1. Alternative strategies to the colonisation policy of the Military Government

1.1. The Polamazônia programme as of 1975

At the height of the Brazilian "economic miracle," the prevailing "El Dorado" mentality allowed the private sector to penetrate the Amazônia Legal planning region. Amazônia Legal is the largest regional unit in Brazil. It has an approximate area of 5.2 million km², or about 61% of Brazil's territory.[1] The region overlaps three distinct biomes: Brazil's Amazon biome, parts of the *cerrado* biome and the northern part of the Pantanal biome.

The scope for private sector activity with economic exploitation and almost unlimited territorial expansion of the Amazonian periphery was greatly expanded and became the new focus of the Military Government's development strategy. The official rationale for this far-reaching decision to switch from state-controlled small-scale agrarian colonisation to the private sector was the first oil price crisis in 1973, when the government was forced to cut back its investments due to the severe financial consequences of expensive oil imports, which accounted for up to 30% of total import costs. Between 1973 and 1976, the price of oil increased up to five times. 80% of the national oil demand had to be imported.

By the mid-1970s, it became clear that the failure of agricultural settlement along the Transamazônica between Altamira and Itaituba was due to organisational shortcomings and fundamental ecological problems. *Terra firme* soils are not suitable for agriculture because the lack of inorganic nutrients (nitrogen, phosphorus, etc.), rapid humus decomposition, silting and insufficient colloidal binding of artificial fertilisers, together with the problems of weed infestation and plant diseases, quickly lead to yield losses. Land surveying without knowledge of natural conditions, failure of the selec-

1 Amazônia Legal (Legal Amazon) is formed by the states of Acre, Amapá, Amazonas, Pará, Rondônia, Roraima, Tocantins, and Mato Grosso, and also by the west of the state of Maranhão. The boundaries have been altered several times. In 1977, the state of Mato Grosso became part of the Legal Amazon. Tocantins, after its creation, joined the group in 1988. In 1953, during the second term of President Getulio Vargas, the establishment of the Superintendência do Plano de Valorização Econômica da Amazônia (SPVEA) documented the objectives of valorising the natural resources of the tropical rain forest region with the creation of a targeted planning region, formerly known as Hiléia Amazônica. In 1966, the Superintendence for the Development of the Amazon (SUDAM) was created, responsible for promoting economic initiatives in that region. The planning region Amazônia Legal was established to define the geographical delimitation of the political region in which SUDAM operates. Its purpose was promoting the regional development and the integration of the regional productive base in the national economy.

tion principle in settlement, lack of agricultural extension, inexperience in dealing with the conditions of the humid tropics and unrealistic land use models (crop rotation, rapid conversion to permanent crops) caused initial problems. In addition, overly optimistic official yield forecasts, on which the repayment of government loans was based, unsuitable seeds, lack of cooperative organisation, insufficient marketing opportunities, tropical diseases and inadequate medical care contributed to the desperation of many settlers and to a high percentage of return migration (Kohlhepp 1976a; 1976b).[2]

Since the government was not interested in admitting failures in official planning, the oil price crisis was used to launch a second phase of regional planning strategies with the active participation of the private sector. The Second National Development Plan (1975–1979) focused on the concept of growth poles, which had been discussed in Latin America since the mid-1960s.[3] The "poles of development" were based on separate sectoral priorities, e. g., livestock projects and mineral extraction.

In the Polamazônia programme (SEPLAN 1974; SUDAM 1975; SUDAM/SUDECO 1975), the growth pole concept (Perroux 1950, 1955; Hirschman 1958; Boudeville 1968)[4] was misinterpreted and the result was not a "decentralised concentration" of development, but the widening of the inter- and intra-regional development gap. The periphery became even more dependent on the centre at the national as well as the international level. Instead of growth poles with radiating development impulses, enclaves emerged, artificially maintained (Kohlhepp 1978a; 1978b; 1997b). Conservative modernization "from above" by the military government, incorporating the private sector with the regional and national elites by financial incentives, had to keep up the democratic appearance in order not to endanger international creditworthiness. The military administration saw its leading role as that of the only protagonist capable of realizing modernization through rational planning (Becker and Egler 1992), the regional component often being treated in a superficial manner (Ianni 1979b; Théry and Rivière d'Arc 1980).

1.2. Mentality of "El Dorado": Territorial exploitation by private national and international capital

National and international capital investors were attracted by extremely favourable tax reduction incentives and other benefits. Since the mid-1960s, cattle ranching had increasingly switched from the humid savannahs (*campos cerrados*) of the central Brazilian highlands (Planalto Central) to the peripheral areas of the Amazonian rain forests where a large part of the *cerradão* transition forest had been cleared. As the new roads advanced, ranching constantly expanded into the humid tropical rain forests, higher stock densities being expected. 65 % of the cattle-breeding units acquired their land, before the corridors along the trunk roads – reserved for agrarian colonisation – were established by law in 1971 under INCRA control. This produced conflicts of interest in an area planned for small and medium-sized holdings, mainly with *posseiros*,

2 For a detailed analysis of the agrarian colonisation in the Amazon region see volume 1 of Jan Kleinpenning in the present publication of Kleinpenning/Kohlhepp (cf. Kleinpenning 1975; 1979).

3 See: Hansen (1967), Friedmann (1972), Sandner (1971; 1975).

4 About transferability from industrialized countries to developing countries: Conroy (1973) and Santos (1974).

people without official land title.[5] The ruthless invasion of Indigenous territories was seen as a necessary measure for economic development.

1.2.1. Expansion of cattle ranches in tropical rain forests

The possibility of employing considerable reduction of corporation tax (up to 50 %) as venture capital made it most profitable for Brazilian and foreign companies and financial groups to acquire large tracts of land in Amazônia Legal, gaining additionally from very low land prices. In the beginning, the traditional cattle-breeders from Minas Gerais, Goiás, Mato Grosso do Sul, São Paulo and Rio Grande do Sul, who had less cash available and could employ less tax savings operated largely as managers, administrators, subcontractors or, more rarely, as partners to investors without any experience in the cattle ranching sector.

In 1974, Minister of Agriculture Paulinelli openly stated that it would be foolish to leave Amazonia to those who were not capable of using the land without technical and financial aptitude and efficiency. He only believed in entrepreneurial agriculture to the exclusion of subsistence farming. This statement was in direct contrast to the earlier agricultural colonisation programmes of the Military Government.

