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Reading Colonist Landscapes

Social Factors Influencing Land Use Decisions by Small Farmers in the Brazilian Amazon

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Despite the importance of small farmers as agents of landscape change in the Amazon, surprisingly little is known about their land use decision-making processes. The nascent research literature on this subject, which includes only a handful of empirical studies, is largely informed by two underlying frameworks: the normative economic tradition and a structuralist capitalist incorporation perspective. Both frameworks tend to view land use change deterministically, reflecting the underlying logic of economic expansion that each framework interprets differently. Yet, both frameworks tend to view those land use changes as occurring in a sequence of identifiable and predictable linear stages.

The basic argument of this chapter is that both of these frameworks make poor starting points for the analysis of rural household land use decision-making. If we continue to adhere to the underlying assumptions of these frameworks, we will not move any closer to a more accurate and complete understanding of the highly heterogeneous and complex forces at work in shaping colonist landscapes. I do not propose any substitute framework; indeed I would caution against efforts to achieve any kind of unified conceptual hegemony. Rather, I urge healthy doses of both conceptual and methodological pluralism.

This chapter reviews the research literature on the dynamics of landscape change among small farmers in the Brazilian Amazon from both normative economic and capitalist incorporation perspectives. The findings of a recent comparative survey of 240 small farmers in Rondônia are presented to demonstrate the diversity of land use patterns found in this agrarian population. Finally, the household and land use histories of three

farmers during their initial settlement period are described to illustrate the range of land use strategies that farm households pursue in response to changing internal and external conditions. These findings suggest that no single theoretical framework adequately explains the variations in land use patterns observed in this population. Rather, farmers operate on the basis of a "situational rationality" in regard to land use decisions. A list of factors that probably influence those decisions is appended for future research.

The Normative Economic Tradition

Arguably the most influential movement in the analysis of land use in the Amazon arises from neoclassical economics. With its emphasis on the concepts of "rationality" and "utility maximization," the normative economic tradition (NET) asserts that farmers manage the landscape as they would any other useful resource to maximize utility constrained by exogenous (market and environmental) and endogenous (household labor) characteristics.

In its simplest form, the NET model posits that increasing capitalization of agriculture is accompanied by a generalized shift, through a series of progressive linear stages, from subsistence-oriented polycultures, based on labor-intensive temporary ground/food cropping systems, to increasingly more commercial-crop-oriented monocultures, dependent on capital-intensive mechanical and chemical inputs. In the subsistence stage, farmers are seen as risk-averse, emphasizing food security over cash income in the short term. In the commercial stage, priority is given to net financial returns on investment (profit), with a view toward long-term capital accumulation that might be invested in more lucrative activities outside of agriculture.

Predicting land use transition in Amazonian colonist communities has proven to be a tricky proposition. Jones and others (1995), using cross-sectional data from a 1991 survey of eighty-three multiproduct farms in the municipality of Ouro Preto of Rondônia, estimate the production functions of several agricultural land use activities. Their aim was not to predict specific land use sequences over time, but rather to examine the determinants of gross farm income and deforestation. The authors found evidence of increasing returns to scale in cattle. However, cattle income appears to be a "hedge" that permits more extensive cultivation of subsistence food crops rather than providing a springboard for investing in more risky perennial crops, suggesting a possible "target income" response by

farmers (183). This finding would appear to challenge the profit-maximization assumption of the NET. Moreover, the authors found that deforestation appears to be driven more strongly by crop profitability than by profitability of cattle production. While the authors affirm that "Rondonian farmers appear to be making economically thought-out land use choices"(183), consistent with NET, they concede that income maximization and capital accumulation by themselves are not the sole criteria used by farmers in making land use decisions. Once farmers earn a "target income" from one activity (for example, cattle), they diversify into other activities (for example, plant annual crops) to reduce the risk of household food scarcity.

