According to the data from the Organization for Cooperatives of Brazil (OCB), national organization of cooperatives, the total number of cooperatives in active operation was 2,440 at the end of 1982. Since the total of approved cooperatives was 2,781, 341 cooperatives are considered to be inactive.

In the data furnished by OCB, cooperatives in operation are classified by the type of business as shown in Table 5-13. Agricultural cooperatives (including agro-industry cooperatives) are included in the category of production cooperatives in the table.

The above figures are for single cooperatives. In addition, there are central cooperatives and federations consisting of several cooperatives. The number of these federations are 41 in the production sector; 11 in rural electrification and telephones; 9 in labor; and 2 in credit.

Table 5-13 Cooperative in Operation by Type of Business (Year-end 1982)

	Production	Consumption	Rural Electrification/and Telephone	Labor	Housing	Credit	Total
Number of Cooperatives	1,074	271	202	216	228	449	2,440
Number of Members	1,153,227	600,182	309,704	227,026	213,649	577,248	3,081,072

Source: OCB/BNCC, Panorama Cooperativismo, 1982

5-4-3 Type of Agricultural Cooperatives

Agricultural cooperative refers to a cooperative which engages in activities relating to agriculture, such as production, sales, and agro-industry (including livestock products, forest products, and marine products), as well as purchasing of production materials. In Table 5-13 these are listed as production cooperatives. Since almost all of the production cooperatives in the table relate to agriculture, and the number of non-agricultural cooperatives is negligible, almost all of the 1,074 production cooperatives can be thought of as being agricultural cooperatives. The total number of members belonging to production cooperatives, being 1,153,227, accounts for about 20% of the total number of farms throughout the country which is about 5,100,000.

This rate of participation, though not to be compared with that of Japan (100%), is considerably high among developing countries.

Sales and agro-industry represent the majority of agricultural cooperative activities. Agricultural cooperatives which conduct agro-industry amount to about 400, nearly half of the total.

(1) Sales and purchasing activities

Table 5-14 below shows the proportion of sales of staple products by agricultural cooperatives in total production for 1981-82. In crops, the agricultural cooperative share is highest in wheat (88.2%); followed by soybean (64.1%) and barley (48.8%).

Table 5-14 Share of Agricultural Cooperatives in the Sales of Staple Products (1981-82)

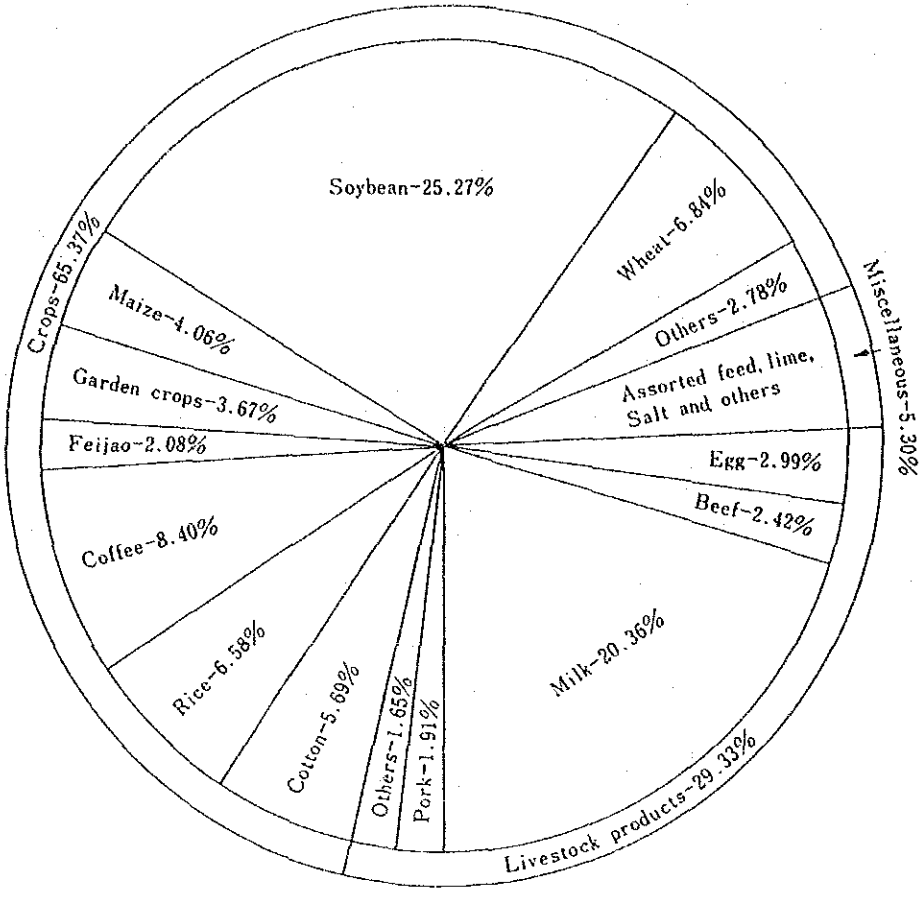
Items	A. Production (ton)	B. Sales by Agricultural Cooperatives (ton)	B/A Proportion (%)
Soybean	12,834,624	8,226,779	64.10
Wheat	1,819,504	1,604,711	88.19
Maize	12,601,262	2,513,659	19.95
Rice	9,718,074	1,291,909	13.29
Feijao	1,670,086	356,032	21.32
Barley	110,140	53,729	48.78
Coffee	2,022,000	321,204	15.89
Cacao	303,520		15.00
Seed cotton	1,935,091	538,051	27.80
Milk	6,039,784 (kl)		22.84

Source: OCB Data

Cooperative sales in value by products are illustrated in Figure 5-1. The sales of agricultural products account for 65% and those of livestock products about 25%, among the latter milk is the largest.

Agricultural cooperatives which operate both sales and purchases are called mixed agricultural cooperatives. There seems to be no agricultural cooperatives which operate only in purchasing.

Figure 5-1 Proportion of Sales by Agricultural Cooperatives Classified by Products (1982)



Source: OCB, Panorama Cooperativismo, 1982

In case of mixed agricultural cooperatives, there are members who utilize the cooperatives only for purchasing. In addition, there are many cases in which non-members also purchase from the cooperatives. When a mixed agricultural cooperative engages in credit activities, it must be authorized and supervised by the Central Bank (Banco Central do Brasil) which controls agricultural cooperatives in addition to INCRA. In recent years, it appears to be government policy to separate credit business from agricultural cooperatives and have it done by credit cooperatives. However, many mixed agricultural cooperatives are engaged in credit activities in practice, such as advanced payments to members for sales of products and defered payments for purchase. And the government is assisting this form of credit with Pre-EGF loan to cooperatives as mentioned earlier.

(2) Rural credit cooperative

In addition to the mixed agricultural cooperatives authorized by the Central Bank to engage in financing activities, there are also

credit cooperatives which deal exclusively in credit service. As indicated in Table 5-13, there are 449 credit cooperatives in Brazil, but most of them (335) are mutual credit cooperatives, with rural credit cooperatives numbering ninety-one.

Rural credit cooperatives provide loans mainly under the above-mentioned Rural Credit System (SNCR). Loans are made to cover production cost (short-term), and purchasing of land, fixed facilities, and machinery.

The number of rural credit cooperatives and cooperative members shows that only a small proportion of farmers who accept SNCR loans utilize rural credit cooperatives, and that most of the farmers seem to utilize the Brazil Bank (Banco do Brasil) and ordinary commercial banks which have many branch offices and are easily accessable.

(3) Agro-industry

Next to marketing activity, agro-industry is the most important commercial activity of agricultural cooperatives. There are some cases that mixed agricultural cooperatives combine agro-industry and sales activities, although there are many cooperatives which conduct only agro-industry. There are 603 agricultural cooperatives which engage in agro-industry as their main business. The items of agro-industry also include the manufacturing of lime, fertilizers, agricultural chemicals, and salt manufacture. The largest number of agro-industry cooperatives deal in dairy products (118), processing of raw milk (60), processing of cotton (ginning, cottonseed oil) (85) and coffee (76).

5-4-4 Scale and Organization of Agricultural Cooperatives

Dividing the total membership of about 1,150,000 by the number of operating cooperatives, the average number of members per cooperative is a little over one thousand. Some cooperatives consist of over 3,000 members, while others consist of less than one hundred (The Cooperative Act prescribes that the minimum number of members shall be twenty).

As for the area of agricultural cooperatives, some are organized by farmers of one town or village (or one part of the town or village), while others are organized by farmers of several states.

In Brazil, agricultural cooperatives are not systematized as in Japan with federations being on three levels: local, prefectural, and national. However, there are federations or central cooperatives organized by single cooperatives on state level or covering several states.

There were forty-one federations of agricultural cooperatives as of December 31, 1982. The largest federation among them is probably Cotia Central Cooperative, whose head office is situated in Sao Paulo.

Cotia Central Cooperative was developed from a potato-grower

cooperative organized by eighty-three immigrants from Japan who settled in the Cotia district of the state of Sao Paulo in 1927. At present, it is organized by nine unit cooperatives, engaging in a wide range of activities: sales, purchasing, and agro-industry. Membership of the nine unit cooperatives was 11,432 at the end of 1983. Geographical distribution of the unit cooperatives is four in Sao Paulo, and one each in North Parana, South Parana, Rio de Janeiro, Mato Grosso do Sul, and Minas Gerais.

In addition to the above-mentioned federations, there is the Organization for Cooperatives of Brazil (OCB), a national organization of cooperatives of all kinds. Having special status under the Cooperatives Law, it engages in promoting cooperativism, counseling, information service, and training staff of cooperatives. Furthermore, each state has similar organization for cooperatives. OCB and each state organization for cooperatives are funded by the contributions received from cooperatives and the government subsidies, in accordance with the Cooperatives Law.

5-4-5 Agricultural Cooperatives in Para and Maranhao

The foregoing is the national situation concerning agricultural cooperatives, but there is considerable difference among regions. The number of cooperatives is larger in the southern and southeastern regions and smaller in the north. Cooperatives in operation in the whole country amount to 1,074. The states of Rio Grande do Sul (164), Minas Gerais (163), and Sao Paulo (153) have a conspicuously large number of cooperatives, while the total of six states in the northern region is only twenty-four. An overview is outlined below regarding the agricultural cooperatives in Para and Maranhao which together occupy the large part of the Greater Carajas Program Area.

(1) Para

Para has thirty agricultural cooperatives, only ten of which are in operation, and it is significant that there are many inactive cooperatives. In the 1970s, under the federally-implemented Amazon Development Program, many cooperatives were formed under the guidance and assistance of SUDAM and INCRA. It was said that many of them were organized "from above" in a hasty manner and failed to perform the business.

Of the ten agricultural cooperatives in operation, five are agro-industry cooperatives and five are sales/purchasing cooperatives. The Para Livestock Industry Cooperative in Belem is the largest, has 650 members, a slaughterhouse with a capacity of 584 head per day, and a freezer with a capacity of 112 tons. In terms of sales also, this cooperative is the largest in the state, followed by the Tome-Acu, Paraense, and Amazonica agricultural cooperatives. These three cooperatives are mixed agricultural cooperatives combining sales and purchasing activities, and organized by Japanese-descended farmers.

Both the Paraense and Amazonica agricultural cooperatives are located near Belem. Though they are of small scale -- Paraense has eighty-three members and Amazonica forty-three -- they are shipping quality fruits such as papaya (from the Hawaiian seed) and melon as far as the large consuming center of Sao Paulo, as well as exporting some quantities. The total of fruit shipments from both cooperatives represents 82% of the cooperative marketing of fruit in the country. In addition, the Paraense agricultural cooperative engages in the joint sales of oil palm to the nearly oil mill (DENPASA). The cooperative is planning to construct an oil mill for processing the palm of its members. The Amazonica agricultural cooperative has a similar plan and its members have started planting oil palm seedlings (described in detail in the Chapter of Agro-industry).

(2) Maranhao

Maranhao has thirty agricultural cooperatives in operation, nine of which are agro-industry cooperatives. There are two cooperatives with over 2,000 members, both being agro-industry cooperatives dealing in rice milling, cassava flour milling, and pepper processing. The others are of small- and medium-scale, with less than 500 members.

Rice is the major item of cooperative marketing in the state, accounting for 43% of the total cooperative marketing, followed by milk (23%), maize (16%), feijao and beef cattle.

In addition to these agricultural cooperatives in Maranhao, a branch office of the Goiya Chuba Agricultural Cooperative (head office located in the state of Goias), is located in Imperatriz. It has a warehouse with a capacity of 300,000 bales, and engages in the joint sales of soybean, maize, and rice produced in the surrounding areas. It receives produce from both members (150 persons) and non-members within the area under the jurisdiction of the branch office. It is engaging also in the purchasing of agricultural materials, and endeavoring to increase the yield by selling hybrid seed of maize produced by the Cargil Company to the members and non-members.

5-4-6 Agricultural Cooperatives and Development of the Greater Carajas Program Area

Agricultural cooperatives in Brazil vary in scale and type, and seem to be a mixture of American type and Japanese type. Both Japanese and American cooperatives were originally introduced from Europe in the latter half of the nineteenth century, but they took different course of development thereafter.

Agricultural cooperatives in Japan are systematized into unit multipurpose, cooperatives, prefectural federations, and a national federation. Since unit cooperatives are local organizations, members have a strong sense of cooperation, but lack the economic merit of scale. On the other hand, agricultural cooperatives in the U.S.A.

are mostly large-scale, extending over a wide area. Their operational efficiency is high, although the cooperative spirit of members is low.

The above-mentioned Cotia Cooperative started from a small local cooperative and it has developed into a federation of the Japanese type. And then, in order to gain high operational efficiency and to rationalize management, the present Central Cooperative of Cotia was organized, which is somewhat similar to the large-scale cooperative of the American type. Brazil will hopefully develop agricultural cooperatives of her own, taking the advantages of both the American and Japanese types.

Agricultural cooperatives are fairly well developed and stabilized in south and southeast regions, but still undeveloped in north and northeast regions in which the Greater Carajas Program Area situates. If the basic policy for the agricultural development in the Greater Carajas Program Area is to promote small and medium farms, agricultural cooperatives will have to play an important part of the agricultural development.

The common feature of the agricultural cooperatives which are successful in this region is that they involve a group of farmers aiming at commercial production. Furthermore, these agricultural cooperatives are not only engaging in sales, but also in the operational aspects of members' activities through the joint purchasing of the necessary materials; they also engage in counseling on technical matters.

As one of the measures adopted by the government for promoting agricultural cooperatives, Pre-EGF loans are granted to agricultural cooperatives organized by small- and medium-scale farms. It is considered effective for the agricultural development in this region that the government supports cooperatives by a "package deal" combining technical extension and other government support.

However, it will take time to establish such cooperatives, as shown in the example of Para where most of the cooperatives, formed "from above" in the Amazon Development Program, resulted in failure. Rather than to aim at an ideal from the beginning it is preferable to proceed step by step; starting from what can be carried out easily and then expanding activities when operations are well-established. In the COLONE Settlement (in Maranhao), where our field survey was conducted, the settlers have formed a cooperative and engage in the joint sales of easy-to-handle products. COLONE has processing facilities for pepper produced by its members. It is reported that COLONE plans to transfer the processing facilities to the cooperative when the latter becomes capable of managing the processing business. As stated earlier, the Paraense Agricultural Cooperative in Para is engaging in the joint sales of oil palm fruit bunch and also plans to enter the oil extraction business. The production of palm oil is generally carried out as an integrated activity, from planting to oil extraction. It must be noted as a new example in the oil palm industry that small-scale farmers engage both in cultivation and processing by utilizing the cooperative organization.

It is considered important for the development of the PGC Area to introduce capital, materials and know-how from the south, and the same can be said for the promotion of agricultural cooperatives. There are several precedents: in the Cerrado Development Region, agricultural cooperatives are operated by experienced people from the Cotia Cooperative; all members of COPERGEL (organized in 1981) in Barreiras district, the state of Bahia, in Cerrado region, are settlers from southern Brazil; and in the COOPERAVALE Branch Office, located in Diamantina district, the state of Mato Grosso, 70% of the members are settlers from the state of Parana, and all the staff were dispatched from the head office in Parana.

Some agricultural cooperatives in northern and northeastern Brazil are tied up with those in southern Brazil. For instance, the Amazonica Agricultural Cooperative in Para consigns products for sale at markets in the south, such as Sao Paulo, and entrusts the purchase of materials from the south, to an agricultural cooperative in southern Brazil. Such cooperation between agricultural cooperatives in the south and those in the north will be mutually beneficial. Furthermore, it is considered feasible for agricultural cooperatives in the north to tie up with the consumers' cooperatives that are presently developing in the south.

5-5 Research and Extension Service

5-5-1 Research

Agricultural research (including stock-farming and forestry) is conducted under a cooperative system of agricultural research of which the central organization is the Brazilian Agricultural Research Enterprise (EMBRAPA), operating under the jurisdiction of the Ministry of Agriculture.

EMBRAPA, in addition to the research carried out by its own research institutions, has the responsibility for coordinating state research institutions, universities and other official and private research institutions. The main national and state research institutions under the control of EMBRAPA are as follows:

(a) National commodity research centers (NCRCs)

Fourteen research centers classified by commodity, is located in each of the main production areas.

(b) Special research services

National Genetic Resources Center, Agriculture and Food Processing Center, National Soil Survey and Conservation Service, and Basic Seeds Production Service

(c) Regional research institutions

Research center for the "Cerrados", research center for the semi-arid tropics, research center for the humid tropics

(d) State research corporations and research units

Each of the fourteen states has a state research corporation. In the states of the PGC Area, there is the Agricultural Research Corporation of Maranhao (EMAPA) and the Agricultural Research Corporation of Goias (EMGOPA). In the other states and territories, Agricultural Research Units (UEPAEs or UEPATs) have been established as state or territorial institutions.

The names of these institutions are listed in Table 5-15 and Figure 5-2.

Among these institutions, the Research Center for the Humid Tropics (CPATU) is most closely related to the Greater Carajas Program. The Center was established as a regional institution of EMPRAPA in 1976 to provide the scientific information necessary to formulate the development measures from the standpoint of protection and utilization of natural resources. For this purpose, it conducts comprehensive research in the fields of natural science and social science related to agriculture in the humid tropics in the great Amazon region.

The Center has a staff of nearly five hundred (seventy-seven researchers), and nine experiment stations, engaging in such study as research of various crops (including pasture), stock-farming, and forestry, and the combined planting systems for various crops. However, research into rubber and oil palm is conducted by National Center for Research in Rubber Tree and Oil Palm (located in Manaus in the state of Amazonas), a commodity research institution of EMBRAPA.

5-5-2 Extension Service

Extension service is conducted by the following organizations: Agricultural Technical Assistance Corporation (EMBRATER) under the jurisdiction of the Ministry of Agriculture, as the central organization; State Agricultural Assistance Corporation (for example, EMATER in Maranhao) under the control of EMBRATER; regional extension offices; and municipal extension offices. Each regional office comprises agricultural experts, veterinarians, social development technicians, and clerical staff (some of which are working full-time, and others are posted at municipal offices. Several persons (4-5) are working at municipal offices.

The number of regional offices and municipal offices by state, and the number of municipalities and farms which received extension services are indicated in Table 5-16.

Table 5-15 Cooperative System of Agricultural Research - Location of Institutions

National Research Institutions

a. National Commodity Research Centers (NCRC):

- National Center for Cotton Research, Campina Grande (Paraiba)
- National Center for Rice and Beans Research, Goiania (Goias)
- National Center for Sheep and Goats Research, Sobral (Ceara)
- National Center for Agricultural Pesticides Research, Campinas (Sao Paulo)
- National Center for Research in Temperate Climate Fruit Culture, Cascata (Rio Grande do Sul)
- National Center for Beef Cattle Research, Campo Grande (Mato Gross do Sul)
- National Center for Dairy Cattle Research, Coronel Pacheco (Minas Gerais)
- National Center for Research in Vegetable Crops, Brasilia (Federal District)
- National Center for Research in Cassava and Fruits Culture, Cruz das Almas (Bahia)
- National Center for Maize and Sorghum Research, Sete Lagoas (Minas Gerais)
- National Center for Research in Rubber Tree and Oil Palm, Manaus (Amazonas)
- National Center for Soybean Research, Londrina (Parana)
- National Center for Swine and Poultry Research, Concordia (Santa Catarina)
- National Center for Wheat Research, Passo Fundo (Rio Grande do Sul)

b. Special Services:

- National Genetic Resources Center (CENARGEN), Brasilia (Federal District)
- Agriculture and Food Technology Center (CTAA), Rio de Janeiro (Rio de Janeiro)
- National Soil Survey and Conservation Service (SNLCS), Rio de Janeiro (Rio de Janeiro)
- Basic Seeds Production Service (SPSB), Brasilia

Regional research institutions

a. National Resources Research Centers

- Research Center for the "Cerrados" (CPAC), Brasilia
- Research Center for the Semi-arid Tropics (CPATSA), Petrolina (Pernambuco)
- Research Center for the Humid Tropics (CPATU), Belem (Para)

b. Forestry Research Regional Unit in the Central-South (URPFCS), Colombo (Parana)

State Systems

a. State companies

- Agricultural Research Company of Minas Gerais - EPAMIG
- Agricultural Research Company of Goias - EMGOPA
- Agricultural Research Company of Espirito Santo - EMCAPA
- Agricultural Research Company of Santa Catarina - EMPASC
- Agricultural Research Company of Rio de Janeiro - PESAGRO
- Agricultural Research Company of Ceara - EPACE
- Agricultural Research Company of Pernambuco - IPA
- Agricultural Research Company of Bahia - EPABA
- Agricultural Research Company of Maranhao - EMAPA
- Agricultural Research Company of Paraiba - EMEPA
- Rural Extension and Technical Assistance Research Company of Mato Grosso do Sul - EMPAER
- Agricultural Research Company of Rio Grande do Norte - EMPARN
- Agricultural Research Company of Mato Grosso - EMPA
- Agricultural Research Company of Alagoas - EPEAL

b. Integrated programs located in:

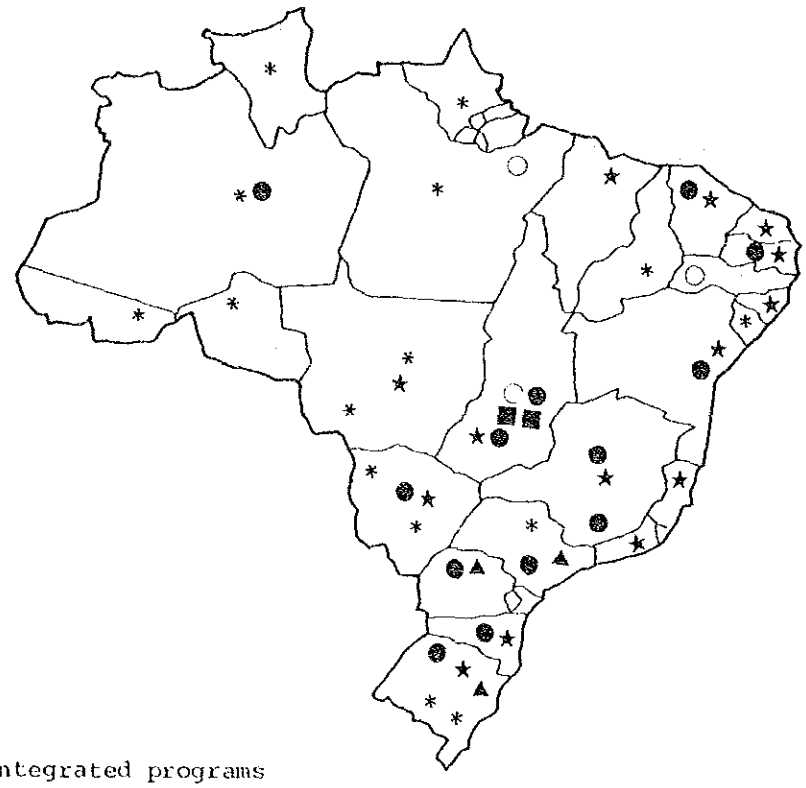
- Sao Paulo
- Parana
- Rio Grande so Sul

c. State and Territorial Agicultural Research Units (UEPAEs and UEPATs):

- UEPAE of Altamira (Para)
- UEPAE of Aracaju (Sergipe)
- UEPAE of Bage (Rio Grande so Sul)
- UEPAE of Bento Goncalves (Rio Grande do Sul)

- UEPAE of Caceres (Mato Grosso)
- UEPAE of Corumba (Mato Grosso do Sul)
- UEPAE of Dourados (Mato Grosso do Sul)
- UEPAE of Manaus (Amazonas)
- UEPAE of Pelotas (Rio Grande do Sul)
- UEPAE of Porto Velho (Rondonia)
- UEPAE of Rio Branco (Acre)
- UEPAE of Sao Carlos (Sao Paulo)
- UEPAE of Teresina (Piaui)
- UEPAE of Boa Vista (Roraima)
- UEPAT of Macapa (Amapa)

Figure 5-2 Cooperative System of Agricultural Research



▲ - Integrated programs

● - National Commodity Research Centers

■ - Special services

○ - Natural Resources Research Centers

◇ - Forestry Research Regional Unit in the Central-South

★ - State companies

* - State and Territorial Agricultural Research Units

Table 5-16(A) Number of Extension Offices by State

State	Office					
	Municipal			Regional		
	1980	1981	1982	1980	1981	1982
Brazil	2,231	2,371	2,456	188	190	193
Rondonia	12	12	13	1	1	2
Acre	12	24	31	-	-	5
Amazonas	20	25	27	-	-	-
Roraima	10	13	15	-	-	-
Para	68	65	56	10	10	10
Amapa	9	10	11	-	-	-
Maranhao	101	98	97	15	15	15
Piaui	83	90	95	12	12	12
Ceara	102	121	122	12	13	13
Rio Grande do Norte	88	88	91	11	8	8
Paraiba	127	131	137	10	10	10
Pernambuco	133	133	136	10	10	10
Alagoas	59	56	58	6	7	4
Sergipe	33	36	33	4	2	2
Bahia	140	179	196	18	19	19
Minas Gerais	322	345	361	17	17	17
Espirito Santo	49	51	55	4	4	4
Rio de Janeiro	58	58	58	3	4	4
Parana	239	245	252	17	17	18
Santa Catarina	191	192	194	13	13	13
Rio Grande do Sul	157	177	177	5	5	5
Mato Grosso do Sul	40	48	49	3	3	3
Mato Grasso	54	48	60	5	6	7
Goias	112	113	118	12	12	12
Distrito Federal	12	13	14	-	2	-

Source: Ministry of Agriculture, EMBRATER.