National, multinational and foreign banks, insurance companies, real estate companies, mining, transport and road construction companies as well as industrial groups from a wide range of sectors have been attracted to set up livestock projects. On average, 55 % of the capital invested was taken from tax payments. The projects approved by SUDAM were tax-free for 12 years. In addition to tax savings, risk diversification resulting from the range of sectors in which they operated also played a decisive role. For non-Brazilian investors, the focus was on reinvesting profits, as the transfer of profits abroad was prohibited.

Under the law in force in the 1970s, cattle ranchers, like other agricultural enterprises, were only allowed to clear a maximum of 50 % of their property in rain forest areas. Due to the huge area of Amazônia Legal, it was almost impossible to control the extent of the clearing.[6] The size of the cattle farms ranged from 10 000 to several hundred thousand hectares, although SUDAM had set the official maximum area at 60 000 ha since 1973. In 58 % of the farms, investments of DM[7] 5 to 10 million were planned, 15 % wanted to invest more than DM 10 million. Two large projects with investments of more than DM 50 million were carried out by Volkswagen do Brasil in south-eastern Pará with 140 000 ha and by the Liquigas Group (Suiá Missú, 566 000 ha) – with headquarters in Italy and part of its capital owned by the Vatican Bank – in Mato Grosso.

5 During Glaser's fieldwork in 1968 (Glaser 1971), land acquisition for cattle ranching projects began in the *cerradão* areas and rain forests east of the Rio Araguaia in northernmost Goiás (now Tocantins State).

6 Initially, the extent of deforestation in the rain forest could only be verified by analysing aerial photographs and ERTS satellite images taken every 18 days when the satellite flew over the area. This meant that the government could only react with a delay when the limits were exceeded, and this was only partially carried out.

7 With the application of projects, SUDAM asked for the scope of the investments planned. According to SUDAM documents, the amount stated was converted by the author in all projects into DM (Deutsche Mark) for a publication in Germany (Kohlhepp 1979). This is the reference mapped in Figs. 1 and 2.

Table 1 shows the volume of project applications for livestock facilities approved up to October 1983.[8] Mato Grosso, with 476 projects, accounted for almost 42 % of the total number and 57.5 % of the total project area,[9] followed by Pará (33 % and 23.5 %). While in 1977 Mato Grosso (340 projects) was by far the leading cattle breeding state in Amazônia Legal with 57 % of all projects and 65 % of the area, the other Amazonian states gained importance in cattle breeding projects at the end of the 1970s (Kohlhepp 1979; 1987a). In all cattle breeding projects, only about 25 000 jobs were planned. On average, only one person was needed as direct labour for 235 ha of pasture.

Table 1: Cattle ranches receiving tax concessions in Amazônia Legal (project applicatons approved before October 1983)

Federal States and Territories (T)	**Number of ranches**	**Number of jobs**	**Proposed head of cattle**		**Total area[2)]**		**Average ranch size in ha[2)]**	**Average head of cattle per ranch[2)]**
			in 1000	in%	in 1000 ha	in%		
Acre	10	372	139.6	2.3	289.9	3.3	28 993	13 966
Amapa (T)	22	521	94.9	1.6	153.4	1.7	6974	4312
Amazonas	20	671	142.8	2.4	290.1	3.3	14 502	7 141
Goiás[1)]	40	1319	359.5	5.9	701.2	8.0	17 531	8976
Maranhão[1)]	17	576	99.0	1.6	139.3	1.6	8193	5821
Mato Grosso[1)]	199	13 725	3733.8	61.6	5063.8	57.5	25 447	18 763
Pará	159	7434	1412.9	23.3	2069.4	23.5	13 015	8886
Rondônia	5	134	40.0	0.6	52.7	0.6	10 534	7992
Roraima (T)	4	139	40.8	0.7	41.1	0.5	10 280	10 206
Total	**476**	**24 891**	**6062.8**	**100.0**	**8800.9**	**100.0**	**18 489**	**12 737**

1) Share of Amazônia Legal

2) Land use limited by law to 50 % of total ranch area

Source: Kohlhepp (1987a, 32), based on projects' statistics in: SUDAM (1983), and author's calculations.

In 1983, the total area of approved cattle projects was 8.8 million ha with a planned cattle population of 6.1 million animals. At that time, cattle population in the Brazilian Amazon was about 2.5 million (1976),[10] including cattle on Marajó Island. The average

8 All the applications for cattle breeding projects approved by SUDAM until October 1983 were evaluated in detail by the author in the SUDAM main office in Belém, according to SUDAM statistics. The results entered in Table 1 with the author's own calculations.

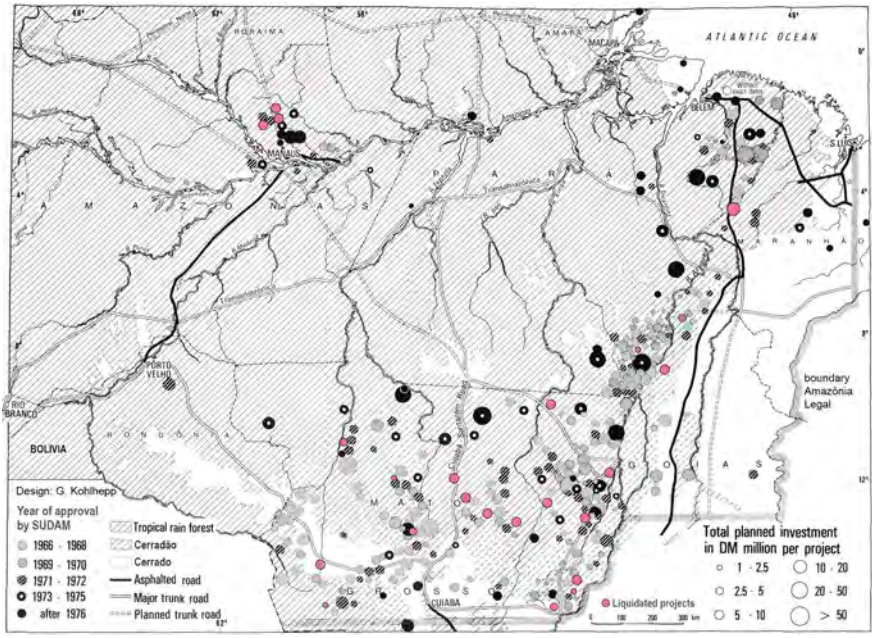
9 Considering the legally fixed percentage of a maximum use of 50 % of the individual project area.