In a study prepared under the Alternatives to Slash and Burn Program, Vosti and his colleagues (1998) sought, in part, to identify the socioeconomic and biophysical factors influencing land use patterns among small farm households in Rondônia. This cross-sectional study, drawing upon a 1995 survey of 150 households in Theobroma and Pedro Peixoto colonization projects, correlated land use, especially the trend toward pasture, with the set of household characteristics summarized in table 8.1.

The study presents some surprising findings and highlights the important point that the factors driving deforestation decisions are not always related to those that determine subsequent land use decisions. For example, the authors found that while households owning urban properties ("urban link") tended to clear more forest than those without such links, urban landownership had no significant effect on type of land use, a finding that conflicts with my own research (Browder and Godfrey 1997, 315). Educational attainment positively correlates with both deforestation and land use, favoring the transition to pasture. Farm distance from market negatively correlates with deforestation and has a predictable effect on land use in which farms closer to market specialize in perishable annual food crops while those more remote specialize in cattle. Secure land tenure positively correlates with both deforestation and land use, favoring the transition to pasture. Social participation (in farmer groups, church, and so forth) negatively correlates with deforestation.

Vosti and his colleagues (1998) also developed a linear programming model to evaluate the impacts of biophysical and economic factors on land use decisions over a twenty-five-year period, assuming the optimization of income. Although the authors do not explain how they specified a dynamic model from a cross-sectional database, they predict (in their baseline scenario) a progressive increase in areas in pasture and secondary growth, and a corresponding decrease in primary forest cover, while an-

Table 8.1. Factors affecting deforestation and land use

Factor	Deforestation Effect	Land Use Impact
Urban link	positive	none
Consumer durable goods	negative	none
Household labor	positive	none
Educational level	positive	more pasture
Off-farm income	none	fewer annuals
Forest product extraction	negative	more fallow
Distance from market	negative	positive
Secure land tenure	positive	pasture
Soil quality	negative	less pasture
Social participation	negative	—
Years in residence	positive	—
Age of farm	none	—

Source: Vosti et al. 1998.

nual and perennial crop areas remain constant. The configuration of activities that maximizes income over this time period, following their analysis, is pasture combined with annual cropping and "sustainable timber extraction." Alternative farming systems that include agroforestry as a component are dismissed by the authors as too risky, even though other survey research in Rondônia suggests that the majority of Rondônia's farmers would integrate agroforestry into their farms if certain impediments to doing so were alleviated.[1] Income generation is an important variable in land use decisions, but income maximization is not necessarily so.

Another utility maximization approach in the NET was developed by Caviglia and Kahn (n.d.) in which a discrete choice (Heckman) model is used to estimate the probability that small farmers will adopt "sustainable agriculture" in Rondônia (defined as intercropping perennials, annuals, or beekeeping versus slash-and burn). Based on a survey of 171 farmers in Ouro Preto municipality, the authors' analysis posits the decision to adopt sustainable agriculture as a dichotomous choice, based on utility (combined family income and leisure). The most significant variable determining the farmer's probability of adopting sustainable agriculture is the farmer's knowledge that sustainable agriculture exists. Social participation was also positively linked to adoption probability as was the number of years in residence on the current farm. The authors' analysis does not explicitly indicate a particular land use sequence leading to "sustainable agriculture," but it does confirm the importance of specific variables

(knowledge, social participation, and years farming) in defining the direction of land use change.

