HUMAN CARRYING CAPACITY ON THE TRANSAMAZON HIGHWAY: AN OVERVIEW OF THE SYSTEM

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I. INTRODUCTION:

The present paper gives an overview of the agroecosystem in the colonization area of the Transamazon Highway. It summarizes the initial physical conditions such as the layout of the colonization area, soils, climate, topography, and vegetation. It also discusses the colonists and the decision processes they follow in the critical allocations of land, capital, and labor. Labor and cash requirements for different agricultural processes are analyzed. Since the requirements for labor either from the colonist's family or from hired wage labor often limit the amounts the colonist can plant, the distribution of family labor as influenced by demographic factors is discussed, together with the availability of supplementary hired wage labor. The many ties with the market economy are explored, including the influence of financing and markets on the various decisions in the agricultural process. The phases of the agricultural cycle such as land clearing, allocation of land to different uses, allocation of labor and cash, and the allocation of the products produced to storage, sale and consumption are all analyzed. Pest and spoilage problems encountered in storing the products and the effects of various arrangements related to selling the products which have been allocated to sale are discussed. The operations in agricultural production from planting through harvesting for the annual crops in use in the area have been treated separately (Fearnside 1975b), as have the relations of the yields of the six most widely-planted annual crops with soils and the effects of burning, cropping, and fallowing on soil nutrients and erosion (Fearnside 1975a). The portion of the agricultural production

subsystem dealing with perennial crops, hunting and gathering, and animal husbandry will be treated in a separate paper.

The present paper also deals with the many interrelations between the different aspects of the system, giving special emphasis to those that act as buffers to shield the colonist against failure. The decision process for deciding to abandon or sell a lote is also discussed, together with the implications of the turnover of colonists for future changes in agricultural patterns in the area. Other trends affecting agricultural patterns due both to outside influences and the internal mechanisms of the system are also assessed.

The overview of the agroecosystem given in the present paper, along with the others dealing with the agricultural production subsystem, is a prelude to the construction of computer simulation models of the system. These models are aimed at producing a series of estimates of carrying capacity for human populations.

II.) CHARACTERISTICS OF THE AGRICULTURAL SYSTEM:

A.) LOCATION AND LAYOUT OF THE COLONIZATION AREA:

The colonization areas of the Transamazônica which have been settled by small farmers under the auspices of INCRA (National Institute for Colonization and Agrarian Reform) are divided into three administrative areas: Marabá, Altamira, and Itaituba. The Altamira area, which is the location of the present study, is by far the largest of the three. The portion of the Altamira area lying in the Altamira-Itaituba section of the highway has approximately 3120 colonist families, or about 59% of the total for the Transamazon Highway. This area covers a strip along the highway extending from Km 12 to km 245 West of Altamira, with

one [redacted] km break for a forest reserve. The strip varies in width from 20 kms to 2 kms on each side of the road. Each family has a 100 hectare lot called a "lote". Lotes are grouped into units of 10-70 lotes called "glebas", each gleba occupying approximately 5 kms of one side of the road. In the parts of the colonization area where the strip of colonization is wider than the 2-km length of one of the 500 m X 2000 m roadside lotes, the interior lotes are reached by transverse roads called "travessões" which run perpendicular to the Transamazônica at the boundaries between glebas every five kms. Much of the lenghs of the travessões has been mere trails impassible even to burros, but this situation is improving as construction proceeds. At least the first 10 kms and often more of most travessões is passable by jeep in the dry season. The interior lotes are packed between the travessões with dimensions of 400 m X 2500 m. Most colonists that live on the edges of the Transamazônica have INCRA-built houses in their lotes, while those with interior lotes have houses in agrovilas in accordance with INCRA's "philosophy of rural urbanism". Agrovilas are small villages of approximately 50 houses and are spaced at intervals of about 10 kms along the Transamazônica and at depths of about 10 kms in the longer travessões. Numbers of colonists have abandoned their houses in the agrovilas in favor of shacks in their lotes. The interior agrovilas are much more primitive than those along the roadside. There is also a larger "Agrópolis" which houses government functionaries.

The study area for the present study consists of the part of INCRA's Altamira administrative area (PIC-ALTAMIRA) lying along the Altamira-Itaituba section of the highway. Within this an

"intensive study area" has been delimited which includes 215 lotes. This includes the roadside lotes from 10 kms of the highway between kms 45 and 55 (roadside lotes of glebas 15, 16, 17, & 18), plus three travessões (15/17, 16/18, & 17/19). The data collection effort has been based in Agrovila Grande Esperança, located at km 50 West of Altamira, or 3°22" S. Lat, 52°38" W. Long. in the Municipio of Prainha, Pará State.

B.) PHYSICAL SETTING:

The study area is entirely in the plateau of terra firme between the Xingú and Tapajós Rivers. Soils, like just about everything else, are very patchy. The soils map made by Projeto RADAM (Radar in Amazonia) shows 12 soil types occuring in the general study area, five of which occur in the intensive study area (Brasil, RADAM 1974). The series of roadside profiles taken by IPEAN (Northern Institute for Research in Agriculture and Ranching) shows nine soil types in the general study area, six of which occur in the intensive study area (Falesi 1972, pp 43-54). The main soils in the intensive study area are different types of podzólico vermelho-amarelo and concrecionario lateritico. There are also some small bands of terra roxa, the best soil type. The soils show a wide range of colors, proportions of sand to clay, and numbers of lateritic concretions. Often several noticeably different patches of soil will be found in the same 100 hectare lote.

A 36-year average of annual rainfall in Altamira is 1.7 meters, with most of it coming in the rainy months of December to May. The dry season is fairly pronounced with 26 mm average rainfall in the dryest month, August (Falesi 1972, p. 11). There is considerable variability, however, in the intensity of the dry season from one year

to the next. The division between the wet and dry seasons is not terribly sharp, and the date of the beginning of the rainy season is also not predictable with great precision. These facts add to the variability in burn qualities in agricultural fields. The rainfall is very patchy on a small scale from day to day. Weather stations maintained by IPEAN at kms 23 and 101 show considerable differences between daily and even between monthly rainfall totals. The patchiness extends to a much smaller scale than this, with differences over a few kilometers on a day-to-day basis. The climate is classified as Aw in the Köppen system (Pereira & Rodrigues 1971).

The virgin forest in the area consists of several types of tropical rainforest, many of which are different types of liana forest (cipoal) with an extraordinarily large number of vines. The vegetation map published by RADAM (Brasil, RADAM 1974) shows six types of forest in the general study area, and the intensive study area is perched on the junction of three of them, all of which fall into the category of "dense" forest. The vegetation map published by IBDF (Brazilian Institute for Forest Development) also shows three forest types in the intensive study area and gives species lists (Brasil, IBDF 1975). These show 80, 85, and 63 species of trees with DBH's of over 25 cms occurring in the three forest types. The average total wood volume for the three forest types estimated by IBDF (Brasil, IBDF 1975, pp.52-54) as 90, 81, and 114 m^3/ha respectively. The IBDF data shows considerable variation between one-hectare quadrats, which confirms casual field observations. The variation in forest biomass affects not only the potential value of the wood, but also adds to the variability in labor requirements for clearing and should influence the nutrient inputs from burning.

[redacted]opographic relief in the area is highly variable. A few colonists have nearly level lotes, but most have severe limitations from steep slopes. This not only precludes any prospect of mechanized agriculture, but also holds a considerable potential for erosion, especi under annual crops.

C.) TYPE OF FARMING:

The kind of market-oriented pioneer farming being done in the area is largely based on annual crops so far, with upland rice being the most prominent cash crop. Maize, beans, and manioc are also planted as cash crops, but less frequently and on a smaller scale. The approach is usually highly land-intensive, with labor and especially capital inputs minimized. Financing has enabled many, but not all, colonists to expand the size of their plantings, usually through hiring supplementary labor. Colonists are not oriented towards establishing an equilibrium system based on shifting agriculture with fallow periods consciously intended to renew soil nutrients lost from cropping. Many colonists have plans for future conversion of their land into perennial cash crops, such as pasture, black pepper (pimenta do reino) and cacao. Since land is being cleared for annual crops faster than available capital and labor permit it to be converted to perennial crops, large amounts of second growth (capoeira) have been generated. There has been a significant amount of pasture planted by colonists, much of which has no fencing or livestock. There is considerable variation between colonists in the type of farming employed, some of which appears to be explainable in terms of difference in the backgrounds of the colonists.

