CHAPTER 5

PRESENT CONDITIONS OF AGROSILVIPASTORAL ACTIVITIES

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5.1 Conditions of Agriculture

5.1.1 Agriculture in the Amazon Region

In the Amazon region, subsistence agriculture based on the slash-and-burn cultivation is traditionally developed. At the end of the 19th century, in order to meet the demand for rubber created by the automobile industry, which rapidly grew in the USA, the Amazon region started to be developed as a great pole for the production of natural rubber. In the 30's, the production of jute as raw material for packing the exportation coffee increased. The 50's were notorious by the expansion of black pepper production.

However, these products production, in the international market, soon suffered a drop such as the case of the natural rubber production that soon lost competitiveness due to the drop in the international price caused by the successful cultivation of rubber trees in Malaysia. As for the jute, due to the stagnation of coffee in the market and to the development of petrochemical products for its package, the demand for the natural material simply finished. On the other hand, the black pepper which is still produced does not have resistance to the attack of diseases and pests nor present price stability due to the oscillation of prices in the international market.

The agricultural production systems now practiced in the Amazon region are as follows; (i) the subsistence agriculture of basic products through the slash-and-burn cultivation system; (ii) the cultivation of commercial products such as fruit; and (iii) the mechanized cultivation of products for the market. The slash-and-burn cultivation system utilizes the nutrients accumulated in the biomass producing rice, cassava, feijão beans, maize, among others.

The Amazon region is characterized by the large variety of tropical fruit trees, and the following ones are being cultivated: (i) native species such as cupuaçu, açaí, pupunha, etc.; and (ii) exotic species such as coconut, passion fruit, orange, etc.. some products that can be industrialized such as cacao, rubber, dendê, among others are also being cultivated. Since these species can be attacked by diseases and pests when planted in the monoculture system, in general they are being cultivated in consortium with other commercial species in relatively small areas.

The consortium is being practiced through several combinations according to each producer. A research carried out in the States of Pará, Amazonas, Rondônia and Acre during 4 years, from 1988 on, has identified 97 agroforestry combinations practiced by 121 farmers (Smith et. al. 1995). Out of these 97 combinations, only 11 were observed more than twice. The main cultivated species were orange, cupuaçu, black pepper, cassava, cacao and rubber tree according to the order of occurrence (Table 5.1-1). Orange, the species observed more frequently, is being cultivated in consortium with cassava, rubber tree, cupuaçu, passion fruit, pineapple, etc., though in several cases it is cultivated as a monoculture. Cupuaçu is being largely cultivated in consortium with banana, freijó, pupunha, castanha-do-brasil, orange, rubber tree, macacaúba, black pepper, among other, also aiming at the prevention against the attack of the "vassoura-de-bruxa" (Table 5.1-2).

Table 5.1-1 Species Utilized in the Agroforestry Systems in the Amazon Region

Species	Scientific Name	Quant.	Origin
Orange	*Citrus sinensis*	32	X
Cupuaçu	*Theobroma grandiflorum*	29	A
Black pepper	*Piper nigrum*	26	X
Cassava	*Manihot esculenta*	25	NA
Cacao	*Theobroma cacao*	23	NA
Rubber tree	*Hevea brasilensis*	21	A
Banana	*Musa sp.*	20	X
Coco	*Cocos nucifera*	16	X
Castanha-do-Brasil	*Bertholletia excelsa*	12	A
Passion fruit	*Passiflora edulis*	12	NA
Avocado	*Persea americana*	9	NA
Mango	*Mangifera indica*	9	X
Café Robusta	*Coffea canephora*	9	X
Freijó	*Cordia goeldiana*	8	A
Açaí	*Euterpe oleracea*	7	A
Pineapple	*Ananas cosmosus*	7	NA

Source: Smith, NJ.H et. al. 1995.
Origin: A-Amazon Region, NA-Tropical America, X-Exotic

Table 5.1-2 Examples of Consortium with Cupuaçu

Combination	Location
Cupuaçu, Banana	Between Altamira - Itaituba, in Pará
Cupuaçu, Freijó	Tomé-açu, Pará
Cupuaçu, Pupunha	Between Rio Branco - Porto Velho, Pará
Cupuaçu, Macacaúba, Mahogany	Tomé-açu, Pará
Cupuaçu, Pupunha, Castanha-do-Brasil	Between Rio Branco - Porto Velho, Pará
Cupuaçu, Laranja, Black pepper, Rubber tree	Between Altamira - Itaituba, Pará
Banana, Cupuaçu, Castanha-do-Brasil	Araras, Pará
Banana, Pupunha, Cupuaçu,	Between Rio Branco - Porto Velho, Pará
Coco, Cupuaçu,	Between Agrovila Coco Chato - Itupiranga, Pará
Cassava, Cupuaçu, Orange, Avocado	Belterra, Pará
Orange, Cupuaçu,	Belterra, Pará

Source: Smith, NJ.H et. al. 1995.

5.1.2 Agriculture in the State of Pará

The economy of Pará State mainly developed through the exploitation of natural resources, such as mineral and forestry resources. The agricultural development started in the 30's and ever since the production of rice, cassava, maize and feijão beans is being increasing. The construction of the Belém-Brasília highway in 1972 has contributed to improve the geographically disadvantageous conditions of the region. In 1985, Pará became the biggest producer of black pepper and castanha-do-brasil in the whole Brazil.

In terms of land use in Pará State, the agricultural cultivation area occupies only 3.6% while the artificial pastures represent approximately 26% of the State total area. During the period 1985 - 1995, the agricultural cultivation area was reduced while the artificial pastures presented a considerable expansion. The agricultural production in Pará present a growth tendency of products such as rice, maize, feijão beans, cassava and banana, while the cacao production is

declining.

5.1.3 Agriculture in the Study Area

In the micro region of Marabá, basic products such as rice, cassava, feijão beans and maize are being largely produced through the slash-and-burn system. In parallel to this basic agriculture, the cultivation in small areas of products such as fruit trees and products that can be industrialized such as banana, pineapple, orange, mango, coffee, watermelon, avocado, cacao, coconut and black pepper is also being carried out (Table 5.1-3). In the period 1993-1998, the production of feijão beans was relatively stable while there was a strong increase in the production of rice and maize in 1994, and cassava in 1995.

As for the other products, there was an increase in the production of pineapple and coconut, while the production of coffee, orange, mango, cacao and banana remained stable. The fruit plants recently planted such as acerola, cupuaçu and passion fruit already started harvesting. These were introduced through projects of the Agrarian Foundation of Tocantins-Araguaia (FATA), Farmers' Cooperative of Araguaia-Tocantins (COCAT) and Technical Assistance and Rural Extension Company (EMATER).

Table 5.1-3 Agricultural Production in the Micro region of Marabá (1993-98)

Product		Cultivated Area (ha)						Production					
		1993	1994	1995	1996	1997	1998	1993	1994	1995	1996	1997	1998
Rice	ton	2360	13820	10820	13180	12580	13200	3068	16246	12946	16204	15324	15260
Feijão beans	ton	1440	1540	1540	1605	1786	1316	753	790	790	816	906	571
Cassava	ton	2000	1910	3920	4000	5372	5222	29700	28500	58800	60000	82580	67630
Maize	ton	1800	5150	5650	6300	6350	7700	2370	6775	7375	8281	8116	8780
Banana	thousand bunches	1266	1580	985	985	1495	1597	1582	2946	1153	1153	1785	1658
Coffee	ton	32	35	35	15	29	40	51	56	56	24	46	64
Cupuaçu	thousand units	0	0	0	0	275	230	0	0	0	0	2064	621
Orange	thousand units	46	78	78	78	53	0	3450	5850	5850	4275	2226	0
Watermelon	thousand units	54	65	72	0	0	0	48	58	65	0	0	0
Avocado	thousand units	16	16	20	0	0	0	480	480	600	0	0	0
Pineapple	thousand units	23	55	65	65	65	65	466	1110	1314	1314	1314	1314
Acerola	ton	0	0	0	0	10	10	0	0	0	0	80	80
Cacao	ton	50	50	61	60	60	60	33	39	50	50	36	36
Coconut	thousand units	35	45	55	35	55	70	205	285	335	175	335	515
Mango	thousand units	190	190	190	0	0	0	5700	5700	5700	0	0	0
Passion fruit	thousand units	0	0	0	0	10	10	0	0	0	0	60	60
Black pepper	ton	5	5	5	0	0	0	11	7	7	0	0	0

Source: SAGRI DIEST 2000
Remark: Rice with husk

5.2 Conditions of Animal Husbandry

5.2.1 Animal Husbandry in the Amazon Region

In the Amazon region, the animal husbandry is characterized by the extensive system practiced by large-scale farms, and the majority was implemented in the 70's, stimulated by the development policy of the federal government aiming at the national integration. The animal husbandry production generated by these farms represented in 1985 ¼ of all the agricultural production of the States of Pará and Rondônia together. The cattle herd in Rondônia State has increased 30 times in the period 1970-1990.