Scatena and his coauthors (1996) come the closest to developing a schematic model of the factors that influence crop and fallow sequences on small farms in the Brazilian Amazon from a NET perspective. In their 1992 survey of sixty-five landholdings near Santarém, Pará, the authors examine different general strategies that farmers have followed to maximize production and household utility. Presumably based on respondent recall, the authors diagrammatically reconstruct the sequence of land uses (in this case specific crop choices) over time from four predominant vegetation starting points: mature forest, short fallow (1–3 years), mid-length fallow (3–6 years), and long fallow (8–12 years). From these original conditions, the authors estimate the "conditional probabilities" (percentage of their sample) that farmers will elect a specific crop pathway following clearing. Examining the authors' data suggests that temporary crops (rice, beans, corn, manioc) and pasture are the most probable postfallow cropping choices. Although the number of planting cycles is not specified for each crop, it is clear that cropping choices vary somewhat depending on the existing vegetation type. Rice, the most prevalent crop in all scenarios, was planted on 88 percent of the fields cleared from mature forest, on 58 percent of the fields cleared from older fallow, on 50 percent of the mid-aged fallows, and on 45 percent of the young fallows. Manioc is usually the last crop planted before a field is retired back into fallow (Scatena et al. 1996, 35–36). Acknowledging that no single variable determines fallow length and crop selection, the authors hypothesize that several general economic and ecological factors come into play: the productivity of the landscape (soil, water, climate), costs of site preparation and agricultural treatments, land availability, labor availability, age structure of families and their subsistence requirements, and various local economic conditions (for instance, land values, credit, off-farm income, commodity markets) (37).

On the whole, researchers in the NET tend to privilege the utility maximization assumption about farmer land use behavior. One issue here is how "utility" is defined, that is, from the farmer's perspective or that of the outside economist who is likely to think in terms of gross income or some other monetary measure of productivity. Given this assumption, farmers are viewed as uniformly selecting land uses (crop choices) that will result in the highest income/productivity, and the only variability in this pattern is introduced by the differential capacity of farmers to overcome a series of exogenous and internal constraints to income maximization.

Controlling for the constraints, then, would enable the economist to predict the land use sequence. But, when asked "what is useful?" farmers often reply with a range of responses not intuitively derivable from strict economic calculus (see the appendix at the end of this chapter for a list of factors that hypothetically influence colonist land use). A comprehensive model of land use change, if one is indeed possible, must go beyond basic assumptions of the normative economic tradition.

The Capitalist Incorporation Model

Drawn largely from neo-Marxist interpretations of the global division of labor, unequal exchange, and surplus extraction, the capitalist incorporation model (CIM)—also called the "capitalist penetration model"—situates the transition from peasant forms of subsistence farming to modern, mechanized agribusiness in the milieu of labor exploitation. In the Brazilian frontier context, landless farmers are pushed into the Amazon, applying their labor value to the land by clearing forest and planting short-term subsistence crops. This initial stage of frontier settlement paves the way for subsequent "incorporation/penetration" by agribusiness and other social elites, who appropriate the labor value "congealed" in the landscape and push the peasantry off the land once again in a repeating cycle of forest destruction and social expulsion and itinerancy.

Out of this doctrine emerges a conceptual scheme of landscape transition that is based on the progressive impoverishment and victimization of the peasantry. Faced with monopolistic crop marketing agents, declining soil nutrients and crop yields, falling prices, mounting farmer debt, and household labor losses due to sickness and out-migration, peasant immiseration induces a sequence of landscape successions that further impoverishes and weakens both social and ecological systems. All of this is seen as facilitating the spread of capitalism.

Ozorio de Almeida (1992) adopts the CIM framework, but avoids explaining exactly how market expansion induces specific land use changes on peasant farms and in so doing does not situate her analysis squarely in a Marxist interpretation. Rather, based on field surveys of colonists in both private and government settlement projects in Mato Grosso, she observes four land use options following clearing of forest and planting of annual crops: intensification of annual crop production through technical inputs, or shifts to perennials, pasture, or fallow. In addition, the author employs an econometric analysis to ascertain the factors that might influence farm income, capital accumulation, and farmer mobility ("itiner-

ancy"). The author finds that "local economic and institutional" factors (nonfarm income, size of cultivated area, land title, and extension of technical assistance) explain most of the variation in household income, while "individual variables" (farm household age structure and startup costs) most strongly correlate with long-term investment and savings. Perhaps the most interesting finding concerns the role of itinerancy in promoting accumulation. Contrary to the assumption of many NET models, that farmers arrive on the land with the expectation of maximizing income from production, Ozorio de Almeida's study suggests the logic of itinerancy. For some farmers, occupying the land, clearing forest, selling out, and moving on in the short term enhances their own capital accumulation. While this reason for itinerancy is conceptually consistent with utility-oriented NET approaches, it is not a scenario that is frequently hypothesized in NET analyses. Again, while "economic rationality" clearly plays an important role in influencing farmer land use decisions, such rationality is often embedded in a more specific "situational rationality" that mediates the relative influence of economic and noneconomic forces.