[redacted]LONISTS AND COLONIST TURNOVER:

The colonists settled on the Transamazônica have come from all over Brazil and also have a wide variety of backgrounds and initial resources. Despite early intentions of bringing 65% of the colonists from the Northeast (Arruda 1972, p. 5.9), only 30% of those actually settled in the Altamira area by the end of 1974 came from Northeastern states. The distribution of colonists from different states within the Altamira area is highly non-random, with clusters of colonists from the same state occurring in different agrovilas and travessões. The lion's share of terra roxa has gone to colonists from Pará, Gaúchos from Rio Grande do Sul, and colonists of Japanese origin, with most of the colonists from other areas getting poorer soil types. Emilio Moran of the University of Florida is making a more detailed study of this phenomenon. The colonists in the intensive study area of the present study have a much larger representation from the Northeast (particularly Rio Grande do Norte) than occurs in the Altamira colonization area as a whole. Colonists from one area are quick to place stereotypes on those from other areas, with other colonists most commonly being divided between the catagories of those that "want to work" and those that "don't want to work". Some background differences appear justified, such as the greater emphasis on labor-intensive crops such as black pepper by the Japanese, more self-sufficiency from gardens and a diversity of small subsistence plantings among Paraenses, and more grandiose plans requiring large amounts of financing from those from Southern Brazil. Emilio Moran has been making a study of the effects of different backgrounds on the colonist's agricultural behavior. His preliminary impressions

the best predictors of the type and success of the colonist's agricultural efforts were previous agricultural experience previous experience with credit, family size, and initial capital (Moran, pers. comm.). My own observations tend to confirm these impressions. Of colonists settled in the Altamira area by the end of 1971, 29% had had no previous experience working on their own in agriculture, 79% had had no previous experience with credit, and the median family size was six persons (Brasil, INCRA 1972, p.202 Most brought little or no money with them, but some did bring money.

One characteristic of the colonists that does not appear to vary much is their lust for cash. Although many studies of tradition systems of subsistence agriculture can be justly criticized for the projection of the investigator's own materialistic value system onto peoples who do not share these values (Nietchmann 1971), this does not appear to be a problem here. It would be hard to imagine a more materialistic place than Altamira.

The composition of the colonist population is changing noticeabl as colonists sell or abandon their lotes and newcomers replace them. The new colonists usually bring more capital with them and thus have the capability to install more perennial cash crops. The influx of new colonists has definitely accelerated the shift to pasture. A large proportion of the newcomers are from the South. The largest concentration of wealthy newcomer families have settled in the area of terra roxa near km 90. One family has eight lotes and participate in a number of business enterprises. Some of the wealthy newcomers own 3000 hectare ranches in the land behind the colonization strip, in addition to their lotes in the colonization area.

D CLEARING:

1.) LAND CLEARING OPERATIONS:

Preparing new land for planting involves several operations. First is the "broca", which involves cutting vines and understory plants in preparation for felling. This is usually done with a fire-hook-like tool called a "foice", although inexperienced colonists sometimes use machetes. This is completely a man's job. The amount of labor required varys considerably depending on the openness of the forest. Both broca and felling are harder work than the other operations and hired labor is paid about one-third more. Broca should be done at the end of June and in July.

Following the broca the felling (derruba) should be done in late July or in August. This is also strictly a man's job, and the labor required varys depending on the number and size of the trees. Axes are the most common method, but there are some power saws. Getting parts and repairs for power saws is so expensive and so time-consuming that most colonists find it not worth the bother. Of six power saws in Travessão 16/18, only one is in working order. The cost of felling by axe and powersaw is about the same; the axe requires more time and labor but is much surer. Late starts for the broca and derruba are common. This is especially true of financed clearings, where bureaucratic delays in the liberation of funds very often result in the colonist being caught by the rainy season before he had a chance to burn. In the first year a similar problem arose since nearly all colonists were settled in the area after the appropriate time for clearing had passed. The colonists have also often failed to clear at the appropriate time either because their inexperience did not make them sufficiently aware of the great importance of

clear[redacted] time (in the early years), because they chose to work as hired hands in the lotes of other colonists while neglecting their own clearings, or because for many individual reasons they did not get around to it in time. Poor burns, which nearly always result from a late clearing but can also sometimes occur even with a timely clearing, are a major limitation on annual crop production. Burn qualities vary widely for a variety of reasons (Fearnside 1975 p Burning is usually done in October, but some colonists occasionally wait until as late as January.

Following burning, unless the burn has been very good, "coivara" must be done--the piling up of unburned branches. This is usually also considered a man's job, although women may help occasionally especially if it is in second growth. The amount of labor required varys tremendously depending on the quality of the burn and the crop to be planted. If the rains permit, the piles of branches (coivaras) are also burned.

2.) INFLUENCES ON RATE OF LAND CLEARING:

The rate of land clearing varys considerably from one colonist to the next, but generally it is proceeding quite rapidly. The rate appears to be mostly limited by labor. Certainly it is not limited by ambition, and so far within the intensive study area it has not been limited by lack of land. Legally, colonists are only to be permitted to clear 50% of the forest on their lotes. This has been interpreted to allow the forest reserve to be substituted with "permanent" crops, which include tree crops such as cacao as well as non-tree crops such as black pepper and even sugar cane. No clearing regulations whatever are being enforced in the area, however At least one of the wealthy "colonists" on the terra roxa area near

Km 90 h[illegible]d the entire 100 hectares cleared, and others have had more than the allowed 50% cleared with no indication that any consequences will befall the owners. IBDF (the Brazilian Institute for Forest Development), which is responsible for the clearing regulations, has only six employees in the Altamira administrative area, which consists of a 100 km strip on each side of 420 kms of highway, or 84,000 km^2. The IBDF staff has recently been cut from ten to six due to "insufficient funds", and three of the six confine their activities to managing a nursery for tree seedlings leaving only three to issue lumbering permits, conduct forest surveys, and enforce game and forest conservation laws. By contrast, INCRA had 442 employees in PIC-ALTAMIRA at the end of 1974.

Stream banks are nearly always cleared. Brazilnut trees (castanheiras: Bertholetia exelsa) are also not supposed to be cut. Although they are sometimes cut directly, more often they die as a result of inadequate clearing around the base of the tree before burning.

A few colonists clear the best land first and leave less desireable land for later. Most, however, simply start clearing at the road and move back through the lote regardless of land quality. Of 83 colonists whose lotes were sampled in the intensive study area, all but three started clearing at the road; 11 cleared inferior land before better land elsewhere in the lote, while three bypassed patches of poorer land in favor of a less-conveniently located patch of better land.

The early INCRA plan to clear 2.5 hectares for each colonist before settling him on his lote was only carried out for a handful of the first colonists and did not affect any of the colonists in the intensive study area.

[redacted]cing from the Banco do Brasil with the field assistance of ACAR-PARA (Association for Credit and Rural Assistance of Pará) has been a great stimulus to land clearing. In 1973/74, of the 3095 "regularly settled" colonists remaining in the Altamira project, 59% had loans for agriculture from the Banco do Brasil averaging Cr$4252 per colonist (as of Jan. 1, 1975 US$1 = Cr$7.4, but the cruzeiro has been falling in value with relation to the dollar steadil at around 20%/yr over the last couple of years). Almost all of these loans included money for clearing. Some colonists also have financed power saws.

