/14728028.2013.770316.

Soper, Rachel. 2020. "From Protecting Peasant Livelihoods to Essentializing Peasant Agriculture: Problematic Trends in Food Sovereignty Discourse." *The Journal of Peasant Studies* 47 (2): 265–85. https://doi.org/10.1080/03066150.2018.1543274.

Sousa, Carla da Silva, Rômulo Simões Cezar Menezes, Everardo Valadares de Sá Barreto Sampaio, Francisco de Sousa Lima, Fritz Oehl, and Leonor Costa Maia. 2013. "Arbuscular Mycorrhizal Fungi within Agroforestry and Traditional Land Use Systems in Semi-Arid Northeast Brazil." *Acta Scientiarum. Agronomy* 35 (3): 307–14. https://doi.org/10.4025/actasciagron.v35i3.16213.

Ssorin-Chaikov, Nikolai. 2015. "Sociopolitics." *Reviews in Anthropology* 44 (1): 5–27. https://doi.org/10.1080/00938157.2015.1001645.

Stephen Porder. 2013. "Iowa in the Amazon: Commentary." *The New York Times*, 2013, Late Edition (East Coast) edition. https://search.proquest.com/docview/1461319480?pq-origsite=primo.

Steward, Angela. 2013. "Reconfiguring Agrobiodiversity in the Amazon Estuary: Market Integration, the Açaí Trade and Smallholders' Management Practices in Amapá, Brazil." *Human Ecology* 41 (6): 827–40. https://doi.org/10.1007/s10745-013-9608-6.

Strang, Veronica. n.d. "Justice for All: Inconvenient Truths and Reconciliation in Human-Non-Human Relations," 24.

Szerszynski, Bronislaw. 2017. "The Anthropocene Monument: On Relating Geological and Human Time." *European Journal of Social Theory* 20 (1): 111–31. https://doi.org/10.1177/1368431016666087.

Thaler, Gregory M. 2017. "The Land Sparing Complex: Environmental Governance, Agricultural Intensification, and State Building in the Brazilian Amazon." *Annals of the American Association of Geographers* 107 (6): 1424–43. https://doi.org/10.1080/24694452.2017.1309966.

Thaler, Gregory M., Cecilia Viana, and Fabiano Toni. 2019. "From Frontier Governance to Governance Frontier: The Political Geography of Brazil's Amazon Transition." *World Development* 114 (February): 59–72. https://doi.org/10.1016/j.worlddev.2018.09.022.

Tocheva, Detelina. 2018. “Domestic Mode of Production.” In *The International Encyclopedia of Anthropology*, 1–4. American Cancer Society. https://doi.org/10.1002/9781118924396.wbiea1803.

Toledo, Peter Mann de, Eloi Dalla-Nora, Ima Célia Guimarães Vieira, Ana Paula Dutra Aguiar, and Roberto Araújo. 2017. “Development Paradigms Contributing to the Transformation of the Brazilian Amazon: Do People Matter?” *Current Opinion in Environmental Sustainability*, Open issue, part II, 26–27 (June): 77–83. https://doi.org/10.1016/j.cosust.2017.01.009.

Tsing, Anna. 2000. “The Global Situation.” *Cultural Anthropology* 15 (3): 327–60. https://doi.org/10.1525/can.2000.15.3.327.

———. 2009. “Supply Chains and the Human Condition.” *Rethinking Marxism* 21 (2): 148–76. https://doi.org/10.1080/08935690902743088.

Tsing, Anna Lowenhaupt. 2000. “Inside the Economy of Appearances.” *Public Culture* 12 (1): 115–44.

———. 2005. *Friction: An Ethnography of Global Connection*. Princeton, N.J: Princeton University Press.

———. 2012. “On NonscalabilityThe Living World Is Not Amenable to Precision-Nested Scales.” *Common Knowledge* 18 (3): 505–24. https://doi.org/10.1215/0961754X-1630424.

———. 2015. *The Mushroom at the End of the World: On the Possibility of Life in Capitalist Ruins*. Princeton: Princeton University Press.

Tsing, Anna Lowenhaupt, Andrew S. Mathews, and Nils Bubandt. 2019. “Patchy Anthropocene: Landscape Structure, Multispecies History, and the Retooling of Anthropology: An Introduction to Supplement 20.” *Current Anthropology* 60 (S20): S186–97. https://doi.org/10.1086/703391.

Turner, B.L., and Paul Robbins. 2008. “Land-Change Science and Political Ecology: Similarities, Differences, and Implications for Sustainability Science.” *Annual Review of Environment and Resources* 33 (1): 295–316. https://doi.org/10.1146/annurev.environ.33.022207.104943.

Turnhout, Esther, and Susan Boonman-Berson. 2011. “Databases, Scaling Practices, and the Globalization of Biodiversity.” *Ecology and Society* 16 (1). http://www.jstor.org/stable/26268850.

Vadjunec, Jacqueline M., Dianne Rocheleau, and others. 2009. “Beyond Forest Cover: Land Use and Biodiversity in Rubber Trail Forests of the Chico Mendes Extractive Reserve.” *Ecology and Society* 14 (2): 29.

Vanhaute, Eric. 2012. “Peasants, Peasantries and (de) Peasantization in the Capitalist World-System.” In *Routledge Handbook of World-Systems Analysis*, 313–21. Routledge.