Therefore, animal husbandry in the Amazon region is being developed by the large-scale farmers. However, a tendency of introducing animal husbandry in their properties by the settlers of the PAs (Settlement Projects) is being observed. As causes of this tendency, the following factors can be mentioned (Muchagata. M. & K. Brown. 1999):

a. Feasible introduction with low capital and manpower investment.
b. Show the existence of productive activity to avoid invasion of land.
c. Stable market to the cattle and easiness to sell.
d. Improvement of daily income through the production of milk.
e. Easy access to credit lines through the use of existing pastures as bank guarantee. Besides, these pastures can be rented to third parties.

In the Amazon region, almost half of the pastures are degraded since the second half of the 80's (Serrão & Toledo, 1988). The degradation was caused mainly by the invasion of weeds, by the deterioration of soils fertility due to the extensive cattle raising for long time, and by the incidence of diseases and pests in the pastures monoculture (Smith, Serrão, Alvim & Falesi, 1995). In general, the invasion of weeds is caused by the insufficient management of pastures. The use of pastures can be extended for long periods through the periodic control of weeds, including activities such as weeding, fertilization, and the application of herbicides (Veiga, 1995).

As the main utilized pastures, we can mention that at the initial stage of development the introduced species were jaraguá (*Hyparrhenia rufa*) and colonião (*Panicum maximum*), which were replaced by quicuio-da-amazônia (*Brachiaria humidicola*) and recently by braquiarão (*Brachiaria brizantha*) which is used in most of the pastures. The previously utilized species were replaced because species that presented a relatively low demand of soils nutrients, more resistant soil coverage, and resistance against the attack of diseases and pests became necessary.

5.2.2 Animal Husbandry in Pará State

The animal husbandry in Pará State started in the beginning of the 30's, and currently the bovine cattle, mainly the Zebu race, and the bubaline cattle are raised. Stimulated by the fiscal incentives of the federal government in the 70's, there was a large-scale expansion of animal husbandry. In the mid 80's, the Zebu cattle production in Pará represented 65% of all the country's northern region production. Also in terms of bubaline cattle, Pará became the major producer in the country (IBGE, 1996).

The animal husbandry in Pará is characterized by the fact that most of the pasture areas is utilized by a small number of large-scale cattle raisers. Farms with more than 1,000 ha occupy approximately 50% of the total area. Besides that, cattle raisers with more than 10,000 ha represent 24% of the total. Through the land privatization process, approximately 80% of the whole territory of Pará State was private land in 1995 (IBGE, 1996).

In Pará, the swine cattle herd presented a reduction in the period 1985-1996, while the cattle herd and poultry herd doubled in the same period. In terms of land use, Pará had 5.8 millions ha of pasture areas in 1996, which represented 40% more in comparison with the figures in 1985, i.e. an expansion of 140 thousand per year.

5.2.3 Animal Husbandry Activities in the Study Area

(1) Main Animal Creation

The bovine creation in the Study Area has been the most popular sector of the cattle breading. The main activity is the bovine recreation, where the small scale producers also produces milk, when the large scale producers realized the fattening. The price payed to the producers is R$ 0.15 to 0.18/liter for the milk and about R$ 2.6/kg for the fat cow in the Study Area. The small scale producers have restrictions for the number of animals possible to be created due to the pasture size. They tends to sell the young animals with 200 to 250 kg for R$ 1.2/kg (price in the farm).

The main animals created in the region and it's quantity are shown bellow:

Table 5.2-1 Main Animals and Their Quantity (1999)

	Bovine	Buffalos	Swine	Ovine	Caprine	Chiken
Marabá	193,500	120	12,800	600	300	131,700
São João do Araguaia	29,000		4,100	250	150	35,900
São Domingos do Araguaia	55,000	150	6,200	390	300	66,800
Brejo Grande do Araguaia	68,000	100	2,500	170	200	20,500
Palestina do Pará	35,000	100	3,100	120	150	21,400
Total	380,500	470	28,700	1,530	1,100	276,300

Source: IBGE, 2000

Among the bovines in the Study Area, the Nelore and Zebu species prevail for meat production. They have resistance to high temperatures and are not exigent in food. In the case of dairy bovine, there is a race of Gir of the Zebu genus and hybrid Girolanda (Gir x Holandesa). The micro region has actually about 380 thousand heads of bovine, and half is located in Marabá municipality. Between 1996 and 1999, the effective bovine number had a small increase. On the other hand, the effective dairy bovine number was 16,000 heads in 1999, producing about 6.6 million liters of milk per year.

The main races of animals in the Study Area are as follows:

Table 5.2-2 Main Races of Animals in the Study Area

Bovine for Meat	Dairy Bovine	Buffalo	Swine	Sheep	Goat	Chicken
Crossbred	Crossbred	Crossbred	Crossbred	Santa Inês	Anglo Nubian	R.I.R.
Nelore	Gir	Murrah	Piau		Crossbred	New Hampshire
Santa Gerturdes	Girolanda	Mediterrâneo	Large White		Sannen	Plymouth Rock
Guzera	Holandesa	Jaffarabadi	Landrace			

Obs.: The underlined names show the most popular races and the names in italic show the local races.

The large scale producers can not be compared to the small ones in term of creation control, once they have well structured installations and use professional and experienced labour. They can be compared to the cattle breading management realized in temperated zones.

(2) Present Pasture Area

In the Study Area, the repeated fire during the dry season realized by the small scale producers cause the seed reduction of forest species and soil fertility losses. It causes the establishment of a vegetation dominated by weeds and shrubs. There are few natural pastures in the Study Area, where most part of the pasture is composed by improved pastures. The improved pasture formation demands financial resources. The pastures managed properly by the large and medium scale producers are possible to be utilized during 8 to 9 years. On the other hand, the pastures of small scale producers initiate the degradation after about 3 years of use, once there are no management after the implantation except of fire use.

The use form of pasture is classified in at least 3 types: 1) Continuous grazing: the cattle stays in the pasture for long periods, being practiced by major part of the small scale producers; 2) Rotational grazing: the area is divided into several number of areas and the animals are transfered systematically from one to another area, being practiced by major part of large scale producers; and 3) Chopped forage use: intensive method to feed the confined animal with chopped forage, being used in goat and sheep creation projects assisted by SEAGRI-Marabá, but not common in the Study Area. The large scale producers use effectively improved pasture, while the small scale producers use low quality pasture or even weeds.

The pastures of Braquiarão (*Brachiaria brizantha*) and Quicuio-da-amazônia (*Brachiaria humidicola*) are the most used. When the objective is the fattening, the Capim Colonião is also partially used. The pasture monoculture is generally used in the Study Area, having few cases of consortium pastures. The main species of pasture are presented below:

Table 5.2-3 Main Pasture Species Adopted in the Study Area

Local Name	Name in English	Scientific Name	Observation
Capim Elefante	Nepier grass	Pennisetum proureum Schumach	Perennial Specie with periodic cut, used partially by the innovator producers.
Braquiarão	Signal grass	Brachiaria brizantha (Hochst. Ex A. Rich) Stapf	Specie more used actually in the Study Area.
Quicuio-da-Amazônia	Creeping signal grass	Brachiaria humidicola (rendle) Schweickt	Specie that was used widely.
Braquiaria	Surinam grass	Brachiaria decumbens	Specie used traditionally in general.

Local Name	Name in English	Scientific Name	Observation
	(Jamaica) Signal grass (Australia)	Staf.	
Jaraguá	Jaragua grass	Hyparrhemia rufa	Loses taste in the maturation, being widely present in the pasture.
Esterela Africana	African star grass	Cynodon plectostachyus	Infests dry areas, being widely present in degraded pastures.
Andropogon	Gamba grass	Andropogon gayanus	Loses taste during the maturation, being widely present in degraded pastures.
Capim Colonião	Guinea grass	Panicum maximum Jacq.	Widely found in fertile lands.
Mombaça		Panicum maximum var monbaca	New specie with high profits, being used by large and medium scale producers.
Tanzânia		Panicum maximum va. tanzania	Ditto

(3) Support Capacity

The support capacity of pasture can be calculated according to the effective cattle maintained annually in a pasture unit. According to the bovine cattle composition of the small and medium scale producers in Palestina do Pará, the calculated number based on animal quantity of SAGRI is about 44.