Past financing policies have had the effect of encouraging colonists to clear new land while leaving second growth behind. Financing terms were much more attractive for clearing virgin forest than for cutting second growth for longer use of the areas already felled. Loans for felling virgin forest were given at 7% interest with a three-year grace period and eight years to pay back the debt, while cutting second growth had 15% interest and had to be paid back in full the following October. The policy has since changed: beginning with 1974/75 all loans have 15% interest and are due the following year. This has resulted in an increased number of colonists opting for cutting second growth in preference to felling more virgin forest. The influence of financing can be expected to decrease in the future both due to less attractive terms and more colonists being disqualified from financing due to previous defaults.

F.) LAND USE ALLOCATION:

1.) HOW LAND USE DECISIONS ARE MADE:

Land use allocation decisions are made by the head of the family, usually with a view to maximizing his short-term cash income, plus a

limited amount of land being planted to satisfy his subsistence needs and some other land going to more long-range cash cropping enterprises. Sometimes a small amount of land is also allocated to experimentation with new crops.

Colonists have varying amounts of capital and family labor available to them, and must allocate their land to crops which will not demand more capital inputs and more labor than they have available, including hired supplementary labor. It should be noted that not all colonists allocate their land wisely, and sometimes exceed the constrai on labor, and more often capital. Labor requirements vary from crop to crop and month to month so that different allocations can have more or less efficient use of family labor and capital. Hired supplementary labor at critical periods, as in the rice harvest (as well as in the clearing already discussed) can greatly extend the area plantable, and allow fuller utilization of the family's labor potential during the planting and weeding phases which take up the balance of the year. Migrant laborers from other parts of Brazil are often available at these peak times, although much of the labor comes from financed coloni hiring their unfinanced neighbors. Days of labor are often exchanged between neighbors, but this does not extend to exchanges across agricultural operations: a day of harvesting may be traded for a day of harvesting but not for a day of some other operation.

The relative amount of effort put into short-term as opposed to long-term schemes varys widely from colonist to colonist, as does the scale of their cash-making schemes. Many colonists have highly unrealistic plans for making big money. In the early years, one colonist in the intensive study area petitioned INCRA to be allowed to purchase an entire gleba (all on credit) so that he could develop

a large cattle ranch (also on credit). Although most colonists' dreams were never quite as grandiose as this, many have embarked on land-use plans that require much more capital than they can expect to have. Many have planted pasture without having money for fencing or livestock. Some speak of plans to plant pasture and then later sell the lote so that they can buy some virgin land elsewhere and begin again with sufficient capital for livestock. When I tried to caution one colonist who was about to embark on a large black pepper plantation with no capital for fertilizers and other inputs, his response was "têm que riscar!". While some colonists show the sort of risk-averse behavior that one might expect to find, the number that are willing to take tremendous risks has never ceased to amaze me. The penchant for risk-taking is illustrated by the number of colonists that invest large amounts of time and money in cash plantings of rice in remote lotes at the ends of closed travessões, and then are stuck with several hundred sacks of rice as far as 10 kms from the nearest road when construction of the new travessão proves to be slower than they had anticipated.

Several colonists have experimented with small and not-so-small plantings of off-beat cash crops. Rumors of new crops sometimes spread in a gold rush-like atmosphere: "Peanuts are the thing; they are living money!" or "Grapes! I never thought they would give here, but so-and-so has some and they're this big!". Most such experiments have come to naught, but a few have been successful. The phenomenon of experimentation is discussed separately (Fearnside 1975b). The previous success or failure of a colonist's plantings of a crop, and probably also the success or failure of the plantings of his neighbors, has influenced land use allocation decisions in a number of cases in

the intensive study area.

While some colonists make small experiments with several possible cash crops, there are many others who are inclined to place everything they have on a single crop and not waste time on small-scale "jokes". They want to "spread their legs," as they put it.

There are some differences in land use allocation choices made by colonists of different backgrounds. Sometimes this involves a preference for crops with which the colonist has had previous experien The differences also involve the balance between short and long-term cash crop schemes, between labor- intensive and land-intensive developments, in the diversity and size of plantings, and in risk-aversion. As already mentioned, differences in initial capital, previ agricultural experience, and experience with credit, and family size seem to be important in allocation behavior.

2.) INFLUENCE OF THE MARKET ECONOMY:

The expected market price for a product is always a primary consideration in the colonists' choosing of cash crops. Market availability is also important, as there are numbers of crops that cannot be sold at any price. Market price and availability are discussed separately for annual crops (Fearnside 1975b) and will be discussed separately for perennial crops and forest and animal products. The stability of market prices is not mentioned by colonist in reference to land use allocation decisions. Very occasionally the negotiability of the product is mentioned as a talking point in favor of its use, such as the advantage of raising pigs or chickens which can be sold whenever the colonist needs money as contrasted with rice which only produces money at a fixed time once a year. The price of initial cash inputs cannot be avoided in making land use

decisions. Subsequent needs for cash inputs are suprisingly ra
taken into consideration.

The availability of transport to markets can have a great e
on the viability of different crops. Some colonists who chose l
in the ends of travessões in preference to roadside lotes farthe
Altamira badly misjudged the importance of this factor. Even fo
those without the special problems of the travessões, the distan
separating the intensive study area from Altamira and the high c
of transportation (Cr$30/person/round trip in 1975) make it impo
for colonists to sell small amounts of produce in the weekly ope
market in Altamira and thus encourages one-shot cash crops such
rice.

3.) INFLUENCE OF FINANCING:

Financing has had an important influence on land use decisi
Crops such as rice for which financing has been readily availabl
have been favored over unfinanced crops such as manioc, despite
manioc's much more certain yield and more efficient spreading of
the work load throughout the year. Now that financing is becomi
harder to get manioc appears to be gaining in popularity as a ca
crop. In addition to the influence from less financing, the shi
to manioc may be partly due to acculturation to more traditional
Amazonian ways.

Financing has also had the effect of discouraging interplan
In the early years financed rice was not permitted to be interpl
with maize, but this restriction is no longer being enforced.

Financing has also influenced the choices of seed varieties
Financed fields were required to be planted with seeds supplied

G.) AGRICULTURAL PRODUCTION:

The operations and problems occurring from the planting of the crops through the harvesting and preparing for storage or sale are described separately. The effects of soils, variety, planting density, and interplanting are discussed for the six major annual crops (rice, maize, Phaseolus beans, Vigna cow-peas, bitter manioc, and sweet manioc) in: "Soils Nutrients and Annual Crop Yield Prediction for use in Modeling Human Carrying Capacity on the Transamazon Highway: Summary of Progress" (Fearnside 1975a). The operations in agricultural production such as planting, weeding, and harvesting, as well as the problems of insects, weeds, vertebrate pests, and disease are discussed for all the annual crops in use in the area in: "Agricultural Practices, Problems, and Prospects for Annual Crops in Use on the Transamazon Highway" (Fearnside 1975b). A similar overview will come later for perennial crops, hunting and gathering, and domestic animals.

During the agricultural production phase the family labor and capital that the colonist has at his disposal are employed in the fields according to their availability and the needs of the different crops in each month. Sometimes the colonist has misjudged the amount of labor or capital that will be required by the crops, and the exact amounts are never completely knowable beforehand since requirements may be increased unexpectedly by events such as toppling of rice, or decreased by events such as the death of one of the crops. The amount of family labor and money the colonist has available may also change unexpectedly, as when an illness or accident removes the colonist or some of his family from the labor force at a critical period, or if money intended for the crops is spent for some unexpected emergency, as in treating an illness. Hired labor may be hard to find at a

critical period, the costs may increase more than the colonist had anticipated, etc., etc. All of these problems, in addition to those discussed in the separate papers already mentioned, contribute to the great variance observed in crop yields.

H.) ALLOCATION OF PRODUCTS TO STORAGE, SALE,& CONSUMPTION:

After the harvest the product is allocated between such uses as storage, consumption, and sale. The product allocated to storage must include a portion earmarked for use as seeds in the following year, unless the colonist expects to use seeds supplied by INCRA or purchased from the outside. The amount stored will also depend on the adequacy of the storage containers that the colonist has to protect the stored product from rats. If the colonist does not have adequate protection he sometimes opts to sell his product and buy the product later as he needs it. I suspect that such decisions have most often been the result of the colonist's misjudgeing the amount the price of the product will increase between the time he sells it and the time he buys it back.