10 The number of bovine livestock in the Legal Amazon region in Brazil surpassed 93 million heads in 2020 (IBGE 2022).

number of cattle per project was up to 12 700, according to information on the application form. A stocking density of 1 to 1.5 cattle/ha was highly optimistically expected. When evaluating the cattle statistics, it should be noted that SUDAM has only recorded cattle farms in Amazonia that are eligible for tax relief. The total number of private cattle ranches operating without incentives and outside the SUDAM conditions was much higher. The amount of land acquired by cattle ranchers could only be estimated. The areas in the rain forest cleared by cattle ranchers up to 1982 were estimated at about 140 000 km², and the total area acquired by cattle ranchers – some of it concealed as land speculation – was probably up to 350 000 km² (Kohlhepp 1987a, 32).

Fig. 1 shows the date of implementation of the livestock projects approved by SUDAM from 1966 onwards, as well as the investment volume. The regional distribution of the projects was concentrated in Mato Grosso and south-eastern Pará. More than 50 % of the total livestock investors were based in São Paulo (Fig. 2).[11] Already at the beginning of the 1980s there were several farm closures.

Fig.1: Large cattle breeding projects with tax benefits in Amazônia Legal 1983 (> 15 000 ha; year of approval and scope of investments)



Source: Kohlhepp (1979; 1987a).

The irreversible damage to the very unstable ecological balance in tropical rain forests caused by large-scale slash-and-burn clearing resulted in radical ecological changes, erosion damage, nutrient leaching, surface encrustation and disruption of the water

11 Figs. 1 and 2: Mapping of the location of projects, date of approval, scope of investments, origin of the capital (headquarters of investor's company) was organised by the author according to SUDAM's yearly statistics and documents, and originally published in Kohlhepp (1979) and in an actualized version – data from SUDAM, 1983 – in Kohlhepp (1987a, 29).

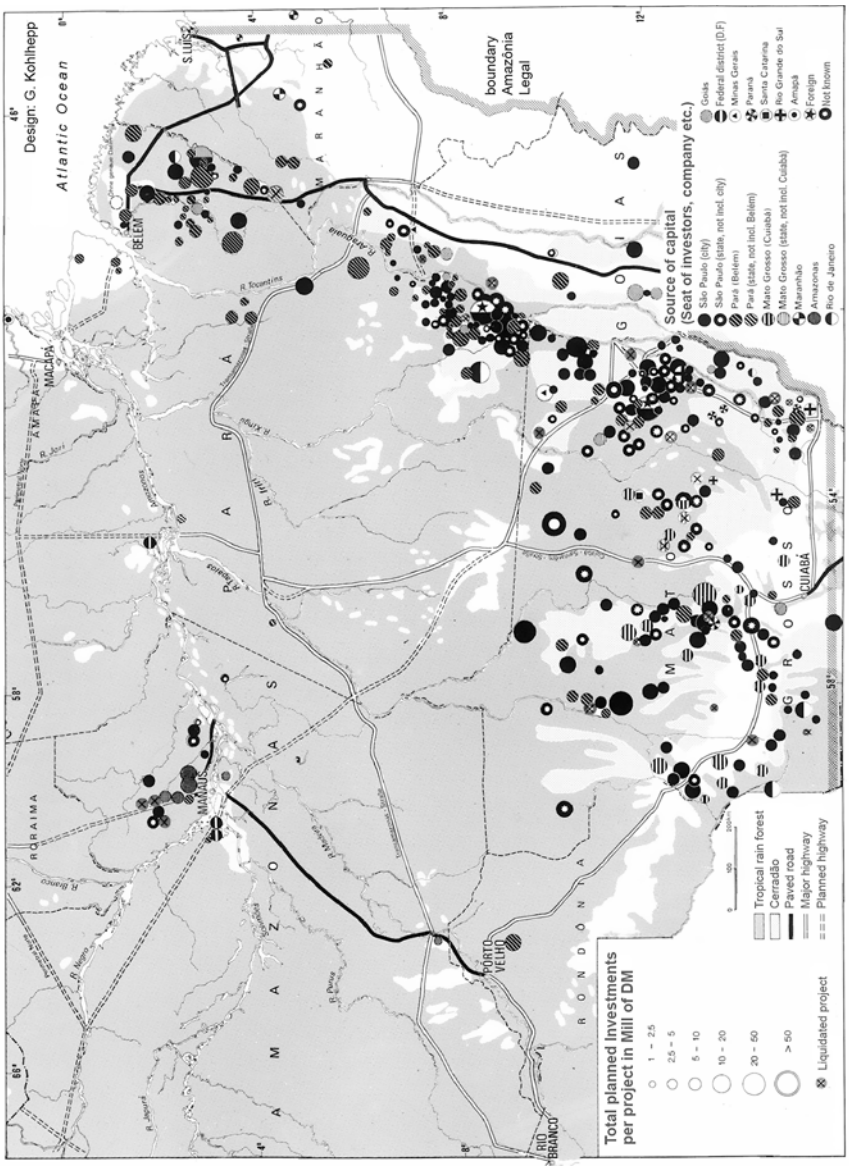


Fig. 2: Regional origin of investors and scope of investments in cattle breeding projects in Amazônia Legal 1983

Source: Kohlhepp (1979; 1987a).

balance, even before the new areas could be sown with grass seed. Other consequences were CO_2 emissions from forest fires, changes in local and regional climate with increasing instability of the annual rainfall cycle. The conversion of large areas of biodiverse tropical rain forests into grass monocultures as pastureland led to controversial disputes in Brazil, with scientists in particular speaking out vehemently against the planned government measures.[12]

12 Goodland and Irwin (1975); Fearnside (1982; 1985); Schmink (1982); Schmink and Wood (1984); Hecht (1983; 1984); Kohlhepp (1979; 1984a). On the conflict constellation and the situation of the tropical timber industry in Pará: Schönenberg (1993); Scholz (1999).

The pasture grass was sown by plane, the cleared pastures were stocked with zebu cattle (Nelore breed) and crosses between zebus, European breeds and *criollo* cattle. Pastures formed after forest cutting and burning (first-cycle pastures) have been established using forage grasses, such as *Panicum maximum* (Guinea grass), *Hyparrhenia rufa* and *Brachiaria decumbens*. New forage grasses such as *Brachiaria humidicula*, among others, replaced the traditional grasses because of better performance in humid tropical areas. The productivity of first-cycle pastures is high during three or four years but declines rapidly with decreasing soil fertility and weed encroachment (Serrão and Nepstad 1996, 222). In advanced stages of degradation, i. e., up to 10 years after pasture establishment, the carrying capacity, which is around 0.7 animals/ha during the lifetime of first-cycle pastures, drops to below 0.3 cattle/ha. With the use of improved pasture technologies and the intensification of cattle production, much degraded first-cycle pastures have been converted to second-cycle pastures (Mattos and Uhl 1994).