Table 5-16(B) Number of Municipalities and Farms which Received Extension Service

State	Municipality			Farm		
	1980	1981	1982	1980	1981	1982
Brazil	3,034	3,183	3,179	1,186,956	1,189,135	1,238,287
Rondonia	7	7	13	5,441	11,114	13,852
Acre	12	12	12	7,693	8,955	5,770
Amazonas	37	40	63	32,482	24,478	15,957
Roraima	2	2	8	4,199	4,391	8,796
Para	68	78	78	25,461	18,535	22,137
Amapa	5	5	5	2,033	2,367	2,490
Maranhao	121	119	121	85,159	68,680	56,649
Piaui	114	114	114	32,904	30,243	39,949
Ceara	141	141	141	36,713	27,435	49,995
Rio Grande do Norte	139	139	146	21,597	29,603	24,143
Paraiba	171	168	168	27,780	30,015	32,146
Pernambuco	146	146	146	61,277	46,053	54,995
Alagoas	84	93	95	17,326	26,349	32,782
Sergipe	74	74	74	29,749	18,067	19,679
Bahia	270	270	270	116,716	105,208	111,736
Minas Gerais	577	597	600	162,848	169,249	170,000
Espirito Santo	53	53	57	42,995	39,760	45,531
Rio de Janeiro	61	64	64	21,866	19,166	23,023
Parana	290	298	310	159,207	199,303	135,920
Santa Catarina	195	197	199	77,428	92,530	98,008
Rio Grande do Sul	157	177	177	136,610	123,938	188,928
Mato Grosso do Sul	55	60	64	12,413	25,199	24,147
Mato Grasso	50	55	58	15,409	18,950	21,205
Goias	204	193	195	49,380	46,982	37,549
Distrito Federal	1	1	1	2,270	2,565	2,900

Source: Ministry of Agriculture, EMBRATER.

According to Table 5-16, the total of municipal extension offices in the whole country is 2,456. Since some offices cover the neighboring municipalities as well, the number of municipalities covered by the extension service is 3,179. Considering that there are 4,133 municipalities in the whole country, the extension service extends over about 77% of the total. The number of farms receiving the service was 1,238,287 in 1982. In Table 5-17 a comparison has been made of the total number of farms and the farms which received the service in 1980 according to the census. It shows that in the whole country 23% of the farms received the service, while in Para (9.8%) and in Maranhao (11.2%) the rate of acceptance is low. The fact that activities of the extension staff are limited by the lack of traffic facilities in these states is regarded as one reason for the low rate.

In 1982, the number of farms which accepted the service was slightly higher than that in 1980 for the whole country, while it was lower in Para and Maranhao.

Table 5-17 Comparison of All Farming and the Number of Farms which Received Extension Service

	Total of Farms (A)	Number of Farms which accepted extension service (B)	A/B ratio
Brazil	5,167,578	1,186,956	22.9 %
Para	224,085	25,461	11.3 %
Maranhao	496,929	85,159	17.1 %

5-5-3 Agricultural Development, Research and Extension Service in the Greater Carajas Program Area

It is considered essential to improve the depth of the studies suiting to the local conditions, to implement the program for agricultural development in the PGC Area, even though the research system is well-established. For these purposes, not only large amounts of capital but also competent personnel are required. Cooperation from international organizations and developed nations can be obtained in this regard.

With respect to the extension service, it may be inevitable that the rate of coverage is low due to the large land area and inadequate traffic facilities, but it is important to begin by strengthening the

extension service in the key areas for the development of the PGC Area. The Study Team saw the pamphlets and manuals at extension offices during the field survey, and many of them seemed to be produced by the central organization (EMBRATER) for national use. It is considered that they should be produced to cover each particular region instead.

5-6 Agricultural Institutions in Relation to the PGC Area's Development

In the preceding sections, a brief review of the major institutional systems related to agriculture was made with a focus on the functions of these systems at the PGC Area. It seems that most of these systems are well devised at the federal level, and the major problem to be solved in the future will be the adjustment and coordination of these systems so that they can suit the specific conditions and development objectives at the regional or sub-regional level, and on strengthening the functions of their actual policy instruments.

The study team was strongly impressed by the rapid expansion of land occupation stimulated by the construction of road and other transport facilities. The present pattern of land development seems to have its advantage in inducing initiative and vitality of the private sector, but on the other hand brings about an apprehension that land enclosure by small number of large-scale land holders may take place and widen the gape between large and small farms. Another concern is that the present pattern of development may accelerate the transaction of land and create a sort of land speculation in the Area. Although there observe some well-managed large-scale beef cattle farms, the pasture management is generally extensive, and the attractiveness of land holding in the Area under the present circumstances seems to be the possibility of using it for pasture with low investment and management costs.

As previously mentioned, Amazon is presently the largest tropical humid forest zone remaining in the world. Thus, it is desirable that the development of the Area will orderly proceed in harmony with environmental conservation and be based on long-run perspective.

For formulating a development strategy with long-run perspectives, it will be essential to clarify the position of the Area in Brazil as a whole with respect to agricultural production. It is conceivable that the selection of suitable products and proper level of production, as well as prediction of possible impacts of the selected production pattern on the local societies are among the important issues for considerations in deciding the development strategy.

From the results of the review made in this chapter, it is assumed that the Brazilian government is aiming at efficient utilization of land with promotion of small- and medium-size farms, and reduction of income disparity. Such policy instruments as institutional credits (SNCR), price support (PGPM), and land tax in line with these basic objectives seem already well devised at the federal level. Thus, it is believed that the PGC Area's resource potentials would be actualized in harmony with environmental conservation if these instruments are well coordinated and effectively implemented in accordance with the conditions and development objectives of the Area.

6. AGROINDUSTRY

6-1 Purpose and Scope of the Study

The purpose of this study is to clarify the current situation of the agroindustry with a view to making recommendations about the selection of suitable crops and their producing areas for the Greater Carajas Program (PGC) Area.

In the narrow sense agroindustry refers to processing and manufacturing using agricultural products as materials, but in a broader sense, the concept of agroindustry embraces agriculture and related industries, such as agribusiness. That is to say, in addition to agricultural production it includes the storage, processing, and marketing of agricultural products, the manufacture and sale of agricultural inputs and machines, the relevant finance, insurance, and information industries, and the government organizations and related bodies that administer and coordinate these industries. The concept agroindustry thus covers a very wide area, and differs between countries and stages of development, as well as with the analyst's viewpoint. For the above-stated purpose of this study, it is interpreted as the process by which farmers realize the value of their products. Hence this report will analyze and evaluate the current situation of processing, with a view to increasing value added, and of the marketing system, in which prices are formed.

First, in this chapter, as an aid in studying the feasibility of establishing agricultural producing areas, the overall condition of the processing and marketing of agricultural products in the PGC Area, will be described within the context of the national development of the said industry (6-2-1).

Next, to provide further information to arrive in the selection of products, prior to analyzing the situation of processing and marketing by primary products, the characteristics of products from the viewpoint of the necessity for processing and of demand are enumerated, and the role of processing and marketing in agricultural production is studied (6-2-2).

In the analysis of the current situation by major products, the situation of processing, storage, transportation, and marketing is analyzed from the viewpoint of what are the problems about processing and marketing for farmers to select the products, and of what is required to increase market competitiveness and to create a producing area (6-2-3).

Finally, as a summary of this chapter, requirements for processing and marketing when farmers select the crops are rearranged according to the characteristics of products and production methods (6-3).

In this Study, data and information on the processing and marketing of agricultural products were collected from related organization, such as government agencies, private corporations, and agricultural cooperatives, and also from farmers. However, as will be described later,

due mainly to the fact that the condition of the agroindustry in the PGC Area is somewhat undeveloped except for certain products in the Castanhal sub-region, uniform, and time-serial statistics, or data for all the areas and products were very limited. Therefore, the analysis of the current situation of processing and marketing is based largely on interviews and observations, as well as the statistics obtained through the study in Brazil.

6-2 Current Situation of Processing and Marketing of Agricultural Products

6-2-1 Overall Condition of the PGC Area

According to the Industrial Census 1975[1] published by Brazilian Institute of Geography and Statistics (IBGE), most of the manufacturing industries using agricultural products such as the food industry and the beverage industry, are situated in the southeastern and southern states, with a particular concentration in Sao Paulo (Table 6-1). These manufacturing industries in the north and northeast, where the PGC Area stretches, are generally underdeveloped. For example, although the northeast has a comparable number of companies in the food industry to the south, the former output is far less than half that of the latter. Looking at the states of Para and Maranhao, which take up most of the PGC Area, they rank high in the north and northeast respectively in terms of their food industry contribution, but on the national level each of them accounts for well below 1% of the total production value. With regard to the contents, these manufacturing industries using agricultural products as the main raw materials, most of them are relatively traditional primary processing such as milling of rice and of cassava flour (farinha de mandioca). Soybean products, instant coffee, orange juice, and other products which increased in production creating export earnings in the south and southeast during the 1970s are rarely found being manufactured in the both states. In addition these industries consist mainly of small-scale manufacturers such as those with less than 5 employees.

This situation shows that in contrast to southern Brazil where the processing industries using agricultural products such as sugarcane, coffee, and soybean have developed along with the increase in the production of these crops, the agricultural production in the PGC Area is in an unstable condition, producing smaller quantities of raw materials, including those "produced" by gathering, than southern Brazil. Such underdevelopment in agricultural production, together with the poor condition of transportation infrastructure, and storage and marketing systems, is causing the unstable supply of raw materials for manufacturing industries, and is retarding the expansion and modernization of agricultural processing. The underdevelopment of agricultural processing is caused by delays in the introduction of new processing facilities, the lack of skilled workers, the poor conditions of infrastruc-

1) "Industrial Census 1980, Brazil" has not been published yet.

Table 6-1 Distribution of Farm-Product-Related Manufactures (1975)

a. Food

Area	No. of Companies	No. of Employees (year end)	Production
North	4.3	2.8	1.2
Northeast	21.1	22.4	10.9
Southeast	44.5	50.1	59.1
South	22.9	21.0	24.9
Central West	7.2	3.7	3.9
Total %	100.0	100.0	100.0
(Number)	(48,205)	(500,006)	(Cr$126,835 million)

b. Beverages

Area	No. of Companies	No. of Employees (year end)	Production
North	2.8	5.4	2.6
Northeast	14.0	13.3	10.6
Southeast	51.3	55.5	64.1
South	29.6	22.1	19.8
Central West	2.4	3.7	2.9
Total %	100.0	100.0	100.0
(Number)	(3,075)	(53,689)	(Cr$9,883 million)

c. Tobacco

Area	No. of Companies	No. of Employees (year end)	Production
North	2.0	-	-
Northeast	42.0	-	-
Southeast	13.7	-	-
South	38.0	-	-
Central West	4.4	0.3	0.0
Total %	100.0	100.0	100.0
(Number)	(205)	(21,711)	(Cr$6,118 million)

d. Rubber

Area	No. of Companies	No. of Employees (year end)	Production
North	2.4	2.1	2.2
Northeast	11.3	5.1	1.7
Southeast	59.6	80.4	90.7
South	22.8	11.2	4.9
Central West	3.9	1.2	0.5
Total %	100.0	100.0	100.0
(Number)	(1,235)	(46,125)	(Cr$12,569 million)

e. Leather and By-products (including fat and oil)

Area	No. of Companies	No. of Employees (year end)	Production
North	1.2	-	-
Northeast	33.9	9.9	7.2
Southeast	40.1	46.3	48.0
South	21.1	42.1	43.6
Central West	3.6	-	-
Total %	100.0	100.0	100.0
(Number)	(1,752)	(36,201)	(Cr$3,780 million)

f. Textiles

Area	No. of Companies	No. of Employees (year end)	Production
North	0.7	-	-
Northeast	16.6	13.4	13.9
Southeast	68.9	73.6	73.1
South	13.5	11.0	11.0
Central West	0.3	-	-
Total %	100.0	100.0	100.0
(Number)	(6,138)	(33,776)	(Cr$52,484 million)

Source: IBGE, Censo Industrial 1970

ture necessary for commercialization and of marketing systems, and also by undeveloped related industries, e.g. information, finance, or machine manufacturing. On the other hand, the absence of modern agricultural processing is holding the Area in a disadvantageous position regarding management of the agricultural production. This is especially, noticeable for northern region's crops which are unable to compete with those of southern Brazil as raw materials from only a viewpoint of transportation cost, because the latter are favoured by having processing facilities nearby, and superior infrastructure.

Though the necessity of extensive field research in the agro-industry of northern Brazil has been recognized since the 1970s,[1] a series of statistics and data which will clarify the relation between agricultural processing and agriculture can scarcely be found. Therefore, the following observation on agricultural processing in the PGC Area are based mainly on the Superintendency for the Development of Amazonia (SUDAM) survey on the distribution of agroindustry by region and materials, and the "Cadastro Industrial 1982" (Industrial Survey) of the states of Maranhao and Para. The coverage of these surveys, however, is limited to the registered enterprises and priority projects approved by SUDAM or other government agencies.

Agricultural processing and manufacturing in the state of Para began by collecting and processing of native rubber which increased from the end of the 19th century to the beginning of the 20th century, and declined after about 1910 when rubber plantations were launched in Southeast Asia. Since then, the major agricultural processing activities in the state have been textile making using jute, or beverage making using guarana, but except for jute which had been introduced and successfully cultivated by Japanese immigrants, most of the materials have been obtained from native or semi-native plants. Since the 1970s preferential tax systems and other government programs formulated for the purpose of promoting establishment of factories, and other financial incentive schemes have advanced the modernization of textile industry, and also made progress in new fields of processing such as palm oil and fruit juice. Agricultural processing, which is concentrated in Belem and its suburbs, in the state of Para, still depends heavily on native plants such as Brazil nuts and acai.

Maranhao's processing is mainly of such major products as rice, cassava, and maize. In this state, these crops are mostly for self-consumption, and the processing is, largely low grade, for example, rice polishing and milling. As for the regional distribution of registered companies, concentration can be seen in cities such as Sao Luis and Imperatriz. There are considered to be a considerable number of unregistered small-scale rice mills and cassava mills near producing areas. Most of the rice, which is produced extensively all over the state, is

1) "Situacao e Perspectiva da Agroindustria Regional" (presented at the seminar under the theme "Survey on Processing Techniques of Agricultural Products and Livestock-related Products", held in Santarem in March, 1979)

transferred to the major cities in the country and is cleaned there. Babassu processing is one of the other important agricultural processing industries in this state. Since the 1960s with the aid of the Superintendency for the Development of Nordeste (SUDENE)'s preferential tax and financial programs, the nuts, which used to be transferred to southern Brazil for processing, have been crushed within the state. The oil mills are distributed in the northern part where babassu grow in large quantities. However, since raw materials are supplied by gathering, which is seasonal, and feeder roads for collection are in a poor condition, operations are quite unstable.

Details about the state of Goias are hazy, because the Industrial Survey is not available. Recently, however, development of the cerrado area has increased the production of wheat, soybean, and sugarcane dramatically, and processing factories such as soybean oil mills and alcohol plants are under construction. However, these phenomena are concentrated in the southern part of the state, in the northernmost part of the state, which is included in the PGC Area, rice, cassava milling, and babassu crushing are presumed to occupy a major position in the processing industry, as in the state of Maranhao.

6-2-2 Characteristics of Products as in Relation to Processing and Marketing

When considering the relationship of agricultural production to processing and marketing, attention should be paid to differences in product characteristics: products to which immediate first-stage processing in the producing area is indispensable for the sake of preventing spoilage, products to which processing is not especially necessary except for simple preparation, and products to which certain treatments such as special packing for marketing may be necessary although what is normally called processing may not be. These characteristics vary slightly according to demand and conditions, destination to domestic and international markets. Therefore, in this section, prior to analyzing the current situation of processing and marketing which is a given condition for crop selection, the characteristics of major products seen from the point of view of the necessity for processing and of demand are examined first. In addition, from the standpoint of agricultural production, the significance to each product of the existence of processing plant near the producing area will be discussed. Processing includes not only transformational processing but, in a broader sense, includes preparation, preservation and packing. One product undergoes several stages of processing, so the scope implied by "the necessity of processing", is not clear. Thus, characteristics of products affecting the necessity of processing are studied below from the uniform viewpoint of whether the quality will be damaged, decreasing the bargaining power of producers, if transformational processing is not done promptly after harvesting.

From the viewpoint of the above-stated quality preservation, farm products are roughly divided into (1) those for which transformational processing is indispensable, (2) those for which transformational proc-

essing is not especially necessary, and (3) those for which transformational processing is not a prerequisite. These products are described below.

(1) Products for which processing is indispensable

This includes palm oil, rubber, sugarcane, and cassava. These products will usually decrease in quality or in weight of goods by oil acidification, natural coagulation, change in sugar content, and descomposition, respectively, kept for a long period of time after harvesting. For example, the free fatty acid (FFA) of oil palm on the day of harvesting is 1.8 to 2.0%, but it rises to 3 to 4% in a few days, decreasing the commodity value on the market.

The contrast to the former three products, cassava is preserved for home food. If it is to be sold in the form of chips, it only needs to be shelled, sliced and sun-dried. If it is to be stored for self-consumption for a short period of time it can be preserved by storing in a dark cool place. When it is used as a material for starch, it needs processing within 48 hours after harvesting in order to prevent degradation. Most of the cassava produced in the PGC Area is eaten in the form of cassava flour. Since cassava begins decomposing within 24 hours of harvesting, processing should be carried out as soon as possible.

Commodity value is also influenced by the processing methods such as the type and scale of equipment. In the case of palm oil even if it is transferred into the plant immediately after harvesting, it is difficult to obtain good-quality oil if it goes into processing after the fruit has become separated from the bunch for lack of facilities for steam heat treatment as is found in traditional oil mills or where old equipment is used. Today, oil palm and rubber are still gathered by local people and put on the market after first-stage processing. These products are inferior in quality and their competitiveness in the market is low.

In order to maintain or strengthen the bargaining power of the produces of these crops, processing facilities of economically suitable scale with adequate level of technology have to exist in the vicinity, although the distance to such factory and the size and technological level required differ according to the kind of crop.

(2) Products for which transformational processing is not especially necessary

Babassu, soybeans, and maize are included in this category. Although these crops need certain processing facilities according to their uses, the biggest difference of these crops from those included in (1) is that the former can bear storage and transportation for long periods if they undergo simple treatment after harvesting, for example, threshing or drying. If the cultivations is done on a very large scale, proper facilities for after-harvest treatment, storage, and transportation are needed, however, planting can be done even if these

facilities are outside the area in which the crop is to be harvested.

In terms of transportation cost, the distance to oil mills or the distance to flour mills or feed factories is certainly an important point for farmers to consider before deciding to plant for babassu, soybeans or Maize. However, it will not necessarily be the distance to a processing plant; for soybeans, for example, the distance to an oil mill might be replaced by the distance to an exporter or to an exporting port. The point here is the distance to the use area or the processing plant. In this sense, they are of a different nature because the processing plant is not "indispensable" as in (1).

(3) Products for which transformational processing is not a prerequisite

Included in this category are such precious fruits as papaya and melon, and vegetables. However, since these products degrade with the passage of time after harvesting like those included in (1), special packing and transportation devices are needed to decrease the chance of decomposition and damage during distribution. For cultivators, some form of facilities for packing and packaging will be necessary. The choice of markets is naturally restricted by distance and time, although the kind of packing or means of transportation may also be an influence. When fruits are grown for juice or canned food, considering the costs for preservation and transportation, the existence of a processing plant near the producing area will be advantageous when selecting products.

6-2-3 Current Situation of the Processing and Marketing of Major Products

(1) Oil palm

The production of palm oil (crude oil) in Brazil is estimated at about 22,600 tons. About 40% of it, 8,700 tons, is produced in the state of Para, the rest in the state of Bahia (Table 6-2). Thus it can be said that palm oil is produced exclusively in the states of Para and Bahia. However, there are big differences between them in the production of fruit bunches, which are the raw material of palm oil, processing, and distribution.

First, the palm oil industry in the state of Bahia depends on a native species (Dura), of which the recovery rate is low, for 80 to 90% of its raw material, resulting in unstable procurement. The time between harvest and treatment is long, and the quality of crude oil is low. On the other hand, all the production in the state of Para is from a cultivated species (Tenera), and the area under cultivation has been increasing recently.

Next, in Bahia, oil palm was originally introduced by Africans, who used palm oil traditionally. The palms became wild and the local people have for centuries gathered the fruit bunches, and used the oil

expressed by hand for their own food or fuel. At present, there are 6 modern mills belonging to 4 corporations. Most of the oil palm is expressed in these mills to make oil, but some 30% of the crude oil produced in this state is still put out to traditional small-scale mills driven by man or animal (Table 6-3). In Para, the palm industry started later than in Bahia. Since there were no native palm forests, the plantation enterprises combined with oil mill were established from the beginning, and the newest equipment has been introduced. Only one main company — partly with Dutch investment — is in operation now, the enterprise seems to be more profitable than the companies in Bahia.

Thirdly, palm oil produced in Bahia is sold to oil and fat manufacturers in southern Brazil in the form of crude oil. It is also used in press-rolling of steel manufacturing. Palm oil is consumed mainly in northeastern Brazil after being made into soap or cooking oil there. So most of it is supplied to the domestic market. On the other hand, Para exports most of its palm oil to the foreign market in the form of crude oil. As for palm kernels, while some companies in Bahia obtain oil from them with their own mills, Para sells the kernels to fat and oil makers in Maranhao and Goias: partly because the company in Para has worked jointly with the Dutch plantation development company since it was established, the export of crude oil is dealt with by a Dutch trading company. In 1983, about 40% of the total production of about 9,000 tons was for the domestic market, but from the beginning production was aimed mainly at the international crude palm oil market and the larger part of production still goes for export.

The area under palm oil cultivation in Para is concentrated in municipality of Benevides and Bragantina district near Belem, which has relatively good infrastructure. As of 1984, total planted area was about 7,700 ha, and harvesting area about 5,000 ha. Of the total planted area, 5,100 ha belongs to the plantation company with oil expression facilities, as described before, and the rest (2,600 ha) is cultivated by a group (30-40) of farming families who belong to a cooperative mainly of Japanese immigrants (Figure 6-1).

The enterprise[1)] was begun in 1967 as a plantation project of SUDAM, and later a Dutch company[2)] provided capital to construct and operate the oil expression plant. Since 1979, the largest shareholder has been a Brazilian company, but the Dutch company and the SUDAM still maintaining capital shares. Shares are also held by International Finance Corporation (IFC) and the Dutch Finance Corporation for Developing Nations (FMO), so the company has a solid capital base and its technical level appears to be high.

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1) Dende do Para S.A. (DENPASA)
2) Handels Vereninging Amsterdam (HVA)

Table 6-2 Oil Palm Production in Para

Year	Brazil (Crude oil)	F.F.B. (ton)			Crude Oil (ton)	Kernels (ton)
		DENPASA	Others	Total		
1978	18,585	23,798	-	23,789	4,680	-
1979	19,700	27,791	-	29,791	5,790	694
1980	21,079	29,157	6,097	35,254	6,090	972
1981	21,922	34,720	6,144	40,864	8,143	1,500
1982	22,579	36,286	6,727	43,013	8,725	1,817
1983	-	37,676	8,840	46,516	9,915	1,618
1984*	-	46,260	12,000	58,260	12,400	2,356

* Prevision

Source: Relatorio DENPASA and Paraense Cooperative.

