ANEXO 6 - ESTIMATIVA DE PRODUÇÃO (SISTEMA AGROFLORESTAL 4)

Kg/Ha

ANO	ESPÉCIE					
	01	02	03	04	05	06
01	-	-	3000	600	640	350
02	-	-	7000	-	-	-
03	-	1088	4000	-	-	-
04	1147	1360	-	-	-	-
05	3060	1360	-	-	-	-
06	6885	1632	-	-	-	-
07	9562	1632	-	-	-	-
08	9562	1632	-	-	-	-
09	9562	1632	-	-	-	-
10	9562	1632	-	-	-	-
11	9562	1632	-	-	-	-
12	9562	1632	-	-	-	-
13	9562	1632	-	-	-	-
14	9562	1632	-	-	-	-
15	9562	1632	-	-	-	-

Obs.:
1 - Açaí
2 - Graviola
3 - Maracujá
4 - Arroz
5 - Milho
6 - Feijão

In: CONGRESSO BRASILEIRO SOBRE SISTEMAS AGROFLORESTAIS, 1.,1994, Porto Velho . Anais. Colombo:EMBRAPA-CNPF,1994. 496p. (EMBRAPA. CNPF. Documentos, 27). p.415-429 ISSN 0101-7691

FARMING SYSTEMS AND ECONOMIC PERFORMANCE IN THE BRAZILIAN AMAZON

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RESUMO - Este artigo mostra resultados de um levantamento feito recentemente no Estado do Pará, na rodovia Transamazônica. Com estes dados fazemos uma análise do padrão de vida e das mudanças de riqueza dos produtores pequenos. Consideramos origens das pessoas e também a estrutura dos sistemas agrícolas. Apresentamos informações sobre padrão de vida, acumulação dos bens duráveis, migração, mão-de-obra na familia, uso de mão-de-obra pelas atividades agrícolas, e tipos de sistemas nesta região. Mostramos que não tem uma relação entre região de origem de produtor e sucesso econômico em agricultura. Mas, mostramos que tem uma relação entre sucessso e tipo da sistema. Em particular, sistemas agroflorestais parecem melhor em termos da acumulação dos bens duráveis. Concluimos com uma discussão das limitações deste resultado.

ABSTRACT - This article gives the results of a recent survey undertaken in the state of Para, along the Transamazon Highway. With these results, we perform an analysis of the standard of living and the accumulation of wealth among small producers. We consider birth origins and the structure of the farming systems. We present information on the standard of living, the accumulation of consumer durables, migration, family workforce, the allocation of labor time, and types of farming systems. We show that there is no relationship between the region of origin of the producer and economic performance. However, we show that there is a relationship between type of system and success. In particular, agroforestry systems seem to perform better, in terms of the accumulation of wealth, as reflected in consumer durables. We conclude with a discussion about the limitations of this finding.

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Note: The views expressed are those of the authors, and do not necessarily reflect reviews of agencies or institutions.

1. INTRODUCTION

Sustainability of land use in the Amazon basin is key to the maintenance of the tropical forest biome. In this regard, various proposals have been advanced, including the promotion of extractive reserves, the reduction of developmental incentives, and the encouragement of agroforestry activities. These proposed solutions have strengths and weaknesses, and consensus has not emerged regarding the optimal approach to land use in this critical region of the world.

Sustainability is a concept open to various and sometimes conflicting interpretations. From an ecological perspective, sustainability may refer to the maintenance of an ecosystem, at the expense of human uses. Clearly, the cessation of human activities in natural areas would sustain the natural systems in place, but at considerable societal cost. Sustainable development, which necessarily involves a human dimension, seeks to protect social welfare by integrating human activities into natural areas without destructive impact on the resource base. (See HOMMA 1991.)

Sustainable development is key to the long-run maintenance of Amazonian forests, given the population base in place. In this regard, it is important to identify and promote farming activities that are not excessively exploitative of soil fertility and are capable of generating an acceptable standard of living for the households involved. Moreover, it is crucial that such activities be practicable for small producers, since they form the majority of active farming households in the region, and since the regional impacts of corporate capital may be expected to decline with reductions in development incentives.