The colonist must also set aside an adequate amount of product for his family's consumption between one harvest and the next. The amount put into storage for later consumption will depend on the size of the colonist's family. Presumeably some allowance is also made for the losses to rats and insects in storage, but this is rarely mentioned. It is quite common for colonists to store an inadequate amount and to run out before the arrival of the next harvest.

After providing for seed and direct consumption needs, the colonist usually allocates the product remaining to sale. Occasionally if the colonist has a pressing need for cash he will sell more than he otherwise would have. When the amount of the harvest is small and

the colonist does not have enough both to provide for his family's needs and to pay off his debts, he invariably opts for feeding his family.

The colonist's allocation of products to sale does sometimes cut into the nutritional quality of his family's diet. This is particularly true when domestic animals such as pigs and chickens, and sometimes eggs, are sold rather than eaten.

I.) PRODUCT STORAGE AND SPOILAGE:

Rice, maize and beans, are stored until they are either eaten, sold, or used as seeds. Smaller amounts of farinha (grated, leached and heat-dried manioc) are also sometimes stored.

Rice is stored in the greatest quantity. Stored rice often suffers tremendous losses from rats and insects, and sometimes also from getting wet and rotting. The losses vary greatly from colonist to colonist; losses of 10% are commonplace, and sometimes they reach 50% of the rice stored. Losses vary with the type of container used. Rice is sometimes kept in an open pile in the house, or in an open bin for some time after the harvest. This usually results in severe losses. Rice kept in sacks is also readily attacked by rats and moths and sometimes beetles. The rat losses are usually greater if the sacks are kept in a house in an agrovila than if they are kept in a shack in the colonist's lote due to the much greater rat population in the agrovilas. A very few Northeasterners use a kind of basket woven from palm fronds for storing rice. The traditional storage of rice in beehive-shaped piles of panicles kept in the rafters of a house, which is used in the older settled area North of Altamira, is not used in the intensive study area. Some colonists store rice either in oil drums or in 18-liter kerosene tins.

A new arrangement allows large lots of rice to be stored in a government warehouse before sale. Rice stored under this plan receives a much more effective treatment of drying and fumigation. This only affects rice stored for sale under the plan, and does not affect rice stored for seed grain or for family consumption.

Maize stored by colonists often suffers severe losses from beetles and rats. Some colonists leave maize stored in an open pile of ears still on the cob or in an open bin after removal from the cob. These methods result in heavy losses. Sacks, drums, kerosene tins, and storage chests are used with the same effects as for rice. Gesarol is the usual insect poison used, although it often is not sufficient unless applied in large quantities if the beetles already have a good start in the field.

Both Phaseolus beans and Vigna cow-peas are stored in the same ways as rice and maize. There is not much problem with losses even when precautions are minimal. Sometimes Gesarol is used, but less often than for rice or maize.

Farinha is sometimes stored, but on a lesser scale than the seed crops since it can be produced year-round and is not kept for planting. It is usually simply kept in sacks, and is not bothered much by rats or insects.

J.) PRODUCT SALE:

The colonist is in a very weak position in dealing with merchants buying his products. He must sell his products at prices far below the value of the products on markets in Brazil's urban centers, and the goods he buys with the proceeds are at much higher prices than those paid for the same goods in the cities. The differences are

often much more than can be accounted for by the costs of transportation, often exceeding 100%.

In 1974 the lack of effective cooperation to organize the marketing of the rice crop was apparent. The colonists easily lost as much of the value of their crop to middlemen and the vaguaries of the Brazilian economy as they did to rats and insects. When the colonists sold their rice at the time of the harvest the price was Cr$40 or Cr$45/saco of 50 kgs, either when sold to private buyers or to the Banco do Brasil. Four months later the going rate was over Cr$120/saco. Similarly maize went from Cr$20/saco of 60 kgs for maize of any quality at harvest time to Cr$60/saco if damaged by insects and thus useable only as chicken feed and Cr$120/saco if good enough to be used as seed grain (which is a special case). This occurred in a space of two months. Beans went from Cr$150/saco of 60 kgs at harvest time to Cr$300/saco four months later. Many colonists did not store enough grains to last to the next harvest, and were soon buying them back at inflated prices. Inflation in Brazil is tremendous -- 26% in 1974 and projected for 32% in 1975-- but the jump in agricultural prices after the harvest season was so out of line that it might have been sufficient to move the colonists to organize a marketing cooperative to increase their bargaining power with the grain dealers. Although there was much grumbling among the colonists about the price situation and the need for a cooperative, nothing happened. The individual colonist dealing with the grain dealers at harvest time could neither afford to wait for a better price or bargain for a better one by himself.

Luckily, for the 1975 harvest the colonists were saved from repeating the marketing problems of 1974 even without having succeeded in organizing a grain marketing cooperative. The government instituted a new program under which colonists could store their crops in the government warehouses operated by CIBRAZEM (Brazilian Warehousing Company) without actually having sold the product to the Banco do Brasil. The colonist is given a loan equal to the value of the product at the officially established minimum price at the time he puts his product into storage. The minimum prices were roughly doubled when the plan was instituted to bring them more into line with market prices. If the price on the outside market then goes up dramatically as it did in 1974, the colonist can withdraw the stored product, sell it, and pay off the loan plus interest and fees for drying, fumigating, and storing the product. The term of the loan can be made long enough to last to the next harvest. All of this was explained in a slick brochure in which a smiling farmer named "José" goes to the bank and learns all about it (Brasil, Min. de Agric., Comissão de Financiamento da Produção, nd.). Numbers of colonists expressed scepticism about the plan despite its obvious advantages. Then, just at the time of the rice harvest, the Highway Department (DNER) closed the highway to trucks between Marabá and Altamira, so the flood of private trucks looking for rice to buy did not arrive as in 1974. Many colonists had preferred to sell to the private dealers in 1974, which at that time paid about the same or slightly more than the Banco do Brasil, because the private dealers would come to the colonist's lote with his truck rather than making the colonist pay for transportation to a CIBRAZEM warehouse, and because the privare dealer would pay the colonist on the spot in cash rather than making the colonist suffer

through the inevitable red tape only to receive his money later at the bank and after deductions had been made for a variety of fees and debts. The lack of the alternative to sell to private dealers at the time of the 1975 harvest, plus the higher minimum price, meant that many colonists participated in the plan. Also, due to a restriction on entering the plan that only lots of at least 5000 kgs of rice could be entered, some colonists set themselves up as middlemen buying smaller lots of rice at about Cr$60/saco of 50 kgs and entering them in the plan at the approximately Cr$90/saco 1975 minimum price for the rice varieties planted in the area. There is some variation in the minimum price depending on quality: there are four rice grain length classes, two of which are for varieties planted in the area, and seven quality categories for each grain length class. The new government plan represents a great improvement over the situation in 1974, and should decrease the loss of value to middlemen in future years.

The arrangements for transportation of the rice to the CIBRAZEM warehouses were improved in 1975 over 1974. In 1974 the rice that went to CIBRAZEM was normally hauled from the intensive study area by private vehicles for about Cr$10/saco. In 1975 a cooperative hired three private trucks to haul the rice (at less than Cr$1/saco for the intensive study area). There also were numbers of other private trucks hauling rice, but at lower rates due to the competition from the cooperative. The transport operation was frustratingly slow due to a bottleneck caused by the small number of laborers hired to unload the trucks at the warehouses and the business-as-usual schedule for running the drying machines. Trucks often had to wait two or three days to unload rice. After a couple of weeks

the cooperative discontinued the rice-hauling program, and the private truckers' rates skyrocketed. In spite of everything, the 1975 arrangement was generally considered an improvement over the past and future improvements should increase the probability that colonists will continue to sell their rice to the bank through the government plan.