Table 5.2-4 Estimated Composition of the Cattle and Number of Animals in Small and Medium Properties of Dairy Bovine Farming

Category	Heads	%	U.A.*	Total of U.A.
Males	1	1,7%	1,5	1,5
Rebanho leiteiro	25	43,1%	1,0	25,0
(dairy cows)	(17)			
(not dairy cows)	(8)			
Garrote of 2-3 years	8	13,8%	0,8	6,4
Garrote of 1-2 years	8	13,8%	0,6	4,8
Male Calf	16	27,6%	0,4	6,4
Total	58	100,00%		44,1

Source: *SAGRI

Considering the fact that the medium pasture area in small and medium properties is 50 ha, the support capacity is estimated in 0.88 heads/ha. On the other hand, in a well managed large property, although there are no detailed data, can be estimated in an occupation rate of 1.5 to 2.0 heads/ha that seems to be near the reality of the region pasture.

(4) Characteristics of Livestock Activities

a. The large scale producers represent the major part of the total meat cattle production, that sell to Belém and northeast region. But, the intensive system of meat cattle is not used as those developed in the south part of Brazil. The birth rate is still low, about 60 to 65%.

b. The castration of male animals is not normally realized in the extensive cattle creation. It is because the high quality meat production has no advantage in most part, and the meat selling condition is not favourable. The cattle is sold alive mainly for the northeast and

Pará markets. Besides, they believe that the bulls grows faster than the castrated animals.

c. Some projects of ovine, caprine and chiken production, etc., in small scale, that are implemented by the orientation of SEAGRI and/or NGO, have being developed with success. There are dairy processing units (cheese production) in several locations, where swine is produced taking advantage of the wey availability, that is sub-product of the cheese production. The small and medium animal creation can be realized only with the family work. Especially the chicken creation is an activity proper to small scale producers, once there are no chicken creation in commercial scale around and has great demand.

d. The small and medium animals creation has not the management technology improved yet to promote the technical assistance for the small scale producers. So, it is necessary the technical training for the technicians and extensionists of SEAGRI and NGO.

e. The cattle creation in sylvipastoril system, or, the livestock activities integration with the tree production, has being practiced partially and is an effective system to create cattle. The pasture in coconut cultivation can take advantage of the sub-products as an efficient food complement.

f. The effective buffalo cattle in the Study Area is very limited in the statistical data, but it seems to be greater in quantity. Although the several preconception against the buffalo, the small and medium traditional cattle breaders know it's utility. The degrades pasture are relatively few in buffalo creation properties.

5.3 Conditions of Silviculture

5.3.1 Silviculture in Brazil

(1) History of Reforestation

The reforestation projects were started in large scale in Brazil in the 60's, when there was a strong increase in the demand of raw material for the production of paper and cellulose, and of vegetal charcoal for the metallurgical companies in the States of Paraná, São Paulo and Minas Gerais. Particularly, there was an expansion of reforestation areas from 1966 on when the federal government adopted a national program for the fostering of reforestation aiming at the recuperation and at the exploitation of forestry resources. The main adopted species were the Pinnus sp. and the Eucalyptus sp.. The technologies of silviculture, including genetic improvement, soil preparation, cultivation and cultural treatments, were rapidly developed through the intensive experiences with those exotic species. These first pioneer reforestation activities contributed to the development of the entrepreneurial reforestation, which today adopts mainly the eucalyptus species.

The total area of planted forest in Brazil reaches around 7 millions ha in 1990 (FAO, 1990). This figure is the result of reforestation activities carried out in an annual basis of 300 to 400 thousand ha from the beginning of the 70's onwards. Today, Brazil became the major world producer of *Eucalyptus* short fiber cellulose, with around 50% of the world production.

(2) Economic Position of the Forestry Sector

In economic terms, currently the Brazilian forestry sector (native and planted) is responsible for the supply of more than 250 millions m^3 of wood. Out of the total, around 18 millions m^3 are used for the production of sawed wood, 1.6 millions m^3 for plywood, 58 millions m^3 for vegetal charcoal, and 13.5 millions ton for the production of paper and cellulose, besides the use of more than 100 millions m^3 of wood for primary consumption (firewood) (MMA/SBF, 2000).

The global revenue of the Brazilian forestry sector as of 1998 was of approximately US$ 30 billions, around 4% of the national GDP. Out of this total, the processed wood sector (sawed) contributed with US$ 5.1 billions, the panels sector (plywood and reconstituted material in general) with US$ 3.6 billions, the furniture sector with US$ 6 billions, and the paper and cellulose sector with US$ 11.4 billions. The remaining was distributed among the sectors of energy/firewood, metallurgy and vegetal charcoal, among other products of forest origin (MMA/SBF, 2000).

5.3.2 Silviculture in the Amazon Region and in the Pará State

(1) Reforestation

1) Industrial Reforestation

In Pará, several industrial reforestation projects are being carried out by private companies in several regions, in fulfillment of the regulation that obliges the lumber mills and metallurgical companies to carry out reforestation, in conformity with the alteration of the Forestry Code in 1989. The reforestation projects started in 1992, and currently certain commercial value species such as Paricá, Mahogany and Teka are being cultivated in agricultural cultivation areas and in degraded and abandoned pasture areas. The EIDAI, however, a lumber mill company established in Belém, is carrying out reforestation in different areas since 1973 when the company was established. In the last years, Paricá, a native and precocious species, is being utilized as the main species. For organic fertilization, the sawdust mixed with other processing residues is utilized. The industrial reforestation projects in progress in Pará State are listed in the following table (May 1999) (Table 5.3-1).

Table 5.3-1 Industrial Reforestation in Pará (as of 1999)

Company	Planted Area (ha)	Number of Planted Trees	Municipalities	Main Species
Eidai do Brasil Madeiras S/A	1,272	2,212,000	Belém-Icoaraci, Portel, Breves, Igarapé-Açu, Garrafão do Norte	Paricá, Mahogany, Teak, Ipê, Castanheiro-do-brasil, Faveira, Andiroba, Sumaúma, Morototó
Tramontina Belém S/A	550	450,000	Aurora do Pará	Ipê, Mahogany, Paricá, Jatobá, Teak, Freijó
Pampa Exportações Ltda	260	216,320	Vigia	Mahogany, Teak, Paricá, Ipê, Sumaúma
Floraplac Industrial Ltda.	4,000	3,100,000	Paragominas and Dom Eliseu	Paricá
Berneck Selectas &	654	408,750	São Miguel do	Paricá, Teak, Mahogany,

Company	Planted Area (ha)	Number of Planted Trees	Municipalities	Main Species
Triânglo			Guamá and Nova Timboteua	Sumaúma, African Mahogany
Serraria Marajoara Ltda.	896	1,106,750	Redenção	Mahogany, Cedar, Teak
Maginco Verde S/A	200	70,000	Nova Timboteua	Paricá, Teak, Mahogany, Sumaúma, Virola
Imasa Indústria de Madeiras Ltda	365	504,000	Redenção	Paricá, Mahogany, Sumaúma, Teak
Cemex Comercial Madeiras Exportaço S/A	345	690,000	Santarém	Mahogany, Freijó, Cedar, Jatobá, Ipê
Nordisk Timber Ltda.	50	84,800	Marabá	Mahogany, Freijó, Paricá, Teak
Total	8,592	8,842,620	-	-

Source: AIMEX - Association of Wood Exporting Industries of the State of Pará, 1999

The AIMEX (Association of Wood Exporting Industries of Pará State) installed in 1997, in the municipality of Benevides, close to Belém, a Center for the storage of seeds and production of seedlings. There, seeds and seedlings are commercialized with the collaboration and technological guidance of EMBRAPA and SECTAM. On the other hand, in an agreement with the PROECO, the ELETRONORTE – company of electric energy supply – has proposed a plan to construct a center of seedlings and seeds in Tucuruí (250 km from Marabá), collecting the seeds from the natural forest of 173 km^2 that the company has in Pará, through the technical cooperation and guidance from EMBRAPA, SECTAM and FCAP (Faculty of Agrarian Sciences of Pará).

Recently, public organizations such as SUDAM, FCAP, EMBRAPA, and private companies with forestry activities such as AIMEX and others are uniting with the aim to install a system for the supply of seeds. Currently, research about seeds in forestry nursery is being carried out. In 1996, a plan for the production of seeds was elaborated, with the implementation of two seeds laboratories and a germ plasm bank to supply and store seeds of known origin.