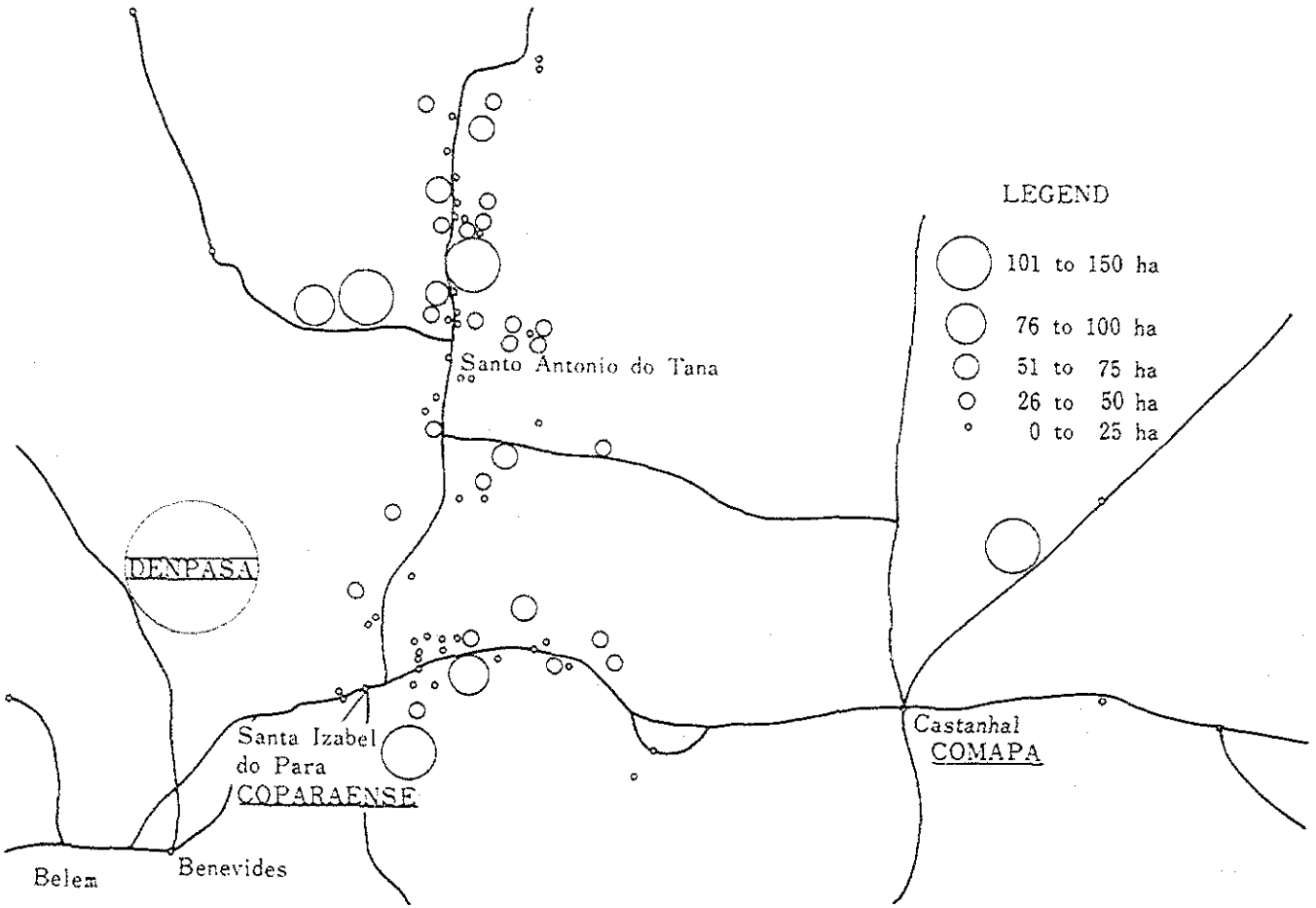
Table 6-3 Palm Oil Production by State and by Company

State/Company	ton/year	%
Para		
DENPASA	5,800	25.8
Bahia	16,700	74.2
Opalma	6,000	26.7
Oldesa	5,500	24.4
Pindorama	200	0.9
Rodoes*	5,000	22.2
Total	22,500	100.0

* Extraction facilities by animal

Source: CPE, Potencial de Produsao de Oleaginosas Mamona e Dende, 1980

Figure 6-1 Para: Distribution of Palm Plantations in Bragantina District



Currently the area of the farm under plantation is 5,060 ha of which about 2,500 ha is productive in 1984 and the estimated harvest of FFB (fresh fruit bunches) is about 46,000 tons. Until recently, in order to utilize the full capacity of the mill, the company has been buying FFB from the Japanese-descended farmers of the Paraense Agricultural Cooperative.

However, the company's own farm has now reached the production stage, and in the period from April to June, at the height of the harvest, the mill with a processing capacity of 20 tons of FFB an hour is said to be unable even to process the FFB harvested from its own plantation.

The company is making only crude palm oil, as mentioned before, and is exporting about 60% of the total production through the Dutch trading company from the port of Belem; the remaining 40%, is sold to fat and oil manufacturers in Sao Paulo and Sao Luis[1] (Figure 6-2). Selling prices for export are on FOB, Belem, based on the international market prices of palm oil and other vegetable oils. Prices for the domestic market are decided with reference to the international market price and by bargaining with users. The price of crude palm oil in Brazil is considerably higher than the international price even when the international price is relatively high, due to the strong potential demand within the country far exceeding the domestic supply. Meanwhile, all of the total production of palm kernels are sold mainly to the states of Maranhao and Goias, instead of squeezing oil (palm kernel oil) therefrom, because the amount of kernel obtained is too small to warrant economical operation of oil extraction. The amount obtained and sold was about 1,500 tons in 1983.

On the important subject of transportation costs to Sao Paulo, comparison with those from a producing area in Bahia is instructive. Freightage of crude palm oil from Belem by tanker lorry costs Cr$150/kg and for heavy cargo the cost is Cr$120/kg (as of Sept., 1984). Whereas, freightage of fat products (soap, cooking oil, etc.) from Nazare in the state of Bahia is Cr$49/kg (as of Jun., 1984). Although there is a little difference in the base of calculation, transportation cost to Sao Paulo from a producing area in Para is 2 to 3 times as high as that from Bahia. This is considered to be one of the reasons why most of the crude palm oil produced in Para is exported. If a large shipment is carried at a time in the future as a result of increased production, marine transportation between Belem and Santos will be considered, decreasing the freightage by one-half of the cost of road transport and increasing the competitiveness of Para palm oil in the domestic market.

Production in Para is currently disadvantaged in respect of domestic transportation, but the future outlook for competitiveness in

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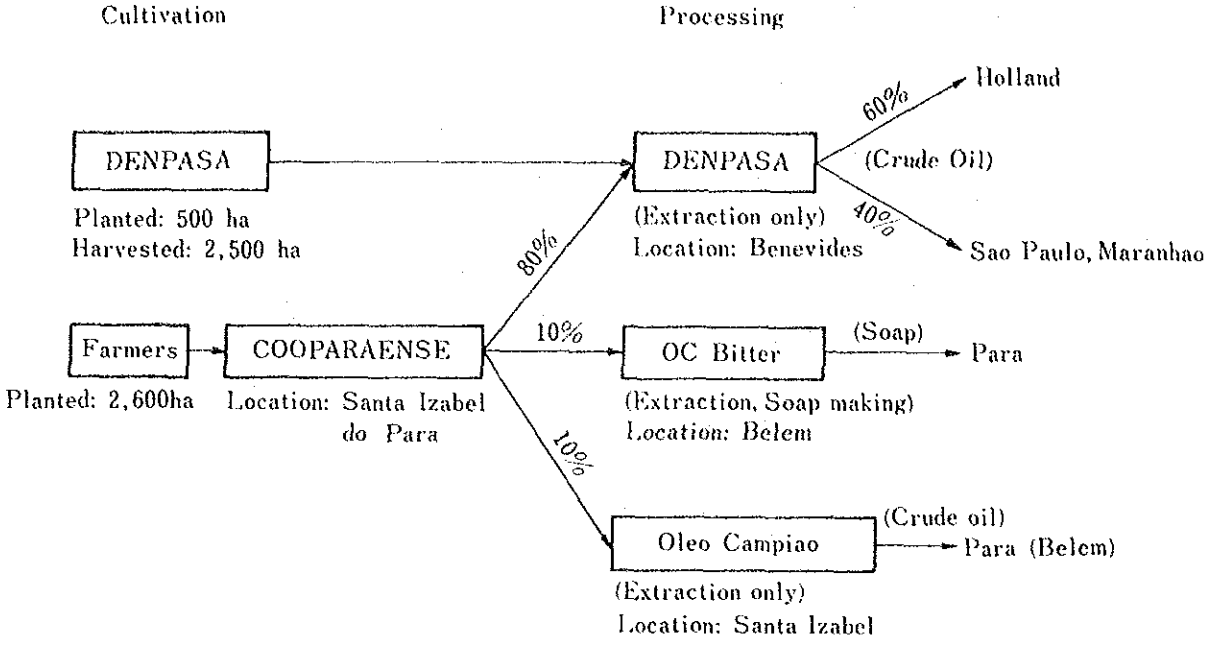
1) Sao Paulo: Industriais Gessy-Lever Ltda. and SANBRA (Sociedade Algodoeira do Nordeste Brasileiro S.A.)
Sao Luis: OLEAMA (See (2) Babassu)

Figure 6-2 Example of Processing and Distribution of Oil Palm (as of Aug. 1984)



southern markets is brighter when the following factors are considered: all the raw materials come from the cultivated species, Tenera, which ensures a stable supply, extracting facilities are the newest and are capable of high productivity, the production cost of crude oil is lower than in Bahia, and lastly freightage could be reduced by using marine transportation. Furthermore, distance export from the port of Belem to African or European markets, is more advantageous than from the major palm oil producing countries, i.e., Malaysia and Indonesia.

The remainder (2,600 ha) of the total area planted (7,700 ha) in Para is owned by 60 farming families of Japanese descent who belong to the Paraense Agricultural Cooperative. The size of the individual farms planted with oil palm ranges from 25 to 150 ha. Cultivation and harvesting are done by the individual farmers, and the harvested fruit bunches are sold jointly through the cooperative to the nearly oil mill (DENPASA). This is unique type of oil palm plantation and marketing, compared with the conventional type of estate plantation or "nucleus estate system" which has been recently developed in Malaysia and some other palm oil producing countries. This seems to open the way of small farmers' participation into oil palm industry.

Many farming families near Belem used to grow pepper as a staple crop, but production was damaged severely by a disease occurred in the

1960s. Recently some farmers have converted to tropical fruits such as papaya, melon, and passion fruit, or poultry. The development of perennial crops which are suitable for the natural conditions of this area, and also economically stable have long been hoped for in the region. Recently, the tropical fruits have been facing keener competition from producing areas nearer to consuming market's in the south and southeast, so the necessity of substitute crops has increased even more. As a result, oil palm, which had been cultivated with official support since the 1970s as a substitute for pepper, was reconsidered. In 1975, the Paraense Agricultural Cooperative began joint raising of nursery seedlings. The National Credit Bank for Cooperatives (BNCC) and the Bank of Brazil provided finance, and the State Agricultural Extension Organization gave technical advice to this project.

In addition to the initial 2,600 ha, about 400 ha was planted in 1984. The production of FFB was about 6,000 tons in 1983 and 10,000 tons in 1984. Judging from the above production figures against the planted area, it appears that the planted areas are not fully utilized. However, the farmers are now eager to increase the production, because the international price of palm oil is favorable and, on the other hand, the production of papaya and melon for shipment to the south, which are the main source of their cash income, has recently been facing with competition with the newly emerged producing areas. Since the technical level of these farmers are high, and they have experience in the production of commercial crops, rapid increase of oil palm production can be expected.

At present, harvested fruit bunches from the cooperative are sold to the plantation company. However, as described before, the extraction capacity of the company mill reached its limits, as the company palms come into the production stage. Construction of an oil mill by the cooperative has been considered for several years, and at the beginning of 1984 a new company was established for this purpose. The cooperative intends to start operating the mill in the middle of 1986 with the assistance of other relevant organizations.

Another agricultural cooperative called Amazonica at Castanhal in the Bragantina district started raising of seedlings in 1983, subsidized by the Ministry of Agriculture. It is encouraging the members to plant oil palm and is also preparing a palm plantation which will be under the direct management of the cooperative. These two cooperatives and the Tome-Acu Agricultural Cooperative are planning to plant a total of around 25,000 ha oil palm and to build 5 oil mills.

In Para, not only these cultivators but several leading private companies are making plans to develop plantations and carry out parallel extraction operations (Table 6-4). These project sites are located in Baixo-Tocantins and Tome-Acu micro-regions, which are considered to be suitable for oil palm cultivations, and are said to have a plantation area of 3,000 to 10,000 ha.

Table 6-4 Oil Palm Development Program in Para

Companies	Location	Planned Plantation Area
REASA	Moju	6,000
DENPASA	Acara	10,000
AGROMENDES	Acara	6,000
COMPANHIA REAL	Acara	5,000
DENAM	Sto. Domingo do Capim	3,000
COOPAPAENSE	Sta. Izabel	
COOPAMA	Castanhal	25,000
COMTA	Tome-Acu	

Source: Ministry of Agricultural, Para Oil Palm Program, 1983

As described above, in the area surrounding Belem in Para, which is included in Castanhal sub-region in the PGC Area, the the cultivation of oil palm by farmers (mainly members of agricultural co-operatives) is in progress, along with the development of palm plantations by leading private corporations.

This area is considered to be suitable for oil palm production in terms of natural conditions. Also in terms of economics it may have considerable advantages, because its infrastructure is the best in the PGC Area, and the market price of palm oil is on upward trend recently. Moreover, growers in this area have the experience accumulated from previous projects and mainly cultivators have abundant experience in commercial production of other industrial crops and tropical fruits.

Given the above circumstances, the establishment of oil mills in or near the producing areas is essential for the development of oil palm cultivation in this sub-region, as the harvested fruit bunches need to be processed promptly, although there are also other factors to be improved concerning variety, nursery seedlings, farm management, and finances for cultivation.

As stated before, the quality of oil contained in the fruits rapidly deteliorates unless they are promptly processed. And, the oil mill has to be of certain scale and equipped with modern facilities, otherwise the oil may not be internationally competitive both in quality and cost. From the stand point of the oil mill, it is essential that sufficient amount of the fruit bunches are supplied constantly in order to operate the mill efficiently.

It will be important, therefore, that some arrangement be made so that interests of the oil mill and farmers meet for the benefit of both sides, i.e., the former being the stable and reliable buyer of the fruit bunches at fair price and the latter being the steady supplies of the material needed by the mill.

Anyhow, establishment of processing facilities is a pre-requisite for the formulation of oil palm producing areas in this sub-region.

(2) Babassu

Babassu is a very important native product in the PGC Area, which include Maranhao which has country's largest area of indigenous and largest babassu production, followed respectinvely by Goias and Para. Actually these three states combined produce about 90% of the Brazil's total production (Tables 6-5 and 6-6). In each state babassu occupies an important position in agricultural production. In Maranhao, especially, the gathering industry accounts for as high as 12.4% of the total agricultural production including cultivation. Babassu accounts for 97.8% of the total production by gathering, and appears to play an important role in the State economy (Table 6-7).

For utilization, a nut is divided into shell, flesh, inner flesh, and seeds,[1] and which will be made into fabrics, starch, charcoal, and oil, respectively. At present, farmers sell mainly seeds, and use the rest as charcoal for home or local use. Consequently so far, the main products obtained from babassu are cake (contains 7 to 8% of fat), which is extracted from seeds, and a residue meal (no fat). The crude oil is further processed into soap, surface active agents, cosmetics, and cooking oils. Cake and meal are used for fodder. Most of the oil is for domestic use, but the meal is exported mainly to West Germany and Benelux countries.

The extraction of babassu began in the 1930s in Brazil. Since the extraction and processing industries were concentrated in southern Brazil at that time, material supply was transported from northern to southern Brazil. At the beginning of the 1960s, a fat and oil maker in southern Brazil came to Sao Luis to establish a processing plant[2] which would use babassu as the main material. Since then a relatively modern plants have been constructed in the state of Maranhao. Currently the total production of crude babassu oil in Brazil is about 140,000 tons per year, and 70% of it, or about 100,000 tons, is presumably produced in Maranhao. Other producing areas are in the state of Piaui and other northeastern states, and most of the seeds are extracted in the production states or their neighboring states (Figure 6-3).

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1) Average composition of the nut is as follows: shell 15%, fruit flesh 20%, inner fruit flesh 59%, and seed 6%.
2) Oleaginosas Maranhenses S.A. (OLEAMA) - mentioned later.

Table 6-5 Quantity and Value of Babassu Production (seeds)

State	Quantity (ton)			Value (Cr$ million)		
	1979	1980	1981	1979	1980	1981
Total	250,913	250,951	241,888	2,591	3,938	6,686
Para	174	114	70	2	2	2
Maranhao	186,190	183,455	181,253	1,868	2,814	4,927
Piaui	19,445	20,214	18,543	228	343	497
Ceara	2,928	2,975	2,947	22	38	71
Pernambuco	3	3	3	0	0	0
Bahia	534	530	542	5	8	18
Minas Gerais	235	207	56	2	3	1
Goias	41,404	43,451	38,394	464	730	1,170

Source: IBGE, Anuario Estatistico do Brazil 1983

Table 6-6 Distribution of Wild Babassu

State	Estimated Area (1,000 ha)					
	[1]	[2]	[3]	[4]	[5]	(%)
Maranhao	12,000	8,500	8,665	8,665	9,457.5	(66.7)
Mato Grosso	1,500	800	2,000	2,000	1,575.0	(11.1)
Goias	1,000	1,000	1,000	1,000	1,000.0	(7.0)
Minas Gerais	1,000	-	1,000	1,000	1,000.0	(7.0)
Piaui	1,200	1,200	300	300	750.0	(5.3)
Para	-	-	200	200	200.0	(1.4)
Amazonas	-	-	50	200	125.0	(0.9)
Bahia	-	-	-	50	50.0	(0.3)
Ceara	-	-	-	30	30.0	(0.2)
Others	700		280	480	-	
Total	17,400	11,500	13,925	13,925	14,187.5	(100.0)

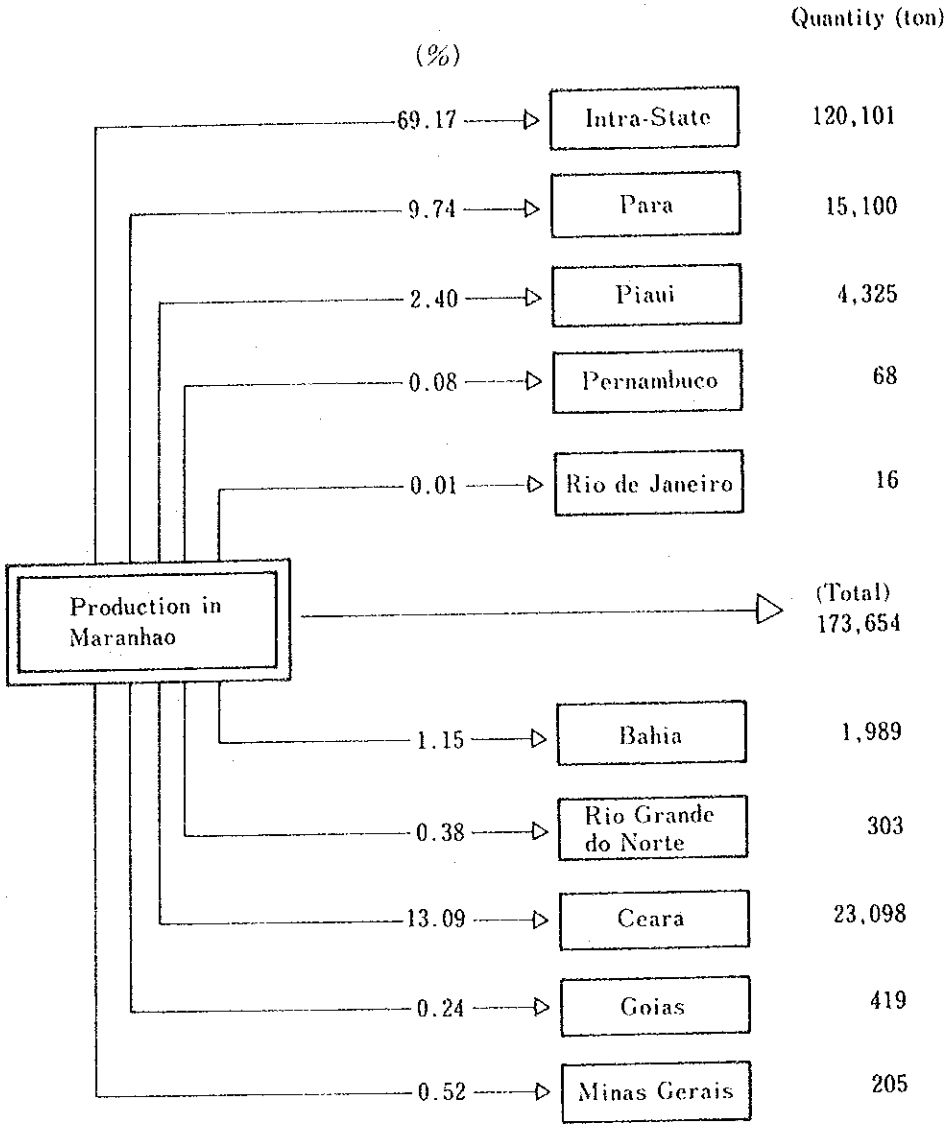
Source: [1] Akira Kono, "Necessity for Planning in the Babassu Industry"
[2] H.C. Braga and D.C. Dias, "Social and Economic Conditions of Babassu"
[3] Ariosto Peixoto, "Statistic Data of Oil Vegetables"
[4] TOBASA, "Babassu Oil in Tocantins"
[5] IBGE

Table 6-7 Position of Babassu in Agricultural Output

Production	Brazil		Maranhao		Para		Goias	
	Cr$ million	(%)	Cr$ million	(%)	Cr$ million	(%)	Cr$ million	(%)
Cultivation (A)	927,748	98.4	20,407	87.6	13,587	91.4	33,150	97.8
Percentage (%)	100.0	-	2.2	-	1.5	-	3.6	-
Gathering (B)	15,266	1.6	2,876	12.4	1,273	8.6	730	2.2
Percentage (%)	100.0	-	18.9	-	8.3	-	4.8	-
Total (C) =(A)+(B)	943,014	100.0	23,283	100.0	14,860	100.0	33,880	100.0
Percentage (%)	100.0	-	2.5	-	1.6	-	3.6	-
Babassu (seed) production (D)	3,938		2,814		2		730	
Percentage (%)	100.0		71.5		0.1		18.5	
(D)/(B) %	25.8		97.8		0.2		99.9	
(D)/(C) %	0.4		12.1		0.0		2.2	

Source: IBGE

Figure 6-3 Sales Locations of Babassu Seeds Produced in Maranhao (1975)



Source: Basic Data IPEI

The Maranhao Industrial Survey (Casdastro Industrial do Maranhao) of 1982, lists 32 babassu extraction and processing mills, but does not give extraction capacities or any production figures.[1] According to survey conducted by the Maranhao State Agricultural Planning

1) Mills which are listed but not actually operating are included.

Committee (CEPA-MA), the national total extraction capacity in terms of seeds is 500,000 tons per year, and 80% of them are process in the state of Maranhao.[1] Therefore total capacity of these extraction mills is estimated at about 400,000 tons. Meanwhile, seed production, was about 180,000 tons in 1981, of which an estimated 70% were extracted in the state. It can be easily inferred from this that these mills are not operating at full capacity. As will be seen later, large mills are supplementing with soybeans to fully utilize their capacity.

Next, looking at the geographical distribution of these mills, Sao Luis with 10 has the most, and other mills are situated in Bacabal, Caxias, Timon, etc. An overall survey of the state shows that they are concentrated in the northeastern part, where there are dense growths of babassu, and processing mills are relatively near the production areas of seeds. Of these mills, those with more than 50 employees, 4 in Sao Luis, 2 in Caxias, and 2 in other municipalities, totaling 8; the rest are mostly small scale cottage industry type mills. Furthermore in the areas of dense growth there presumed to be many small mills not listed in the Industrial Survey. Among the companies listed, four undertake second-stage processing; the main product of each company is soap.

According to the Para Industrial Survey (Cadastro Industrial do Para) of 1981, in the state of Para there are 9 factories that process babassu in Belem, 1 in Santa Izabel, 1 in Muana, and 1 in Irituia. Among these, the factories in Belem and Irituia procure 100% of their materials the seeds and crude oil of babassu from other states to make cooking oil and soap. Only 50% of the babassu seeds used in the factory in Santa Izabel are produced within the state.

In the northernmost part of Goias, which is included in the PGC Area, an oil mill that has a seed processing capacity of 42 tons per day was constructed in Tocantinopolis several years ago[2], though it is said to be doing no processing except making charcoal from shells. There is a corporation which was established in 1981 for the purpose of carrying out overall industrialization of plantation and processing of babassu, and which was planning to construct a factory in Sao Sebastiao do Tocantins.[3] The company was planning to purchase the material from a cooperative nut cracking center which was to be organized by producers and gatherers in the Bico do Papagaio area, and ultimately to process 28 tons of seeds per day. However, the progress made on this project is not known.

One of the reasons why the oil mill in Tocantinopolis did not come into operation as planned is said to be the unstable gathering operations. As mentioned before, while the extraction capacity of the whole Maranhao is 400,000 tons per year, only 120,000 tons are esti-

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1) CEPA-MA, Monografia do Babassu, 1979.
2) Tocantins Oleo de Babassu S.A. (TOBASA)
3) Goias Babassu S.A.

mated to be extracted; it can be said that the biggest problem of the babassu processing industry in that state is the difficulty in procuring raw material. Indeed, the harvesting babassu is a somewhat primitive process. Gathering of nuts is limited to very small areas which are accessible to the gatherers' domicile. There is no gathering in the rain seasons, when carrying out is difficult, in addition, the use of a hatchet to take seeds out of the gathered nuts is a very inefficient method.

One whole family can gather 40 to 70 kg of nuts per day, which are cracked open to obtain only 3 to 5 kg of seeds.[1] Until the early 1970s nut-cracking was done under trees, and shells are left there to decompose. Currently, however, nuts are more often carried into a home workshop, and shells tend to be used as home fuel or as the material of charcoal. Some gatherers take starch out of inner fruit flesh and use it for their food. According to the above-mentioned survey by the Maranhao Agricultural Committee, the cracking of babassu nuts is concentrated in the harvesting season, between July and December, and about 70% of the annual output is produced in this period.[2]

Babassu gathering is usually a part-time job done when workers have no agricultural work. Although production per family is very small, as stated above, it is a precious cash source for the local people who have only a few ways of gaining an income. In the years when agricultural production drops because of drought, the population of babassu gatherers is said to increase greatly, thus the gathering of babassu, probably plays an important role in the economy of poor farmers. Interviews conducted in Maranhao and the southern part of Para in September, 1984 showed that the residents receive Cr$700 to 800 for 1 kg of babassu seeds. Gatherers sometimes exchange nuts directly for necessities such as rice, sugar, cooking oil, etc. instead of receiving cash.