Vanhaute, Eric, and Hanne Cottyn. 2017. “Into Their Land and Labours : A Comparative and Global Analysis of Trajectories of Peasant Transformation.” *ICAS REVIEW PAPER SERIES*, no. 8: 1–21.

VanWey, Leah K., Álvaro O. D’Antona, and Eduardo S. Brondízio. 2007. “Household Demographic Change and Land Use/Land Cover Change in the Brazilian Amazon.” *Population and Environment* 28 (3): 163–85. https://doi.org/10.1007/s11111-007-0040-y.

Veltmeyer, Henry. 2018. “Resistance, Class Struggle and Social Movements in Latin America: Contemporary Dynamics.” *The Journal of Peasant Studies* 0 (0): 1–22. https://doi.org/10.1080/03066150.2018.1493458.

Walker, Robert. 2003. “Mapping Process to Pattern in the Landscape Change of the Amazonian Frontier.” *Annals of the Association of American Geographers* 93 (2): 376–98. https://doi.org/10.1111/1467-8306.9302008.

———. 2004. “Theorizing Land-Cover and Land-Use Change: The Case of Tropical Deforestation.” *International Regional Science Review* 27 (3): 247–70. https://doi.org/10.1177/0160017604266026.

Walker, Robert, John Browder, Eugenio Arima, Cynthia Simmons, Ritaumaria Pereira, Marcellus Caldas, Ricardo Shirota, and Sergio de Zen. 2009. “Ranching and the New Global Range: Amazônia in the 21st Century.” *Geoforum* 40 (5): 732–45. https://doi.org/10.1016/j.geoforum.2008.10.009.

Walker, Robert, Scott A. Drzyzga, Yali Li, Jiaguo Qi, Marcellus Caldas, Eugenio Arima, and Dante Vergara. 2004. “A Behavioral Model of Landscape Change in the Amazon Basin: The Colonist Case.” *Ecological Applications* 14 (sp4): 299–312.

Walker, Robert, Stephen Perz, Eugenio Arima, and Cynthia Simmons. 2011. “The Transamazon Highway: Past, Present, Future.” In *Engineering Earth: The Impacts of Megaengineering Projects*, edited by Stanley D. Brunn, 569–99. Dordrecht: Springer Netherlands. https://doi.org/10.1007/978-90-481-9920-4_33.

Walker, Timothy. 2007. “Slave Labor and Chocolate in Brazil: The Culture of Cacao Plantations in Amazonia and Bahia (17th–19th Centuries).” *Food and Foodways* 15 (1–2): 75–106. https://doi.org/10.1080/07409710701260214.

Wartenberg, Ariani, Wilma Blaser, K. Janudianto, James Roshetko, Meine van Noordwijk, and Johan Six. 2018. “Farmer Perceptions of Plant–Soil Interactions Can Affect Adoption of Sustainable Management Practices in Cocoa Agroforests: A Case Study from Southeast Sulawesi.” *Ecology and Society* 23 (1). https://doi.org/10.5751/ES-09921-230118.

Whitfield, Stephen. 2017. "'More Vital to Our Future than We Realize?' Learning from Netting's Thesis on Smallholder Farming, 25 Years On." *Outlook on Agriculture* 46 (4): 258–64. https://doi.org/10.1177/0030727017744931.

Wittman, Hannah, Michael Jahi Chappell, David James Abson, Rachel Bezner Kerr, Jennifer Blesh, Jan Hanspach, Ivette Perfecto, and Joern Fischer. 2017. "A Social–Ecological Perspective on Harmonizing Food Security and Biodiversity Conservation." *Regional Environmental Change* 17 (5): 1291–1301. https://doi.org/10.1007/s10113-016-1045-9.

Wolf, Eric R. 1955. "Types of Latin American Peasantry: A Preliminary Discussion*." *American Anthropologist* 57 (3): 452–71.

———. 1966. *Peasants*. Foundations of Modern Anthropology Series. Englewood Cliffs, N.J: Prentice-Hall.

Wood, Charles H., and Roberto Porro, eds. 2002. *Deforestation and Land Use in the Amazon*. Gainesville: University Press of Florida.

Young, Allen M. 1994. *The Chocolate Tree: A Natural History of Cacao*. Smithsonian Nature Books. Washington, D.C.: Smithsonian Institution Press.

Zarrillo, Sonia, Nilesh Gaikwad, Claire Lanaud, Terry Powis, Christopher Viot, Isabelle Lesur, Olivier Fouet, et al. 2018. "The Use and Domestication of Theobroma Cacao during the Mid-Holocene in the Upper Amazon." *Nature Ecology & Evolution*, October, 1. https://doi.org/10.1038/s41559-018-0697-x.

Zee, Jerry C. 2017. "Holding Patterns: Sand and Political Time at China's Desert Shores." *Cultural Anthropology* 32 (2): 215–41. https://doi.org/10.14506/ca32.2.06.

Zimmerer, Karl S, Judith A Carney, and Steven J Vanek. 2015. "Sustainable Smallholder Intensification in Global Change? Pivotal Spatial Interactions, Gendered Livelihoods, and Agrobiodiversity." *Current Opinion in Environmental Sustainability*, Open Issue, 14 (June): 49–60. https://doi.org/10.1016/j.cosust.2015.03.004.