This paper presents an analysis of small producers based on a recent survey undertaken along the Transamazon Highway, between Altamira and Ruropolis, in the State of Para, Brazil. The survey was undertaken by field researchers from EMBRAPA/CPATU, with cooperators from SUDAM and the International Institute of Tropical Forestry (IITF) in Puerto Rico. The analysis presented addresses the relationship between farming system and changes in standards of living among small producers.

The paper is organized as follows. These introductory remarks are followed in Section 2 by a description of the field activity and a critique of evaluation methods typically used to address farming system potential. Section 3 gives an introduction to the survey data, and section 4 is a discussion of the main findings on the central issue. Section 5 concludes the paper.

2.1 THE SURVEY ACTIVITY

The survey was undertaken in the month of June, 1994, and involved three teams. 132 small producers were visited, and a twenty page questionnaire was administered in an

interview lasting approximately one hour. The questionnaire elicited information on (1) personal characteristics of the household (demographics, migration history, durable goods possession, etc.), (2) farming practices (crop types, productivity, land areas involved, etc.), (3) farm technology and equipment, and (4) farmers' perception of regional problems. The instrument was developed on the basis of several prior field activities (Homma et al 1993).

An attempt was made to collect a random sample by conducting interviews on each travessao at 2 kilometers and at 5 kilometers, and along the Transamazon Highway at each intersection with travessoes and midway between these intersections. In practice, the sampling protocol proved problematic to implement. Household heads were not always present, farm abandonment had occurred, and it was difficult at times to locate the specified property or housing structure. Nevertheless, the sample is most likely random, and—if not—possesses a majority of randomized selections of small producer households, within the area sampled.

The focus of the survey was small producers; large ranching operations were excluded from the sample. In addition, the travessoes normally were not penetrated to their full length, since this would have considerably augmented travel time, thereby reducing sample size. Thus, the sample was censored by design, and does not contain responses for large operations or for those located far from the main axis of the Transamazon Highway, probably poor subsistence households.

The goal of the survey was to collect information that could be used in quantitative analysis, as opposed to the elicitation of opinions. Although onions were, in fact, elicited about the problems small producers face in the region, the main effort was directed at numerical characterization of social, economic, and agronomic characteristics of the individual household. An effort was made to build a sample sufficiently large for the use of inferential statistics.

2.2 ANALYSIS APPROACHES

The research undertaken was aimed at off-farm analysis of farming systems. Much agronomic research is conducted on experimental plots, and as a result emphasizes the purely technical aspects of agriculture, since social and economic conditions are effectively filtered by the institutional setting. Such research can be difficult to transfer to actual producers, particularly in tropical areas where variations in physical and ecological conditions can be considerable (ABEL and PRINSLEY 1991; ROCHELEAU 1991; SCHERR 1991).

Economic considerations are often taken into account by the construction of *model* farms, which provides the analytical framework for cost / benefit analysis of some system of interest (e.g., HECHT 1992; TRINDADE de ALMEIDA and UHL 1993).

Typically, such model farm constructions are abstractions from empirical sites, which *a priori* represents a simplification of the set of factors influencing economic successes and failures. Moreover, model farm construction is by nature static in approach, whereas actual farms undergo processes of change and evolution. In this regard, the structure of an empirical farm observed on site is determined both by current conditions and by expectations regarding the future. Profitability for some farming system, indicated by model farm construction, may be considerably discounted by actual farmers who must anticipate price variability and life cycle changes in family labor supply.

The approach we have taken is to consider actual farms in an empirical sample. We seek to identify in this sample farming configurations that are consistent with economic success, as well as with ecological sustainability. The intention is that such systems—if they exist—may be promoted through the appropriate design of public policy (WALKER **et al.** 1993).

3. WEALTH DYNAMICS, ORIGINS, AND FARMING SYSTEMS

Wealth and income are difficult to measure in inflationary economies and when financial institutions and services are not readily available. This problem is exaggerated when temporal information is sought. Consequently, we collected data on a set of consumer durables. Such goods are wealth components, and can be expected to be highly correlated with income and total household assets.