The future of cooperatives in the area could make a great difference in such product sale arrangements as transporting cereals and marketing perennial crops. If the present bank plan for cereals continues, it is very unlikely that a cooperative would enter into marketing grains. There is currently a plan for one of the government agencies concerned with Amazonian development (POLAMAZONIA) to aid a now nearly defunct cooperative to expand greatly and eventually take over numbers of functions now performed by INCRA, ACAR-PARA, the Banco do Brasil, and COBAL (Brasilian Food Company)) The present plan, which is subject to modification, calls for the cooperative to have eight semi-autonomous "centers" each serving 300-500 families. The cooperative would begin by organizing the comercialization of lumber, but would then, according to its organizer, in Altamira, branch out to serve as an intermediary between the bank and the colonist in granting loans. Funds would be loaned to the cooperative by the bank, and the cooperative would re-loan them to the colonist. This would hopefully eliminate the delays in "liberation" of individual loans which has been a recurrent problem for financed colonists in a system where the changes of the seasons in the agricultural year do not wait for the slow-moving bureaucracy to catch up. Also, as INCRA continues its planned retreat from the area, the cooperative would eventually take over

such services as the tractors in the roadside agrovilas and the threshing machines to the extent that finances permit. The cooperative's organizer also talks of selling other types of machinery, chemicals, etc., as well as consumer items currently supplied by COBAL through the eight centers. It must be emphasized that this is all strictly a plan, and like most plans is likely to be much reduced when the time arrives for actual implementation.

The obstacles to forming a successful cooperative in the area are many, as is shown by the several failed attempts that have occurred so far. Although the law which established the colonization program with a goal of 100,000 families authorized the organization of up to 100 cooperatives (Decreto No. 67.557 Art. 4, Nov. 12, 1970: Brasil, INCRA. 1973, p. 83) none of the organization attempts have succeeded so far. At least two attempts at organizing general cooperatives have failed, and a third which was organized for arranging the export of railway ties to an American firm was in its death throes at the time of the announcement of the new plan. The railway tie scheme was given its coup de grace by international market considerations when the cooperative was underbid by Guatamala. The cooperative never had really stirred much interest among the colonists, partly due to the experience of the previous failed cooperatives, partly due to suspicion of the fast-talking São Paulo lawyer that organized the cooperative, and partly due to the colonists' lack of sufficient trust in their fellow colonists to lay their money on the line before the cooperative had proved itself. The cooperative currently claims 150 members, although I know of none in the intensive study area.

Paramont among the reasons for the lack of support among the colonists at large for any of the past cooperative schemes appears to be a profound lack of self-reliance among many colonists. There is a debilitating tendency for many colonists to whine about their condition and complain that INCRA is not doing enough to help them, rather than to take practical steps to solve problems themselves either alone or in groups. The outpouring of complaints without corresponding action related to the lack of a grain-marketing cooperative in 1974 is only one of many illustrations of this. It may be that the planned reduction of INCRA's presence in the area will jolt colonists out of this pattern, but this remains to be seen. Since a successful cooperative will require a joint effort on the part of many people, there is no guarantee that these difficulties can be overcome in the near future. The mechanism of a cooperative holds great promise for improving the life of the colonists; efforts to break down the present impediments will undoubtedly continue even if success is not achieved in the immediate future.

K.) WAGE LABOR AND SHARECROPPING:

1.) WAGE LABOR:

Many colonists have worked as wage laborers in other colonists' lotes at one time or another. There are a few colonists that support themselves almost exclusively on this sort of activity, but most only do it once in a while when they need money, and a few proudly boast that they never work for hire. Often a colonist's sons will work a few days as a wage laborer while his father tends the family's lote. Unfinanced colonists often work for financed colonists, especially during the peak periods of harvesting and felling.

Sometimes colonists work for others to the detriment of their own crops, as in working in the felling during the best time period and chancing getting a poor burn by leaving their own clearings until later. Working for pay is always attractive if the colonist needs money for a specific purpose as the return is usually immediate.

During the peak periods, especially during the felling, there is an influx of temporary laborers from other parts of Brazil. These are most often young men from Maranhão. Even with these additions, there is no shortage of work opportunities during the peak periods. Supporting oneself in this way throughout the year would be more difficult, however, as there would be long periods with no work.

The pay for wage labor is higher than in other parts of Brazil, but then so is the cost of living. Wages in the agricultural year 1974/75 (July to July) were Cr$20/day plus food for felling and Cr$15/day plus food for the other less-strenuous operations. This is considerably better than the minimum wage in Pará, which was Cr$326.40/month as of January 1, 1975.

Some work is contracted out by the job rather than by hiring laborers at a daily rate. This system is much more advantageous to the person doing the hiring as it results in both more work done for the money spent and less headaches. This system is most prevalent in dealings with the migrant laborers from outside of the area, but sometimes colonists will contract to do jobs for other colonists as well.

2.) SHARECROPPING:

Numbers of colonists have planted crops through different sharecropping arrangements on other colonists lotes. This was particularly common in 1973/74 when many colonists were either unable to burn or got a very poor burn on their own lotes. In such cases the colonist who was unable to burn would often arrange with a neighbor who had gotten a better burn for a patch of his land on a sharecropping basis. Sharecropping also occurred more often in the earlier years when some colonists with lotes isolated at the ends of closed travessões would arrange to plant in the lotes of colonists with access to a road. Sometimes a sharecropping colonist will have plantings in several lotes.

Most sharecropping arrangements require that the land owner do the felling, burning and coivara and delegate to the sharecropper the planting weeding and harvesting. There are sometimes other arrangements, with the proportions of the product harvested going to the two parties depending on the amount of work done by each. Usually the split is 50-50.

In addition to sharecropping arrangements with annual crops, there are sometimes sharecropping deals struck for raising domestic animals, especially pigs but sometimes also chickens. The person feeding and caring for another colonist's pigs keeps half of the meat and offspring produced. There are no sharecropping arrangements involving cattle in the intensive study area, although some colonists tend other colonists cattle for a monthly fee.

There are several colonists that have other people farming in their lotes who neither pay rent nor a share of the produce. These

are "moradors" ("livers"). The colonist with moradors in his lote has the advantage of not having to pay for felling virgin forest, which can be especially advantageous if the colonist intends to plant pasture. The morador uses the land for a year or two for annual crops, and then either he or the colonist will plant pasture in the cleared land. The morador sometimes will agree to do other tasks to help out the land owner, and he and his family represent a ready supply of hired labor should the colonist need help with the part of the lote that he clears and plants himself.

L.) GIMMICKS: OTHER SOURCES OF CASH INCOME:

Many colonists have some means of earning money in addition to agriculture in their own lotes or wage labor or sharecropping in other lotes. Of 69 colonists for which this information is available, 51% have had some alternative source of income. Money-making activities are tremendously varied, and range from selling cookies to INCRA employees to prosiytizing for Protestant missions. The amount of time spent on these activities, and the amount of money earned, varys greatly.

There are a few colonists who arrive with capital who are engaged in larger scale activities. Some are small industrial enterprises, such as the rice milling plant which has been installed in the intensive study area by a newcomer colonist. Outside of the intensive study area there is one colonist who has a lathe and several other power woodworking tools, plus a generator, and is manufacturing a variety of candlesticks, ashtrays, and other bric-a-brac from local woods. One of the wealthy newcomer colonists in the terra roxa area near km 90 has damed a stream and is building a sawmill, among other things.

INCRA made an effort to stimulate cottage industries in the area by teaching basket-weaving to the colonists' wives. Baskets woven by the women were sold to visiting V.I.P.'s in the air-conditioned motel that INCRA maintains in the Agrópolis at Km 46. A spaceous building was constructed in the Agrópolis to serve as the headquarters for "Projeto Artesano", but unfortunately it was built in a swampy location and so was condemned and never used. The basket-weaving project was active in 1974, but has since disappeared from the scene.

There are numbers of service activities performed by colonists and their families. Some have installed small general stores in their houses in the agrovilas. In the Agrópolis, some of the owners of the larger stores are also gentleman-colonists. Some of the colonists have daughters who work as servants for government functionnaries, some work, or have wives or children that work, in government jobs such as school teachers, tractor drivers, etc. Some work occasionally in professions such as carpentry or masonry. A few of the more prosperous colonists own pickup trucks and make money hauling passengers and freight. One of the wealthy colonists near km 90 owns several large trucks. Outside of the intensive study area some colonists have set up roadside restaurants, one of them with capital having built a successful truck-stop.