2) Other Reforestation Experiences

The Japanese immigrants already carry out, for more than 30 years, the cultivation of trees in the agricultural cultivation areas of the Japanese colonization of Tomé-Açu, planting, for instance, native species with high commercial value such as Castanheira-do-Brasil, Freijó and Andiroba. These species offer an indispensable shadow for the cacao crop (Table 5.3-2). Exotic species with high commercial value such as African mahogany and Teak are also planted in consortium with the black pepper. Due to the cultural treatments of the planted trees such as fertilization, formation pruning and control of diseases and pests, good results are being obtained. The cultivation of arboreous species carried out in the agroforestry system represents a tendency of increase in Pará State.

Table 5.3-2 Arboreous Species Planted in Tomé-açu for Multiple Purposes

Popular Name	Scientific Name	Description	Quantity
Freijó	Cordia goeldiana	Wood in general	33,073
Andiroba	Carapa guianensis	Wood in general	21,657
Mahogany	Swietenia macrophylla	High commercial value wood	8,884
Castanha-do-Brasil	Bertholletia excelsa	Fructiferous, Shadow, Wood in general	5,648
Ipê	Tabebuia spp	High commercial value wood	4,021
Teak	Tectona grandis	Precocious, Heliophyte, High commercial value wood	3,291
Gmelina	Gmelina arborea	Precocious, Heliophyte, High commercial value wood	1,800
Paricá	Schizolobium amazonicum	Precocious, Heliophyte	1,378
Mango tree	Mangifera indica	Fruit	1,260
Macacaúba	Platymiscium ulei	High commercial value wood	1,252
Abricó do Pará	Mammea americana	Eatable fruits, Resin used for liqueur	1,097

Source: Yamada, M. Japanese Immigrant Agroforestry in the Brazilian Amazon. 1999.
Obs.: Only the species with more than 1 thousand trees planted are mentioned.

The program "RPPN – Private Reserve of Natural Patrimony" is a remarkable example through which IBAMA supports reforestation projects by the civil society. The Ecological Park of Gunma (Gunma-no-Mori), in the municipality of Santa Bárbara, is a forestry project carried out in collaboration with the province of Gunma, Japan, where the reforestation of Mahogany and African mahogany (Khaya Anthotheca) is being carried out with the aim of creating a forest and woods with matrices trees. On the other hand, AIMEX has carried out a reforestation in the land of the Center of Technological Diffusion of Forest Seeds, besides promoting an experiment of planting and germination together with reforestation diffusion activities. Among the NGOs, the activities of SOPREM (Society for the Preservation of the Amazon Natural and Cultural Resources) are remarkable. This NGO is being promoting awareness and environmental education activities, supplying seedlings of native forest species together with fructiferous species for the population and entrepreneurs of the region since the 70's. In Tomé-açu, the Center of Forestry Studies of Amazon (CEFLAM) distributes seedlings with commercial value with no charge for the farmers, through which forestry activities of the social reforestation model are being carried out.

(2) Production of the Wood Sector

The production of wood log in the North Region is presented in the following table (Table 5.3-3). The total production of wood log, originated both from the natural forest and from plantations, in the North Region, is doubling each 5 years since 1975, presenting an increase of 5 times until 1990. In particular, the wood production in Pará has increased 9 times in the same period. On the other hand, Pará represents the major part of the production of wood originated from planted forests.

Table 5.3-3 Production of Wood Log at the North Region according to Origin: Natural Forest or Planted Forest (1975 to 1991)

Origin of the Wood Log	1975		1980		1985		1990*	
	thousand m^3	%	thousand m^3	%	thousand m^3	%	thousand m^3	%
Natural Forest	10,013	95	19,880	93	39,522	97	54,312	97
Pará	4,858	46	13,672	64	22,478	55	43,335	77
Amazonas	3,494	33	3,692	17	5,185	13	3,614	6
Rondônia	287	3	361	2	9,469	23	2,417	4
Amapá	388	4	599	3	901	2	829	1
Roraima	28	-	136	-	108	1	98	1
Acre	958	9	1,420	7	1,381	3	1,317	3
Tocantins	-	-	-	-	-	-	2,702	5
Planted Forest	572	5	1,392	7	1,207	3	1,586	3
Pará	572	5	1,392	7	1,077	2	1,246	2
Amapá	-	-	-	-	130	1	340	1
Total	10,585	100	21,272	100	40,729	100	55,898	100

Source: "Diagnóstico e Avaliação do Setor Florestal Brasileiro", FUNATURA/ITTO, preliminary version.
* Average 1989/1991
Remarks: Data are of the Legal Amazon region, except for Maranhão and Mato Grosso.

5.3.3 Silviculture in the Study Area

(1) Forestry Resources

According to the Forestry Inventory of the Wood Potential Preliminary Evaluation of the Municipality of Marabá, the total volume of wood with diameter larger than 45 cm at the chest height is of 122.13 m^3/ha and the number of trees is of 28.27/ha in the dense forest. The identified species are classified in the following 4 commercialization classes (Table 5.3-4): 1) wood with acceptance in the international market (exportation); 2) wood with acceptance in the domestic market, with possibility of exportation; 3) wood with acceptance in the domestic market; and 4) wood without defined use.

Table 5.3-4 Classification of Forest Species according to Destination

Commercialization Class	Species	Percentage (%)
Exportation	27	26.0
Domestic Market with Possibility of Exportation	17	16.3
Domestic Market	33	31.7
Without Defined Use	27	26.0
TOTAL	104	100.0

Source: "Forestry Inventory of the Wood Potential Preliminary Evaluation of the Municipality of Marabá" (Program of Mineral Integration in the Municipalities of the Amazon, 7/1996).

The main species with more than 1 m^3/ha are as follows (Table 5.3-5):

Table 5.3-5 Classification for the Main Forest Species with Commercial Value

	Main Species
Exporting Class	Angelim Pedra (*Dinizia excelsa*, Leguminosae) Ipê (*Tabebuia serratifolia*, Bignoniaceae) Cedar (*Cedrela odorata*) Mahogany (*Swietenia macrophylla*, Meliaceae) Itaúba (*Mezilaurus itauba*, Lauraceae) Maçaranduba (*Manilkara huberi*, Sapotaceae)
Domestic Market with Possibility of Exporting Class	Breu Sucuruba (*Trattinckia burseraefolia*, Burseraceae) Copaíba (*Copaifera officinalis*, Leguminosae) Sumaúma (*Ceiba pentandra*, Bombacaceae)
Domestic Market Class	Cajuaçu (*Anacardium giganteum*, Anacardiaceae) Castanheiro-do-brasil (*Bertholletia excelsa*, Lecythidaceae)

Remark: Species with commercial value with more than $1m^3$/ha of volume

On the other hand, the Forestry Management Project, started in 1998 in the Municipality of Marabá, shows the fact that the removal of wood is occurring with ipê, jatobá, cedar, angelim, tatajuba, in the order of the extracted wood volume.

(2) Reforestation

In the Study Area, COSIPAR, a company producing pig iron, is carrying out the large scale industrial reforestation with eucalyptus with the use of cloning technology. The adopted species are the Eucallyptus urograndis (hybrid of Eucallyptus camaldulensis and Eucallyptus tereticornis) and another hybrid of Eucallyptus grandis and Eucallyptus urophylla (scientific name still undefined).

The eucalyptus planted in March 1999 (species still without a scientific name and which is the result of the crossing of *Eucallyptus camaldulensis* with *Eucallyptus tereticornis*) has today 5 to 9 cm of diameter at the chest height, and 5 to 7 m of height. COSIPAR plans to plant, from now on, mainly the species which expected growth is faster (*Eucallyptus urograndis*, which is the result of the crossing of *Eucallyptus grandis* with *Eucallyptus urophylla*).

Besides this, CVRD - Vale do Rio Doce Company, a mining company, has decided to start a large-scale industrial reforestation project (approximately 60 thousand ha) with eucalyptus in an area 150 km distant from Marabá.

On the other hand, for small-scale farmers the homogeneous large-scale reforestation is difficult due to the need of financial and manpower resources. However, this would be possible if they could have access to free seedlings and seeds, together with technical assistance.

The SEAGRI of the municipality of Palestina do Pará is constructing a center of forest nurseries, in a 3 ha area, with the objective of distributing with no charge for the interested farmers the seedlings of arboreous species such as mahogany, teak, and fructiferous species such as açaí and coffee, utilizing the municipality own budget and through the cooperation with some NGOs.

(3) Wood Production

The wood production (for the production of firewood and for processing) in the Study Area, with the predominance of the municipality of Marabá in 60%, tends to be reduced.