To construct the wealth changes experienced by the farming households, we determined the goods that were owned upon arrival on the property, and those that are presently owned. Then, on the basis of cluster analysis, we constructed a set of four wealth classes, and determined whether individual households shifted between classes during their land tenure on the transamazon Highway. These data, with the wealth classes, are presented in Table 1, and they are aggregated in Tables 2 and 3.

These data show appreciable accumulation of consumer durables between initial and current periods. Nearly 60 percent of the sample experienced wealth improvements. Those that underwent immiserization were a relatively small fraction, approximately eight percent (Table 3). The magnitude of wealth improvements was also pronounced. In particular, fully 23 percent of the sample enjoyed accumulation shifts of two wealth classes. On the other hand, intense immiserization of two shifts down affected less than one percent of the sample (Table 2).

The households originated mostly in the Northeastern part of Brazil by birth (52 percent; Table 4). In addition, considerable numbers came from the southern states of Santa Catarina, Espirito Santo, São Paulo, and Rio Grande do Sul (35 percent). Surprisingly few show an Amazonian origin (2.4 percent). On the other hand, many individuals

lived in the north prior to settling on their current property (23 percent; Table 5), although quite a few long distance migrations occurred from the south, immediately prior to occupation (38 percent).

The properties tend to house five resident workers (table 8), which represents growth from the initial period of 1.5 familial workers on average. Generally, farms experienced a larger familial workforce than at present during some earlier period of maximum agricultural activity (7.6 on average).

The farming systems tend to be highly diversified showing components of annual production, agroforestry, and cattle ranching (table 9 and 10). Only three farms had no annual production out of 132 respondents, while 109 of them had at least a few cattle. In addition, large numbers possessed perennial production, with cocoa the most frequently observed crop (87; see Table 10). Black pepper was second, with 77 properties showing evidence of current production.

System diversification at sample level is further illustrated by reference to Figure 7, showing average allocation in percentage terms across the three main farming activities. On average, most time is allocated to perennials (41 percent), followed by annual production (25 percent). Ranching activities receive the least labor on average, at 25 percent. These labor allocations include familial and wage labor.

4. FACTORS INFLUENCING WEALTH ACCUMULATION

Two analyses were undertaken to examine factors associated with economic performance, and—in particular—wealth accumulation. Chi-Square tests were performed to investigate the relationship between economic performance, and (1) migrant source region and (2) farming system. These results are presented in Table 12, which statistically assesses the information contained in Tables 6 and 11. The lower panel shows the results for region of birth origin; these results are insignificant, and we do not reject the null hypothesis that no relationship exists between region of origin and economic outcome. Thus, migrants from the various regions appear to do about the same, in terms of the economic performance variable we implement in our statistical tests.

In the upper panel are results for the relationship between farming system and wealth dynamics. We have defined our farming system variable on the basis of the labor time allocation data. A farming system is classified agroforestry if 50 percent or more of the property labor-time is dedicated to perennials. The 50 percent threshold is used to define annual based system and ranching systems as well.

For this analysis, we reject the null hypothesis of no relationship between wealth dynamics and farming system. The significance probability is sufficiently low to be

consistent with the hypothesis alternative to independence. Thus, we conclude that some relationship exists. In particular, it appears that the agroforestry systems as we have defined them show superior performance to annual-based production and ranching activities.

5. DISCUSSION AND CONCLUSION

Our data and results show that some wealth accumulation has occurred in agricultural areas along the Transamazon Highway. Small producers have adopted highly diverse systems including components of agroforestry, annual crops production, and ranching. Many individuals come from outside the region, which nevertheless provides an important staging area for penetration into development zones.

It is important to note in reference to our frequency data on wealth accumulation that we are working with a censored sample. In particular, farm failures leading to outmigration are unobserved, since we only interviewed individuals currently engaged in farming. In addition, land sale and outmigration may occur on the basis of farm success. While we do not know the relative magnitudes of these two effects, it is likely that most outmigration is attributable to farm failure, in which case our data contain a proportion of successes greater what would be observed in the actual population of individuals who have attempted farming in this region. It remains a critical policy concern to determine the actual percentages of successes and failures over the entire population of Amazonian farmers.