In the 1990s, it became already clear that cattle farming, with its ecological and socio-economic constraints, should be only expanded on already deforested land, and that the unsustainable monocultural grazing systems favoured through tax incentives should be transformed into alternative, more sustainable semi-intensive cattle farming models and – much better – into intensive agrosilvipastoral models (Serrão and Nepstad 1996; cf. Hohnwald *et al*. 2010).

The economic prospects were breeding, rearing and fattening and – in some places – meat processing. Brazil had the advantage that the *Trypanosomiasis* disease transmitted by tsetse flies was unknown in the New World tropics. In the 1970s and 1980s, meat from Amazonia served almost exclusively to supply the domestic market, as exports to the European domestic market and the United States were subject to restrictions. With the start of the Polamazônia programme, the export of beef from Amazonia for the world market became a long-term goal that has only become very successful in recent years. [13]

Land speculation and violent conflicts with squatters (*posseiros*) caused serious problems. Several investors only were interested in increasing the value of their estates, favoured by nearby road building, new settlements, and other investments in infrastructure. Cattle breeding served as a suitable means to acquire land using tax incentives. A highly speculative land market emerged, which became more interesting for many investors than cattle breeding itself. "The land itself was the commodity" (Hecht 1985, 680). High profits were made through land speculation which quickly increased the extent of the cleared areas. In times of high inflation, this was a capital safeguard. When productivity of the newly acquired lands played only a secondary role, careful management of the pastures did not take place, leading to the degradation of the deforested areas. For government-subsidized cattle ranching projects, clearing was the hallmark for recognition as "improved land." Overgrazing proved profitable and led to faster forest clearance by shortening grazing per unit area (Hecht *et al*. 1988; Margulis 2004).

In some cases, planned investments were moved back to the company's headquarters, mainly in São Paulo. In the second half of the 1970s, the deforestation of large areas of rain forest had for the first time attracted the attention of scientists and a public interested in the ecological consequences. The vulnerability of the tropical rain

13 Cf. chapter III.5.

forest ecosystems to degradation soon became apparent when the integrated cycle of biomass was destroyed.

In the area of podsolic soils in south-eastern Pará, the possibility of permanent grazing seemed very doubtful. The use of artificial fertiliser was hardly conceivable for economic reasons because of the huge areas involved. Due to the overgrazing mentality of the contract managers and the uncontrolled increase in livestock density, which was allowed to many profit-sharing subcontractors, a tendency towards savannah formation was to be feared. The highly speculative tendency to create large-scale landholdings was reinforced by the fact that livestock farming seemed to be economically unviable in the early days, as the carrying capacity was exhausted after only a few years and livestock density decreased sharply (Hecht 1985; Fearnside 1986a; 1986b).

One of the most important private investors in livestock projects was the automobile group Volkswagen do Brasil. The company faced the problem of having to reinvest the non-transferable part of the profits in Brazil. The offer of the Military Government to invest in Amazonia was very gladly accepted by the company management because of the tax advantages. In 1973, with the approval of SUDAM, a 140 000 ha cattle farm was established in south-eastern Pará in the municipality of Santana do Araguaia. VW do Brasil began its project by clearing the rain forest without any experience in agriculture or livestock activities. The regional natural conditions of the remote area were largely unknown and there was no detailed information about the soils. The distance of 2100 km to the headquarters of VW do Brasil in São Bernardo do Campo, S. P., initially proved to be a logistical challenge; aeroplane connections were urgently needed. According to the existing legal regulations, an area of 44 000 ha was cleared by 1984, the livestock amounted to 47 000.[14]

VW do Brasil's Fazenda Vale do Rio Cristalino (CVRC) was very well organised and has been managed by a Swiss agricultural engineer and expert in cattle breeding since 1978. In contrast to many other ranches visited, agrotechnical knowledge was practised here at a high level by an expert who was present almost all the time. Two innovations were realised through this project: Fertilising the pastures (by air) and the production of hay. The regular fertilisation made it possible to increase the dry matter yield per hectare by 2.5 times. Due to a significant dry period of more than three months (June to mid-September), the existing fodder gap was successfully closed by hay and silage. Fattening became successful at a time when cattle in other regions were low in weight. In the initial phase, a rotation system of pastures was practised. In the beginning, the cattle were sold and transported to São Paulo. The planned stocking density of 1.4 animals per ha was achieved and was to be increased by silage. In 1980, the soil quality was examined in detail. The VW ranch proved to be a model farm with excellent management, scientifically based trials with support of the Swiss University of Zurique (ETH), e. g., breeding trials, silage, additional feeding systems, trials on fertilisation and erosion control by avoiding overgrazing.[15] The slopes were not cleared to avoid erosion and landslides.

14 According to CVRC statistics of October 1984. Targets until 1988 had been: 54 000 ha of pastures, 106 000 head of cattle; forest reserve 85 700 ha.

15 Detailed information of the estate manager Friedrich Brügger during the visits of the author at the Fazenda Vale do Rio Cristalino in 1980 and 1982. The first field trip to the Fazenda occurred in 1975 (cf. Kohlhepp 1979; 1987a).

A permanent staff of 230 people (1982)[16] worked within the ranch in a privileged location and under good infrastructural conditions. In stark contrast, subcontractors (*empreiteiras*) were allowed to use hundreds of unskilled workers to cut and burn forests, clear pastures and build fences on the VW do Brasil ranch. These subcontractors, who worked on all the ranches in the region, were unchecked violators of human rights, decent living and working conditions and social standards. The *empreiteiras* were registered companies that were fiscalised by the Ministry of Labour, but it was known that this did not work in the interior of Amazonia.

A slaughterhouse built with a German company and other investors 50 km away was within an area of influence of about 300 km and included ranches with 1.4 million cattle. The target was a slaughter capacity of 150 000 cattle per year. A steam turbine based on wood feed, a cooling system and a water treatment plant allowed additional installations for the production of canned goods, frozen meat, meat extract, packaging material and a tannery – initially only for the domestic market.

During the Military Government, Volkswagen and many other large investors had been invited to participate in the Polamazônia programme and were attracted by the fiscal benefits of the "development model" of exploitation and deforestation of the Amazon. There is no doubt that the initiative to strengthen the "Brazilian miracle" was a support for the repressive political system and guaranteed economic and other benefits, especially for foreign or multinational companies. The activities of large corporations such as Liquigas, VW do Brasil, Villares, Vilela, Mappin, Scarpa, Mendes, Alcântara Machado, Swift, Anglo, Caterpillar, Rank Xerox, Lunardelli, Camargo Corrêa, Finasa, Levy, Bradesco, Codespar, Ometto and others created an "empire" of large landowners. This concentration of powerful groups with huge landholdings obviously helped the Military Government to improve political control in regions with anti-military movements nearby.