Table 5.3-6 Wood Production in the Study Area (m^3)

Municipality	Wood	1993	1994	1995
Marabá	Firewood	5,200	5,000	5,000
	Processing	40,000	34,000	28,000
São João do Araguaia	Firewood	1,000	1,000	-
	Processing	4,000	3,800	-
São Domingos do Araguaia	Firewood	3,000	3,000	-
	Processing	7,000	7,500	-
Brejo Grande do Araguaia	Firewood	1,100	1,500	-
	Processing	5,400	6,000	-
Palestina do Pará	Firewood	1,000	1,000	1,500
	Processing	4,500	5,000	7,500
Total	Firewood	11,300	11,500	-
	Processing	60,900	56,300	-

Source: IDESP, 1999, Coordenadoria de Estatística Estadual – CEE
Remark: "-" means value not found

In the municipality of Marabá, since 1997, there are only 3 logging licenses granted through the submittal of forestry management projects. The removal of wood from the natural forest through the forestry management is still small in the Study Area. However, according to the owner of a lumber mill visited in the northwest region of Marabá, the supply of wood log is being carried out, in the last years, by the settlers who are logging inside the native forest. The west portion of the municipality of Marabá still has a great volume of uncut trees, thus with potential for the production of log wood. Since a communal silviculture started in 2000, which is attracting several communities, one can infer that the wood production by the small-scale farmers shall increase.

(4) Participatory Forestry Management

The Socio-Agronomic Laboratory of Tocantins (LASAT) is implementing communal silviculture projects in 3 communities in the municipalities of Marabá, Itupiranga and Nova Ipixuna. These projects are being implemented with the collaboration of the IMAZON and EMBRAPA. As execution methodology, training in technology is offered to the producers and the LASAT elaborates management plans based on the survey carried out by the producers on the volume of uncut trees. Out of the 100 ha of forests, wood is removed each 2 years from a 10 ha area. The removal volume represents 40% of the total, representing approximately 25 m^3/ha. Lumber mills are located within the communities, and are equipped through resources coming from the Pilot Program for the Protection of Brazilian Tropical Forests (PPG7). In the 3 communities, 41 families are interested in participate in the project. Besides, the promotion of the increase of participant families within the projects executing communities and the increase of participant communities is planed.

(5) Forest Exploitation Activity

In the municipality of Marabá, wood logs, firewood, vegetal charcoal and castanha-do-brasil are being extracted from the natural forests. The extraction of castanha-do-brasil presents a decreasing tendency. The native plants, over fifty years, produce 16 to 55 liters/ ha/ year (EMBRAPA, 1997), though the production varies a lot each year. The production of castanha-do-brasil was reduced to one tenth in the last ten years. The selling price of the

castanha-do-brasil for the extraction farmers is of R$ 22-40/liter. Brejo Grande do Araguaia and Palestina do Pará produce some tons of babaçu nuts each year.

Table 5.3-7 Forest Products Extracted in the Municipality of Marabá

	1989	1990	1991	1992	1993	1994	1995
Log (m^3)	75,000	55,000	50,000	50,000	40,000	34,000	28,000
Firewood (m^3)	10,000	6,000	6,000	5,000	5,200	5,000	5,000
Vegetal Charcoal (t)	60	42	38	35	32	30	60
Castanha-do-Brasil (t)	550	600	550	500	450	420	38

Source: SEBRAE. Socioeconomic Diagnosis of the Municipality of Marabá. 1995.
Coordenadoria de Estatística Estadual (CEE). Município de Marabá.

5.4 Present Conditions of the Rural Producers

5.4.1 Conditions of Land Ownership

The rural producers in the Study Area can be classified into 3 groups according to the land ownership: (i) large-scale producers who utilizes the large-scale farm for the re-breeding and fattening of the bovine cattle; (ii) small-scale producers carrying out familiar agriculture through the slash-and-burn cultivation system, and also a small-scale animal husbandry; and (iii) medium-scale producer who expanded his cultivation area with a tendency in concentrating in animal husbandry activities. Several organizations and plans/programs utilize different criteria for the producers classification according to the possessed land. For this Study, we will adopt the following criteria taking into consideration the present conditions of the Study Area: (i) small-scale producer with less than 100 ha; (ii) medium-scale producer with 100 to 1,000 ha; and (iii) large-scale producer with more than 1,000 ha, because: (i) the average area in the settlements is 50 ha, however the familiar producer outside of the settlements usually have an area larger than this; and (ii) properties over 100 ha, in general, tend to concentrate in animal husbandry and less in agriculture. The cattle husbandry farms size varies from a thousand to thousands of hectares, and in average[1] the size is 3,500 ha.

The total number of rural producers is difficult to be precisely identified, therefore we deduced the approximate figures from the number of members of the Syndicate of Rural Producers, to which mainly the small-scale farmers are associated, and from the number of members of the Syndicate of Rural Producers, to which mainly the large-scale producers are associated. The estimate [2] is as follows: (i) small-scale producers between 10,000 and 19,000; (ii) medium-scale producers between 3,000 to 4,000; and (iii) large-scale producers in aproximately 300.

In general, the small-scale producers adopt the slash-and-burn cultivation system in the forest areas, implementing pastures in for the acquisition of cattle. Consequently, they have several types of areas such as cultivation area, pastures, capoeira, and even remaining forest areas. On the other hand, the large-scale producers concentrate in cattle husbandry, with rare cultivation areas. Therefore, the large-scale producers' areas are predominantly pastures with some remaining forest areas, with relatively few capoeira and capoeirão areas. In general, the

[1] Vincent de Reynal, 1999: Average area in the municipalities of Marabá, São João do Araguaia, São Domingos do Araguaia.
[2] The total number of members o the syndicates were taken into consideration, 12,000, in 5 municipalities (BMP, 1999) and the existence of non members in 30%; and that 85% have less than 100 ha and 15%, more than 100 ha.

small-scale producers almost always try to implement more pastures through the slash-and-burn system, with a tendency of having less forest areas and more pastures along the period of permanence in their land.

5.4.2 Present Conditions of Agricultural Farming

Agricultural farming practiced in the Study Area are classified into 3 types: (i) large-scale producers who have as main activity the meat cattle production; (ii) small-scale producers of familiar agriculture; and (iii) medium-scale producers located in between the first 2 groups. In general, the main activity of the small-scale producer is the re-breeding, and the income comes from the milk production and from the sale of cattle with approximately 8 months and of cows with no more use for milk production. In the case of medium- and large-scale farmers, they usually have a certain level of initial investment to start business, and we can find cattle raisers dedicated to several different activities such as: (i) meat cattle production, from the purchase of calves until the fattening up to 3 years; (ii) integrated cattle husbandry, encompassing breeding, re-breeding and fattening; and (iii) the specialized cattle husbandry even in the production of reproducing animals. The detected activities are described in the Table 5.4-1.

Table 5.4-1 Agricultural Farming in the Study Area

Producer Level	Area	Number of Producers	Characteristics
Small-scale Producer	Up to 100 ha	10,000 to 19,000 producers	Subsistence familiar agriculture, carried out through the slash-and-burn system, with possible sale of production surplus, and small-scale animal husbandry specialized in re-breeding, breeding and milk production. Can cultivate fructiferous species in small scale. Have relatively several areas of juquira, capoeira and capoeirão appeared after the burning of the area.
Medium-scale producer	100 to 1,000 ha	3 to 4,000 producers	Up to 200 ha of property, the familiar agriculture still persists, however with a smaller index of subsistence agriculture and slash-and-burn system utilization. Meat cattle husbandry, encompassing re-breeding, breeding and/or fattening, with a well structured management. Activities in other sectors are not rare. They have permanent employees, but the temporary employees are predominant. Facilities with the initial investment. In larger properties, there is a smaller proportion of capoeira and capoeirão.
Large-scale producer	over 1,000 ha	approx. 300 producers	There is even the integrated cattle husbandry, encompassing re-breeding, breeding, fattening and genetic improvement. There are permanent employees. Owners tend to reside in urban areas, leaving the management to the manager. The forest areas and pastures are predominant, with few areas of capoeira and capoeirão.

Source: Field research, September of 2000.

(1) Agricultural Activity of Small-scale Producers

The small-scale producers in the Study Area have as main activities the production of rice, cassava, and maize through the slash-and-burn system, besides the animal husbandry through the extensive system, with slight variations depending on the period of permanence in settlements. In the cultivation areas prepared with fire, the yield drops after 2 to 3 years of utilization. Then the areas are abandoned for recuperation through the natural succession. When these areas are considered recuperated, they are again utilized through the slash-and-burn system. In the Study Area, the tendency of introducing extensive animal husbandry by planting pasture after fire, besides the use for cultivation was observed despite de small size of the properties.