Work by political ecologists Jane Collins (1986) and Susan Stonich (1995) points to the structural determinants of small farmland use change in efforts to explain the high rates of small farm failure. Although not specifying a typology of farm-level land use pathways, Collins (1986) proposes a synergistic model relating colonist differentiation (toward poverty) with processes of ecological degradation in the Brazilian Transamazon, northeast Ecuadorian Amazon, and the Tambopata Valley region of the Peruvian Amazon. Drawing upon secondary sources, namely Moran (1976, 1981), Smith (1982), and Wood and Schmink (1979), Collins notes that colonists participating in the government's Transamazon colonization program did not enter the region with comparable skills, experience, and capital, but were initially segmented into two groups, "brokers and clients," according to Moran. "Brokers were entrepreneurs or independent farmers who were able to generate their own capital and to reinvest in their enterprises. Clients depended on brokers for their access to cash and produced mainly for subsistence rather than reinvestment. Clients were subdivided by Moran into laborers and artisans depending on their antecedent economic activities" (Collins 1986, 3).

From the onset of their Amazonian experience, then, smallholders were differentiated in their capacities and access to resources, and presumably reached land use decisions on the basis of different situationally specific criteria. One would not expect to find, therefore, a single land use deci-

sion-making function applicable to most households that might be discernable from the uniforming optic of NET.

Collins's models of social and ecological cycles provide a convincing outline of a general trajectory of land use transition. She situates the driving force of these cycles in the context of the political economy of Brazilian agricultural modernization ideology, with its emphasis on cash crops (in this case an ecologically inappropriate variety of rice), induced into colonist communities of the Transamazon through short-term government loans. The challenge that Collins and others present is in accurately characterizing the migrant population as diverse from the onset and understanding that different logics of land use decision-making associated with different colonist subgroups set in motion an often unpredictable dynamic in landscape change.

So, given such diversity, how do we read colonist landscapes in the Amazon? How do we explain the dynamics of landscape change? I suggest we critically examine what deeply entrenched paradigms have to offer, carry forward what seems to work in specific local situations, and shrug off the excess theoretical baggage. But, it would behoove us to begin from a perspective of openness toward diverse possibilities—toward pluralism.

Diversity and Differentiation: Farmers of Rondônia

In this section I report selected findings of my 1992 survey of 240 farm households in three municipalities of Rondônia (Rolim de Moura [RM], Ouro Preto [OP], and Alto Paraiso [AP]), all settled about the same time (between 1981 and 1982), to illustrate the range of land use strategies followed by this seemingly homogeneous agrarian population. On the surface, these farmers appear to be homogeneous in regard to lot size (average = 80.6 hectares, standard deviation [std. dev.] = 8.0), the proportion of the sample in which owner resides full time on the farm (average = 90.7 percent, std. dev. = 1.79), the proportion of the sample that acquired their lots free through the government (average = 37.6 percent, std. dev. = 16.1), and the proportion of the sample holding definitive land titles (average = 49.6 percent, std. dev. = 9.65). In other words, the baseline survey revealed that absentee rural landownership was uncommon; most farm owners dwelled on their farms. Moreover, most farms were purchased from private landowners and speculators, not acquired through the Brazilian National Institute for Colonization and Agrarian Reform (INCRA). And, finally, half of the farmers were legal owners of their land. Beyond

Table 8.2. Land use patterns (hectares)

Variable	RM[a]	OP[b]	AP[c]	Total
Average farm size	79.6	73.5	88.7	80.2
Mean area in temporary crops	5.4	6.4	6.1	6.0
Mean area in permanent crops	3.7	6.0	12.9	8.2
Mean area in pasture	26.7	23.0	13.9	20.8
Sample size	61	97	82	240

Source: John O. Browder 1992 field survey.
a. RM = Rolim de Moura
b. OP = Ouro Preto
c. AP = Alto Paraiso

these apparent similarities, significant differences in land use, income generation, job creation, capital investment, and natural resource use emerge between these three study sites.