There are a few colonists that have sources of income from outside of the area, such as those that have relatives from outside that send them money or those that left some sort of property or investments in their places of origin.

In addition to the alternative sources of money, it should be noted that some of the colonists have relatives in the area that could potentially provide some critical support in case of a crop failure or

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In addition to the alternative sources of money, it should be noted that some of the colonists have relatives in the area that could potentially provide some critical support in case of a crop failure or

other emergency. Of 68 colonists, 35% have relatives in the area. The importance of kinship-based relations as a form of insurance policy against bad times surely much less than in more traditional areas. Nevertheless, the number of such ties is growing as marriages continue and as those older sons that don't leave the area buy lotes of their own.

The importance of small-time cash making gimmicks or other forms of support should not be underestimated due to the sometimes trivial amounts of money involved. The ability to obtain a small amount of money at a critical time can sometimes make a great difference for someone who would otherwise have virtually nothing in the time between harvests.

M.) ALLOCATION OF MONEY:

Money which is obtained through financing is more restricted in its use than is money from sale of products or other money-making ventures. Most of the financing money goes to paying for supplementary labor in clearing and harvesting. The bank loans for cereal crops are doled out to the colonists in several small parcels, with the requirement that the fields be inspected by ACAR-PARA personnel before the liberation of each portion of the loan. This limits the amount that can be lost if the colonist does not apply the money as specified. A portion of the money is legitimately spent by the colonist to support his family while he in effect hires himself to work in his own lote. This money goes for food and other expenses in the same manner as money received from other sources with no strings attached. Many colonists are disenchanted with the amount of the financing money which is spent on the several trips that must be

made to the Agrópolis and to Altamira in order to arrange for the loan and pick up the small parcels of money as they are liberated.

There is a small amount of leakage of money received through financing to other uses. Occasionally there are horror stories of colonists who blew their entire loan in the bars of Altamira and arrived home with "nem um tostão na bolsa". Such incidents are relatively rare, and can be expected to decrease as such colonists fail to pay back debts and are thus disqualified from further financing. Although affecting only a minority of colonists, there are instances of colonists buying financed powersaws, fertilizers, burlap bags, mules, and other items and then immediately reselling them for cash. The now much reduced role of credit in the area will mean that income from such sources will be insignificant in the future.

The money coming from product sale, wage labor, and the assortment of other sources is allocated to such uses as payment of the colonist's debts, investment both in the colonist's agricultural developments in his lote and in other non-agricultural money-making schemes, food, and other expenses.

If the colonist's products have been sold to the bank or entered in the new storage-and-minimum-price scheme, the debts due to INCRA and the bank are deducted directly from the value without the money passing through the colonists hands. Otherwise the colonist must take the money to the bank and pay. A few select colonists that are considered good risks by the local storekeepers are allowed to buy goods at the stores on credit. The store debts are paid either at the end of the month or at harvest time, but the numbers of failed stores resulting from unpaid debts make the shopkeepers cautious about granting

such credit. There is considerable variability among the colonists in the priority they put on paying debts. Some will undergo quite a bit of privation in order to pay off debts, while for others the debts are the last item on the list.

The colonists allocate a large amount of their money to buying food not produced in their lotes. The foods bought are all too often nutritional zeros: large amounts go to carbohydrate-loaded items like macaroni and sugar rather than meat or, even less frequently, vegetables.

There are numbers of non-food expenses that quickly use up available funds, such as clothing, kerosene, soap, medicines, and transportation to Altamira. There are some regular bills, such as a monthly water fee for those in the roadside agrovilas where piped water is available, and a monthly fee for health insurance for members of the "Sindicato Rural". Very few colonists make any significant expenditures on education, and taxes are not a problem. A few colonists buy durable household goods such as sewing machines or furniture, but much more common is the dissipation of funds on shiny plastic knick-knacks. Some colonists elaborate at length on their plans for consumerism when their next big harvest comes in; one wanted to go to Manaus to buy bluejeans and a tape recorder. The amazing thing is that a couple of them have actually made the trip. Such expenses can often cut into funds spent on food. It is not uncommon for colonists to go for long periods without meat, but never lack for batteries in their transistor radios. The lure of Altamira's glittering shops acts as a giant magnet sucking the money out of the surrounding colonization area. The colonists allocate virtually nothing to savings: almost all money received vanishes within a few weeks or days or even hours.

N.) CONSUMPTION AND NUTRITION:

The quantities of food and other items consumed vary from family to family depending on the family size and other factors. The quantities of some things, particularly those bought with money, are quite flexible depending on the colonist's finances.

The staples of the diet are rice, beans, and farinha. Other less-preferred items from the colonist's lote which supply carbohydrates are sweet manioc, sweet potatoes, and yams. Purchased carbohydrate sources include macaroni, sugar, and sometimes bread. Vegetable oil major item which is almost always purchased.

Animal protein is by no means a daily item in many colonists diets, but the amount varys. Usually it comes either from game, chickens, eggs, domestic pigs, canned sardines, one of several canned spam-like preserved meats, or dried fish which is imported to the Altamira area from Santarém on the Amazon River. Beef is almost never eaten by colonists in the intensive study area except very occasionally as salted "charque". Fresh fish is also almost never eaten, although once in a great while a colonist catches some in a stream. Some domestic animals are sold outside of the area, especially pigs but sometimes also chickens and eggs. When cattle are more common, they will be sold for cash rather than eaten by the colonists.

Colonists eat relatively few vegetables. The major vegetables (in season) are squash, green maize, green onions, tomatoes, cucumbers, and green peppers. There are several others which occur less frequently. The problem of the small amount of vegetables eaten is discussed separately (Fearnside 1975b).

The main fruits eaten are bananas , papayas (mamão), pineapples (abacaxi) and limes (limão). Of lesser importance are cashews (cajú),

guav[illegible] (goiaba), custard apples (graviola), and passion fruit (maracujá). [illegible]t other fruit trees are not yet old enough to be producing. The array of fruits eaten can be expected to increase greatly when oranges (laranja), mangoes (manga), jack fruit (jaca), coconuts (cõco de Bahia), etc. are producing. Contributions from gathering such as brazilnuts (castanha), bacaba palm (Oenocarpus bacaba), açai palm (Euterpe oleracea), and cupuaçu (Theobroma grandiflorum)and a few less-frequent items make some additions to the diet in season.

Foods for babies, especially powdered milk, are often high-priority items among cash purchases. There are numbers of other canned goods, coffee, etc., that are purchased in varying amounts depending on the availability of cash. Some of these take on the aura of status symbols.

There is a noticeable inequity in the distribution of food within the family when a limited item such as meat is involved. Men get consistently more and better pieces of meat than do women. Babies eat constantly and get whatever they ask for.

There are numbers of cultural differences between colonists from different parts of Brazil related to diet. I suspect that Paraenses or other colonists from Amazonian backgrounds may have better-balanced diets than colonists from other parts of Brazil, even though they often have less financing, smaller fields, and less cash-bought amenities. The Paraense's greater emphasis on hunting game, together with the custom of a more diverse planting in the yard around his house, probably give him a better diet than his less self-sufficient neighbors from the South or the Northeast. Emilio Moran and Millicent Fleming-Moran of the Anthropology Department of the University of Florida did fieldwork in an agrovila at Km 23 for studies of the differences in behavior of colonists from different backgrounds, including differences in diet.