The current situation of the distribution routes and pricing arrangements of babassu seeds will be described below, referring to the detailed survey conducted by the Maranhao State Agricultural Planning Committee[3] together with the field investigation carried out by the Study Team.

There are two cases of sales of the nuts: i.e.,

a) Ownership of the gathering area is known and owner participantes in buying and selling.

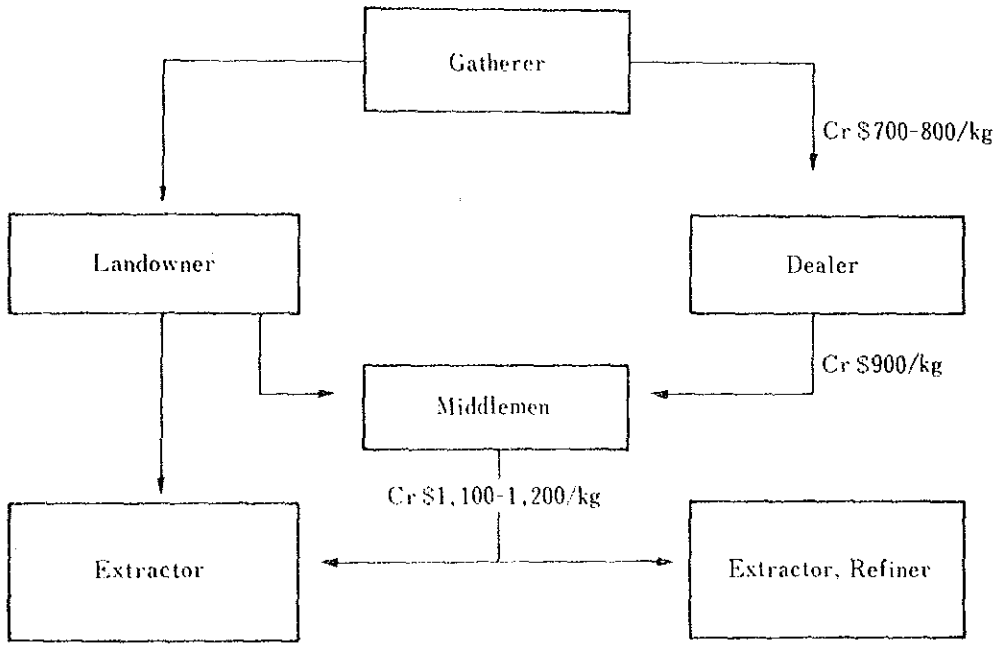
---

1) According to the survey conducted by CEPA-MA, some families produce 12 to 15 kg of seeds per day, but more than 50 percent produce less than 3 kg per day (CEPA-MA, op. cit.). And the interview conducted in August, 1984 revealed that residents sell an average of 20 kg of seeds during the 5 months from September to January the following year.
2) CEPA-MA, op. cit.
3) CEPA-MA, op. cit.

b) Ownership of the gathering area unknown or uncertain and the gatherer(s) sell direct to the processor(s).

In both cases, seeds are sold to collectors[1] in cities (for example Sao Luis or Caxias, etc.) where processing mills locate (Figure 6-4). In the case of a), however, the owner of the land often places several agents in the gathering area, and gets them to buy the seeds from the gatherers. If the gatherers are living in the area, the owner buys at a price 15-20% lower than the current price. Alternatively the owner may adopt a system of lease or commission, instead of directly interfering in the selling and buying, but in either case, the gatherers pay "rent" (land rent) in one form or another.

Figure 6-4 Distribution Route of Babassu Seeds



Note: Price information was obtained from the interview with local residents and OLEAMA conducted in Aug.-Sep., 1984

Source: Aspectos da Comercializacao de Alguns Produtos Agricolas da Regiao Norte

1) Many of these collectors deal with other agricultural products besides babassu such as rice, cassava flour, etc.

The survey conducted by the Maranhao State Agricultural Committee shows[1] that the price the farmers receive is lowest in areas where ownership of land is established. According to the survey, the percentages of seed price at each distribution stage are 60 to 80% for gatherers, 10 to 16% for dealers, and 10 to 25% for landowners.

Babassu seeds were covered by the Minimum Price Guarantee System until the 1980/81 crop year, but the minimum price was usually far lower than the market price at each stage of distribution, and this policy had little effect on babassu distribution. For this reason the price guarantee for babassu was abolished.

Of the seeds produced in Maranhao, about 70% are processed within the state (Figure 6-3), of these, half are processed in the city of Sao Luis, 30% of which being pressed by the above-mentioned fat and oil company.[2]

The company was established in 1961, invested by a fat and oil maker in Rio de Janeiro[3] and has been until now the biggest babassu oil manufacturer in Brazil.

The company's extraction facilities have the capacity to treat about 120 tons of babassu seeds per day. During the harvesting season (September to March), the mill operates at full capacity, treating about 3,000 tons per month. In other months, however, the amount processed declines to about 600 tons per month, or one-fifth. Thus the mill treats 20,000 to 25,000 tons a year, operating at 60 to 70% of the capacity on average. In 1983 it treated 22,000 tons of seeds and produced 12,000 tons crude oil. The annual amount processed varies slightly being influenced by droughts for example, but there have been no big differences since it started operation (Table 6-8). Other factors influencing production volume are related to the problems of babassu supply due to the limited gathering areas and unstable collection methods.

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1) This survey does not reveal the situation of land ownership in each area. Price percentage at each distribution stage is as follows:

Area	Gatherer (%)	Cellector (%)	Landowner (%)
Caxias I	76.2	9.8	14.0
Caxias II	60.0	16.0	24.0
	65.0	10.0	25.0
	70.0	10.0	20.0
Bacabal	78.9	11.5	9.7

Source: COBRAPI, Companhia Brasileira de Projetos Industriais

2) OLEAMA

3) Uniao Fabril Exportadora S.A. The company bought babassu seeds from the state of Maranhao until 1961. Details about the establishment of OLEAMA are given in Luiz da Rocha Porto, "Breve Historia da Economia do Babassu", 1982.

Table 6-8 Trends in Babassu Seed Shipment to Sao Luis

(Unit: ton)

Year	OLEAMA	Others	Total	OLEAMA/Total (%)
1962	18,019	49,007	67,026	26,88
1963	18,419	33,071	51,490	35,77
1964	24,806	55,368	80,173	30,94
1965	21,393	63,775	85,168	25,12
1966	19,358	62,903	82,264	23,54
1967	14,566	45,900	60,466	24,09
1968	12,474	44,927	57,401	21,73
1969	18,347	67,659	86,006	21,33
1970	13,387	62,826	76,213	17,57
1971	15,675	31,011	46,686	33,57
1972	21,816	38,035	59,852	36,45
1973	20,327	48,691	69,019	29,45
1974	20,574	70,319	90,893	22,64
1975	17,354	37,238	54,592	31,78
1976	17,719	51,890	69,609	25,45
1977	18,276	42,636	60,912	30,00
1978	14,543	42,459	57,002	25,51
1979	18,347	43,980	62,334	29,43
1980	15,359	25,161	40,520	37,90
1981 (Jan/Jun)	5,554	8,083	13,637	40,72

Source: Breve Historico da Economia do Babassu

The company buys the seeds for processing from 6 to 10 large collectors in Sao Luis, Santa Ines, Bacabal, Caxias, Chapadinha, and other towns at Cr$1,100 to 1,200/kg (August, 1984). As described before these collectors buy the seeds from middlemen (local dealers), who live near the babassu palm growing areas, from land-owners or directly from gatherers. The number of these middlemen and middlemen/landowners who buy the seeds from gatherers, is said to be 100 to 150. The limits of the gathering area may extend 200 to 300 km from the mill. The economic limit is said to be 300 km from a mill, and seeds coming from further than that are not competitive. The company follows this principle and its seeds usually come from the thick

stands in the northeast of the state. Seeds produced in other states or even in the southern part of Maranhao are not used because of transportation costs and conditions, even at the time of material shortage. Meanwhile, in order to keep the year-round operation, the company has been using soybeans as supplementary material since 1983.

In 1983, the trial period of soybean crushing, the company treated only 700 tons, but it is said to be planning to buy 4,000 to 5,000 tons of soybean in 1984. When babassu is compared to soybeans as a material for extraction, while the former contains an average of 60% of oil, the percentage of oil contained in the latter is 20%. Moreover, babassu contains much lauric acid, and for some uses soybean oil cannot be substituted for babassu oil. At present, while the purchase price of babassu seeds at the mill is Cr$1,100 to 1,200/kg, that of soybeans at the production area is Cr$20,000 to 21,000 per bale (60 kg) and in addition, freightage from the production area to the mill is charged to the company. Freightage from Balsas, where soybean production was established recently, is Cr$52/kg and that from Goianesia is Cr$60/kg. When this is added, the cost of raw material to produce 1 kg of crude soybean oil is about the same, or a little higher than that of babassu oil.[1] Thus, when the extraction cost is included, soybean is considered disadvantageous as a material for oil extraction.

However, in order to ease the difficulties in obtaining raw material which sometimes arise when depending on babassu only, the company intends to continue to use soybeans as a supplementary material, and hopes that soybean production in Maranhao, Balsas, and Imperatriz in particular, will become established and expand.

Meanwhile the company also buys palm kernels from the above-mentioned oil palm extraction mill (DENPASA) in Para.

The company produces 10,000 to 12,000 tons of crude babassu oil annually, and sells more than half of it to its parent company, a fat and oil maker in Rio de Janeiro. The remainder is used to make soap, cooking oil, and candles, or is exported in the form of crude oil. The proportion of oil export varies according to international prices. Thus, half of the 1983 production was exported because of a sharp rise in the international price. Recently the company has expanded its second processing operations and there are a large variety of products. These second processed products are sold mainly in northern and northeastern Brazil, since south of Bahia is the territory of the parent company. Babassu meal is exported to West Germany, Holland, Spain, and elsewhere (Figure 6-5). As of August, 1984, babassu had an advantage over soybeans in the price of product.

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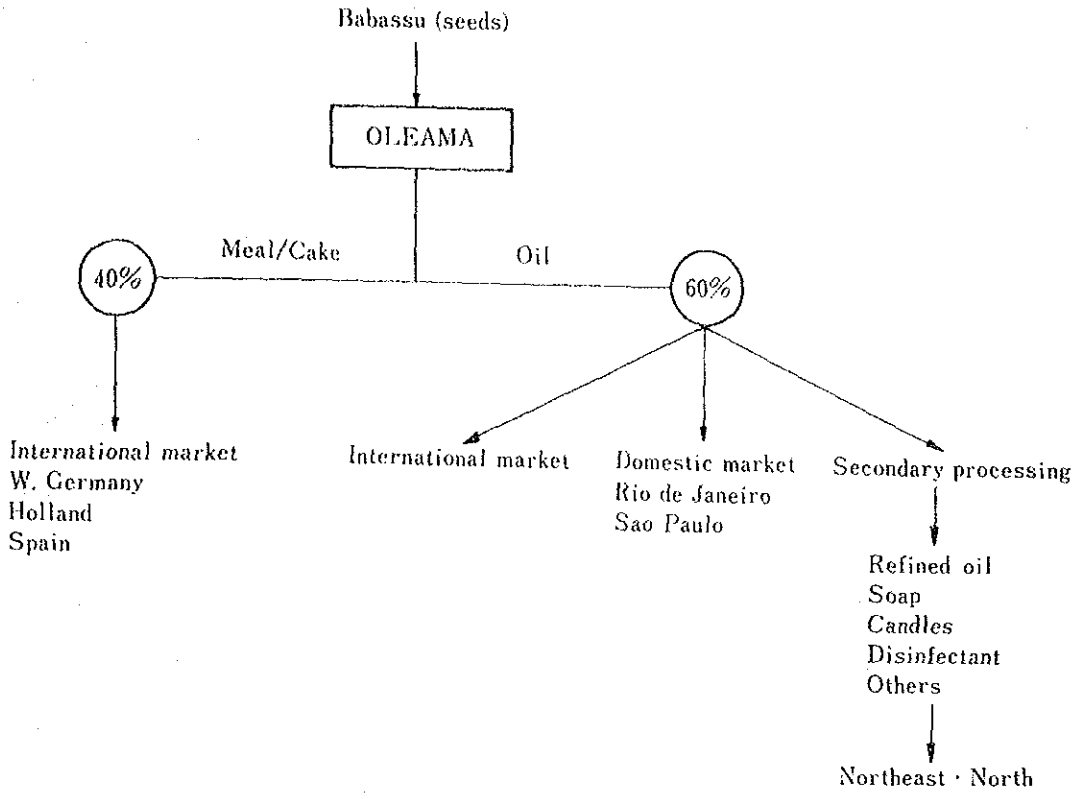
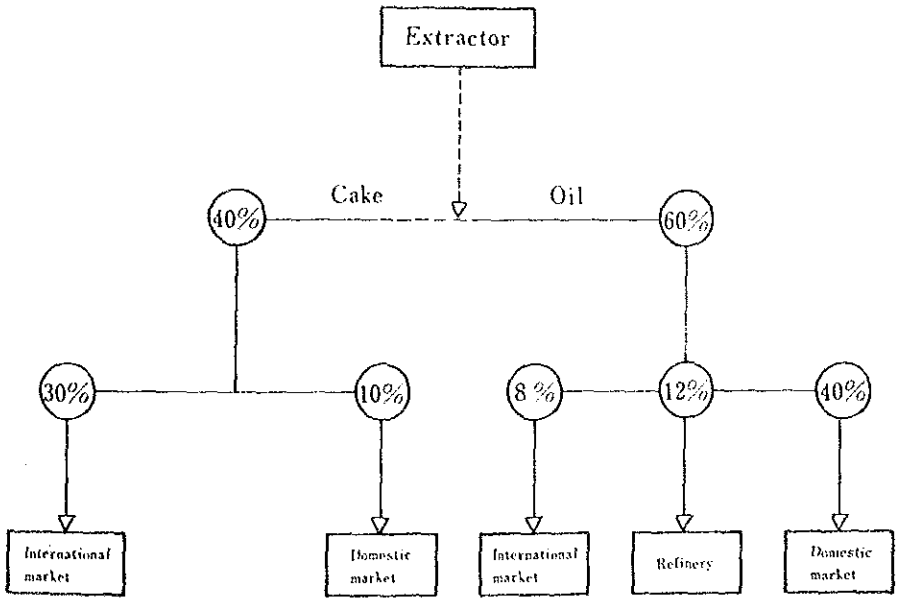
1) Using the above-stated percentage of oil, the raw material cost to produce 1 kg of crude oil can be calculated as follows:
Babassu: 1,200 ÷ 0.6 = Cr$2,000
Soybean: (21,000 - 60 + 52) ÷ 0.2 = Cr$2,010

Figure 6-5 Flow of Babassu Products of OLEAMA



〈Reference〉 Flow of Babassu Products in Maranhao State Extractor



Unlike Para's palm oil, which is carried by onland transportation, babassu meal is transported to southern Brazil mainly by sea, shipping from the port in Sao Luis (Itaqui). For marine transportation one sailing must carry at least 1,000 tons of cargo, so shipment is done only in production peak period. During the period, about one shipment is made in a month, totaling 5 to 6 shipments a year. At other times the meal is hauled overland by tanker lorry. Freight cost and time required for transportation to Rio de Janeiro are Cr$40 to 50/kg and 10 to 12 days for marine transport, and Cr$100 to 120/kg, 3 to 5 days for land transport.

Looking at the situation of the oil extraction industry as a whole babassu has the problem of excess capacity in extraction facilities. On the other hand, however, as has been described, palm oil suffers from a deficiency of extracting capacity throughout the area, which puts babassu suppliers at an advantage, and might act as an incentive to increase production. However, though a study has been done on planting techniques, it will take a considerable time for methods for the commercial cultivation of babassu to be established. Therefore, unless efforts are made to substantially expand the collection area and stabilize the gathering work by constructing feeder roads, and to increase seed production by mechanizing the crushing nuts,[1] the excess processing capacity will not be used to advantage for material suppliers.

An advantage of babassu is the composition of its oil. While oil palm is highly competitive against soybean (now the most important oilseed in Brazil), in oil productivity per unit area, babassu oil —— because of its lauric acid —— has industrial uses which soybean oil can not substitute.

When techniques for integrated utilization of babassu nuts are put into practice, an estimated 800,000 tons of starch, 600,000 tons of fiber, 2,400,000 tons of charcoal and alcohol material can be obtained annually from 4,000,000 tons of nuts. This figure is obtained, by a rough calculation, from the current annual production 200,000 tons of seeds (kernels). The figure could in fact be larger because some nuts still containing seeds are being discarded. When integrated utilization is made possible, parts which have been previously unusable will be come marketable, and this, in addition to the above-mentioned uniqueness of its oil will increase the competitiveness of babassu oil against other oils and possibly give an incentive to gatherers. This could overcome the problems of underutilization of resources, so it is hoped that techniques for integrated utilization will be further developed.

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1) Various crushing machines have been developed by American and Japanese makers, but these are still not perfected for practical use.

(3) Para rubber[1)]

Production of natural rubber in the PGC Area is currently negligible except for that in the state of Para[2)]. Para rubber gained its name in the days when Belem was named Para then the principal point of export of this Amazon region product. The state of Para produces about 3,000 tons of Para rubber annually, both coagulated and concentrated latex, and ranks third in Brazil in the production of natural rubber of the Hevea genus (Table 6-9). Natural rubber production including rubbers from other genera changes this figure a little, but still Para occupies the fifth position. However, of the total output of natural and synthetic rubbers in Brazil (280,000 tons), only 10% is natural rubber, of which the state of Para produces 10%. Therefore, its output is small in absolute terms, and does not hold a major position in the economy of the state.

Table 6-9 Quantity and Value of Production of Rubber (Hevea) by State

	Quantity (ton)			Value (Cr$ million)		
	1979	1980	1981	1979	1980	1981
	(Coagulated latex)*					
BRAZIL	28,269	21,250		837	2,079	
Rondonia	2,103	2,016	3,119	98	188	629
Acre	9,545	11,367	12,857	409	1,222	2,140
Amazonas	6,970	5,854		278	549	
Para	1,284	1,702	1,588	36	95	154
Amapa	19	42	12	1	2	1
Mato Grosso	347	269	314	15	23	57
	(Concentrated latex)					
BRAZIL	1,288	2,571	1,168	30	155	99
Amazonas	-	696	-	-	78	-
Para	1,206	1,668	1,038	28	68	88
Amapa	82	207	130	2	9	11

* Including scrap such as cuplump, tree lace, etc.

Source: IBGE, Anuario Estatistico do Brasil, 1983

1) Hevea brasiliensis. Other than Para rubber, there are a veriety of rubber trees of the Hevea genus in Brazil, and the most popular is Para rubber. However, the statistics in Table 6-9 are considered to include all latex produced from the Hevea genus.
2) There are plantation projects by PROBOR which will be described later (Table 6-11), but they are not yet in the production stage.

Major producing municipalities are Santarem, Muana, Sao Francisco do Para, Cameta, Benevides, and Altamira; included in the PGC Area are Muana, Sao Francisco do Para, Cameta, and Benevides, which are all located in the lower basin of Tocantins river. Other municipalities that produce Para rubber, though the amount is small in the PGC Area are also concentrated in the northeastern part, but it is noticeable that only Sao Felix do Xingu has recently increased its production in the south.

Meanwhile, according to the information provided by the Para State Industrial Association,[1] more than 80% of the total output of natural rubber produced in the state in 1983 was from native trees. On a national level, production from cultivated trees is increasing as the result of the Natural Rubber Development Program (PROBOR) that has been carried out by the Superintendency for Rubber (SUDHEVEA) since 1972. At the same time production from native trees is also increasing by the recuperation of native plants. Thus, the rubber from native trees still accounts for 80% of natural rubber production (Table 6-10). The areas contracted (finances approved) and actually planted in Para are respectively, 1,890 ha and 1,596 ha under PROBOR I, 17,300 ha and 7,602 ha under PROBOR II, and 6,746 ha and 2,660 ha under PROBOR III, as of the end of December, 1983 (Table 6-11). Of the area already planted (11,858 ha) about 20% is in the production stage.[2] However, financial difficulties slow the progress of the program throughout the country.

On the processing side, latex collected from cultivated trees is coagulated and made into smoked sheet in the processing facilities attached to the farm, or is concentrated to 60% in a centrifuge to be shipped in the form of liquid. On the other hand, latex obtained from native trees, which account for over 80% of the total natural rubber production in Para, is mostly smoked into balls or lumps as it was in the old days. In this method latex is smoked and coagulated at the center or the top of a wooden stick of about 1 m long, over a fire using the shells and husks of a resin-rich palm such as urucuri, cohune or cocurita. When the latex on the stick coagulates and dries, additional latex is coated on, to produce a ball weighing about 60 kg. However, this lump of rubber often contains foreign substances or different varieties of rubber mixed in and this crude latex will be considerably inferior in quality compared to that produced by the sheet method or the crape method which is widely used in the world today.

Crude latex obtained and treated as above is bought, like the babassu seeds, if the ownership of the gathering area is known, by the landowner (called a "seringalista") and if not, by middlemen and then sold to rubber mills in such cities as Belem (Figure 6-6). The quantity distributed in the former way seems to be greater than in the latter. Also like babassu, payment for this crude latex is made to gatherers called "seringueiro", sometimes bartering with daily necessities, such as rice, sugar, salt, and medicine.

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1) FIEPA, The Present Situation and Perspectives of the Agroindustry in the Greater Carajas Program Area, 1984.
2) FIEPA, op.cit.

Table 6-10 Natural Rubber Production in Brazil
(by native and cultivated tree)

(Unit: 1,000 tons)

Origin	1979	(%)	1980	(%)	1981	(%)	1982	(%)	1983	(%)
Native	21.5	(86.0)	23.2	(83.0)	24.3	(80.2)	26.3	(80.1)	28.2	(80.1)
Cultivated	3.5	(14.0)	4.6	(16.6)	6.0	(19.8)	6.5	(19.9)	7.0	(19.9)
Total	25.0	(100.0)	27.8	(100.0)	30.3	(100.0)	32.8	(100.0)	35.2	(100.0)
(1979=100)										
Native	100		108		113		122		131	
Cultivated	100		131		171		186		200	
Total	100		111		121		131		141	

Source: SUDHEVEA

Table 6-11 Planting of Rubber under PROBOR (as of Dec. 31, 1983)

a. PROBOR I

State	No. of Projects	Total contracted area (ha)	Total planted area (ha)	Contracted value (Cr$)	Disbursed value (Cr$)
Acre	22	3,435	1,869	224,565,338.96	279,606,304.56
Amapa	2	210	50	25,285,800.21	11,110,838.36
Amazonas	61	5,000	4,500	504,567,459.56	556,477,239.32
Bahia	50	2,990	2,990	138,842,769.11	105,190,840.50
Mato Grosso	24	2,194	2,194	219,861,780.94	206,478,188.72
Para	35	1,890	1,596	117,207,572.40	122,899,536.81
Rondonia	41	583	583	76,677,092.89	66,975,752.73
Total	235	16,302	13,782	1,306,907,814.07	1.348,728,737.00

b. PROBOR II

State	No. of Projects	Total contracted area (ha)	Total planted area (ha)	Contracted value (Cr$)	Disbursed value (Cr$)
Acre	770	11,534	9,895	1,667,339,809.19	1,847,250,477.72
Amapa	14	147	94	32,123,838.37	16,627,625.76
Amazonas	716	29,756	19,313	4,881,044,311.49	4,683,402,139.87
Bahia	131	5,276	3,092	1,571,690,764.71	797,254,659.05
Espirito Santo	138	4,991	3,610	872,197,981.46	964,016,354.39
Goias	1	40	20	6,179,983.88	5,013,084.88
Maranhao	17	8,220	817	1,265,120,720.40	285,660,199.79
Mato Grosso	236	27,524	14,406	5,414,814,410.05	4,801,701,195.88
Para	216	17,300	7,602	2,655,266,177.63	2,738,283,904.21
Rondonia	970	17,753	15,304	3,300,381,154.98	3,375,241,521.88
Roraima	52	156	18	107,511,149.74	11,294,360.90
Total	3,261	122,697	74,171	21,773,670,301.90	19,525,645,524.33

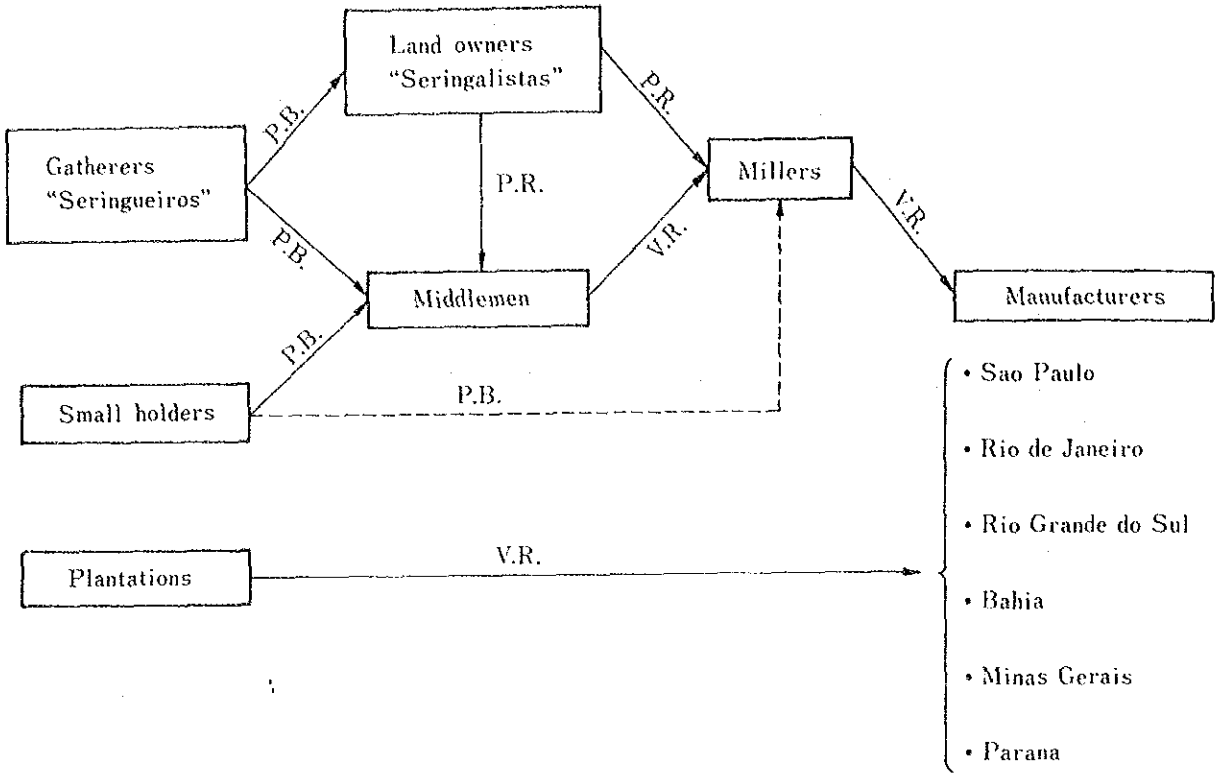
c. PROBOR III

State	No. of Projects	Total contracted area (ha)	Total planted area (ha)	Quantity of contracted ORTNs (Cr$)	Balance of Capital Disbursed (Cr$)
Acre	251	2,668	1,195	885,910.68	951,620,321.76
Amapa	13	102	52	20,525.40	27,605,366.74
Amazonas	141	5,355	2,215	1,573,365.93	1,881,193,229.65
Bahia	121	1,926	913	402,513.04	443,191,876.26
Espiritor Santo	120	3,056	1,313	644,997.62	562,166,110.51
Goias	15	405	205	93,965.74	77,261,928.35
Maranhao	49	967	388	252,251.08	341,715,873.94
Mato Grosso	503	8,964	5,340	2,302,731.20	2,688,479,904.42
M. Grosso Sul	3	60	-	15,220.49	4,114,323.33
Minas Gerais	28	438	220	74,438.41	90,981,619.50
Para	284	6,746	2,660	1,604,555.06	1,144,471,220.77
Pernambuco	60	1,915	807	462,302.27	459,780,140.71
Rio de Janeiro	1	200	-	32,636.02	13,949,055.15
Rondonia	185	3,138	1,992	811,818.55	747,148,941.76
Roraima	15	266	130	92,821.90	69,334,825.19
Sao Paulo	98	980	490	209,226.60	211,214,526.97
Total	1,887	37,186	17,920	9,479,279.99	9,714,229,265.01

Note: The Financial data regarding the "Banco do Brasil" are as of 30/09/83.