Comparing the gross income per hectare, there is a great difference among rice (R$280/ha), maize (R$360/ha) and cassava (R$750/ha) produced through the slash-and-burn system and animal husbandry (R$50 a R$150/ha) (Table 5.4-2). The cassava flour processed at the property gains an aggregated value corresponding to 50%.

Table 5.4-2 Yield and Sale of Basic Products

	Yield (kg/ha)	Gross Income per Hectare (R$/ha)
Rice	1,400	280
Maize	1,333	360
Feijão beans	250	125
Cassava	7,500	750 (1,125)*

Remark: * Flour
Source: Interview with farmers

The livestock income of small-scale producers is generated by the sale of milk, cattle and cows with no more use for milk production. The producers opt for not selling the cattle because they consider this a form of saving.

The rental of pastures is a normal practice. Small-scale producers, even without financial conditions to have a cattle herd, plant pasture in the areas after the slash-and-burn in order to raise the cattle of third parties. There are two types of rental, short term and long term: the first one requires the payment in cash (R$4/head/month); in the second one, the pasture owner gets the calves borne in the second year, and in the following years the calves are split between the pasture owner and the cattle owner.

Some producers are planting fruit trees, being influenced by technical assistance projects carried out in the last few years. The experience is quite profitable for those successful producers. Through a research carried out with farmers, the following classification of small-scale producers was confirmed, i.e.: (i) subsistence agriculture mainly carried out through the slash-and-burn system; (ii) producers in transition from agriculture to animal husbandry; (iii) producers dedicated to animal husbandry, who are actively introducing the cultivation of fruits; (iv) producers dedicated only to animal husbandry, oriented to the recuperation and/or expansion of pastures; (v) producers who try to carry out the sustainable farming through the cultivation of fruit trees within the natural forests.

(2) Agricultural Activity of Medium-scale Producers

In this Study, producers with areas from 100 to 1,000 ha are classified as medium-scale

still maintaining the familiar agriculture, the others with larger areas tend to concentrate in animal husbandry, oriented to the expansion of pastures. On the other hand, there are also some farm owners that also carry out activities in other sectors.

The producers carrying out multiple agricultural activities are those with areas from 100 to 200 ha, and who practice the cultivation through the slash-and-burn system, the animal husbandry, and the cultivation of fruit trees. The income of this category producers comes from the sale of: (i) rice and flour that represent a relatively high proportion of the total sale of agricultural products and their by-products; (ii) male and female cattle bred and raised in the farm and cows with no more use for milk production; and (iii) the fruits such as cupuaçu and banana. The income per hectare of fruits is higher than that of animal husbandry.

Producers dedicated only to animal husbandry are those who purchase a relatively large area when they arrived to the region. These producers depend on the income generated by the animal husbandry. They do not use fire in land preparation and utilize little contracted out manpower since the area is not that large for so. Basically, they carry out the meat cattle husbandry, encompassing breeding and re-breeding, with some cases specialized in fattening. The aspect that differs them from the small-scale producers is the programmed control of cattle management through the pastures rotation with the division of pasture land.

The producers who also perform other activities are those who do not depend on the income generated by the animal husbandry. In general, they have started and still practice the cattle husbandry in the same way as the previous group who only dedicates to cattle husbandry, and the only difference is that they have income from other sources. These producers have permanent employees but do not hire a manager for the farm. Some of them utilize fire for land preparation utilizing contracted out manpower. They also hire temporary employees when necessary for the removal of weeds and other tasks.

(3) Agricultural Activity of Large-scale Producers

As aforementioned, producers with more than 1,000 ha are considered as large-scale producers in this Study. In the composition of large-scale producers, there are those who started the activity by exploiting the castanha-do-brasil, and others who invested, from the 60’s on, stimulated by the development policy for the Amazon region. Several farms are administered by managers, with the absence of the owner, who sometimes even live in big cities of the Country. For this Study, large-scale producers were classified into 3 groups according to their activities: (i) meat cattle husbandry, encompassing breeding and re-breeding; (ii) meat cattle husbandry, specialized in fattening; and (iii) meat cattle husbandry, specialized in genetic improvement.

For the maintenance of a farm with approximately 1,000 ha, usually the owners only contract some permanent employees, contracting temporary manpower only when necessary. The farm administration is carried out by the owner him/herself, without a contracted manager. In this class, the existence of the production of rice and cassava for the consumption of the owner and workers’ families is also possible.

In the class of producers with thousands of ha, the integrated cattle husbandry can exist, encompassing the breeding, re-breeding and fattening. This class of producers usually contract a manager and other workers and sometimes reside in other cities and even in other States.

In properties with more than 10,000 ha, the meat cattle husbandry is carried out, encompassing breeding, re-breeding, fattening and genetic improvement. In this class, the farms have contracted managers and dozens of contracted workers. The owners tend to develop other activities in the urban areas. In some cases, one only owner has several farms in different locations.

5.5 Analysis of Related Examples of the Recuperation of Degraded Areas

As examples of experiments related to the recuperation of degraded areas and to high sustainability agrosilvipastoral farming practiced in the State of Pará and in the Study Area, we can mention 3 cases: 1) cultivation of fruits and forest species in consortium; 2) efficient utilization of capoeira, capoeirão and natural forests; and 3) reform of degraded pastures. The cultivation of fruits in consortium is being spread as a new attempt among the small-scale producers through the assistance of governmental organizations and NGOs. On the other hand, the reform of degraded pastures characterized by the fact of being actively carried in order to maintain the existing production system, independently of the size of properties. The analysis of some ongoing concerning projects is presented as follows.

5.5.1 Inter-cropped Cultivation of Fruit and Forest Species

(1) Agroforestry Activities in the Japanese Colony of Tomé-Açu

In the Japanese colony of Tomé-Açu, the agroforestry systems are being experimented since 1975, through the inter-cropped cultivation of fruit species and products that can be industrialized such as black-pepper, passion fruit, cacao, rubber tree, etc., with arboreous forest species such as freijó, andiroba, etc.. As the result of experiments and mistakes during one forth of a century, the good growth of some arboreous forest species became possible. The experiments in relation to several combinations of species and the cultivation environment supplied valuable information for the projects of recuperation of degraded agricultural areas in other regions. The experiments in Tomé-Açu can be considered an advanced paradigm of agroforestry systems in the Amazon region.

(2) Belterra Small-Scale Agro-forestry Project

In 1984, a farmer lent an area of 1.5 ha to EMBRAPA for the implementation of an agro-forest system experiment with cupuaçu, banana, forest species and feijão. At first, banana was planted to make shadow for the cupuaçu; and feijão was also planted in consortium. Banana production started in the 2^{nd} year producing until the 5^{th} year, and was removed in the 6^{th} year. In that place the following trees species were planted: Mahogany, Cumaru, Tatajuba and Castanha. Leguminous plants (*Chamaecrista rotundifolia*) were also planted to avoid the occurrence of weeds and to improve soil conditions.

Apparently, the agro-forest system was being followed up and maintained by EMBRAPA for 10 years with good results until the area was returned back to the farmer in 1994. When the area was returned back to the farmer, the cupuaçu maintenance was abandoned and the disease attacked most of the plants. However, the forest species developed well and can be logged within 5 years. So, the producers participation is important for the project success.

(3) Experimental Project of Agro-forest System with Leguminous in Altamira

The EMBRAPA station (80 ha) studies the adaptation of leguminous species in agro-forest systems. Leguminous crops are planted in intercropping with fruit trees, forest species and cacau in order to improve the soil, providing initial shading to cacau and mainly to avoid the invasion of weeds. The leguminous species to be introduced are *Feijão de Porco, Feijão Guandu, Desmodium ovalifolium, Chamaecrista rotundifolia, Chamaecrista repens* and kudzu (puerária).

The good growth of trees and leguminous crops is due to the fertile soil ("terra roxa"), although this soil is physically degraded due to intensive use. The management of leguminous plants for soil restructuring and weed control shows a reduction of 60% in manpower. However, some leguminous crops such as kudzu (puerária) are excessively aggressive and spread over the main crop. Thus, the selection of appropriate leguminous is necessary. It is reported that growing leguminous crops is good from the agronomic, ecological and economic points of view.