It is hard to believe that one of the world's most important car manufacturers overestimated the economic profitability of the ranch but underestimated the costs of the project, the logistical problems in an infrastructurally isolated region and the very complex social situation of hiring workers in the interior of Brazil. The ecological consequences of deforestation were generally not discussed by the decision-makers and the warnings of scientists (Goodland and Irwin 1975; Sioli 1973; 1984) mostly went unheard or were simply not implemented.[17] Protests by environmental movements were ignored. In 1975, a conference of the Brazilian Society for the Advancement of Science (SBPC) discussed scientifically based criticism of forest destruction by CVRC and other cattle ranches. Under the military regime, open protests against government strategies were often interpreted as terrorist or "communist" activities.

Passing on responsibility for the working and living conditions of non-permanent workers by outsourcing contracts to completely uncontrolled subcontractors, which

16 In October 1984, 381 people were employed (880 family members, 205 children in the primary school).

17 On 8 August 1975, the author was invited by the president of VW do Brasil, Wolfgang Sauer, to report on a visit to the CVRC ranch. In this conversation the author addressed the ecological problems of forest destruction, the lack of regional suitability of soils and ecosystems for cattle breeding, conflicts of interest in land use, and regional social inequalities and conflicts with subcontractors. Sauer had an overly optimistic view of cattle ranching as part of the government's development strategies in Amazonia. See also the author's publications on this topic: Kohlhepp (1979; 1987a), among others.

is common in the Brazilian hinterland, was one of the fundamental mistakes made by the top management of VW do Brasil and all other investors. Workers employed by *gatos* to clear forests in groups of a few hundred were exploited by subcontractors who paid very low wages, violated workers' rights, set inhumane labour standards and additionally enriched themselves by selling food at extortionate prices. The conditions in these guarded camps can be described as slave-like. It seems incomprehensible that VW do Brasil did not understand that the ultimate responsibility lay with the owner of the ranch. It was clear to the management that foreign investors – even in their capacity as competitors – were subject to harsher scrutiny.

In the early 1980s, press articles began to focus on the VW do Brasil project. In Brazil, criticism turned from ecological commentary on rain forest destruction to condemnation of foreign capital activities in Amazonia. In Germany, scientists and environmentalists criticised the cattle ranching projects in Amazonia and especially VW's involvement in the highly problematic "development strategy" of the Military Government in Amazonia, which was much appreciated by investors.

In the mid-1980s, press and television reports, newspaper and magazine commentaries, news agency interviews and allegations by the Rural Pastoral Commission (CPT) accumulated into a national and international press campaign against CVRC ("biggest fire of the century," "slave labour") that was devastating for Volkswagen's good standing. Although some reports were journalistic exaggerations with lurid headlines, scientific results were misquoted[18] and the well-known general problems were focused on the VW ranch, the reputation of the largest company and leading car manufacturer in Brazil was at risk. In a time of economic crisis, declining car sales, government price controls on beef, and rising inflation, the VW top management in Germany and Brazil decided to sell the ranch to the Brazilian Matsubara group from Paraná in 1987 at enormous financial loss. Despite, or perhaps because of all the scientific achievements and innovations in veterinary medicine, the project turned out to be a financial disaster.[19] VW could have spared itself the cattle breeding adventure. Despite all the expertise, it was the wrong agricultural activity in the wrong place at the wrong political time, and fortunately ended relatively early, unlike many other large cattle ranches in the region.

With the fiscal incentives of the II National Development Plan, the establishment and expansion of cattle farms in Amazonia began. In summary, the investments were realised in a highly problematic economic sector, in an ecologically vulnerable region, with high investments and state subsidies, very low productivity and with dramatic conflicts of interest and social tensions. In some regions, there were violent conflicts with the Indigenous population and their shifting cultivation, as well as with *posseiros*, who had cleared their land for years without formal title and were deprived of their livelihood. Large landowners who had bought the land "rent-free" tried to force them to vacate, sometimes with small compensation payments. When the *posseiros* refused to move, there were often violent confrontations with the notorious *pistoleiros* of the *fazendeiros*. In the 1970s and early 1980s, about 75 % of rain forest clearing was due to cattle ranching. Later, the area of cattle ranching increased considerably and

18 As an example, the editorial of *Time* (October 18, 1982, no.42).

19 In recent years two publications reminded of the adventure of cattle ranching by VW do Brasil: Kopper (2017) and Acker (2017).

reached a critical point in the exploitation of the Amazon region with fundamental ecological consequences.[20]

1.2.2. Mineral deposits and mining activities

The knowledge of the Amazonian geology and its mineral deposits had been very scarce at the beginning of the Federal Government's "Amazonian Operation." It was of utmost importance for the Military Government to realise an extensive survey of the existing mineral resources in Amazônia Legal in order to strengthen and to diversify the export sector. The discovery and exploitation of new ore resources made a considerable progress in the 1970s due mainly to aerial and satellite photography and a great deal of technical expenditure in remote sensing as part of the RADAM project. RADAM (Radar in the Amazon), organised in 1970, was the decision of the Military Government to undertake a reconnaissance survey of the Amazon region. The major objective was to collect information on untapped mineral resources, geomorphology, soils, vegetation, and potential land use. In 1975, the programme was expanded to the whole country (RADAMBRASIL). On board of a Caravelle jet was the side-looking airborne radar Goodyear Mapping System 1000 for large-scale mapping and working with high resolution image scanning.[21]

Many prospecting licenses for – in some cases – very large tracts had been issued to Brazilian and foreign companies. However, tin ore mining in Rondônia which had started in 1958, was totally confined to traditional manual procedures of tin washing. Production increased in 1965 with the construction of the Cuiabá-Porto Velho earth road (BR-364). Washing and refining of tin ore (cassiterite) occurred in isolated places under primitive conditions. About 30 000 workers – most of them from the Northeast of Brazil – lived and worked on their own account in a *garimpo* system, which had surpassed the traditional jobs of the regional population as rubber tappers. Cassiterite was transported by small aircrafts to a central location (Ariquemes). Transport to the national consuming industry had to use the only existing road via Cuiabá to Minas Gerais and São Paulo by haulage trucks. At the end of the 1960s, tin mining changed to hydraulic installations on a group basis and the exploitation expanded from alluvial to eluvial deposits (Glaser 1969). As high initial investments in machinery were required, the government asked mining companies to reorganise cassiterite mining. The Billiton group started the first mechanised mine with modern equipment in 1970. Extensive resources were discovered in Rondônia and other locations in Amazonia. Later, a waterway transport of the cassiterite concentrate and the refined tin was shipped from Porto Velho to Santana port in Amapá before being shipped to international clients. From 1975 onwards, Brazil reduced its dependence on Southeast Asian tin imports and supplied the world market as one of the most important tin producers.