Source: Mapas Trimestrais dos Agentes Financeiros

Figure 6-6 Distribution Route of Natural Rubber in Brazil



Note: P.B. (Preco Basico); Minimum Price
P.R. (Preco Regulador); Regulative Price
V.R. (Valor Referencia); Referencial Value

There are two types of price for crude rubber: the minimum price set by the National Rubber Council (CNB) and the Interministerial Price Council (CIP), and the regulative price. The former is applied when the "seringueiro" or middlemen buy from farmers or "seringalistas". The regulative price is equivalent to the minimum price with 20% added to it as a distribution margin. The minimum price varies with variety, quality, type determined by the place of origin, and also with percentage of water content in the crude rubber. Minimum price of the first group of "Fira Acre" type (a maximum of 20% of water content) which was announced on August 3, 1984, was Cr$2,530,178/ton. Though application of these official prices is supervised by the Superintendency for Rubber, it is not clear to what degree this supervision is effective.

Refined rubber is traded at market prices, using the selling prices of buffer stock as a reference value. If the market prices are higher than this value, a Rubber Market Adjustment Surcharge (TORMB) is levied. The TORMB is used as a fund to buy buffer stock.

The gathering method and distribution system of crude rubber have changed little over the years, hence the relatively low productivity. Though minimum prices are set by the Government, true price control is possible only when the products have acquired dependable levels of quality through adequate processing and storage, thus it is considered extremely difficult to apply official prices to crude rubber.

Products that have been through the process of refinement and curing at rubber mills are shipped mainly to Sao Paulo and Rio de Janeiro to be made into the final products such as tires. According to the above-mentioned Cadastro Industrial, rubber-related manufacturing plants in Para totaled only 16 in 1981, and six of them are intermediate processing mills, refining raw rubber obtained from native trees; four mills located in Belem, one in Sao Francisco do Para, and one in Santarem. Most of their products is sent to "other states". Of the remaining 10, 6 are tire reclaiming mills (4 in Belem, 2 in Castanhal), and 4 are listed under "others". Included in "others" is a mill which makes concentrated latex directly from native field latex by centrifuging. This company used to be a soap maker, and produced only 4 tons of concentrated latex in the year of 1979. The products made at that time were all sold to other states, and the amount of subsequent production after that is not known.

Thus the figures for rubber factories in Para have shown that raw rubber produced from native and cultivated trees in this state is sent to southern Brazil, Sao Paulo for example, for final processing. This situation shows explicitly the structure of the rubber industry in Brazil: while the north has an overwhelming share in the production of natural raw rubber, production of rubber products, including the ones made from synthetic rubber, is concentrated in the south, especially in the state of Sao Paulo. Thus rubber products such as tires manufactured in the south returns to the north to be sold.

This then is the position of Para in the Brazilian rubber industry. If rubber manufacture is to be encouraged in the state in the future, facilities for first processing must be established near the cultivation areas and the distribution system reorganized. Such improvements will lead agricultural producers to grow more Para rubber, resulting in a stable supply of material for rubber manufacturing. In the areas which do not have developed related industries, such as machine manufacturing, or finance, and information, and which do have no advantage other than the proximity to raw material, securing the supply of these materials is the first priority in establishing rubber manufacturing.

This area is considered to have natural conditions suitable for rubber cultivation and the Government and related organizations have

carried out extensive research and experiments to encourage the development of plantations. In spite of these efforts the production of natural rubber has not shown a marked expansion. The reasons for this may be that, in addition to the above-stated problems of processing and distribution, the establishment of a rubber plantation and associated processing facilities would need large capital investment with long gestation period.[1)]

One Government support program, PROBOR, has been mentioned already. Included in this program is a sub-program in which loans can be extended for first planting and recuperation of native plants, and for latex refinery mills and small-scale processing facilities (mini-usina). In Para, only five projects had benefited from this scheme by the end of 1983, loans were given to one projected "mini-usina", and four "mini-usina" combined to native-forest recuperation projects (Table 6-12).

Along with the problem of capital, it is said that lack of skilled workers for tapping[2)] is another important factor hindering the expansion of natural rubber cultivation. In addition, the itinerant nature of much of the work force makes the implementation of proper technical training schemes difficult. This is considered to be part of the reason why the cultivation project that was started in Para by a tire manufacturing company in the 1950s did not develop as had been expected although its capitalization was relatively sound.

Because of the difficulties in adjusting to changes in demand due to the long procurement period, and the intricacies of the handling and processing procedures, natural rubber cannot compete with synthetic rubber. However, since some sectors, for example tire making, need a certain percentage of natural rubber, it is believed that synthetic rubber will not drive natural rubber out completely. In Brazil, the self-sufficiency rate for rubber as a whole is 80%, but that of natural rubber alone is 50%. Therefore a production increase is hoped for, and to achieve this, the improvement and expansion of the distribution system, including technical upgrading from tapping to processing, is an important task.

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1) Natural rubber cultivation was encouraged to Japanese immigrants who moved to the State of Para after World War II but they did not take up. Reportedly because there were problems of capital and labour.

2) Tapping is done by incising the bark to cut the lactiferous ducts and collecting the latex following out. In order to obtain sufficient amounts and harvest continuously, knowledge of the depth, angle, height, time and frequency of the incisions, and other skills are necessary. One of the reasons why natural rubber production, which was at its height from the end of the 19th to the beginning of the 20th century, has been on the decline in Brazil is said to be the careless tapping by the gatherers (seringueiros).

Table 6-12 Processing Mill Construction under PROBOR (As of Dec. 31, 1983)

a. Latex Refinery (PROBOR II)

State	Contracted projects		Implemented projects		Contracted value (Cr$)	Balance (Cr$)
	No.	No. of factory	No.	No. of factory		
Acre	1	1	1	1	13,000,000.00	-
Bahia	1	1	1	1	4,128,660.00	-
Para	1	1	-	-	3,500,000.00	1,250,009.00
Total	3	3	2	2	20,628,660.00	1,250,009.00

b. "Mini-usinas" (PROBOR III)

State	No. of Projects	No. of "Mini-usinas" contracted	ORTN's quantity contracted	Balance of Capital (Cr$)
Acre	62	62	58,306.31	83,265,633.75
Amazonas	3	3	2,388.34	11,448,930.67
Mato Grosso	2	2	1,368.36	5,796,247.44
Para	1	1	788.00	-
Total	68	68	62,843.01	100,510,811.86

c. Recuperation of Native Forests + "Mini-usinas" (PROBAR III)

State	No. of Projects	No. of collocation "Mini-usinas" contracted	ORTN's quantity contracted	Balance of Capital (Cr$)
Acre	25	834/32	77,415.06	307,203,040.73
Amazonas	11	286/09	19,903.52	90,558,217.47
Mato Grosso	1	15/01	1,301.64	2,961,567.98
Para	5	147/04	9,718.92	41,610,240.19
Total	7	120/06	12,978.00	54,713,013.61

Note: The financial data regarding the "Banco do Brasil" are as of 30/09/83.

Source: Mapas Trimestrais dos Agentes Financeiros

(4) Soybeans

Brazil's soybean production is concentrated in the states of Rio Grande do Sul and Parana, which are in the southern part of the country. These two states combined account for about 70% of the country's production. Recently the mid-western states, including Mato Grosso, Mato Grosso do Sul, and the state of Minas Gerais in the southeast have increased their soybean production markedly, raising their share in national production (Table 6-13). In the north and northeast, cultivation of varieties suited for the local environment has begun, although it is still in the experimental stage. It is especially noticeable that the state of Maranhao, much of which is included in the PGC Area, has expanded its production steadily, though absolute quantity is still small (Table 6-13).

Meanwhile, most of the oil mills are in the states of Parana, Rio Grande do Sul, Sao Paulo, and Santa Catarina. There are no available data on soybean oil extraction, but according to the survey conducted by the Brazil Vegetable Oil Industrial Association (ABIOVE), the above-mentioned four states account for 98% of the total processing capacity of the country's oilseed crushing mills[1] (Table 6-14). It is estimated that soybeans make up more than 90% of the material processed in these mills, so the same figure will hold true for the distribution of soybean oil crushing capacity. Thus, soybean oil extraction is still concentrated in the major producing states. Recently, however, soybean oil mills have been built and existing oil factories have begun extraction of soybean oil in the states of Mato Grosso, Goias, and Minas Gerais, showing a northward movement in soybean extraction also. Calculations were based on the above figures: crushing capacity per month is about 1,650,000 tons, and the total production of soybeans is about 15,000,000 tons now, so the average annual operation rate of oil mills is about 75%. However, though the actual rate goes up to 90 to 100% just after the harvest (May and June), it drops sharply to 25 to 30% in January and February when soybeans are out of season, raising once more the problem of underutilized crushing capacity (Figure 6-7).

In the PGC Area, soybean production with tropical varieties has recently begun in Imperatriz, Balsas, and Araguaina, leading the northward movement of soybean production. Yield per unit area is about 3 tons/ha, compared to the average yield of 1.6 tons/ha in the south and central-west, and the highest in the state of Parana, 2.2 tons/ha, so cultivation in this Area seems to be very successful so far. As for processing, as far as the survey results show, soybeans produced in Balsas and Imperatriz (Porto Franco) have been sent to oil mills in Sao Luis, Belem and Teresina.

Regarding the Sao Luis market, as described in the section on

1) Oil palm and babassu oil mills are not included.

Table 6-13 Trends in Soybean Production in Brazil (1979 - 1984)

(Unit: ton)

State	1979	1980	1981	1982	1983	1984
Maranhao	30	96	112	430	n.a.	7.613 *
Piaui	10	-	-	20	n.a.	n.a.
Bahia	2,815	2,224	1,019	354	4,200	35,912
Minas Gerais	195,042	289,542	273,874	390,390	477,528	551,331 *
Sao Paulo	848,400	1,090,058	1,032,000	993,303	966,000	864,000
Parana	4,000,000	5,400,192	4,983,210	4,200,120	4,315,000	4,136,000
Santa Catarina	425,111	718,764	648,196	534,652	405,397	568,000 *
Rio Grande do Sul	3,629,926	5,737,170	6,088,344	4,220,579	5,268,869	5,418,201
Mato G. do Sul	826,705	1,322,082	1,347,447	1,537,341	1,801,000	2,002,389
Mato Grosso	26,503	117,173	224,901	365,501	611,258	1.067,301
Goias	282,402	455,794	382,713	560,916	692,896	913,100 *
Distrito Federal	3,362	13,709	25,551	32,444	39,808	51,990
Total	10,240,306	15,155,804	15,007,367	12,836,050	14,582,052	15,615,837 *

* Estimate

Source: Ministry of Agriculture

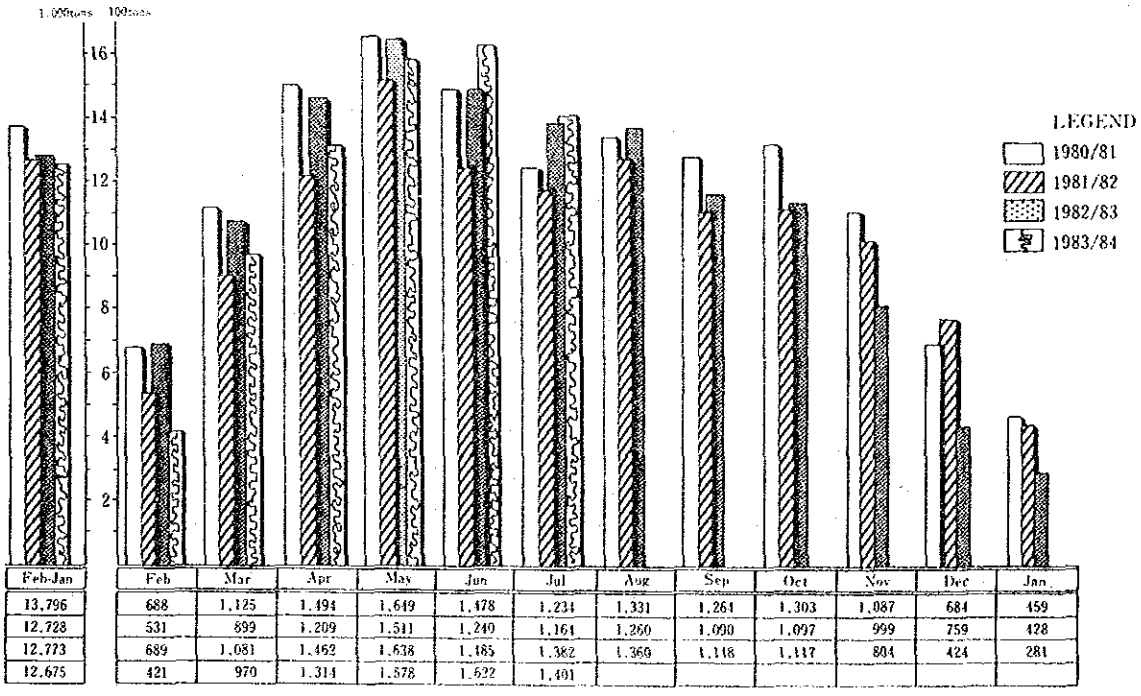
Table 6-14 Crushing Capacity of Oilseeds in Brazil

State	ton/day	(%)
Sao Paulo	16,970	18.5
Parana	30,690	33.4
Rio Grande do Sul	34,619	37.7
Santa Catarina	7,670	8.3
Rio de Janeiro	100	0.1
Mato Grosso do Sul	350	0.4
Goias	800	0.9
Minas Gerais	690	0.7
Total	91,889	100.00

Note: The above information was collected at the end of 1982 and revised in June, 1984.

Source: ABIOVE

Figure 6-7 Soybean Crushing in Brazil (1981 - 1984)



Feb-Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
13,796	688	1,125	1,494	1,649	1,478	1,234	1,331	1,261	1,303	1,087	684	459
12,728	531	899	1,209	1,511	1,240	1,161	1,260	1,090	1,097	999	759	428
12,773	689	1,081	1,462	1,638	1,485	1,382	1,360	1,118	1,117	804	424	281
12,675	421	970	1,314	1,578	1,622	1,401						

Source: Informativo ABIOVE, Aug. 1984

babassu, a babassu oil mill[1] is using soybeans as supplementary material. The oil mill is not planning to convert totally to soybeans, but it intends to increase the purchase of soybean for the purpose of raising the operation rate of crushing machines. This mill started crushing soybeans on a large scale this year (1984). Total purchase is about 5,000 tons and half of it is bought from Goianesia; the rest is bought with in the state, mainly from Balsas. The purchase price was Cr$20,000 per bale (60 kg, August 15, 1984), while freightage from Balsas was Cr$52/kg, that from Goianesia was Cr$60. Generally speaking, if the freightage is charged to users, purchase from nearer producing area is more advantageous to them, provided the price and the quality of goods are the same. Therefore the company is also hoping that the production in Maranhao will increase. In 1983 the company provided small holders in Santa Ines and Chapadinha with seeds for planting, but the crop was poor partly because of bad weather, and the harvested crop had quality problems. On the other hand, soybeans bought from Goianesia, Balsas and Imperatriz are produced mostly by farmers doing relatively large-scale cultivation. Purchase prices and quantities are determined by exchanging information directly with farmers and cooperatives. In reality, however, in the areas where there are no cooperatives, only large farmers may be able to make a direct sale to millers in this way.

In soybean producing areas in the south and central-west, most of the products are sold to mills or exporters through cooperatives, some of which also run mills (Figure 6-8). In the PGC Area, on the other hand, due to the fact that soybean production is still in its infancy, and cooperative activities are not yet developed, the amount transacted through cooperatives is still small. There is a plan to organize a soybean producers' union in Balsas, but in the PGC Area only one cooperative, in Imperatriz,[2] is handling soybeans.

This cooperative has its headquarters in the state of Goias, and has five branches in the state in addition to Imperatriz. It handles mainly storage and consignment sales of farm products and sales of materials to its members. Only three of the branches (including Imperatriz) have storage facilities, such as warehouses and country elevators; the rest only sell materials. The total membership is about 1,000 with 150 belonging to the Imperatriz branch. Most of the members of Imperatriz branch are medium-size holders: 10% hold less than 100 ha, 35% have 101 to 300 ha, 40% 301 to 500 ha, and 15% more than 500 ha.[3] Even the smallest holders have 20 ha. The Imperatriz branch deals in such farm products as rice and maize, but started dealing in soybeans in the 1982/83 crop year, when 8,500 bales (510 tons) were sold. In the 1983/84 crop year 7,000 bales (420 tons) were

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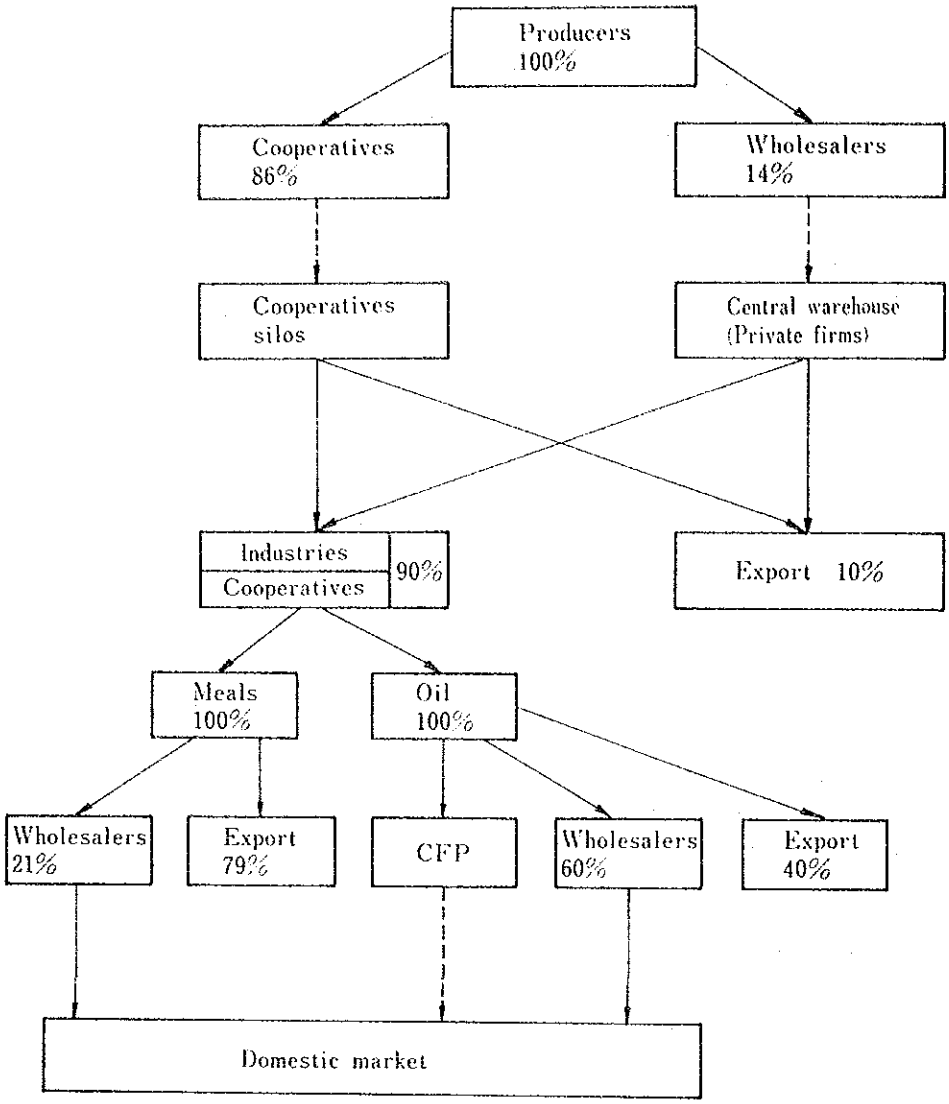
1) OLEAMA
2) Cooperativa Mista dos Productores de Soja de Goiatuba Ltd.
3) This farmland ownership pattern is similar to that of such newly developing agricultural production areas as the state of Goias, rather than that of developed areas like the state of Sao Paulo.

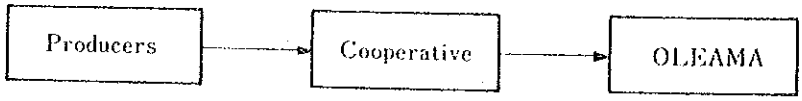
Figure 6-8 Distribution Route of Soybeans

a. Nationwide



Source: CAEMA

b. Cooperativa Mista dos Productores de Soja de Goiatuba Ltda.



sold (Table 6-15). Maize and rice are sold mainly to northeast Brazil through CFP, but soybeans are sold directly to the processing company (OLEAMA) in Sao Luis. This branch has a storehouse with a storing capacity of 24,000 tons and a grain dryer. When selling farm products it does not charge commission, but charges storage and drying costs if necessary.[1)]

Table 6-15 Quantity of Sales by Cooperativa Mista dos Productores de Soja de Goiatuba Ltda.

(Unit: 60 kg sack)

	1980/81	1981/82	1982/83	1983/84
Maize	7,000	5,000	4,000	150,000
Rice	68,000	45,000	34,000	50,000
Soybean	-	-	8,500	7,000
Total	75.000	50.000	46.500	207.000

Source: Cooperativa Mista dos Productores de Soja de Goiatuba Ltda.

This cooperative started, as the name implies, as a soybean producers' association in the southernmost part of the state of Goias, which began increasing soybean production in the 1970s. One of the founders of the Imperatriz branch has more than 10 years of experience in soybean cultivation in southern Goias. He is not only a pioneer in soybean production but a commercial producer of such grains as rice and maize. Furthermore, as was described above, other members of the Imperatriz branch are also medium scale commercial grain growers, and many of them seem to have moved from leading grain producing areas, such as the central-west and the south. The Cooperative, a major one in the central-west handles the country's eighth largest sales volume. The Imperatriz branch, therefore, has close connections with the leading grain producing areas in the central-west. In addition, its members have experience in grain production in those areas, and for

1) As of September, 1984, storage costs per month and drying costs per bale (60 kg) of grain were as follows.

	First half (Jan. - June)		Latter half (July - Dec.)	
	Member	Non-member	Member	Non-member
Storage cost (Cr$)	24	30	45	70
Drying cost (Cr$)	145	181	320	450

this reason they may be a symbolic presence in the northward movement of the production of grains such as soybeans. When commercial cultivation of soybeans and maize is firmly established and expanding in the Area in the future, cooperatives of such medium- and large-scale farmers will play a significant role.