The relative ease with which starchy crops can be grown in contrast to those providing protein makes protein (aside from the problems mentioned with vegetable consumption) the item most often in short supply. Beans are a major source of plant protein, and are not always to be found in the diet due to the total loss of Phaseolus beans in numbers of lotes due to the fungus Rhizoctonia. This is a severe loss when rice, beans and farinha are the staples. Phaseolus beans and probably Vigna cow-peas also are fairly sensitive to acid soil (Fearnside 1975a) which restricts their production in many lotes. Maize is also a major source of protein indirectly through its use as feed for chickens. The extreme sensitivity of maize to acid soil (Fearnside 1975a), plus the serious problems for maize growing posed by insects and rats, make maize growing impossible all of the time in some lotes and some of the time in all lotes. These limitations on protein-providing crops, plus the decreasing populations of game animals, will make protein shortage a continuing problem in the area. This is compounded by the drain on available protein from selling domestic animals to raise cash, the relatively low priority placed on buying meat in the allocation of cash, plus the fast-spending nature of the majority of colonists that would make it impossible for a colonist to, say, budget his funds to buy a can of sardines every day for a year even if he had more than enough money to do so at the outset from the sale of a cash crop.

0.) DEMOGRAPHY:

1.) AGE DISTRIBUTION:

The population is younger than the population of Brazil as a whole, although it is not without some old people. Below in Table I INCRA data for PIC-ALTAMIRA in 1974 as contrasted with census data

for the rural population in Brazil at large (from: Brasil,FIBGE/IBI. 1970, data presented in Hata et.al. 1973, p. 119) shows this difference in larger percentages falling into the younger age groups:

TABLE 1: AGE DISTRIBUTION IN COLONIZATION AREA & RURAL BRAZIL:

INCRA DATA FOR PIC-ALTAMIRA		CENSUS DATA FOR RURAL BRAZILIAN POPULATION	
age group	percent	age group	percent
0-5	24%	0-4	17.2%
6-10	18%	5-9	15.5%
11-15	14%	10-14	12.9%
16=20	9.5%	15-19	10.8%
over 20	54.5%	20-24	8.7%
		25-29	6.7%
		30-34	5.5%
		35-39	4.9%
		40-44	4.3%
		45-49	3.5%
		50-54	3.0%
		55-59	2.3%
		60-69	3.0%
		70 & over	1.6%
		unknown	0.2%

2.) DEMOGRAPHY AND LABOR SUPPLY:

The size of a colonist's family relates both to the number of mouths he must feed and to the amount of help he can get in the field from family labor. The average family size is 5.5 , but since 16.3% of the colonists are single, families of colonists in the other marital status categories are generally larger than this figure would suggest.

INCRA has published a couple of sets of figures from studies done outside of the Altamira area for the equivalence of different

sex and age categories in terms of their contribution to agricultural work. These are shown below in Table 2:

TABLE 2: LABOR EQUIVALENTS IN AGRICULTURAL WORK:

SOURCE 1			SOURCE 2		
age group	man	woman	age group	man	woman
9 - 10	0.30	0.30	7 - 8	0.20	0.15
11 - 13	0.50	0.30	9 - 13	0.25	0.20
14 - 17	1.00	0.50	14- 17	0.50	0.40
18 & over	1.00	0.75	18 & over	1.00	0.75

Source 1 data presented in Tavares et al. (1972, p. 148).
Source 2 data from Brasil, INCRA. 1971, p. 202

It should be remembered that the different age groups and sexes make different contributions to the various agricultural operations, as is mentioned in the discussion of each operation. The methods used for obtaining the INCRA figures are not described in their sources, but they must be taken to represent some sort of average contribution over the entire agriculture year. The variation in family size and sex and age composition greatly affect different colonist families' agricultural capabilities. The size of the family labor force varys considerably, as shown in the frequency distribution of family labor force totals for colonist families which had been settled in the Altamira project by the end of 1971. This distribution, from "source 2" above (Brasil, INCRA. 1971, p. 202) is shown below in Table 3:

TABLE 3: FREQUENCY DISTRIBUTION OF FAMILY LABOR FORCE:

LABOR FORCE (man-equivalents)	PERCENT OCCURENCE	LABOR FORCE (man-equivalents)	PERCENT OCCURENCE
1 - 1.5	9%	4.1 - 4.5	9%
1.6 - 2.0	24%	4.6 - 5.0	3%
2.1 - 2.5	16%	5.1 - 5.5	8%
2.6 - 3.0	8%	5.6 - 6.0	3%
3.1 - 3.5	9%	over 6.0	2%
3.6 - 4.0	9%		

3.) POPULATION GROWTH RATE:

The population is growing rapidly through reproduction, in addition to continued growth of the Altamira area as a whole through the addition of new immigrants. Colonists consider large families to be an advantage in increasing the family labor force. Child care responsibilities devolve upon the women and older female children. Women gain status among other women from babies. There is no birth control.

Data on births and deaths, especially deaths, are considered secret by the Health Department (SESP). The young population insures that the death rate is relatively low. Deaths most often heard about are either accidents such as falling trees or are child deaths from disease. More spectacular deaths from jaguars, snakes, and Indians are generally imaginary.

No data is available specific to the study area relating natality and mortality to nutrition, but it can probably be assumed that what little is known of these relations from studies in other locations would apply to the study area as well.

Census data shows that the rural population grew at a mean annual rate of 3.2% in the Municipio of Altamira from 1960 to 1970, and at

3.1[illegible] the Municipio of Prainha (Brasil, SUDAM. 1973/74, p. 66). SUDAM, the umbrella "superintendência" overseeing Amazonian development, also made a population projection based on life tables for the Xingú microregion which predicts average annual natural growth rates of 4.16%, 4.06%, and 3.76% for the periods 1970-75, 1975-80, and 1980-85 respectively (Brasil, SUDAM 1973/74, p. 76). The same report gives figures for past annual natural increases in the Altamira Municipio from 1965 to 1970 indicating annual percentage increases from reproduction ranging from 3.1% to 4.4% with a mean of 3.8%. If continued at this rate, this corresponds to a doubling time of about 18 years.

P.) BUFFERS AGAINST COLONIST FAILURE:

When a colonist's agricultural efforts fail completely he could be expectdd to abandon his lote rather than remain to quietly starve. There are numbers of buffers in the system which serve to shield the colonist against failures of crops or other disasters. First there are the precations that he can take at the various steps of agricultural production, such as allocating more land to be planted with each crop than he expects to need to feed his family, planting several different crops that could substitute for one another if one of them should fail (such as manioc and rice, or Vigna and Phaseolus), planting several varieties of some crops in case one variety fails (as is sometimes done with rice and Phaseolus), planting different parcels of a crop at different dates, storing more of a product than one expects to use, and having a surplus of carbohydrates effectively stored in the form of root crops which can be used if it is needed or abandoned without great loss of labor if it is not.

Sometimes agriculture becomes impossible early in the year, as from a poor burn or even earlier from failure to fell due to illness or a

de[illegible]ion not to fell due to a closed travessão or some other problem. In such cases the colonist may support himself through sharecropping, or through wage labor in other lotes, or through some sort of other money-making enterprise in the area. If the colonist invests his time and resources in a crop which then fails, he can to some extent replace the loss by buying the product with money earned from the sale of other products, or he can consume some substitute prodict if possible.

In addition to the combination of these buffers in the food production portions of the system, there is invarkably a certain amount of belt-tightening involved as the colonist reduces his consumption of the missing product as much as possible. If he still has an insufficient amount he will begin using other less-pallitable buffers, such as selling his valuables and furniture (since cash savings are usually insignificant), and by defaulting on his debts to INCRA or the bank or to any stores that have sold him goods on credit. Loans or gifts from relatives and friends will also be solicited if he has any nearby that are able and willing to help. Some have as a last resort, especially if they come from urban backgrounds, temporarily left their lotes to look for a job in the city. INCRA forbids colonists to leave their lotes for more than 30 days without written permission or 90 days with permission, on pain of losing their lotes. A couple of colonists have left and come back, but more often the colonist that leaves with the intention of coming back is never seen again.

If all of t ese safeguards fail to provide what the colonist considers an adequate livelihood, he will abandon his lote.