Since the mid-1950s, manganese ore has been mined by the Brazilian Icomi company of the Antunes group with the backing of Bethlehem Steel Corp. in the Serra do Navio, 200 km from the coast of Amapá, at that time a Federal Territory. Manganese

20 Cf. chapters II.3 and III.2.1.

21 The National Department of Mineral Production (DNPM) published 26 volumes of the "Survey of natural resources" (Geology, Geomorphology, Pedology, Vegetation, Potential land use) in the RADAMBRASIL project. Volumes 4–20, 22 and 26 concerned Amazônia Legal (DNPM, 1974–1982).

mining was the first industrial mining activity in the Amazon region. Manganese ore deposits of Amapá, in the precambrian part of the Guiana shield, accounted to 30–32 million t (mt) with a Mn content of 48%. The ore was of very high quality, lacking iron and free of phosphate. Commercialisation of manganese is basically allocated to supplying the iron and steel industry. Between 20 to 60 kg of ore were consumed to produce each ton of steel at the technical level of the 1970s.

The deposits were located in an isolated tropical rain forest region. Mining activities started with the 193 km railway construction from the port of Santana to the Serra do Navio mining location. After the northern channel of the Amazon river had been made navigable, exports of manganese ore could be directly transported by larger cargo ships from the port of Santana to the clients, without making the initially necessary detour via the narrow Furos de Breves west of the Island of Marajó and the Rio Pará. Before starting manganese ore exploitation, negotiations of the government with Icomi resulted in agreements of paying royalties and reinvesting in Amapá 20% of the profits of manganese production.

Two residential settlements were constructed by Icomi: one in the vicinity of the Santana port, denominated Vila Amazonas, the other named Vila Serra do Navio, situated close to the mine. According to Brazilian hierarchical norms of company towns, Vila Serra do Navio was divided into a relatively well-equipped workers' settlement and a separated high-standard part for the staff and qualified personal. The settlements became known as "company towns" and for decades set the standard throughout Amazonia for planning, tropical climate housing, health care and malaria control, as well as well-developed infrastructure in other mining and metallurgical companies (Kohlhepp 1977b). Icomi had few outsourced employees, with nearly all activities involving mining and processing of manganese performed by workers directly contracted by the company (Monteiro 2003). Highly qualified employees came from all over Brazil. They had very good salaries and privileges as free flights to visit their families and longer holidays. Workers were contracted mostly in Amapá. Population in Icomi settlements increased to 4200 (1977) with more than 1250 employees.

The most significant change in manganese processing in Icomi's history was the construction of the plant to concentrate the fine fractions of manganese ore from Serra do Navio to a Mn content of 60% and the pelletisation plant at the port of Santana. This enabled increases in ore volume sold, reaching 1.6 mt in 1971, the highest level in the mine's history. In the 1950s and early 1960s, the Soviet Union (USSR) and India were leaders in producing more than 60% of manganese ore worldwide. Later, Australia and South Africa became important producers. With the Icomi activities, Brazil attained the fifth rank in manganese ore production, exporting mainly to the USA and Europe. As part of Icomi's reinvestment process in Amapá, cooperation with the Dutch Bruynzeel Corp. (Brumasa), which dominated the regional timber trade, in the production of plywood and fibreboard was a success during this period.

In the 1970s, mining corporations believed in the capacity of modern techniques and the ability to overcome traditional activities like extractivism to drive regional economic development. However, Icomi's manganese ore mining in Amapá, its financial contributions, royalties, taxes, wages, social benefits and direct or indirect employment have not been able to ensure long-term regional progress and social stability. Despite demonstrating a high-level technology, a successful export strategy and model installations in the company's settlements, the input in Amapá did not gain gen-

eralised wide-reaching socio-economic effects. After industrial manganese mining and processing ceased in 1990, environmental damage from contaminated water and inadequate waste disposal remained. A few decades of optimism and export-oriented economic success could not achieve the "industrie motrice" effect (Perroux 1955) of a long-term positive impact on regional development. On the contrary, the development pole problem of reinforcing regional development disparities and creating enclaves and intra-regional socio-economic imbalances in a peripheral region showed the danger of only a temporary cycle of mining extraction.

In 1967, bauxite deposits were discovered by the Canadian Alcan Company in the State of Pará on the Trombetas river, a tributary of the Amazon river. The lateritic bauxite deposits on the southern margin of the precambrian Guiana shield, located in an area of dense tropical rain forests, occur on various plateaux covering an area of more than 2200 km² in altitudes varying from 160 to 190 m. The bauxite deposits are high in alumina (43 to 45 % Al_2O_3) and are overlain by 7 to 11 m of unconsolidated sediments. Mineração Rio do Norte (MRN) came to the Trombetas river basin in the 1970s with plans to mine about one billion tons of bauxite deposits. In 1974, an international consortium of Canadian and US companies was founded with Brazilian state participation. Mining operations using open pit mining methods started in 1979. Bauxite ore was crushed, beneficiated, and transported by rail to the near port of Trombetas, where the dried bauxite was loaded on up to 60 000 t ocean going bulk carriers for exports. Later, the national industrial alumina and aluminium industry, 900 km downstream the Amazon river near Belém, was supplied.[22]

In the beginning, open pit mining caused considerable damage by the removal of vegetation and overlying strata before mineral extraction. Degradation of land and enormous water pollution from mine waste were reported by near *quilombo* residents, descendants of runaway slaves. Reforestation started in 1984. Decades later, MRN turned out to be the fourth largest producer of bauxite worldwide.

The iron ore reserves in the Serra dos Carajás in the east of Pará, discovered in 1967, are among the most important deposits (18 billion t of hematite, 66 % Fe) in the world. The extraction of iron ore was the main project of the Programa Grande Carajás (PGC), a regional development programme of enormous proportions. It was combined with large infrastructural investments in new urban centres, railway and port construction, the implementation of a huge hydroelectrical power plant and new industries. The PGC will be analysed in detail in chapter I.4.