In contrast to palms or Para rubber, soybeans can be cultivated even where there are no facilities for primary processing nearby. But, of course, shorter distance to the mill is advantageous. Meanwhile, for a crushing mill it is more important to be close to an area where there is oil manufacturing industry, pig raising, or poultry, that is to say, an area which consumes crude oil or meal. The reasons for this are that the transportation of beans is generally more convenient than oil or meal, and in Brazil, it is difficult to obtain capital equipment and technicians needed for the construction and operation of second and tertiary processing mills in places remote from industrial areas. If poultry and pig raising exist in the cultivation area and there is a demand for soybean meal, it may make economic sense to ship in the form of meat (chicken or pork), which has higher value added, in terms of cost per unit weight. But in this case the problem of how to dispose of the oil as by-product of meal (product) arises.

Therefore, when the processing of soybeans produced in Imperatriz and Balsas is considered, judging from the above-described conditions influential on the siting of oil mills, it will be difficult to set up oil mills in these sub-regions. For the time being soybeans produced in these sub-regions will continue to be sold to the mills as shorter distance as possible. In view of the demand for meal for poultry, Sao Luis, Belem and Teresina will probably continue to be the markets. In southern Brazil, crushing capacity has become too large for the output of soybeans, as we have already seen, and considering that soybean production in the central-west, namely the Cerrado area, is also on the increase, supplies from this area will be directed within the area or to the northeast for the time being.

(5) Maize

Maize is a very important crop in most states in Brazil because natural conditions all over the country are suitable for its cultivation. In area under cultivation and size of production maize is the largest national agricultural commodity. Since the 1960s, especially as the demand for feed increased along with the expansion of poultry and pig raising, production of maize has been increasing. However, it is southern states such as Parana that have sustained this production increase (Table 6-16). While these states are engaged in intensive cultivation using fertilizer and irrigation facilities, the north and the northeast production is mainly for self-consumption and productivity is generally low.

Maize is grown all over the PGC Area, also, being the most important crop after rice and cassava. Generally production methods have the same characteristics as the rest of the north and northeast.

Table 6-16 Trends in Maize Production (1979 - 1984)

(Unit: ton)

State	1979	1980	1981	1982	1983	1984
Rondonia	53,212	106,976	114,065	136,434	97,432	161,218 *
Acre	20,009	21,726	24,130	25,770	19,697	26,808 *
Amazonas	7,315	10,203	7,907	5,635	3,460	2,154 *
Roraima	3,374	5,762	14,479	2,513	591	3,886 *
Para	65,861	76,742	79,983	141,152	68,909	153,050 *
Amapa	628	-	1,161	1,108	864	1,354 *
Maranhao	248,036	270,583	144,470	303,592	86,620	224,000 *
Piaui	109,538	73,548	43,365	123,316	25,621	165,517 *
Ceara	172,214	96,000	21,600	153,349	17,531	252,000 *
Rio Grande Norte	9,898	2,669	2,210	5,743	1,978	83,684 *
Paraiba	112,180	33,981	26,208	26,065	24,954	188,641 *
Pernambuco	184,337	59,042	52,200	94,738	11,895	196,635 *
Alagoas	58,534	8,832	8,257	35,478	4,017	72,911 *
Sergipe	43,613	3,310	16,345	78,260	2,414	54,242 *
Bahia	317,160	282,495	191,075	312,251	105,378	106,474 *
Minas Gerais	2,608,199	3,008,788	2,912,874	3,030,924	2,695,976	2,626,451 *
Espirito Santo	190,930	205,293	221,520	222,540	154,236	212,661
Rio de Janeiro	54,787	45,684	55,044	73,281	68,384	68,568
Sao Paulo	2,277,000	2,335,800	2,752,800	3,392,400	3,164,000	2,900,400 *
Parana	4,169,518	5,466,967	5,363,109	5,430,000	5,018,870	5,376,000 *
Santa Catarina	1,708,649	3,009,995	3,162,590	2,628,756	1,687,325	2,307,410 *
Rio Grande do Sul	1,853,600	3,162,033	3,808,793	3,147,246	3,174,771	3,575,060 *
Mato G.do Sul	146,474	188,396	232,636	257,902	236,443	262,297
Mato Grosso	109,014	142,572	190,765	288,324	319,238	343,770
Goias	1,780,800	1,751,507	1,666,946	1,921,842	1,722,880	1,747,340 *
Distrito Federal	1,500	2,646	2,376	3,858	3,769	4,684
Total	16,306,380	20,372,072	21,116,908	21,842,477	18,743,761	21,117,295 *

* Estimate

Source: Ministry of Agriculture

However, closer observation shows differences in cultivation modes among the districts of the PGC Area. In relatively large scale operations, maize is sometimes produced as a monoculture on a commercial basis but this kind of production is not yet common. Usually cultivation is done on a small scale before sowing the cleared forests with pasture. Maize is inter-cropped with rice or feijao for 1 to 2 years after the forest is cleared. However, in the districts which have little uncultivated land left, small farmers plant successively on the same fields.

The percentage of products that reach the market may vary according to the type of cultivation. The average in the PGC Area is estimated at 50%, which is below the country's average, 63%. Since the cultivation depends largely on rain, output is influenced greatly by the weather, and fluctuate from year to year. In drought years the production of all food crops falls sharply and even less maize reaches the market as a results of increased self-consumption among producers. Most of the maize sold on the market becomes feed, mainly for poultry, and utilization for flour making is negligible.

In the PGC Area, poultry has recently been expanding around cities such as Belem, Sao Luis and Imperatriz (Table 6-17) and the demand for maize feed has grown with it. However, since maize production has not increased as much as the demand for feed, it is considered that the shortfall has been made up by buying from the mid-west and the south. In 1983, gross consumption in the northeast and the north was 1,540,000 tons and 256,000 tons respectively, with 67% and 89% respectively being used for feed. On the other hand, percentage of self-supply was 18% in the northeast and 75% in the north, so most of the purchased maize was used as feed (Table 6-18). However, the situation of supply and demand in Para and Maranhao is complicated, part of the maize production is exported to other states, despite the supply is short in the state.

For example, gross production in the state of Para was about 140,000 tons in 1982, and half of it was produced in the micro-regions of Medio Amazonas Paraense, Baixo Amazonas and Araguaia Paraense. However each district sells most of the produced maize to other states: the first two micro-regions sell mainly to Manaus (the state of Amazonas) and Macapa (Amapa), and the last to Goiania (Goias). This is because, it is more profitable for the producers in each district in the state to sell to nearer consuming areas than ship to more distant cities in the state such as Belem or Castanhal, where poultry production is concentrated. Maize for Belem and Castanhal is bought mostly from grain exchanges in the states of Goias and Paraiba, but sometimes from the states of Minas Gerais and Rio Grande do Sul, and this may be connected with the level of quality needed for compound feed, as well the problem of transport costs.

It is a fact that the maize produced in the state of Para is considerably inferior in quality in respect of moisture and foreign substances content, due to poor harvesting techniques, and post-harvest treatment such as processing, storage and transportation. In

Table 6-17 Production of Pigs, Hens, and Eggs in the Greater Carajas Program Area (1970, 1975, 1980)

Region	Pigs (heads)			Hens (No.)			Eggs (1,000 dozens)		
	1970	1975	1980	1970	1975	1980	1970	1975	1980
Brazil	31,523,640	37,640,000	34,183,000	213,622,503	311,867,000	447,411,000	556,410	843,225	1,303,439
North Region	909,237	1,272,000	1,910,000	7,376,457	11,953,000	11,981,000	11,874	23,001	26,010
State of Para	603,659	816,875	1,078,669	3,938,540	6,549,672	8,269,971	5,008	9,775	12,481
Project Area	534,611	692,434	854,256	2,963,335	5,132,705	6,424,399	4,175	8,705	10,496
Subareas:									
Salgado/Bragantina	71,663	67,673	78,590	1,130,933	1,924,997	2,648,711	767	4,961	3,761
Maraba	5,262	37,700	72,439	34,799	318,782	363,933	57	300	634
Xingu	431	394	2,572	8,695	7,191	24,043	11	9	35
Northeast Region	7,094,856	10,307,000	7,994,000	36,263,701	61,859,000	72,448,000	62,590	117,443	189,731
State of Maranhao	2,760,863	3,308,891	2,799,786	9,060,597	11,714,323	13,194,662	9,198	11,930	18,104
Project Area	2,760,863	3.308,891	2.799,786	9,060,597	11,714,323	13,194,662	9,198	11,930	18,104
Subareas:									
Imperatriz	17,107	97,869	96,483	176,549	775,460	984,893	515	1,002	3,040
Pindare	493,720	401,848	334,148	1,506,184	1,125,261	1,092,905	860	931	1,203
Balsas	61,972	47,691	33,132	165,224	244,461	280,975	436	512	435
Central West Region	2,510,508	3,450,000	2,874,000	12,226,133	16,036,000	20,108,000	24,543	34,236	52,926
State of Goias	1,680,387	2,384,468	1,859,161	7,003,380	9,875,298	11,815,875	13,859	20,486	30,472
Project Area	147,725	151,835	157,533	733,886	917,885	873,212	1,303	2,010	2,046
Subareas:									
Araguaina	147,725	151,835	157,533	733,886	917,885	873,212	1,303	2,010	2,046
Total of PGC Area	2,443,199	4,153,160	3,811,575	12,757,818	17,764,913	20,492,273	14,676	22,645	30,646

Source: IBGE, Censo Agropecuario, 1970
IBGE, Produ ao da Pecuaria Municipal, 1975, 1980

Table 6-18 Estimated Consumption of Maize in Brazil (1983)

(Unit: 1,000 tons)

	Rio Grande do Sul	Santa Catarina	Parana	Sao Paulo	Rio de Janeiro/ Espirito Santo	Goias/D.F.	Minas Gerais	Mato Gross/ Mato G. do Sul	Northeast	North
Poultry	949.0	732.0	877.0	1,833.0	379.0	100.0	993.0	88.0	801.0	143.0
Pig raising	1,199.0	1,172.0	1,542.0	554.0	156.0	140.0	730.0	30.0	102.0	29.0
Other stockraising	320.0	204.0	360.0	936.0	66.0	38.0	558.0	15.0	123.0	55.0
Stockraising Total (A)	2,468.0	2,108.0	2,779.0	3,323.0	601.0	278.0	2,281.0	133.0	1,026.0	227.0
Flour	76.0	240.0	650.0	494.0	80.0	150.0	210.0	-	-	-
Seed	25.0	7.0	45.0	20.0	3.0	16.0	35.0	7.0	38.0	4.0
Storage/Loss	776.0	462.0	580.0	942.0	64.0	219.0	413.0	54.0	476.0	25.0
Total (B)	3,345.0	2,817.0	4,054.0	4,779.0	748.0	663.0	2,939.0	194.0	1,540.0	256.0
(A)/(B) (%)	(74%)	(75%)	(69%)	(70%)	(80%)	(42%)	(78%)	(69%)	(67%)	(89%)

Source: SINDIRACOES

particular, the maize produced by shifting cultivation is subject to heavy losses[1] and reduced commodity value due to inadequate post-harvest treatment. Even when cultivated on a large scale on reclaimed pasture land, the same problems are experienced when local residents are employed for harvesting work.

Consumption of compound feed for poultry in the state of Para is about 7,000 tons per month (1983), an 97% of it is produced in the state. The proportions of composition are usually 60% maize, 35% soybean meal and about 5% micromineral additives. Though produced in the state, maize is often not available in sufficient quantities.

Similarly the state of Maranhao is buying from such states as Para and Minas Gerais to make up its shortage, while shipping the maize it produces out to Ceara and Pernambuco.

When using maize as a feed, if other ingredients such as soybean meal are available, it is advantageous in view of transport costs to make compound feed in the cultivation area and ship in the form of meat, which has higher value added. For cultivators producing maize for feed, it is advantageous if demand from poultry or feed factories exists locally. The figures for registered companies, however show that compound feed factories are concentrated in Belem and Sao Luis, and only one factory in the PGC Area at Acailandia. On balance, as was seen before in the example of Para, maize is shipped out of the state to nearer consuming areas. However, even if the large scale mechanized cultivation spreads in the PGC Area in the future, its competitiveness will be small in the southern and mid-western markets which have big producing areas close by. Therefore, an important condition for the establishment of maize production will be whether feed factories are built and poultry production develops in the PGC Area. In order to increase the competitiveness of the markets in the area against the maize brought in from the south and the central-west, the improvement of post-harvest techniques from the farm to the feed-mills and the reorganization of the distribution system will be as important as the improvement of cultivation techniques of producers.

Improvements on the production side, including post-harvest treatment are an important requirement for small farmers, who account for a large part of regional maize production. In this area maize, as well as such traditional crops as rice, feijao and cassava flour (farinha de mandioca), is mostly sold to wholesalers, retailers and feed factories through middlemen (Figure 6-9). Sales through co-operatives average about 40% of commercialized products nationally (Figure 6-9), but the average in the PGC Area seems to be below that

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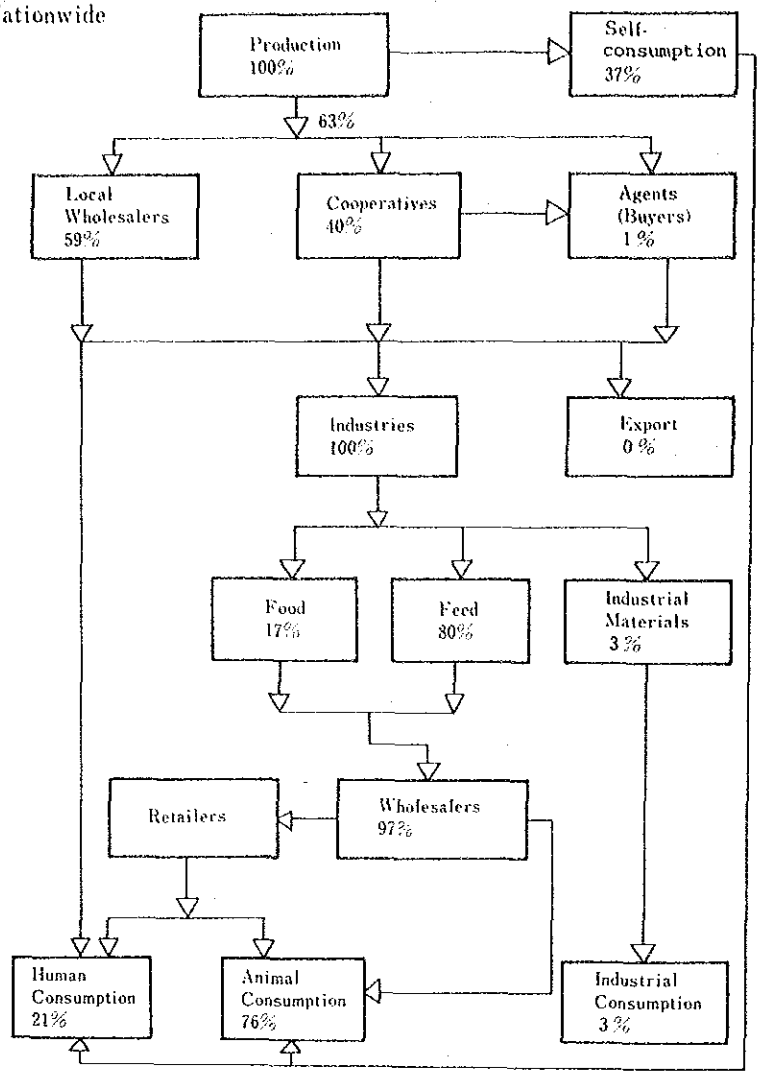
1) According to the survey conducted by National Compound Feed Industries Union (SINDIRACOES), on the nationwide level, losses generated during the harvest of maize accounts for 7% of the total output, and those generated during processing after harvest amount to 5% of the total harvest. In the north, the combined losses amount to about 20%.

Figure 6-9 Distribution Route of Maize

a. Nationwide



b. PGC Area

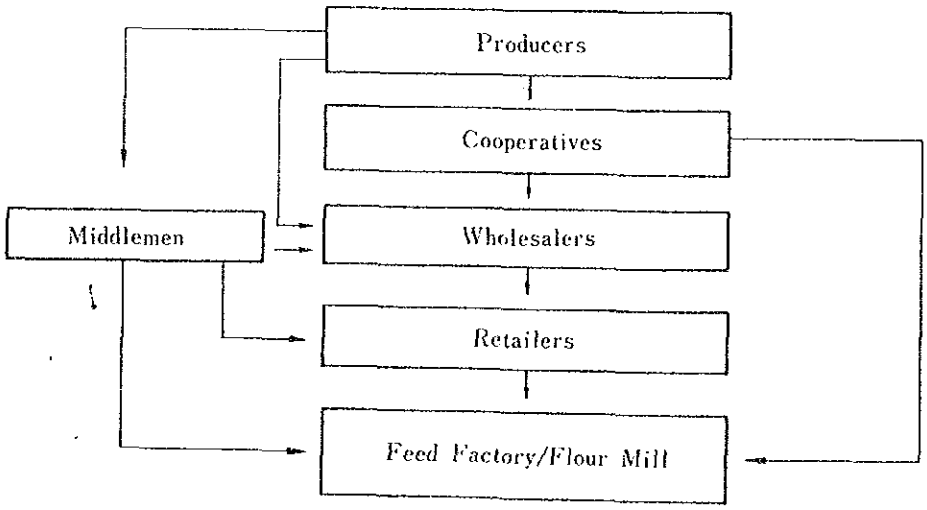


figure because of the scarcity of active cooperatives.[1] Maize is covered by the Minimum Price Guarantee System formulated by the Government. But in order to sell to Production Credit Board (CFP), which is implementing the system; the products carried into the designated storehouse must meet quality standard in respect of moisture and foreign matter contents; the producer must bear the costs of transportation to the storehouse, unloading and drying and must store the products until the minimum price comes into effect. For small farmers, who cannot meet these conditions, it is more convenient to sell to the middlemen who visit the villages. In addition, in the above stated supply and demand situation, market prices have recently tended to exceed the minimum guarantee price, and large quantities have been shipped to open markets.

It is considered that the kind of production for self-consumption which is widely practiced in the PGC Area will not be able to produce maize competitively against large scale mechanized cultivation. However, in order to make the product more profitable for the growers, it is exigent to seek commercialization by rearranging distribution, and the facilities for treatment and storage, as well as by introducing improved varieties and improving cultivation techniques.

At the centers in the southern part of the PGC Area, e.g. Balsas and Imperatriz, the problem is the competition with soybeans, and in small scale cultivation areas such as Bacabal, the competitors are rice and feijao. Regarding these problems, not only market and minimum prices, distribution margins but also the comparison of relative profitability of these crops should be reviewed from the respective cost of production.

(6) Cassava

Cassava has played a significant role in Brazil as an important food crop, but the nationwide importance as a food crop has receded with grains becoming increasingly widely grown. However, it is still a staple food in the north and the northeast, where there are many low-income families. Although production is spread throughout the country, the north and the northeast still account for over 60% of the national production of cassava (Table 6-19).

In the production of cassava, the states of Maranhao and Para, large parts of which are included in the PGC Area, rank high in the country, and it is an important food source in each state. The area under cultivation of cassava is comparable to that of rice or maize. Most of the cassava produced in the area is made into flour called farinha de mandioca[2] in or near the producing areas (farming villa-

1) However, in the sales by Maranhao agricultural co-operatives, maize ranks second after rice (Chapter 5: Institutional System Related to Agriculture).
2) The tuber is peeled, mashed and pressed to remove water and then dried on an iron plate. The recovery rate of flour from tubers is about 30%.

Table 6-19 Trends in Cassava Production in Brazil (1979 - 1984)

(Unit: ton)

State	1979	1980	1981	1982	1983	1984
Rondonia	200,787	279,361	395,536	396,120	407,608	442,870 *
Acre	177,135	211,964	234,610	269,109	275,094	274,605 *
Amazonas	803,304	827,403	835,680	860,748	882,264	908,736 *
Roraima	22,714	17,508	50,313	38,768	56,007	44,238 *
Para	1,445,724	1,239,329	1,524,046	1,681,529	1,849,379	1,696,372 *
Amapa	35,500	34,050	30,456	45,358	53,345	47,640 *
Maranhao	3,064,612	3,279,641	3,112,240	3,493,621	2,439,249	1,858,182 *
Piaui	852,100	833,966	884,684	1,048,950	580,992	419,295 *
Ceara	1,232,000	1,085,000	800,000	577,214	442,088	884,197 *
R. Grande Norte	467,699	486,168	544,718	543,621	389,760	500,267 *
Paraiba	532,249	554,169	464,470	498,426	451,339	534,881 *
Pernambuco	1,881,323	1,508,649	1,442,776	1,666,248	1,356,612	1,580,364 *
Alagoas	377,340	288,276	236,130	221,081	162,818	179,382 *
Sergipe	344,350	408,470	375,950	581,255	599,863	389,376 *
Bahia	4,704,000	4,880,000	5,600,000	4,439,200	3,960,000	3,520,000 *
Minas Gerais	1,843,348	1,939,585	1,864,622	1,362,729	1,281,279	1,237,152 *
Espirito Santo	697,772	408,495	362,500	492,494	574,247	465,496 *
Rio de Janeiro	220,367	175,165	177,800	199,545	194,661	198,240
Sao Paulo	553,000	480,957	592,000	729,286	787,270	705,000 *
Parana	801,241	907,310	1,100,380	1,218,740	1,383,000	1,460,000 *
Santa Catarina	1,120,967	995,195	1,274,881	1,141,097	999,746	1,040,000 *
R. Grande do Sul	2,496,269	1,719,631	1,700,198	1,685,263	1,672,264	1,689,207 *
Mato G.do Sul	521,715	340,090	335,525	272,989	338,697	332,752 *
Mato Grosso	318,105	261,330	270,300	312,690	286,912	268,490 *
Goias	265,440	301,044	303,598	293,794	319,225	352,500 *
Distrito Federal	3,120	2,893	2,947	3,731	2,352	2,400 *
Total	24,962,191	23,465,649	24,516,360	24,073,606	21,746,071	21,031,642 *

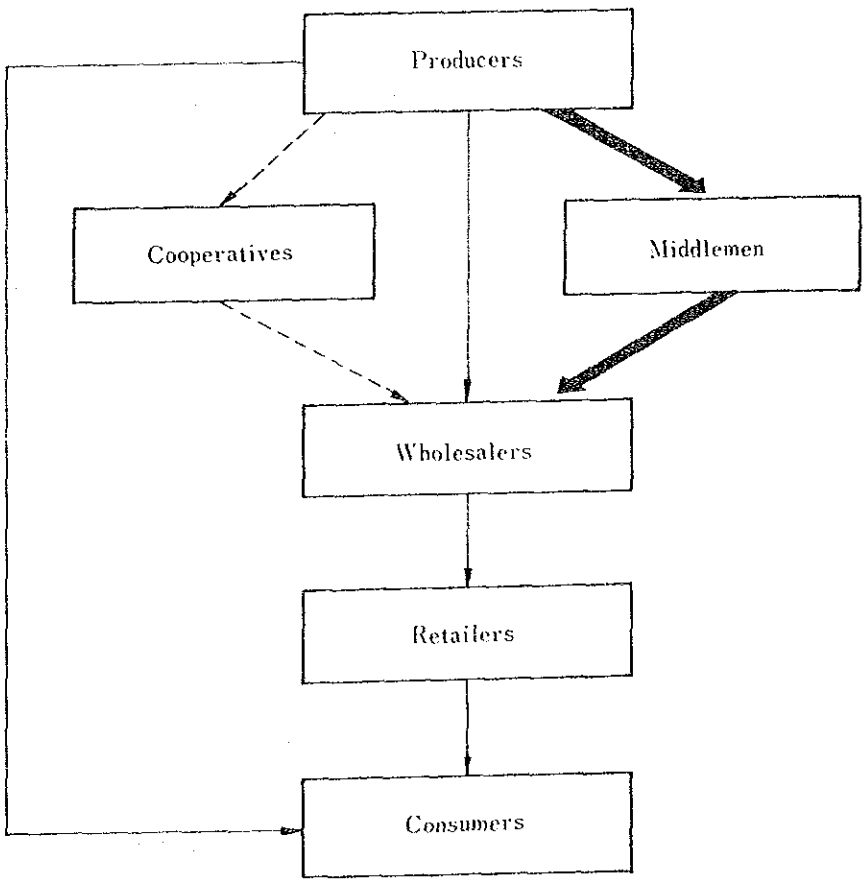
* Estimate

Source: Ministry of Agriculture

ges) for local consumption. This farinha is a staple food in the area. There are other products processed from cassava are flour for bread making and starch, but production is not large.

Cassava, like maize, is basically a crop for self-consumption, but it also serves as a commercial crop, which is important to small farmers, since cultivation is relatively easy and processing facilities are comparatively simple. The rate of commercialization of cassava for the Area is unknown but according to the Agricultural Census (Censo Agropecuaria) of 1980 by IBGE, commercialization of farinha processed in the villages is 85% in the state of Maranhao and 95% in the state of Para. An interview conducted by our field survey shows that in Braganca about 80% of farinha produced in the villages is sold, and also in Bacabal, Maraba and Araguaina, farinha is a main cash source or is traded for other necessities. Producer prices of farinha were Cr$400/kg in Braganca, Cr$500/kg in Bacabal and Cr$300 to Cr$400/kg in Araguaina, as of September, 1984. Most of the farinha processed in the villages is sold to wholesalers and retailers through the middlemen who visit each district (Figure 6-10).

Figure 6-10 Distribution Route of Cassava Flour (farinha de mandioca) in the Greater Carajas Program Area



According to the Agricultural Census of 1980, 74% of farinha produced in the villages is sold to these middlemen in the state of Maranhao, and 88% in the state of Para. Sometimes wholesalers and retailers handle the products, and many of them deal in rice, maize and feijao together with farinha. Though prices at each of marketing is not known, according to the survey conducted in Bacabal, the retail price of farinha was about Cr$1,000/kg, so the distribution margin was 50%. Markets for the commercialized farinha are, like those for rice, mainly in the state and the region (the northeast and the north).