Land Use

Although dozens of distinctive planting regimes of various sizes and species were encountered in our 1992 field surveys, the presentation here is confined to three broad land use categories—temporary crops (maize, manioc, beans, rice), permanent crops (coffee, cocoa, rubber), and pasture (*panicum*, *brachiaria*). In 1992 significant differences in the areas planted in permanent crops and pasture existed among the three study sites. For example, farmers in Rolim de Moura had twice the area in pasture (26.7 hectares) as did farmers in Alto Paraiso (13.9 hectares), but less than one-third of the area in permanent crops, suggesting the prevalence of much more extensive low-input farming systems in Rolim de Moura than in Alto Paraiso. The areas planted in temporary crops were not significantly different among the three study sites (average = 6.0 hectares) (table 8.2). Simply stated, Rondônia's agricultural population has developed heterogeneous land use strategies.

Gross Income

The value of agricultural production in the three study sites clearly reflects the local differences in land use. The average annual farm income for 1991 was U.S.$3,172 for the sample overall. Farmers in Alto Paraiso earned slightly more than those in either Rolim de Moura or Ouro Preto, and 74 percent of that income derived from permanent crops. In Rolim de Moura, not surprisingly, 74 percent of farm income arose from cattle and milk sales and pasture rental (that is, pasture use). Gross incomes from mar-

Table 8.3. Gross income for marketed output (1991 U.S.$)

Variable	RM[a]	OP[b]	AP[c]	Total
Average annual income	3,206	2,909	3,422	3,172
Income from temporary crops	299	1,079	282	589
Income from permanent crops	527	615	2,527	1,283
Income from pasture (cattle)	2,380	1,206	612	1,296
Sample size	59	86	82	227

Source: John O. Browder 1992 field survey.
a. RM = Rolim de Moura
b. OP = Ouro Preto
c. AP = Alto Paraiso

keted output in 1991 were roughly proportional to land use differences, reflecting diverse strategies pursued by a seemingly similar population (table 8.3).

Capital Investment and Assets

The majority (average = 56.4 percent, std. dev. = 12.7) of farmers surveyed reported earning no surplus income in 1991, no surplus income being reported by 70 percent of the farmers surveyed in Rolim de Moura versus 44.7 percent in Ouro Preto. Of those farmers obtaining a surplus, the most commonly cited investment out of eleven mentioned by farmers was to "buy cattle" (to build up the household's herd). But these low levels of reported surplus income do not mean that farmers are without capital assets. Multiple rural property ownership ranged from 13.5 percent of households in Ouro Preto to 20.7 percent in Alto Paraiso. Urban property ownership ranged from 15.0 percent of households in Ouro Preto to 46.7 percent in Rolim de Moura. Commercial savings accounts ranged from 13.8 percent in Ouro Preto to 29.3 percent in Rolim de Moura (table 8.4).