There appears to be no bivariate relationship between region of origin and economic performance. On the other hand, a bivariate relationship exists in the data between economic performance and farming system, as we have defined these terms. In particular, systems focused on perennial crops production seem to have performed best. This result is consistent with arguments made by agroforestry advocates regarding sustainability, namely that agroforestry systems provide the opportunity for economic gain.

On the basis of this result, it is tempting to advance agroforestry as a solution to the sustainability problems affecting Amazonia. Nevertheless, there are several important caveats, as well as restrictions on the interpretation. First, this result is strictly bivariate in nature, and other variables are likely to be operative in affecting economic outcome. The implication is that the simple model relationship is miss-specified; in a regression framework, this would call the result into question due to estimation bias.

Another important consideration is the specification of the farming system variables. In particular, we have chosen time allocation in terms of labor, under the implicit assumption that labor and other inputs are fixed across farming system types. This is not likely to be the case. Finally, the analysis is intrinsically static, whereas farming

systems undergo structural changes as market and ecological conditions change. In particular, the accumulation result might indicate a period when perennials were economically advantageous, in which case would be faulty to assume that the positive relationship will continue to persist. It is of interest to note that in another recent study (Walker et al 1993) implementing a regression framework, no significant relationship was found between economic success and agroforestry adoption. However, the sample size was less than that presented in this paper, and the definition of agroforestry was also restrictive.

We conclude that the result on farming system type is intriguing and potentially useful, but caution that further research is necessary to address the caveats and limitations considered in closing.

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Table 1. Wealth Classes for Small Producers on the Transamazon Highway[1] Durable Goods Ownership. Numbers of Households in Each Class.

Class 1	Class 2	Class 3	Class 4
Does not possess: car generator refrigerator television charcoal stove light gas stove	*Does not possess:* car generator refrigerator television *Possesses one or more:* charcoal stove gas stove gas light	*Possesses one or more, but not all:* car generator refrigerator television	*Possesses:* car generator refrigerator television gas lightgas
Initial period[2] *frequency* 68	26	27	1
Current period frequency 11	56	52	4

[1]Based on ownership of charcoal stove, woodstove, gas stove, bicycle, car, electricity, radio, sewing machine, refrigerator, television, house in city, kerosene light, gas light.

[2]Initial period and current period frequencies do not sum to same number of cases due to incomplete response. Initial period time varies across the sample.

Table 2. Wealth Shifts for[1] Small Producers on Transamazon Highway. Numbers of Farming Households.

Shift	Frequency	Percent
-2	1	0.8
-1	9	7.5
0	39	32.5
1	43	35.8
2	28	23.3

[1]The shift measures movements between wealth classes for durable goods ownership. A farm records 1 if it changes from class 1 to 2, class 2 to 3, or class 3 to 4 between initial and current year. Negative shifts indicate immiserization. Initial period time varies across sample.

Table 3. Economic Performance[1] for Small Producers on Transamazon Highway. Numbers of Farming Households.

	Frequency	Percent
Gain	71	59.2
Loss	10	8.3
Stationary	39	32.5

[1]The economic performance variable is defined on wealth shift measures. "Gain" aggregates all positive shifts, and "Loss", all negative shifts. A stationary outcome occurs when no shift takes places in wealth status between initial and current period.

Table 4. Regional Origins of Small Producers on Transamazon Highway, by birth[1]

Region	Frequency	Percent
Central	12	9.8
North	3	2.4
Northest	64	52.0
South	44	35.8

States included in Central Region
Federal District, Goiás, Minas Gerais, Mato Grosso do Sul

States included inNortheastern Region
Bahia, Maranhão, Rio Grande do Norte, Ceará, Alagoas, Pernambuco, Paraíba, Piauí, Sergipe

States included in Northern Region
Pará, Acre

States included in Southern Region
Santa Catarina, Paraná, Espírito Santo, São Paulo, Rio Grande do Sul

[1] Certain states are omitted from the regions because they were not observed as birth origins in the sample. (e.g., Amapa is not included in the North region.)