According to the Agricultural Census of 1980, about 90% of farinha produced in the villages is processed by small scale producers with land of less than 100 ha both in Maranhao and Para. In Maranhao, especially, production by small farmers with land of under 10 ha accounts for 69% of the total. The census does not cover all producers but general trends in village processing of cassava can be assumed from the figures. That is to say, most of the farinha processed in the villages is produced by small farmers, and the reason why farmers of this scale are capable of processing quantities necessary for commercialization is because only simple facilities are needed for the production of farinha.

However, it is not financially easy for many of the petty farmers to own even these simple small-scale facilities (called "casa de farinha" which means "house of farinha"). There are many farmers who rent the facilities owned by other producers or merchants to process their own cassava tubers. Farmers who own processing facilities are relatively large and wealthy farmers. Some of them own a rice milling machine in addition to cassava processing facilities. In the neighborhood of Bacabal there is a village (comunidade) where 52 of 72 farming families are tenant farmers and the average cultivated area is about 3 ha. In this village, a farmer with 32 ha owned facilities for cassava processing and a rice milling machine which other farmers use, paying 20% of the weight of the farinha as a fee. Villages that have accessible processing facilities are fortunate. In the case of Alto Alegre, some farmers are said to have left their cassava rotting, mainly for home consumption, because there were no facilities for processing and storage in their district.

Meanwhile in the PGC Area, large population centers and cities in each area have relatively modern processing mills that are equipped with pressing machines and dryers. However, even if these mills are at a distance from a production area where the harvest can be carried in before rotting, it is still difficult for many small farmers to take advantage, because they have no efficient means of transport such as truck. Small farmers who are forced to transport cassava tubers, which soon perish, have little bargaining power. So in the areas where co-shipping with other farmers is difficult, they have to process the products by themselves for commercialization. As described before, however, in the case of farinha, many of the producers do not have their own means of transport or sale and most of the produce is sold to middlemen and brokers. Therefore, in order to have these

small farmers select cassava as a profitable crop, it is necessary not only to set up small scale processing facilities in villages but also to improve the distribution, for example by adopting a co-operative selling system to increase their bargaining power.

Considering the current existing demand in the northeast and the north, there seems to be little possibility for the time being of cassava being used in large quantities as a feed material, (i.e. in pellets and chips) or for fuel alcohol. For these uses, processing mills will have to be near the producing area because of the perishable nature of this crop after harvesting. Also the transportation and infrastructive improvements already mentioned will also be required.

(7) Sugarcane

Sugarcane is one of the few crops for which cultivation area and production are increasing steadily throughout the country. This owes much to the National Alcohol Program (PROALCOOL) which was begun in 1975, and the international sugar prices which were high from the end of 1979 to the beginning of 1981. In 1983, production in the state of Sao Paulo accounted for more than half of the country's total output, followed by such traditional producing states as Alagoas and Pernambuco. However, since PROALCOOL has recently been avoiding building factories in areas where production is concentrated in order to diversify the material producing areas, the distribution of sugarcane production areas is changing gradually. In particular, there have been notable production increases in the central-west including in the Cerrado (Table 6-20).

In this situation, while sugarcane produced from the mid-west to the south is made into sugar and fuel alcohol on about fifty-fifty basis, production in the northeast and the north is still made into sugar in the ratio of about 3 to 1 (estimated from Tables 6-21 and 22).

In the PGC Area, sites suitable for sugarcane cultivation are distributed widely, but are mainly in the northwest. In each state, sugarcane occupies larger areas than annual food crops such as rice, maize, cassava and feijao. However, while the country's production tends to grow rapidly as the demand for alcohol rises, production in Para and Maranhao is stagnant in general, and their ranking in the country's output falls each year (Table 6-20).

Looking into the cause of this from the point of view of processing, it can be seen that delayed modernization in the sugar making sector has led to the decline over a long period in the cultivation of sugarcane. It is proving difficult to establish an alcohol-making industry in the Area, where capital is in short supply compared to other producing areas such as the central-west and the south, and also infrastructure and other related industries are in a poor condition; as a result the new planting that has accompanied the establishment of

Table 6-20 Trends in Sugarcane Production in Brazil (1979 - 1984)

(Unit: ton)

State	1979	1980	1981	1982	1983	1984
Rondonia	20,620	24,340	22,980	14,280	-	-
Acre	21,222	22,314	19,163	18,071	-	-
Amazonas	31,752	32,842	85,000	150,750	-	-
Roraima	550	73	3,040	480	130	230 *
Para	310,661	378,155	309,863	243,330	60,937	351,959 *
Amapa	666	678	1,029	1,048	-	-
Maranhao	1,058,542	1,127,527	1,256,023	1,035,114	1,049,574	975,847 *
Piaui	256,464	331,300	629,919	666,305	348,071	667,621 *
Ceara	1,704,300	1,350,000	1,680,000	2,296,346	1,704,240	1,976,097 *
R. Grande Norte	1,540,068	1,778,096	1,555,045	2,847,555	2,429,005	2,886,734
Paraiba	4,787,121	5,213,040	5,230,778	7,269,996	7,168,926	8,515,493 *
Pernambuco	17,689,173	16,568,949	16,999,922	17,578,504	19,628,045	21,200,000 *
Alagoas	18,556,193	17,103,907	20,670,390	21,535,646	21,535,646	22,165,096 *
Sergipe	1,195,948	1,258,660	1,307,386	1,315,139	1,169,289	669,739
Bahia	3,135,000	3,204,000	3,803,960	3,510,900	2,779,482	2,250,000 *
Minas Gerais	7,330,932	8,175,781	8,952,797	10,856,051	13,600,465	14,085,625 *
Espirito Santo	1,088,585	771,063	846,563	1,621,119	1,866,795	2,452,542 *
Rio de Janeiro	9,383,380	9,526,699	9,466,720	10,784,380	10,010,860	11,025,650 *
Sao Paulo	63,570,000	73,041,362	73,578,124	92,228,391	115,000,000	135,000,000 *
Parana	3,191,353	4,451,480	4,888,038	6,830,330	9,680,000	11,050,00 *
Santa Catarina	1,084,780	1,170,361	1,002,820	1,023,550	831,402	1,092,000 *
R. Grande do Sul	1,046,556	869,580	1,003,308	965,779	876,098	908,414 *
Mato G.do Sul	312,336	606,743	912,717	1,496,591	2,512,188	3,496,655 *
Mato Grosso	467,160	420,140	358,630	566,232	868,900	1,486,169 *
Goias	1,111,320	1,218,325	1,335,004	1,785,680	3,498,000	4,511,350 *
Distrito Federal	4,200	5,148	4,290	5,040	-	- *
Total	138,898,882	148,650,563	155,924,080	186,646,590	216,703,375	246,799,783 *

* Estimate

Source: Ministry of Agriculture

Table 6-21 Trends in Sugar Production in Brazil (1979-1981)

(Unit: ton)

Region/State	1979	1980	1981
North/Northeast	2,898,039	2,741,529	3,113,038
Para	5,514	8,269	6,590
Maranhao	14,674	17,668	17,351
Piaui	2,858	2,949	1,372
Ceara	44,545	36,504	31,572
Rio Grande do Norte	83,532	83,436	88,241
Paraiba	141,110	144,782	136,531
Pernambuco	1,324,473	1,275,478	1,396,140
Alagoas	1,151,171	1,034,971	1,277,493
Sergipe	91,511	98,265	103,649
Bahia	38,651	39,207	54,099
Center/South	4,072,568	5,101,989	5,144,524
Minas Gerais	468,854	482,018	445,360
Espirito Santo	52,154	45,869	43,168
Rio de Janeiro	506,059	432,661	472,711
Sao Paulo	2,752,467	3,846,168	3,915,295
Parana	194,701	210,432	180,478
Santa Catarina	44,547	33,498	42,019
Rio Grande do Sul	7,276	9,928	8,476
Mato Grosso	21,669	19,928	21,419
Mato Grosso do Sul	-	-	-
Goias	24,841	21,487	15,598
Total	6,970,607	7,843,518	8,257,562

Source: IAA

Table 6-22 Alcohol Production in Brazil (1979 - 1980)

(Unit: 1,000 liters)

Regions and States	1979			1980			1981		
	Total	(Anhydrous)	(Hidrated)	Total	(Anhydrous)	(Hidrated)	Total	(Anhydrous)	(Hidrated)
North/Northeast	594,399	510,402	83,997	621,648	349,516	272,132	783,046	330,567	452,479
Amazonas	-	-	-	250	-	250	683	-	683
Para	2,423	-	2,423	2,923	-	2,923	1,480	-	1480
Maranhao	4,321	4,318	3	3,800	2,319	1,481	6,866	-	6,866
Piaui	563	-	563	198	-	198	2,500	-	2,500
Ceara	2,834	2,808	26	1,423	1,423	-	10,835	-	10,835
Rio Grande do Norte	27,464	27,442	22	38,620	27,644	10,976	49,438	16,655	32,783
Paraiba	64,090	59,601	4,489	81,274	40,016	41,258	82,168	35,646	46,522
Pernambuco	244,809	197,930	46,879	219,304	96,522	122,782	254,606	93,443	161,163
Alagoas	243,464	216,631	26,833	267,736	177,871	89,865	364,495	182,796	181,699
Sergipe	1,749	1,672	77	4,990	3,721	1,269	6,033	1,183	4,850
Bahia	2,682	-	2,682	1,130	-	1,130	3,942	844	3,098
Center/South	2,853,885	2,319,642	534,243	3,054,486	1,821,946	1,232,540	3,423,669	1,017,082	2,406,587
Minas Gerais	75,184	59,196	15,988	106,765	71,757	35,008	133,722	36,611	97,111
Espirito Santo	10,003	10,003	-	17,677	17,677	-	15,767	-	15,767
Rio de Janeiro	151,941	92,446	59,495	132,770	45,353	87,417	154,029	33,682	120,346
Sao Paulo	2,486,198	2,043,429	442,769	2,603,889	1,542,362	1,061,527	2,840,828	872,319	1,968,509
Parana	92,963	85,954	7,009	139,028	107,646	31,382	197,787	57,680	140,107
Santa Catarina	6,157	-	6,157	5,321	-	5,321	10,617	-	10,617
Rio Grande do Sul	-	-	-	596	-	596	1,603	-	1,603
Mato Grosso	9,555	9,555	-	9,860	8,840	1,020	9,235	5,100	4,135
Mato Grosso do Sul	15,294	15,254	40	28,319	24,695	3,624	42,111	11,689	30,422
Goias	6,590	3,805	2,785	10,261	3,616	6,645	17,970	-	17,970
Total	3,448,284	2,830,044	618,240	3,676,134	2,171,462	1,504,672	4,206,715	1,347,649	2,859,066

Note: Anhydrous alcohol is for mixing in gasoline. Hydrated alcohol is exclusively for alcohol.

Source: IAA

factories elsewhere was rarely seen in the states. According to the survey conducted by the Sugar and Alcohol Institute (IAA), the minimum economical scale of an alcohol-making factory is 30,000 liters per day, and an area under sugarcane cultivation needed for full capacity operating is 1,000 to 1,500 ha. Therefore the construction of a factory brings about a dramatic increase in cultivation area and production rate.

As mentioned before, while the rest of the country's sugarcane production has been increasing sharply, both Maranhao and Para have been losing their relative position, but it should be noted that Maranhao, at least, began in 1976 to increase its cultivation area, which had been in decline until 1975. Furthermore, along with the rise in yield per unit area, production has increased since the latter half of the 1970s.[1] This may be because under the "alcohol factories construction plan" by PROALCOOL which started in 1975, planting of improved varieties increased production. In Maranhao, the number of projects approved by PROALCOOL is 3 as of September, 1984, and the total production capacity per crop is 68,500,000 liters (Table 6-23). As of December, 1981, however, the number was 5 and production capacity was 107,800,000 liters, according to IAA statistics. On the other hand Para had only one project with a production capacity of 2,130,000 liters in December, 1981; a factory with production capacity of 9,700,000 liters was approved in January, 1984, increasing the number to 2. This difference in the situation of processing between Para and Maranhao is considered to be reflected in the previously described production levels.

Recently, however, the number of companies submitting proposals for alcohol projects to the National Alcohol Planning Committee is increasing in Para as rapidly as in Maranhao. As of September, 1984, the number of projects under examination was 10 in Para, 4 in Maranhao, and all, except one in Para, are located in the PGC Area.

The number of PROALCOOL-approved projects in Goias is 31 as of September, 1984, and those under examination number 31; 4 out of each are situated in the PGC Area. However, one of the approved projects is a babassu factory in Tocantinopolis as described before; the rest are all projects in which sugarcane is used. These factory sites are all suitable for or capable of growing sugarcane, and because PROALCOOL is giving priority to "projects in which commercial and advanced techniques are used in production", and has the expressed aim of "integrating agriculture and industry", many of these factories also have farms attached to them. Priority goes to project "which generate productivity commensurate with the investment". Consequently, although the policy of PROALCOOL includes "reviewing the possibility of having small scale producers and factories participate

1) IAA is promoting the Sugarcane Improvement Program (PLANALSUCAR), along with PROALCOOL, and is planning to improve cultivation technique and to introduce improve varieties such as "Republica do Brazil" to increase production.

Table 6-23 Framing PROALCOOL Projects as of 05/09/84

(Unit: 1,000 liters/Crop)

Region/State	Annexed		Automonous				Total			
	Sugarcane		Sugarcane		Other material		Sugarcane		Other material	
	No.	Capacity	No.	Capacity	No.	Capacity	No.	Capacity	No.	Capacity
North	0	0.0	5	91,900	0	0.0	5	91,900	0	0.0
Para	0	0.0	2	31,000	0	0.0	2	31,000	0	0.0
Northeast	67	1,107,648	45	1,028,460	1	39,600	112	2,136,108	1	39,600
Maranhao	1	20,900	2	47,600	0	0.0	3	68,500	0	0.0
Southeast	131	3,913,586	147	2,539,920	11	185,820	278	6,453,506	11	185,820
Sao Paulo	102	3,446,286	105	1,967,800	9	162,120	207	5,414,086	9	162,120
South	6	125,300	35	664,200	4	59,100	41	789,500	4	59,100
Central-west	3	64,500	51	1,238,368	2	54,000	54	1,302,868	2	54,000
Goias	2	51,000	29	685,368	1	9,000	31	736,368	1	9,000
Total	207	5,211,034	283	5,562,848	18	338,520	490	10,773,882	18	338,520

Souce: IAA

the program and setting up mini-distilleries taking into account the characteristics of each region", projects submitted for assistance will necessarily be already capitalized (loans are not extended for the purchase of land) by companies with the technology and expertise to build and operate productive factories and farms.

In recent years, projects in the north which is in sufficiently supplied with alcohol, have been given priority for special PROALCOOL loans. However, with the criteria for assistance gradually becoming stricter, the allotment of agricultural loans decreasing and interest rates rising, it has become difficult even for large companies to enter the alcohol producing industry as integrated cultivators and processors. In addition to this, the quality of labor in the north is generally lower than the center and the south, and bring problems of expertise skill for the construction and operation of factories; this also holds true for other processing industries. An alcohol factory with producing capacity of 22,000 liters per day,[1] which is under construction (as of July, 1984) in Tocantinopolis in Araguaina sub-region, began construction in 1981. The current estimated operations start date is said to be considerably behind that originally planned.

Meanwhile, for medium and small scale growers (producing raw materials only) sugarcane cultivation, which takes one to one and half years from planting to cultivation, also has problems now that agricultural loans are difficult to obtain. Furthermore, for the Area, which has only a few feeder roads, transportation to the factory will be another problem. IAA is instructing the alcohol factories to obtain materials within a distance of 30 km, but the above factory in Tocantinopolis is planning to buy within 20 km, the main consideration seems to be the bad condition of the local roads. It goes without saying that poor conditions of infrastructure will disadvantage factor operations also.

Since sugarcane should be processed within a certain time after harvest (about 24 hours), it cannot be taken out of the area unprocessed. And even when it is made into alcohol or sugar, it is hardly competitive in the markets of the center and south, which have highly productive cultivation areas and processing factories. As for cultivation growing with demand in the north and in parts of the northeast, there is a possibility of it developing in the long run, if the problems of infrastructure, technique and capital can be solved. However, cultivation of sugarcane as a material of fuel alcohol should be reviewed, paying attention to the trends in petroleum production, which has been markedly increasing recently, while its international price has been falling.

Meanwhile production of sugar fluctuates widely year by year and is stagnant in general. Looking at the distribution of sugar factories in the Industrial Survey mentioned before, we find one in Altamira, three in Santarem, and one in Castanhal in the state of

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1) Distilaria Tocantins Industrial S.A.

Para. In the state of Maranhao, there is only one factory in Sao Luis and one in Bacabal. One of the three factories in Santarem and those in Castanhal and Sao Luis are not directly making sugar out of sugarcane, but are refining raw sugar; the remaining two factories are making raw sugar and syrup from sugarcane.

Crude sugar is also commonly made using a simple device in and around the villages, especially in Maranhao. According to the Agricultural Census by IBGE, almost 90% of the sugar processed in the villages comes from facilities owned by the producers themselves. The survey states that most of those who do this kind of processing cultivate areas of between 100 and 1,000 ha. Generally, large scale farmers tend to use their own processing facilities. About 90% of the production of syrup is sold through middlemen, but self-consumption accounts for over 20% of the raw sugar produced, therefore most cultivation, particularly by small producers, is considered for home consumption. This type of villages processing especially by small producers (like other self-consumption crops such as cassava), would benefit from an improvement in the distribution system such as the cooperative marketing.

6-3 Processing and Marketing of Agricultural Products and Selection of Crops

As has already been mentioned the conditions of processing and marketing necessary for agricultural producers to select differ not only with the characteristics of the products themselves, but also with the scale and form of their farm management and the production environment, such as the condition of the infrastructure and the distance to markets. In order to summarize the discussion in this item, farmers are roughly divided into small farmers, who produce mainly for their own consumption, and large and medium scale farmers, who conduct commercial production. Taking the characteristics of products into consideration, an approach to processing and distribution that will make each product competitive in the markets will be reviewed.

Given the current production environment which has already been described, the major obstacles in processing and distribution the farmers face when they commercialize a product, can be summarized as follows, in accordance with the characteristics of products, which we arranged earlier.

First, in order to realize the commercial value of products which decline in quality or lose weight if processing is delayed after harvest, for example oil palm, rubber, cassava and sugarcane, it is necessary to secure processing facilities of an appropriate technical level near the production area. In the case of oil palm production at Castanhal, for example, where prerequisites such as natural conditions, cultivation techniques and infrastructure are relatively satisfactory, and presence of the oil mill close by positively influences the expansion of production and the stabilization of management, and the matching

of product quality with processing prerequisites is being realized. However the next step is to improve distribution for the products in this group, in order to sell the processed products to consuming areas.

On the other hand, products that can stand the storage and transportation for relatively long periods, e.g. babassu, soybean and maize do not necessarily need processing facilities in the neighborhood, but the competitiveness of these products is greatly influenced by the distribution conditions. In the case of soybean and maize production around Imperatriz, for example, cooperatives, which possess distribution information and storage facilities are able to change the crops produced by each farmer into commodities with some level of quality and marketable quantity.

Aside from oil palm, rubber and babassu, which have become the specialities of this area because their range is restricted by the natural conditions, other products which are also produced and marketed in the center and the south such as soybean, maize and sugarcane, the proximity of markets has become an important factor in establishing production areas, regardless of the necessity of processing. For the time being, crops produced in the PGC Area will not be competitive in major domestic markets, but the products substitute. When these products are established as commodities both in quality and quantity, production for international markets may be possible, taking advantage relative proximity of the north to the European and African markets.

As we have seen above, each product needs different conditions of processing and distribution, depending on its characteristics, in order for commercialization to be possible. Taking this into account, let us consider the approach to processing and distribution that would make each product competitive in the markets for small and petty farmers, who produce mainly for their own consumption, and large and medium scale farmers, who produce commercially.

In the PGC Area, other than pepper and tropical fruits, large and medium scale farmers have recently begun commercial cultivation of such perennial crops as oil palm around Castanhal, and such annual crops as soybean, maize and rice around Araguaina, Balsas and Imperatriz. As a whole, however, agricultural production is, for the most part, devoted to the cultivation of food crops such as rice, maize, cassava and feijao by small farmers, which are intended mainly for their own consumption. These crops occupy a larger cultivation area than any other crops now under cultivation in the PGC Area, and also have large output, having an important place in the economy of each state, especially of Maranhao, which does not have any prominent specialities except babassu.

These small and petty farmers, who grow the above-mentioned traditional crops mainly for their own consumption, generally lack capital and modern techniques, and generally their facilities and means of organization not only in cultivation but also in processing and distribution, are inadequate for commercialization purposes. For example, cassava needs prompt processing after the harvest, but there are farmers who are unable to set up even simple facilities for making it into

farinha, also there are few examples of equipment for the processing and storage of maize and rice, although they need very little processing. Consequently in the stage before commercialization, they lose weight and decline in quality, decreasing their commercial value in the market. Also, many of these small producers do not have efficient means of distribution, such as trucks, and they are not strongly organized, making joint shipping difficult. The distribution routes of these four items are almost the same, and sale of the harvested crops depends mostly on middlemen or brokers who come round the villages.

Partly because they are important as staple food, these crops are covered by the government's Minimum Price Guarantee System and these prices serve as a certain standard for producers when they sell their products to middlemen. However, since the producers themselves do not have means of transportation and storage, they cannot benefit fully from this system. Price support policies will have more effect, if they are implemented in coordination with other measures, such as improvements in processing, storage and transportation. The National Warehouse Program (PRONAZEM) that has been carried out by the Brazilian Warehouse Company (CIBRAZEN) and state loans for construction of processing facilities have been playing a considerable role. But it will still not always be easy for the small holders, who have little capital, and no cooperative organizations, to make use of them.

Consequently, in order that the small holders may increase their percentage of commercialized products as well as their bargaining power, it is necessary that an integrated support program, including not only improvements in processing and distribution but also in cultivation techniques and the promotion of farmers' organizations, be carried out.

In Para, cotton is one of the crops which increased production under such an integrated support system, sometime called a package program. In this state, a spinning company[1] began in the middle of the 1970s to provide seeds of new varieties[2] and fertilizer through the State Agriculture Department, on condition that the company may buy the harvest. The department has also been giving instruction in cultivation techniques. Loans for production were added, and recently the State Agriculture Extension Corporation (EMATER) is said to have been spreading techniques more intensively. Under this program, cotton production in the state increased markedly, from 300 ha in planted area and 120 tons in production in 1974 to 11,591 ha and 4,400 tons respectively in 1982.

Thus there is much prospect of increase in production, especially by the small holders, as the result of technical aid by the government, agricultural loans, supply of materials and purchase of harvested crops by processors; in other words, encouragement measures in combined form of technique, capital and market. Partial supportive measures such as

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1) Empresa Linhas Corrente S.A.

2) "Acala del Corro" introduced from Peru.

building small facilities for processing and storage, may lead cultivators to produce commodities. However, for small scale producers, who lack in any of the above production factors, it will be equally important to give technical instruction on the operation of the facilities and the cultivation and harvest of the crops, and also to create a system of distribution and sale. In this Area, where production of crops is insufficient, both in quality and quantity, for commercialization, compared with the center or the south, establishing encouragement programs for processing and distribution sectors only will not have a great effect on farm production; therefore a program which comprehensively helps cultivation, processing and distribution is considered necessary.

Meanwhile, as described before, production by the large and medium scale farmers, who produce commercially still takes up only a small portion of total production in the PGC Area, with the exception of certain crops in some districts. However, oil palm, soybean and maize are already in production on a scale which makes them competitive in domestic and foreign markets. The commercial production of rubber and sugarcane is also likely to increase, although there are many problems yet to be solved.

For example, while soybean, maize and sugarcane will be forced to seek to expand markets in the northeast and the north due to the competition with leading production areas in the central-west and the south, oil palm and rubber are expected to compete in markets outside the Area because being unique specialities of this Area, they have a potential national demand. Also as the demand for palm oil, in particular, has increased recently in developing countries, there is a possibility of a production increase aimed at international markets.

Since farmers who are considering commercial production of these crops already have techniques and capital at a certain level, and organizations for production and sale such as cooperatives, it will be an important task to improve and expand the conditions necessary for processing and distribution in accordance with the characteristics of each product, as we have already indicated, in order to increase its competitiveness. In other words, the primary condition needed by oil palm, rubber and sugarcane, for which processing is indispensable, is the establishment of processing facilities, and that needed by soybean and maize, which can be commercialized without being processed, is the improvement of the distribution system. Naturally, improvements in cultivation techniques, loans and infrastructure are also important, so that large and medium scale producers may expand production and stabilize management further. If possible, an integrated measure is recommended just as it is for small scale producers, but programs concerning only processing and distribution are considered to have a certain effect on agricultural production.

As for the crops, for which integrated utilization is possible typified by babassu, if the processing techniques are improved, this will increase price competitiveness and as a result is expected to create an incentive for gatherers or possibly producers.

7. AN APPROACH TO CROP SELECTION ON THE BASIS OF SOCIAL AND ECONOMIC CONDITIONS

7-1 Introduction

The following factors are considered important in selecting priority crops for production in a region: (1) the objectives of the agricultural development of the region, (2) the present situation and short- and medium-term outlook of given conditions such as land resource, natural conditions, social capability (including technology, organizations and education), transportation and processing infrastructure, agricultural structure, and the market situation within and without the region, and (3) characteristics -- such as suitability to natural conditions and freight bearing capability -- of each crop.