LOTE ABANDONMENT:

Lote abandonment has major implications for the long term future of the system for several reasons. The turnover in the colonist population that this allows, with the consequent shift in the type and scale of exploitation, has already been mentioned. The decision to abandon a lote if it does not produde enough to satisfy the colonist, and at the same time if the colonist feels that he can do better elsewhere, is a natural one as long as the option remains either to move to a new piece of virgin land elsewhere or to change occupations entirely as in moving to a city. Since all colonists have given up a past life to come to the Transamazônica, the idea of being tied to a piece of land come what may is foreign to them. The day when the option to move on to other virgin land no longer exists has not yet arrived, and this consideration does not enter into the colonists' decisions.

Of 3800 families settled in the Altamira Project, 665, or 17.5%, had left their lotes by the end of 1974. If abandonments were to continue at this rate, the original colonist population would have a half-life of only 11 years. Within the intensive study area the rate is even higher, with 33% of the lotes abandoned at least once.

Lote abandonments occur for many reasons, which makes prediction of future trends hazardous. Many of them can be ascribed to the shock of persons from other parts of Brazil and from non-agricultural occupations trying to adapt to the hardships of being a pioneer farmer in the Amazon. Abandonments for these reasons can be expected to decline: those that "don't have the courage to face the conditions" (as the colonists put it) will be weeded out, those that remain will become better adapted, and the conditions will improve. Those with lotes in the ends of the travessees , as much as 20 kms from the

[redacted]ave faced the worse conditions. Although several abandonments [redacted] related to conditions in the travessões, just as many colonists have been leaving on the roadside in the intensive study area. This may be partially due to the much greater ease of finding buyers for lotes on the highway.

One might expect lotes with poorer soil to be abandoned more often than those with better soil, but abandonments appear to be random with respect to soil type within the intensive study area. However, one travessão outside of the intensive study area with notoriously poor soil (Trav. 13/15) is famed throughout the area for its large numbers of abandoned lotes.

Single men appear most prone to abandoning their lotes, which may be due both to the difficulty of running a farm without more labor and to the lower impediment of responsibility for supporting others during the transition to a new occupation.

Those with no previous agricultural experience appear to be more apt to leave than those who grew up as farmers: one man formerly from the intensive study area that had sold popsicles in the streets of Fortaleza before becoming a colonist is now selling popsicles in the streets of Altamira.

Mismanagement of financing is also a big contributor. Many colonists borrowed large sums of money; a few squandered it, but more commonly the money was spent on agriculture as intended but left the colonist in a hopeless finantial situation when the crops failed. The poor burns in 1971/72 and 1973/74, plus the failure of the Barbara rice in 1972/73, left many in this situation. The grace period expires on Oct. 31, 1975 on many of the debts incurred by the colonists in the early years, both with INCRA and the Banco do Brasil.

include the cost of land purchase (Cr$1.40/ha) plus a surveying (Cr$1.20/ha) plus from Cr$5000 to Cr$11,000 for an INCRA-built house, plus living allowances drawn during the first six months, plus charges for any of a variety of items supplied to the colonists in the early years. Colonists have 20 years to pay with a three-year grace period for payments on principal and 6% annual interest charged, however colonists are being required to pay 30% of their INCRA debts this year. The number of abandonments due to hopeless financial situations may therefore be expected to increase in the near future, although eventually the abandonments from this cause should decrease because of the reduced role of financing already mentioned.

Many colonists will sell their lote, or will transfer it to anyone who will assume their debts, that would not abandon their lote to flee the area. Previously anyone buying a lote could assume the colonist's debt under the same favorable terms, but now a prospective buyer must pay the entire debt on the spot. This may slow the turnover of colonists somewhat, but the continued inflow of prospective buyers insures that it will not stop. Any future changes in INCRA regulations on transerring or selling lotes would affect the abandonment rate.

To my knowledge no lotes have been foreclosed so far on the grounds of failure to pay debts. Although there are constant rumors among colonists about what INCRA or the bank will do next, it is obvious that the colonists will eventually have to pay up. In spite of highly favorable financing terms, the existence of debts poses a constant threat to the colonists. Even only a small amount that must be paid every year can be a problem if a crop fails and the colonist has nothing with which to pay. When debt terms extend over eight years

[redacted] it appears as a virtual certainty that a crop will fail [redacted]east one year before the debt is liquidated. Any crackdown on unpaid debts by INCRA or the Banco do Brasil would result in many more abandoned lotes.

Health has been a factor in several abandonments. This may be through decreased capacity to work, as from hernias. The debilitating effects of diseases and paracites may be a contributing factor in some cases. Another health-related factor sometimes mentioned by departing colonists is the suffering from the bites of the "piúm", a small, vicious, blood-sucking dipteran (Simulium amazonicum) which appears in clouds during the rainy months. The distribution of the piúm is very patchy, with some lotes being much worse than others. The feet and ankles of a severely bitten person may swell up like balloons making it impossible for him to work, in addition to the pain and other ill effects.

Many of the abandonments for which causes are known stem from ramdom events with no relation to the production of the lote, such as marital or family problems, accidental death or disablement of the head of the family, quarrels with neighbors, etc. Alcoholism has been a contributing factor in several of these cases leading to fights, unwise use of money, lost work time, and even one murder in the intensive study area.

Since all colonists in the intensive study area still have virgin land available, none of the abandonments so far are the result of declining production following environmental degradation. Some of the abandonments following one or more years of poor crops may have occurred under conditions similar to those that would be expected under the conditions of environmental degradation that would result after

the carrying capacity, but the large amount of noise from oduction-related abandonments makes it difficult to identify these cases in any but a handful of instances where the circumstances surrounding the abandonment are known.

Abandonments can be expected to plan a continued role in the changes in agricultural patterns in the area. Nevertheless, although the faces of the colonists may change, the processes of soil erosion, leaching, regeneration, etc., and the fixed sizes of the lotes and of the colonization area, will remain the same.

III.) CONCLUSIONS:

The colonization area on the Transamazon Highway is a market-oriented pioneer farming system which is, for the present at least, primarily based on annual crops grown in recently-cleared fields. The system is an open one with free inflow and outflow of money, materials, and people, as well as energy and information. The people entering and leaving include both migrant laborers who augment the labor force during peak periods and the colonists who abandon or sell their lotes to be replaced by newcomers.

In the course of the agricultural year the sequence of processes leads from land clearing to the allocation of the cleared land to different uses, to the agricultural production processes such as planting, weeding and harvesting, followed by the allocation of the products produced to sale, storage, and consumption. Connections with the money economy enter into the process at many points, with money coming in through financing, product sale, work as wage labor in other lotes, and a variety of cash-making gimmicks. Money is then allocated between investment in agriculture, paying back debts, living expenses, etc.

of the processes in the system are dynamic: they are constantly changing due both to outside influences and as a consequence of internal mechanisms that have already been set in motion. Influences from outside the area include financing policies, market prices and market availability, and new seed varieties. From within the planting patterns change as colonists who have not obtained adequate harvests leave (along with many who leave for reasons not related to production) and are replaced by others who have different backgrounds and usually bring larger amounts of capital with them. The new colonists follow different patterns of land use allocation. Different patterns also result as colonists that default on loans are disqualified from further financing, and as increased amounts of cleared land and increased investments in perennial crops change the costs and benefits associated with different land use choices. Changes in family labor availability resulting from demographic processes are also internal changes which could be expected to affect the processes in agricultural production since labor demands at peak periods are often factors limiting the amount of a crop that a family can plant. The constraints imposed by the fixed area of land and the processes of soil degradation and regeneration remain unchanged.

The system is characterized by wide variance in many important variables. These include the variability in physical conditions such as soils, topography, weather, insect attack, rats, weeds, and diseases, as well as variability in many agricultural practices such as planting and harvest dates, weedings, and so forth, which add to the variability of the yields obtained. There is also great variability in the factors which influence the colonists decisions

such as the allocations of land, labor, and money, and the decision of whether or not to abandon or sell out. The great variability found in key variables throughout the system will make the stochastic feature which has been emphasized in preliminary computer models (Fearnside 1974) especially important in more comprehensive future models as well. The models will yield predictions of system behavior under different sets of assumptions, which will be used to generate a series of estimates of human carrying capacity.

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