(4) Project to Produce Black Pepper and Leguminous Crops in Consorcium in Altamira

At first introduced in the 70's, currently the black pepper cultivation is a good option for the income raising of small-scale farmers who also perform cattle husbandry. The black pepper plantation occupies small degraded areas in intercropping with leguminous crops for which the technical advice was provided by EMBRAPA. This cultivation is carried out without mechanization or fertilizers. The leguminous crops such as *Feijão de Porco* and *Chamaecrista* are grown mainly for weeds' control. Their utilization also helped in the reduction of manpower costs for clearing the area. It also helps in incorporating nitrogen and organic matter to the soil, increasing the crop development and productivity. This project is pioneer in utilizing degraded areas, considering the production costs reduction, being apropriated for the small scale producers.

(5) Agroforestry Activities in Paragominas

In the reforestation using mahogany (*Swietenia macrophylla*), coffee and black pepper are introduced to supply shadow. For mahogany, the main problem is the attack of "broca" (*Hypsipyla grandella*), however the damages are very reduced in the analyzed experiment. This is the effect of the applied insecticide in the mahogany growth phase from 1 to 6 meters, the most likely for the attack of "broca". The fact that the damages were remarkably reduced after the introduction of irrigation allows to formulate the hypothesis of strong relationship between the dry period and the damages caused by the insect. Through the observation of "broca" ecology based on experiments, the fact that allows the reduction of damages can be inferred.

(6) Project of Pupunha Palm Heart (Palmito) Production in Sapucaia

The project will be implemented by AGROISA (Agroindústrial Sapucaia), as a project approved by SUDAM, in Sapucaia in an area of 840 ha where 2,000,000 seedlings will be planted and 600,000 others will be produced. The area used to be covered with "juquira" before being prepared to plant "pupunha". The soil are improved through the application of organic matter, and sawdust. Earthworms are produced to make humus for soil improvement in some areas.

The planting of “pupunha” will be the base to produce “palmito”. It is expected that the “pupunha” production will be three times more than the “açaí”. Pupunha can be harvested after 18-24 months. Another advantage is that pupunha palmito stays longer, for about 10 days, without oxidizing even after harvest, while Açaí palmito gets oxidized within two hours. Therefore, it is expected that the Pupunha palm heart production will be a new way to utilize the degraded areas.

(7) Project of Irrigated Coconut Production in Redenção

The present project has the objective of irrigated dwarf coconuts production in 82 ha utilizing two small artificial dams. This coconut production is destined to an agro-industry that bottles the coconut water. The price of irrigated coconut is higher and is sold for R$0.30 per unit instead of R$0.18 per unit of non-irrigated coconut. The price difference is due to the amount of water found inside the coconuts – 300ml for the non-irrigated and 500ml for the irrigated one. The present project will be conducted fully by own resources, although credits can be utilized in the future. It is not possible to recover the investiment in the present moment, but it is expected that it will be possible in few years.

(8) Inter-cropped Cultivation of Fruit Species in the Micro region of Marabá

The Center of Popular Education, Research and Syndical Support (CEASP) carries out technical assistance in 3 settlements near Marabá about the intercropping cultivation of Castanha-do-Brasil, Cupuaçu and Graviola in capoeira area. In PA Araras, in the municipality of São João do Araguaia, Cupuaçu and Castanha-do-Brasil within the natural forest are maintained for an efficient utilization. With the PROCERA and WWF resources, the cooperative has purchased a truck with a freezer chamber and one agroindustrial unit for fruits pulp production. The community produces 14 t/year of Cupuaçu. On the other hand, Castanha-do-Brasil started to be planted 10 years ago. The planted Castanha-do-Brasil trees in pasture land 8 years ago do not present a good growth due to the influence of fires, though the trees planted within capoeira 10 years ago are producing fruits. The PA Araras is an old settlement and the community is being organized, the reason why they are probably attaining a relatively successful enterprise.

(9) Assistance to the Small-scale Farmers in the Micro region of Marabá

EMATER – Company of Technical Assistance and Rural Extension (EMATER – Pará) has 642 projects implemented between 1994 and 1996, with mainly the small-scale farmers of Marabá municipality as the target-public, and through FNO resources. However, 70% of these projects ended up in failure, resulting in the delayed repayment of the debts. Several projects related to fruits cultivation failed, while the animal husbandry ones present a high success rate.

One of the failure reasons is the lack of technology of fruits cultivation on the part of farmers, and EMATER does not have a sufficient system to perform technological transfer. As reasons for the non repayment of debts, we can mention the lack of farmers awareness as for the responsibility in repaying the debt, delay in the release of resources loosing the cultivation timing, the precarious growth of crops due to climatic calamities and to the attack of diseases and pests, among others. EMATER has improved the system, currently giving priority to animal husbandry related financing, releasing the resources through the cooperatives in such a way that they supply the resources to the farmers in the form of materials, thus avoiding the use of these resources for other purposes, as well as helping in the procurement of financing for the

installation of irrigation facilities.

(10) Productive Technology in the Agroforestry Systems

In 5 locations in the municipality of Marabá, PED projects – Decentralized Execution Projects - were implemented by SECTAM, in a combination of technical transfer in fruits cultivation and agroindustry for the fruits processing. The adopted species were fruit species such as Acerola, Cupuaçu, Passion Fruit, Castanha-do-Brasil, and forest species such as Mahogany, Andiroba and Teak. Leguminous such as Ingá, Acácia Mangium, and Feijão Guandu (*Cajanos Cajan*) were also experimented. These projects contributed for the technological improvement of the cultivation of some farmers, however the production is not increasing sufficiently to meet the installed capacity of the processing plant, since the installation of the agroindustrial structure was carried out precipitately in a higher scale comparing to the adequate one.

(11) Improvement of Farmers Lives through the Introduction of Agroforestry Systems

POEMA – Program of Poverty and Environment in the Amazon - carries out technical assistance to approximately 150 families in 4 communities in Pará State, as a demonstration project since 1990, aiming at the improvement of life conditions of the poor population. POEMA establishes as the farmer income target a value corresponding to 4 to 6 times the minimum wage. About 5 modules (1 module of 21 x 21m) are allocated for 1 family, where the agroforestry system is planed through several combinations of forest species with different heights, having as basis the cultivation of banana in a spacing of 3m. There are several planted species, including annual crops such as Rice and Cassava; perennial fruit species of short cycle such as Banana, Passion Fruit, Papaya; perennial fruit species such as Cashew, Orange, Acerola, Pupunha, Coconut; and forest species such as Castanha-do-Brasil. The POEMA activities oriented towards the poorest small-scale producers are receiving a good evaluation. This is due to the fact that all the processes are taken into consideration, from the cultivation of agricultural products until the development of treadable products. Apart from this, the private sector is also participating. The participation of the executing agencies can be considered successful.

(12) INCRA Colonization Project - 'Tarumã Mirim'

The INCRA colonization project located in Tarumã Mirim is conveniently located at about 12 km from Manaus and 8km from BR-174. INCRA colonization project was originally initiated in 1992 and was effective from 1995. The total area of 42,900 ha is divided into 1042 lots and currently has 856 farm families. There are 3 projects in the Area.

a. Dendê production: it will be grown by 84 families with 5 ha per family. The project is supported by the EMBRAPA and the seedlings are grown in the community nursery of the colony itself.

b. Forestry Management: an area of 7000 ha of Community forest management is carried out under PPG-7.

c. Eco-tourism: the third project under implementation is an Eco-tourism project, with exploration of ecological trails.

Tarumã Mirim project has settlers from Maranhão and other states settled according to the lots

plan. Besides, they also receive the support from the municipality for building infrastructure and other facilities such as vicinal roads inside the colony. Technical support and the supply of seedlings are also provided by EMBRAPA. However, financing for the individual farmers is still considered to be a major problem and the settlers are hoping to receive the finance through the government programs such as PRONAF.

5.5.2 Efficient Exploitation of Capoeira, Capoeirão and Natural Forests

(1) Jacaranda Project in Manaus

The Jacaranda Project (Brazilian Amazon Forest Research Project) is a bilateral technical cooperation project undertaken by the Japan International Cooperation Agency (JICA) carried out at the Instituto Nacional de Pesquisas da Amazônia (INPA), since 1995. It is included as an associated project to the Pilot Program for the Conservation of the Tropical Forests of Brazil (PPG-7). The objectives of this project are to provide information for sustainable management of forest and to improve reforestation techniques for the rehabilitation of degraded areas. The distribution of different tropical forest types and deforested areas around Manaus are analyzed using satellite imagery of Landsat TM in this project.