The two factors expressed in the above (1) and (2) have the following two dimensions. Since specific sub-regions were designated for investigation, the first dimension is closely related to the aspects of regional development. The second dimension involves the aspects of farm management.

Items covering the first dimension were reviewed from various aspects of the study on regional development potentials outlined in Part II, and also from the previous chapters of this Part. In this chapter, some farm models will be applied to examine what impact changes in the surrounding conditions will have on crops selection. Then, an approach to crop selection will be made on the basis of the above-mentioned two dimensions.

7-2 Impacts of Socio-Economic Factors on Agricultural Production and Farm Incomes -- Farm Management Analysis

Crop selection by farmers varies according to the circumstances[1] in which the farms are placed and with the objectives of the farm management. In this section, by taking into consideration the present situation of farm management and the emphasis of policy at the PGC Area, a study is undertaken to identify the impacts of major socio-economic factors on farmers' crop selection, through an analysis of some typical farm models in the Area.

The following four farm models are studied:

(1) A subsistence farm model as representative of the overwhelming majority of farms producing food crops mainly for self-consumption.

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1) Circumstances here include natural conditions, level of applicable techniques, distance to the markets, transport infrastructure, location of the processing facilities, and situation of such agricultural institutions as institutional credits.

(2) Two farm models of commercial crops, which have begun to appear in some areas. The perennial crop oil palm and the annual crop soybean were selected for this study. Since beef competes against soybean in many areas, a comparative study of these two activities was undertaken.

(3) A land rotation farm model attempting to depict the conditions for the continuation and transition to sedentary cultivation of the shifting cultivation system.

7-2-1 Subsistence Farm Model

The small-size subsistence farms are most commonly observed in the sub-regions of the PGC Area. The objective of this farming is to secure the staple foods and cash income for the farm household, as well as seeds necessary for the following crop year and some reserves. The staple food crops are rice, maize, cassava and feijao, which are assumed to be cultivated by using the labor of three family members.

The quantities of supply for self-consumption by crop are determined with the number of family members assumed to be seven. Rice has been introduced recently and its consumption is growing. Cassava has long been a traditional food crop, but its intake is decreasing as the consumption of rice increases. If there were no rice, the consumption of raw cassava would be 3 kg per day per person. Calculations have been made assuming an amount of 1.5 kg on the assumption that rice represents 50% of consumption. Maize and feijao are also indispensable foods, and the quantity of self-consumption of both also includes seeds for the following year.

(Calculation of food for self-consumption)

Rice	0.5 kg	x	365 days	x	7 persons	= 1,278 kg
Maize	0.2	x	365	x	7	= 511
Cassava	1.5	x	365	x	7	= 3,833
Feijao	0.3	x	365	x	7	= 767

The process of farm model analysis is as follows: (i) the basic solution of the model is represented, (ii) based on the basic solution impacts of rise in rice yield on the cropping pattern and farm income and (iii) impacts of increases in the rice price are investigated.

(1) Contents of the Model

The problem involves a crop selection that enables farmers to secure food for self-consumption and at the same time obtain as much as possible cash income on a limited land area and under the constraints of family labor.

Objective function

$$Z = P_1y_1X_1 + P_2y_2X_2 + P_3y_3X_3 + P_4y_4X_4 - C_1P_1 - C_2P_2 - C_3P_3 - C_4P_4 \quad \ldots\ldots\ldots (1)$$

Constraints

$$X_1 + X_2 + X_3 + X_4 \leq A \quad \ldots\ldots (2)$$

$$b_{11}X_1 + b_{12}X_2 + b_{13}X_3 + b_{14}X_4 \leq B_1 \quad \ldots\ldots (3)$$

$$b_{21}X_1 + b_{22}X_2 + b_{32}X_3 \leq B_2 \quad \ldots\ldots (4)$$

$$b_{31}X_1 + b_{32}X_2 \leq B_3 \quad \ldots\ldots (5)$$

$$b_{42}X_2 + b_{43}X_3 + b_{44}X_4 \leq B_4 \quad \ldots\ldots (6)$$

$$b_{53}X_3 + b_{54}X_4 \leq B5 \quad \ldots\ldots (7)$$

$$y_1X_1 \geq C_1 \quad \ldots\ldots (8)$$

$$y_2X_2 \geq C_2 \quad \ldots\ldots (9)$$

$$y_3X_3 \geq C_3 \quad \ldots\ldots (10)$$

$$y_4X_4 \geq C_4 \quad \ldots\ldots (11)$$

where, X_1 : Planted area of rice (ha)

X_2 : Planted area of maize (ha)

X_3 : Planted area of cassava (ha)

X_4 : Planted area of feijao (ha)

P_1 : Unit price of rice (Cr$10,000/ton)

P_2 : Unit price of maize (Cr$10,000 cruzeiro/ton)

P_3 : Unit price of cassava (Cr$10,000 cruzeiro/ton)

P_4 : Unit price of feijao (Cr$10,000 cruzeiro/ton)

Z : Total revenue (cash income in Cr$10,000)

A : Total area of land (5 ha)

B_1 : Labor availability for October and November (120 labor-days)

B_2 : Labor availability for December and January (120 labor-days)

B_3 : Labor availability for March and April (120 labor-days)

B_4 : Labor availability for May and June (120 labor-days)

B_5 : Labor availability for July and August (120 labor-days)

C_1 : Quantity of rice for self-consumption (1.28 ton)

C_2 : Quantity of maize for self-consumption (0.51 ton)

C_3 : Quantity of cassava for self-consumption (3.84 tons)

C_4 : Quantity of feijao for self-consumption (0.77 ton)

bij: Labor coefficient of each crop (labor-days/ha)

y_1 : Rice yield (ton/ha)

y_2 : Maize yield (ton/ha)

y_3 : Cassava yield (ton/ha)

y_4 : Feijao yield (ton/ha)

In the above model, the inequalities (2) - (7) present the upper limits of land and labor, and the inequalities (8) - (11) the lower limits of self-consumption.

(2) Basic solutions of the subsistence model

Table 7-1 shows the technical coefficient and constraints for the subsistence farm model. It is assumed that the four crops are grown on a land area of 5 ha, and each of three family members works 20 days a month. The problem is to select a cropping pattern that produces the maximum amount of income while food for self-consumption is secured.

The solutions of the LP model are shown in Table 7-2: 2.73 ha for rice, 0.51 ha for maize, 0.48 ha for cassava and 1.28 ha for feijao, representing a total of 5.0 ha. The land areas planted in crops other than rice produce quantities just sufficient for self-consumption. Keeping 1.28 ton of rice for self-consumption, the farmer has 1.45 ton of rice for sale and earns an income of Cr$316,000.

Under the basic conditions assumed for the subsistence farm model, rice is the most profitable followed by faijao, cassava and maize.

(3) Impact of technical changes

Let us now examine the impact that changes in production technologies have on the cash income and cropping pattern of the subsistence farmer. On the assumption that changes in production technologies can be represented by changes in the rice yield, the

Table 7-1 Basic Data for the Subsistence Farm Model

	Labor Input per ha (days)					Yield	Price	Self-
	Oct. -Nov.	Dec. -Jan.	Mar. -Apr.	May -June	July -Aug.	(ton/ha)	(Cr$1,000/ ton)	Consumption (ton)
Rice	8.0	18.0	24.0	0	0	1.0	218	1.28
Maize	4.0	27.0	16.0	8.0	0	1.0	120	0.51
Cassava	8.0	20.0	0	40.0	40.0	8.0	25	3.84
Feijao	8.0	0	0	4.0	16.0	0.6	300	0.77
Labor Constraint (days)	120	120	120	120	120			

Source: Labor inputs and yields: EMBRAPA & EMBRATER, Sistema de Producao, (various issues)
Others: Based on various documents and information obtained during the field observations.

Table 7-2 Basic Solutions of the Subsistence Farm Model

Products	Area (ha)	Production (ton)	Self-Consumption (ton)	Quantity of Sale (ton)	Cash Income (Cr$1,000)
Rice	2.73	2.73	1.28	1.45	316.1
Maize	0.51	0.51	0.51	0	0
Cassava	0.48	3.84	3.84	0	0
Feijao	1.28	0.77	0.77	0	0
Total	5.00				316.1

level of the rice yield was varied to obtain the LP solutions corresponding to different levels of technologies. Figure 7-1 shows that the area of rice increases with improvements in rice cultivation techniques, while the area of feijao decreases, and the production quantities of cassava and maize remain constant at the same level of self-consumption. Furthermore, as the cropping pattern changes, the cash income of the farmer increases. These results indicate that research and extension services substantially affect the cropping pattern and income levels of small-scale farms.

(4) Impact of price changes

The prices producers receive for their crops are greatly affected by government pricing policies. They also depend heavily on what processing facilities are available and the level of the marketing infrastructure. We will examine the way by which the cropping pattern and cash income levels of farmers are affected by producer-price changes brought about by government policies, as well as the present situation of transport infrastructure, and marketing networks. Figure 7-2 shows that, as in the case of changes in production technologies described above, increases in the rice price reduce the amount of area used to cultivate other types of crop. Furthermore, farmer cash income continues to increase even after the cropping pattern is stabilized. From these simulation results, it can be said that the existence of small-size processing facilities for rice and cassava, improvements in transportation infrastructure, and price support policies would help to raise the incomes of small-scale farms.

Figure 7-1 Impact of Rice Yield on the Cropping Pattern and Cash Income

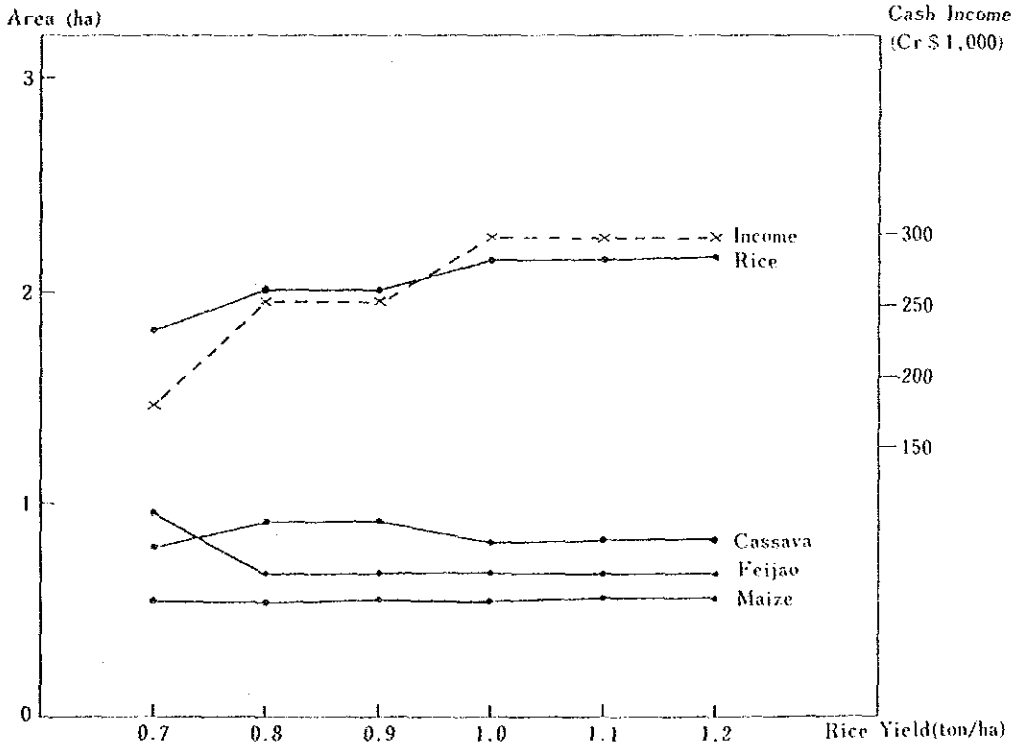
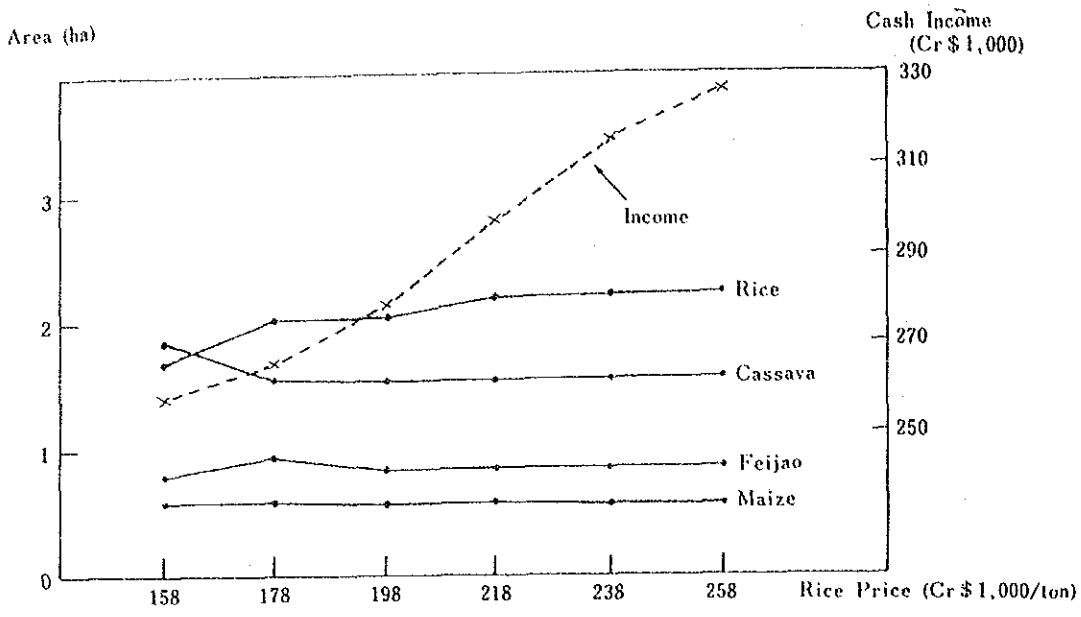


Figure 7-2 Impact of Rice Price on the Cropping Pattern and Cash Income



7-2-2 Large-scale Soybean Farm Model

It was quoted in Chapter 3 that the cultivation of soybean is suited to the natural conditions of Balsas, Imperatriz and Araguaina sub-regions (Information regarding cultivation is summarized in Chapters 4 and 6). In this section we will review the necessary conditions for the formation of soybean producing areas, based on the data obtained during the field observations and by measuring the impacts on soybean production of interest rates, improvements in transport infrastructure and current situation of processing facilities.

It was found during the field observations that some large-scale beef producers attempted to stabilize their businesses by partially converting the pasture lands into soybean fields in response to trends in domestic and international soybean prices and the availability of loans. In addition to these ranchers, farmers who are planning to enter into large-scale farming are very concerned about whether profitability of soybean production exceeds that of beef production. We will now clarify the cost and benefit structure of beef production and soybean cultivation and, review the conditions for establishing a soybean producing area by employing a cost-benefit analysis.

(1) The cost and benefit structure of beef production

As described in Chapter 8, the management patterns of beef production in the PGC Area can roughly be divided into breeding, rearing, fattening, and the combination of these operations. In this section

we will examine the fattening operation (seen extensively on large farms in the Area) of which the profitability is relatively easy to analyze. The costs of fattening operations involve the purchase of cattle and the costs of fattening itself. Normally, a rancher buys cattle of about two years old and sells them after fattening for about two years. The net profit of fattening can therefore be obtained by subtracting the costs of cattle purchase and fattening from total sales. In improved pastures one head of cattle is raised per one hectare of pasture area, and the fatality rate of cattle from disease and accident is 6% for the 3 years old and 4% for the 4 years old. For a pasture area of 500 ha, 250 head of cattle are bought and 225 head are sold each year. The total net profit from fattened cattle was estimated at about Cr$17 million as of September 1984. The total revenue and total cost are estimated at Cr$164 million and Cr$146 million respectively (see Table 7-3).

Table 7-3 Costs, Sales and Profits of Beef Produciton per Year (500 ha)

	Number of Cattle	Unit Price or Unit Cost (Cr$1,000)	Total Cost or Sale or Profit (Cr$1,000)
Cattle Purchase (26 months old)	250	350	87,500
Fatting Cost			58,875
3 years old	2,425	110	26,675
4 years old	230	140	32,200
Total Cost			146,375
Sale	225	727.2	163,620
Profit		(550 kg x 0.55 x Cr$2,400)	17,245

Note: 1. Number of cattle declines according to cattle age because of death.
2. It was assumed that one cattle could be raised by one hectare of pasture.
3. Sale tax was excluded from unit price.

Source: Based on records of interviews with farmers in the PGC Area during the field observations.

(2) The cost and benefit structure of soybean production

The cultivation of soybeans on 500 ha of land requires one combine and one tractor. To cover the cost of farm machinery an expenditure of Cr$150 million is necessary at the commencement of operations. When the durable lives of the combine (8 years), tractor (5 years) and other machinery end, they must be replaced (see Table 7-4). Further, Cr$77 million for operation (including land preparation, harvest, etc.) Cr$1.6 million for labor and Cr$180 million for the purchase of fertilizers and pesticides are necessary each year, totaling Cr$259 million annually (see Table 7-5).

The current cost of soybean production is 75% higher than that of beef production. This indicates that if beef producers convert their pastures to soybean fields they have to purchase new farm machinery and obtain large funds to cover operational costs.

Profits from soybean production would be about Cr$633 million per year, provided that yield per hectare is two tons and the selling price is Cr$20,000 per 60 kg.

(3) Profitability comparison between soybean and beef production

The internal rate of return (IRR) and the B/C ratio -- the most frequently-used devices for cost-benefit analysis -- are used as criteria for profitability comparison. For a farmer who converts his pasture to soybean fields, profits from soybean production can be considered as new income; costs involving investment, operations and sales tax are his new costs; profits from beef production that could have been obtained from 500 ha of pasture are his income foregone; and costs necessary for beef production are his costs saved. The IRR and the B/C ratio can therefore be expressed by the following equations:

$$(1) \quad \sum_{t=1}^{24} \frac{1}{(1 + IRR)^t} (BS_t - CS_{1t} - CS_{2t} - CS_{3t} - BB_t + CB_t) = 0$$

$$(2) \quad B/C = \frac{\sum_{t=1}^{24} \frac{1}{(1 + R)^t} (BS_t - CS_{2t} - CS_{3t} - BB_t + CB_t)}{\sum_{t=1}^{24} \frac{CS_{1t}}{(1 + R)^t}}$$

where, IRR : Internal rate of return
R : Effective interest rate
CB_t : Costs of beef production at year t
BB_t : Profits from beef production at year t
CS_{1t} : Investment in soybean production at year t
CS_{2t} : Operation costs of soybean production at year t
CS_{3t} : Sales tax on soybeans at year t
BS_t : Profits from soybean production at year t

Table 7-4 Machinery Costs of Soybean Production (500 ha)

Type of Machine	Unit Price (Cr$1,000)	Quantity	Total Cost (Cr$1,000)	Life (year)
Combine	100,000	1	100,000	8
Tractor	30,000	1	30,000	8
Others			20,000	5
Total			1500,000	

Table 7-5 Operation Costs of Soybean Production

(Unit: Cr$1,000)

	1 ha	1,000 ha
Operation 1)	155.0	77,500
Labor	3.2	1,600
Fertilizers & Pesticides	359.1	179,550
Total	517.3	258,650

Note: 1) Including land preparation, planting, on-farm transportation, harvesting, etc.

Source: Based on data provided by Cooperative COTIA (1984).

Table 7-6 Profitability Comparison between Beef Production and Soybean Production (500 ha)

(Unit: Cr$1,000)

	Beef Production			Soybean Production						Profit Change
	Sales (1)	Costs (2)	Profit (3)	Sales (4)	Tax on Sales (8%) (5)	Machinery Cost (6)	Operation Cost (7)	Total Cost (8)	Profit (9)	(10) =(9)-(3)
1	163,620	146,375	17,245	333,334	26,667	150,000	258,650	435,317	-101,983	-119,228
2	163,620	146,375	17,245	333,334	26,667	0	258,650	285,317	48,017	30,772
3	163,620	146,375	17,245	333,334	26,667	0	258,650	285,317	48,017	30,772
4	163,620	146,375	17,245	333,334	26,667	0	258,650	285,317	48,017	30,772
5	163,620	146,375	17,245	333,334	26,667	0	258,650	285,317	48,017	30,772
6	163,620	146,375	17,245	333,334	26,667	20,000	258,650	305,317	28,017	10,772
7	163,620	146,375	17,245	333,334	26,667	0	258,650	285,317	48,017	30,772
8	163,620	146,375	17,245	333,334	26,667	0	258,650	285,317	48,017	30,772
9	163,620	146,375	17,245	333,334	26,667	130,000	258,650	415,317	-81,983	-99,228
10	163,620	146,375	17,245	333,334	26,667	0	258,650	285,317	48,017	30,772
11	163,620	146,375	17,245	333,334	26,667	20,000	258,650	305,317	28,017	10,772
12	163,620	146,375	17,245	333,334	26,667	0	258,650	285,317	48,017	30,772
13	163,620	146,375	17,245	333,334	26,667	0	258,650	285,317	48,017	30,772
14	163,620	146,375	17,245	333,334	26,667	0	258,650	285,317	48,017	30,772
15	163,620	146,375	17,245	333,334	26,667	0	258,650	285,317	48,017	30,772
16	163,620	146,375	17,245	333,334	26,667	20,000	258,650	305,317	28,017	10,772
17	163,620	146,375	17,245	333,334	26,667	130,000	258,650	415,317	-81,983	-99,228
18	163,620	146,375	17,245	333,334	26,667	0	258,650	285,317	48,017	30,772
19	163,620	146,375	17,245	333,334	26,667	0	258,650	285,317	48,017	30,772
20	163,620	146,375	17,245	333,334	26,667	0	258,650	285,317	48,017	30,772
21	163,620	146,375	17,245	333,334	26,667	20,000	258,650	305,317	28,017	10,772
22	163,620	146,375	17,245	333,334	26,667	0	258,650	285,317	48,017	30,772
23	163,620	146,375	17,245	333,334	26,667	0	258,650	285,317	48,017	30,772
24	163,620	146,375	17,245	333,334	26,667	0	258,650	285,317	48,017	30,772

When the IRR is larger than the effective interest rate, that is, the B/C is larger than one, profitability of soybean production is higher than that of beef production (the opposite being true if the figures are reversed). As shown in Table 7-7, by substituting the figures in Table 7-6 for the corresponding variables in equations (1) and (2), one obtains an IRR of 16% and a B/C ratio of 1.14 as the solution of the Basic Case. The assumptions made in the Basic Case are a soybean price of Cr$20,000 per 60 kg, an effective interest rate of 10%, and sales tax of 8%. Consequently, if all the soybean produced is sold at the present market price, funds for investment and operation costs are calculated at an interest rate of 10%, and 8% is paid as sales tax, the profitability of soybean production exceeds that of beef production.

Table 7-7 Results of Cost-Benefit Analysis: Soybean Farm-Model (Financial Analysis)

	Assumptions	IRR	B/C
Basic Case	Price: Cr$20,000/60 kg; R = 10%; Tax : 8% on sale	16%	1.14
Case 1	10% of transportation cost paid by soybeans producer	7%	0.93
Case 2	Soybeans price increased by 10% of transportation cost	24%	1.35
Case 3	R = 15%	16%	1.01
Case 4	R = 5%	16%	1.30
Case 5	Tax : 10% on sales	5%	0.87
Case 6	Tax : 6% on sale	25%	1.36

Note: Internal rates of return on the basis of returns to all resources are not affected by the effective interest rate.

(4) Importance of transport infrastructure and oil mill facilities

Farm prices are greatly affected by the demand and supply situation of the crop, as well as by transportation costs from the production area to the processing mill and central market. The assumption in the above cost-benefit analysis was that an oil mill in Sao Luis buys soybean at a price of Cr$20,000/60 kg from Balsas, and because of shortages in material the mill bears the entire transportation cost of Cr$56/kg. If, however, the material procurement conditions change, part of the transportation cost could be accrued to farmers, or if an oil mill is built near the production area, the subsequent transportation costs saved could lower the purchase price.

We will now examine how changes in transportation costs affect the income of soybean producers, and discuss the importance of transportation infrastructure and oil mill facilities in the establishment of soybean production areas. For this purpose, the following two cases were investigated:

Case 1: Ten percent of the transportation cost is borne by the soybean producer, changing the producer price from Cr$20,000/60 kg to Cr$19,644/60 kg.

Case 2: The producer price changes from Cr$20,000/60 kg to Cr$20,336/60 kg as result of saving in transportation cost.

As shown in Table 7-7, IRR and B/C in Case 1 decline to 7% and 0.93 respectively, and those in Case 2 rise to 24% and 1.35. A mere 10% change in transportation costs greatly affects the profitability of soybean production, indicating that the existence of an oil mill in the production area and improvements in transport infrastructure are very important for the formation of soybean producing areas. This is mainly because the cost of soybean transportation is high (17% of the unit price of soybean).

(5) Impact of interest rates

The costs of beef production, composed of cattle purchase and fattening operation, amount to Cr$146 million a year, while the annual current costs of soybean production are as high as Cr$258,650,000. Therefore, when a beef producer begins convert partially pasturelands to soybean fields he needs a large amount of funds to cover operation costs and to buy machinery. This is why changes in the conditions of short-term and long-term credits greatly affect the formation of soybean producing areas.

In the Basic Case the effective interest rate was assumed at 10% a year. Now we will examine how the effective interest rate affects the income of soybean growers. In Case 3 and Case 4 in Table 7-7, the effective interest rates were assumed at 15% and 5% respectively. When the effective interest rate rises to 15%, the B/C ratio becomes 1.01, making the profitability of soybean production the same as that