Since the 1960s, activities of gold and diamond diggers had increased considerably. According to Brazilian law, landowners do not possess subsoil rights but were given up to 10 % of the mining production value. Wildcat miners working in small-scale gold mining (*garimpo*) in Brazilian Amazonia are known as *garimpeiros*. For landless and unemployed men, *garimpos* became an alternative to find a job. In the Marabá region, the centre of Brazil nut trade, workers left their traditional job of gathering nuts (*castanha do Pará*) and were attracted by the beginning gold rush. Owners of the *castanhais* lost their economic and political power. Some started as entrepreneurs and became claim owners in gold mining (Cleary 1990).

Traditionally, *garimpeiros* worked in small crews of men in alluvial gold deposits with rudimentary pans and shovels as had been done for centuries. The uncontrolled

22 Cf. chapter I.4 on the Grande Carajás Programme.

migration of many thousands of *garimpeiros* to the numerous sites in Amazônia Legal caused environmental degradation and conflicts of interest with local and regional planning authorities, small farmers, large landholders, and disturbances in recently founded rural settlements and even small urban centres. The most problematic incidents were invasions into Indigenous territories with violent clashes by force of arms, assaults, and murder.

Because of the use of mercury in the gold extraction process, large areas around the mines are dangerously contaminated and people eating fish downstream from the mine frequently have elevated mercury levels. Gold mining is responsible for environmental damage like deforestation, damming up of small rivers and sedimentation of vital rivers. Frequently, *garimpeiros* were beyond the reach of the law. Despite the vulnerabilities that the activity implies with hazardous conditions, unhealthy work and failing health services, they do not wish to leave. There was a tradition within families, e. g., in Maranhão, where at least one family member was working as *garimpeiro*. In the mid-1980s, the number of *garimpeiros* in the Brazilian Amazon region increased to about half a million.

1.2.3. Gold boom in Serra Pelada

In 1976, the first occurrence of gold was noticed in Serra Pelada, situated between Marabá, 90 km away, and the near Serra dos Carajás. The Serra Pelada site was part of a concession area of the Cia. Vale do Rio Doce (CVRD), the leading Brazilian mining company. After a false radio message announced the opening of the Serra Pelada to *garimpeiros*, activities quickly expanded. Because of road construction from Marabá to the Serra dos Carajás, in 1980 about 20 000 *garimpeiros* arrived. Considering these dimensions, Serra Pelada was not a typical *garimpo* in Amazonia. In the beginning, gold output was low but was bought up directly without interference of intermediaries. The Ministry of Mining and Energy wanted to stop *garimpo* activities and ordered Docegeo, a subsidiary company of CVRD, to start mechanised gold extraction. In some municipalities in the region, there were protests by the *garimpeiros* and manifestations against Docegeo. People were afraid of mass migration of dismissed *garimpeiros* to their small settlements. The Military Government commanded "Major Curió"[23] of the National Information Service (SNI) to impose order in the chaotic situation and to bring Serra Pelada under government control. He gained public interest later as leader of the *garimpeiro* movement. The *garimpeiros* turned out to become a politically relevant pressure group.

When gold mining became successful, there was a veritable gold rush and Serra Pelada became famous. Huge nuggets were discovered, the largest weighed almost 7 kg. In 1980, 6.6 tons of gold were produced, 40 % of the official national outcome. Even Brazil's President General Figueiredo visited Serra Pelada in 1980. Because of social tensions, manual gold digging was conceded until November 1983. Activities in the open pit mine started at 275 m above sea-level. A social stratification already had

23 The infamous SNI colonel Sebastião de Moura (nickname Curió) had taken part in the "anti-guerrilla" campaign in the early 1970s in the Araguaia region. He organized votes for candidates of the government party PDS in Pará's elections. Later, he was elected mayor of Curionópolis and member of Congress in Brasília for Pará (Kostcho 1984; Valverde 1989).

taken place. Claims were concentrated on a small number of people (2 % with 72 % of the production) and the large majority involved worked as "formigas" (ants), digging away the basic material with pickaxes and removing the dross. In 1983, the peak of gold output was obtained with nearly 14 tons. Curió established a tax office where claim owners had to sell the gold to the Central Bank. An enormous hole – 90 m deep in an area of only 50 ha with a maximum diameter of 1.2 km and 450 000 m³ of waste rock removed – resulted from digging and removing the brittle material. Sometimes, CVRD was called for contouring work to avoid dangerous slope gliding, which had killed workers frequently. During the rainy season, Serra Pelada remained closed from November to April, causing intense migratory movements of *garimpeiros*.

In 1986,[24] about 65 000 people were working at Serra Pelada without official contracts in a slavery-like system without any social security, living in unhealthy lodgings, suffering from malaria and other tropical infections. Supply of expensive food was controlled by claim owners. Some had more than 50 claims or had a share in a number of other claims and employed up to 850 *formigas*. These poor *garimpeiros* carried 30 kg bags to the processing area, climbing up 80 m on steep slopes and rickety ladders[25] and were paid by claim holders daily according to the number of trips upwards and running down. In long files, these men made up to incredible 50–60 trips per day, earning on the average 1.5 to 2 minimum salaries. In case of illness, they were dismissed. They were not members of the now founded but soon insolvent cooperative and lived without human rights as "bóias frias" of the mining industry (Kohlhepp 1987a; 1987b).

The situation turned dramatic when the authorisation of manual gold extraction ended, and mechanisation – allowing a 70 % higher output – endangered the existence of claim owners and *formigas*. In their despair at losing their jobs and thus seeing their livelihoods threatened, a rebellion ensued with violent actions, burning down public buildings in the neighbourhood, such as the townhall of Parauapebas. Bridges were destroyed, and street barricades stopped road traffic (Guerreiro 1984; Ab'Sáber 1996c). CVRD wanted the *garimpeiros* to be expelled from Serra Pelada.[26] As in many other large-scale projects in Amazonia, it became apparent that the decision-making level had no insight into the structures of traditional communities in the interior and made no effort to take traditional regional conditions into account in their planning. "The *garimpo* was the utmost utopia of the poor in the region" (Ab'Sáber 1996c, 237). The violent uprising of the affected people was the consequence of this situation.