In the Jacaranda Project, experimental plantings are carried out in the field for long term monitoring of native tree growth and to study their influence on the rehabilitation of degraded soils. Apart from the research project carried out at INPA Forest management Station, abandoned or degraded areas in private lands were selected to carry out experimental plantings, aiming to stimulate reforestation in these areas. The three experimental forest plantations over degraded areas are located in the Municipalities of Presidente Figueiredo and Manaus (Serraria Teixeira, Fazenda Santa Claudia and at the Cooperativa Agricola Mista Efigenio de Salles (CAMES)), where several experiments are on going related to the structure variation of the forest, native specimen characteristics, specimen association, ecosystem comparison based on the soil, etc.. The present project has the objective to contribute with the efficient utilization of the forest resources and the re-utilization of the degraded areas in the economical activities, being one of the few demonstrative experiments in the Amazon region.

(2) Experiment with Forest Species Management in Belterra

The experomental field of EMBRAPA in Belterra is conducting an experimental research project aiming at the production of seeds of trees and at the identification of proper tree species for the region. The total experimental area encompasses 1,000 ha. In a 100 ha area, an experimental cultivation with about 50 forest species was carried out in order to identify the most appropriate species for the region and the main ones are Castanheira (*Bertholletia excelsa*); Acácia (*Acacia mangium*); Andiroba (*Carapa guianensis*); Marupá (*Symaruba amara*), Morototó (*Dydimophanax morototoni*), Tatajuba (*Bagassa guianensis*), Taxi branco (*Sclerobium paniculatum*), Cedrorana (*Cedrelinga cataneiformis*) and Freijó (*Cordia goeldiana*), which are planted in line of cultivation within the capoeira.

In a 60 ha area, capoeira enrichment is experimented, planting trees in lines and in cleared lands. Also, in the experiments in cleared land, within the capoeira, the competition among the 13 species planted by group was observed. It is worthy to mention that the experiments with forest species are being carried out for more than 20 years and the data, which are still obtained, is very important for the study on the behavior of these native species.

(3) Reforestation Project by Intercropping Forest Species in Degraded Areas of Aurora do Pará of Tramontina Company

This project iniciated in 91, has the objective of recompose the forestry use of degraded areas. An area of 1,100 ha has already 950 ha reforested. The project is financed by FNO through BASA, besides their own resources, and has experiments carried out with EMBRAPA. The main forest species cultivated are Paricá, Freijó, Mahogany and Teka, and the first three are planted in a intercropping. Initially, as there was no experiments in degraded areas recovering, the experiments were realized by trial and error. But the results accumulation made possible to acquire new knowledges. It can be said mainly for Paprica, Mogno and Teca that was possible to know very important information as relation with the soil and plantation interval.

(4) Forestry Management by Rosa Madeireira in Paragominas

This company carries out, since 1999, the forestry management in 2,800 ha of natural forests, in its own property. Although IBAMA grants license for the logging of trees with a diameter of 45 cm at the chest height, this company carries out the selective logging of 23 commercial species in a diameter over 57 cm at the chest height. The consumption of log wood at the Rosa Madeireira is of 32,000 m^3/year, thus it demands forest areas of approximately 1,000 ha to meet the annual demand. Consequently, it needs approximately 50,000 ha of natural forests in order to carry out the sustainable forest management. However, the acquisition of natural forest areas in the surroundings is impossible. Consequently, this company is obliged to depend on the supply of wood logs from other companies that exploit the natural forests to complement the necessary raw material not supplied by their own forests. This fact shows the obstacles to make compatible the sustainable forestry management and the entrepreneurial management.

(5) Experimental Reforestation of PAMPA

Pampa, that has a lumber-mill in Belém producing annually 20,000 m^3, carries out since 1997 the experimental reforestation of Cedar, Ipê, Paricá, Mahogany, African Mahogany, Teak, Sumaúma, Freijó, etc., with the aim to assure the supply of raw material in their own properties' forests. The project is characterized by intense measures of control against the attack of diseases and pests. The application of herbicide is carried out some times a year. Although the modern silvicultural treatments, Mahogany is suffering the damages caused by the attack of "broca", and the application of insecticide (Tamaron) is not contributing for the reduction of damages. Consequently, the company continues to have problems in controlling the "broca".

(6) Experimental Reforestation at Eidai do Brasil in Capitão Poço

Eidai do Brasil has acquired an area covered with capoeira at the municipality of Capitão Poço where, since 1997, carries out the experimental reforestation for the recuperation of degraded areas. In an area of approximately 2,200 ha, Eidai carries out: 1) heterogeneous reforestation inter-cropped with Paricá, and 2) cultivation of agricultural products such as rice, maize and feijão intercropped with Paricá, aiming at the improvement of the degraded soil. The company produces approximately 80,000 m^3/year of plywood from 120,000 to 130,000 m^3/year of wood logs. Thus, even with the successful reforestation, the company only obtains half of the wood logs needed for processing. On the other hand, the company produces approximately 8,000 m^3/year of organic manure to be used in the correction of the cultivation area soil. For the production of the organic manure, sawdust and trees bark, residues of the lumber-mill in Belém,

maize straw, swine manure and several fungi. The organic manure is applied in the proportion of 70 liters per tree. This recycling technology was awarded in 2000 by the Federal Government within the technology sector of industrial wastes utilization.

(7) Industrial Reforestation of COSIPAR in Micro region of Marabá

According to the Industrial Reforestation Program (PIF), the consuming companies have to attain their self-sufficiency in terms of raw material for the production of vegetal charcoal until 2012. Cosipar needs 2 to 3 m^3/ton of vegetal charcoal for the production of pig iron, and depends in 90% of the wastes of the lumber-mills production. The company plans to reduce, in the future, this dependency to 5 to 10%, supplying 20% with babaçu and the remaining 60 to 70% with planted eucalyptus. For this purpose, it carries out for 10 years the reforestation with eucalyptus in its 400 ha property, aiming at the production of vegetal charcoal raw material. However, the production of raw material from planted forests is supposed not to present economic advantage considering the low price paid for the vegetal charcoal purchased by the factory. Cosipar also carries out, in degraded areas, the experimental cultivation of eucalyptus intercropped with Rice, since 1999, and with Maize, since 2001. This project results that aim at the recuperation of degraded areas soil and the multiple management shall be evaluated as fundamental information for future projects.

(8) Experimental Cultivation of Neem in Santo Antônio

The experimental cultivation of Neem (*Azadirachta indica*) originated from India is being carried out since 1994, and is being extended among the surrounding farmers. Neem has excellent preventive effect against the attack of insects in the blossoming period (3 months a year), being considered valid against approximately 633 species of insects. The Neem was introduced for the control of pests in animal husbandry and silvicultural farms. Although Neem is appropriate for a relatively dry climate, its adaptation in this region with high rainfall is being successful. The Neem was introduced in 12 municipalities in Pará State, and approximately 100,000 trees were already planted. Neem can be considered useful as natural insecticide with low environmental impact.

5.5.3 Reform of Pastures

(1) Experimental Silvopastoral System for the Recuperation of Degraded Areas in Bragantina

In the experimental field that was covered with capoeira at the initial stage, the reform of pastures was carried out during 10 years, together with the extensive husbandry of horses and sheep. After this phase, in 1994, the soil became notoriously deteriorated, and the animals were reduced to only sheep, and ever since the activity was converted into a silvopastoral system through the cultivation of Paricá, African Mahogany, among others. Currently, the experimental field have 30 fruit species and 17,000 units of arboreous forest species. This project is one of the most advanced in terms of degraded areas recuperation, and can also be evaluated from the academic point of view as for the cultivation environment, selection of adopted species, combination of intercropped species and control of Mahogany pests, considering that the project executor is a researcher.

(2) Project for Re-production of Pasture by the Barreirão System in PAU D'ARCO

The present project aimed to recover the pasture in association with maize in a 30 ha. The Barreirão system that the EMBRAPA assists plant the maize with grass together applying lime and fertilizers to improve the soil. After the harvest of maize, livestock is put into the field which ate both grass and the straws of maize. This method reduces the cost in pasture reforms, since there is a maize harvest. It can be said that is an efficient method of integrated agriculture.

(3) Measures Currently Taken in the Micro region of Marabá

In relatively old settlements located at the southeast portion of the Study Area, there are areas dominated by invading plants such as babaçu. This is due to the productivity deterioration resulting from the management of pastures repeatedly using fire for long time. In areas under this condition, several producers desire to reform the pastures. As measures to solve the pastures degradation problem, some producers stopped the use of fire for the control of weeds. These producers carry out the reform of pastures through the use of expensive manpower for weeding, application of herbicides or utilization of equipment such as tractors and excavators. The expenses with this weed control reduce the income.