Table 5. Regional Origins of Small Producers on Transamazon Highway, by Region of Prior Residence[1]

Region	Frequency	Percent
Central	12	9.8
North	29	23.6
Northeast	35	28.5
South	47	38.2

[1] See preceding table for region definitions.

Table 6. Economic Performance by Birth Region[1]

Region	Gain	Loss	Stationary
Central	6	2	4
North[2]	0	0	1
Northeast[2]	35	5	20
South[2]	26	2	12

[1] The economic performance class is defined on the basis of wealth shift, as discussed in the footnote to Table 3.

[2] Regional frequencies do not correspond to those in Table 4 due to incomplete response.

Table 7. Labor Time Allocation of[1] Small Producers along Transamazon Highway (n = 127)

Activity	Mean Percentage Time
Annual Production	35[2] (23)
Perennials Production	41 (25)
Pasture Activities	24 (19)

1 These data were compiled in response to a question asking producers to provide a percentage estimate of the labor time allocation, over the course of a year, to the three activities. Labor was defined to include family members and non-family wage earners.

2 Average is give above; standard deviation is below in parenthesis.

Table 8. Characteristics of Family Labor[1]

	Mean
Initial workforce (n = 131)	3.9[2] (3.5)
Current workforce (n = 130)	5.2 (4.5)
Maximum workforce[3] (n = 128)	7.6 (7.9)
Average increment[4] (n = 129)	1.5 (4.3)
Average contraction[5] (n = 126)	-2.5 (6.4)

[1]These are numbers of individuals living and working on the property. They may include sharecroppers. Wage labor is not included.

[2]Averages are above; standard deviations, underneath in parenthesis.

[3]Maximum workforce is defined as the number of workers who lived and worked on the farm during its period of peak activity.

[4]Increment is workforce change from initial period, which varies across the sample.

[5]Contraction is workforce change from period of peak activity.

Table 9. Annual Crops[1]

Annual Crops	n = 132
111 21	Rice-based systems Systems, absent rice
44	Rice-based, full complement systems, including corn, beans,and cassava
6 3	Systems with rice monoculture Systems, absent annual crops

1 The annual crop system is typically a component in farms with both perennial crops and cattle.

Table 10. Perennials and Cattle

	Average[1]	75th Percentile	Maximum	Frequency[6]
Cocoa[2] = 132)	9796 (17099)	12000	105000	87 (n
Black Pepper[2] (n = 132)	1393 (2090)	2000	10200	77
Coffee[2] (n = 131)	729 (1933)	500	14300	52
Rubber[2] (n = 131)	44 (210)	0[5]	1500	11
Orange[2] (n = 132)	64 (199)	16	1000	36
Sugar[3] (n = 132)	2.01 (9.97)	0[5]	80	16
Herdsize[4]	28 (37)	30	200	109
Herdsize[4] -others- (n = 132)	7 (27)	3	250	38

1 Average is given above; standard deviation, in parenthesis below.
2 Units: number of plants
3 Units: hectares
4 Units: number of animals
5 Low percentile value indicates extreme distributional skewness.
6 Frequency is the count of farms containing the given component. For example, 87 farms presently obtain some production from cocoa.

Table 11. Economic Performance by Farm System Frequencies[1]

	Agroforestry	Annual	Ranching
Gain[2]	39	16	6
Loss	2	3	2
Stationary	10	14	8

[1]Farming systems were characterized by estimates of labor time allocation. Agroforestry systems are those in which 50 percent or more of total labor time is allocated to perennial production through the course of a year. Similar definitions hold for Annual-based systems and ranching.

[2]The economic performance definitions refer to wealth shifts, as discussed in Table 3.

Table 12. Economic Performance Analysis

Chi-Square Test for Independence between **Farm System** and Economic Performance[1]

$\chi^2 = 11.07$

degrees of freedom = 4

significance level = .024

Chi-Square Test for Independence between **Origin** and Economic Performance[1]

$\chi^2 = 4.15$

degrees of freedom = 6

significance level = .66

[1]Sparse data cells can invalidate the independence test. Collapsing categories "Loss"and "Stationary" did not appreciably affect significance level.