Table 8.4. Capital investment and assets

Variable	RM[a]	OP[b]	AP[c]	Total
Percent of households owning more than one rural property	16.4	13.5	20.7	16.7
Percent of households owning one or more urban properties	46.7	15.0	31.7	28.9
Percent of households holding active commercial savings account	29.3	13.8	15.8	18.4
Percent of households buying new cattle in 1991	16.7	38.3	24.3	28.0
Sample size	61	97	82	240

Source: John O. Browder 1992 field survey.
a. RM = Rolim de Moura
b. OP = Ouro Preto
c. AP = Alto Paraiso

Table 8.5. Rural job creation

Variable	RM[a]	OP[b]	AP[c]	Total
Percentage of farms employing day workers	16.4	21.6	25.6	21.7
Average number of daily wages paid to workers	77.2	69.9	124.3	90.3
Sample size	61	97	82	240

Source: John O. Browder 1992 field survey.
a. RM = Rolim de Moura
b. OP = Ouro Preto
c. AP = Alto Paraiso

Diversity prevails in the investment behavior and asset portfolios found among this agrarian population.

Rural Temporary Labor Employment

The vast majority of farm operations are labor self-sufficient; the household provides all labor requirements (table 8.5). However, one-fifth (21.7 percent) of the farms in the sample overall hired workers on a daily basis (at a daily wage of about U.S.$1.50), typically at harvest or in forest clearing and crop planting activities. Not surprisingly, due to the local emphasis on relatively labor-intensive permanent crop production, the proportion of households employing others for on-farm activities was higher (at 25.6 percent) in Alto Paraiso than in other study sites. The average number of workdays per year (1991) was also considerably higher (124.3 days) than in either of the other study sites. Different farming strategies entail different labor requirements, and Rondônia's agrarian population displays a wide range of both.

Natural Forest Resource Use

Finally, there are significant differences in forest resource use and interest in planting native tree species among farmers in the three study sites. Although the forests in all three study sites share a common classification,[2] much higher proportions of the farmers in Alto Paraiso both extract and market timber and nontimber forest products than their counterparts in either Rolim de Moura or Ouro Preto (table 8.6). Social rather than environmental factors may better explain this difference in resource utilization. Interest in planting native tree species mirrors forest resource use, as a higher proportion of farmers in Alto Paraiso actually plant trees and expressed interest in agroforestry than those in either other site. Explaining the variations in these patterns would be a worthy, but separate, under-

taking. For present purposes, suffice to say the variations suggest a heterogeneous agrarian population who respond differently to resource (income) opportunities.

The Amazon's agrarian population is highly diverse in the landscapes they create, suggesting differences in land use decision-making processes. If reliability of prediction of land use change in the Amazon is affected by the social differentiation within the farming population, as many of the CIM researchers suggest, then understanding the forces driving such differentiation would be a necessary prerequisite to characterizing the process of land use change accurately.

The Dynamics of Land Use Transition: Three Case Studies from Rondônia

In an earlier study (Browder 1994), I hypothesized that three broad classes of factors influence small-farmer land use decisions: environmental factors (agro-ecological constraints, human epidemiology, and crop pathologies); institutional/structural factors (labor, land, credit, extension, and marketing constraints); and household-level factors (demographics and capital constraints). In this study, drawn from my 1984 survey of seventy farmers in Rolim de Moura municipality, I describe the "survival strategies" (in other words, land use decisions aggregated over time) of three colonist farmers over a five-year period (1980 through 1984) to illustrate the wide, and sometimes unexpected, range of factors that determine strategic land use decisions (that is, decisions that set in motion nearly irreversible courses of action). All three farmers began with roughly compa-

Table 8.6. Natural forest resource use and tree planting

Variable	RM[a]	OP[b]	AP[c]	Total
Percentage of farmers extracting wood products	26.2	62.9	84.1	60.8
Percentage of farmers marketing wood products	6.5	5.8	40.2	15.8
Percentage of farmers extracting non-wood forest products	36.1	69.1	96.3	70.0
Percentage of farmers marketing non-wood forest products	4.9	10.3	18.3	11.7
Percentage of farmers already planting native tree species	10.3	21.0	48.8	28.1
Percentage of farmers wishing to plant native tree species in agroforestry systems	4.0	48.9	50.0	39.3

Source: John O. Browder 1992 field survey.
a. RM = Rolim de Moura
b. OP = Ouro Preto
c. AP = Alto Paraiso