The company feared invasions into the central mining concession area and trouble at the mining site high up in the Serra dos Carajás, as well as considerable impacts in regional planning and economic development. Protests of hundreds of *garimpeiros* commanded by Curió in Brasília made the Congress pass the so called "law Curió," defining Serra Pelada as an open *garimpo*. Thus, the temporary continuation of manual extraction down to a level of 190 m was approved until 1987. From 1980 to 1987, official data stated 38 tons of gold produced at Serra Pelada. The proportion of gold smuggled

24 Field visit of the author at Serra Pelada on September 12, 1986.

25 Sebastião Salgado's impressive photos of the inhuman situation at Serra Pelada became well-known worldwide.

26 Cf. chapter I.4.2.3. Due to the tense situation, CVRD staff did not wear company uniforms during a visit by the author to Serra Pelada in September 1986, and the vehicles were not marked with a company label for security reasons.

to the outside world was significantly lower compared to the Amazon region as a whole (27 %). Some claim owners had started mechanisation of gold extraction and installed fortified camps (in a Wild West manner: "Fort Apache" etc.) where they kept machinery and organised separate private gold output.

Curió had banned arms, alcohol, and women within Serra Pelada. In a distance of 30 km, a rapidly growing settlement – later the town Curionópolis – developed, with a commercial area and a separated red-light district. The government was afraid of violent or even armed conflicts in case of closure of Serra Pelada (Guerreiro 1984). Previous cases showed that claim owners trying to valorise their investments stirred up their *formigas* to fight for their jobs. Heavily armed military police took care of "law and order." Migration of unsettled *garimpeiros* already had caused invasion problems in colonisation projects or Indigenous reservations in other Amazonian regions.[27] In 1986, the admission of families and women in Serra Pelada had intended to reduce social tensions, promoting stabilisation and appeasement.

The wild camp area with incredible hygienic and social conditions changed to a more "urban" situation with increasing infrastructure such as shops and a school. At the end of the 1980s, gold output decreased and Serra Pelada's population was aware of the near exhaustion of gold deposits. In 1992, activities in Serra Pelada came to an end and most of the gold diggers left for other *garimpos* in Amazonia. Today, the Serra Pelada mine is abandoned and the giant crater that was created by hand digging has filled with ground water, forming a small, polluted lake. Finally, CVRD received a government's indemnification because of property rights in the area which had been invaded in the 1980s by thousands of *garimpeiros*.

1.2.4. Strategies of industrial development

A new approach to industrial development in Amazonia was to try to diversify the existing industrial sectors, which had focused on the food industry and the manufacturing products of the area's economy.

Table 2 shows the 187 industrial projects approved by SUDAM up to October 1980 and the diversification of sectors in which new investments were made, which appeared to be balanced.

The maximum investment had been in establishing food, chemical and cement industry. The degree of dependence had increased because of the marked movement away from the preparation and processing of regional raw materials such as rubber and jute. 38 % of the investment planned for the industrialisation of Amazonia had been by basic industries and industries for producer goods, 26 % by food and semi-luxuries industry and 18 % for consumer goods and capital goods each.

Expansion of timber industry had been planned as part of a rational forestry and timber plan promoted by SUDAM (Pandolfo 1974). However, it would have been necessary to define the basic features of a forestry policy in order to control the use of the timber resources in Amazonia according to ecological requirements and the problems of using timber in Indigenous territories and in the forest reserves which had been established by law but were not respected and protected. In view of the great wealth

27 In 1985 *garimpeiros* invaded Yanomami territories in Roraima (Serra dos Surucucús). After an alert of FUNAI, they were expelled by the federal police (Cleary 1990, 206).

of species but the low ratio of individual trees per area which could be used in timber industry, destruction of forests by fire clearance was cheaper than selecting useful timber and transporting it for long distances.

Table 2: Industrial investment in Amazônia Legal (projects approved by October 1980)

Sector	Number of projects	Total investments (in %)	% of tax benefit
Food	35	19.8	62.3
Chemical Industry	15	13.0	44.9
Non-metallic minerals	12	10.7	67.2
Timber	24	9.4	50.2
Textiles	14	6.0	37.6
Metal processing	10	5.1	70.6
Electrical	8	5.0	22.7
Mining Industry	6	4.8	18.6
Drinks	9	3.3	33.0
Others	54	22.9	39.0
Total	**187**	**100.0**	**48.0**

Source: Kohlhepp (1984a, 663); author's calculations from data provided by SUDAM in Belém, November 1980.

The industries planned were concentrated almost entirely in Pará (33 % of the industrial investment planned), Amazonas (32 %) and Mato Grosso (25 %). In Table 3, investments and job-creation of private, non-agricultural enterprises are presented. The 65 000 jobs in industrial and mining companies did not imply a perceptible alleviation of the serious unemployment situation. A high level of automation did not favour job-creation and it was of crucial importance for the ability of industrial firms to compete with other industries in the traditional economic centres of Brazil and abroad. Hardly any of the labour force with the required qualification came from Amazonia but from South and Southeast Brazil. Therefore, there was an urgent need to build labour-intensive industries where more unskilled labour could be trained.

The source of investment funds (Table 4) shows the extreme importance of tax reductions as an incentive for the private sector. As had been stated before, this was particularly the case of cattle-breeding (55 %), agro-industry (52 %) and industrial and mining projects (42 %) in which only between 20 % and 23 % had to be obtained from internal resources.

The Polamazônia programme did not only cause fundamental changes in rural areas but especially in the urban centres of Amazonia. The improvement and functional equipment of state capitals – in their role as "bridgeheads" of a centre-periphery system – resulted in a distinct transition of the town centre with social and spatial structural changes. Manaus, the capital of the state of Amazonas, turned out to be a special type of a development pole.

Table 3: Investments and job-creation by private non-agricultural enterprises in Amazônia Legal (up to August 1982)

Amazônia Legal Federal states and territories (T)	**Industry and mining**		**Tertiary and energy sector**		**Special projects**	
	P.I. (in %)	P.J.	P.I. (in %)	P.J.	P.I. (in %)	P.J.
Acre	0.9	362	1.1	255	-	-
Amapa (T)	0.4	3958	1.3	256	2.9	240
Amazonas	31.9	28 945	3.6	2038	15.3	473
Goiás[1)]	2.3	656	2.3	2396	-	-
Maranhão[1)]	5.2	4695	9.9	1050	-	-
Mato Grosso[1)]	25.2	3551	3.0	1892	-	-
Pará	33.1	21 398	76.8	3715	81.7	3224
Rondônia	0.6	1091	1.3	231	0.1	47
Roraima (T)	0.4	193	0.7	5798	-	-
Total	**100.0**	**64 849**	**100.0**	**17 631**	**100.0**	**3984**
Investments in mill. US$[2)]		56.5		136		29
Investments (%)		48.6		11.7		2.5
Planned jobs (%)		57.8		15.7		3.6
Number of projects		206		28		20
Projects (%)		31.3		4.3		3.0

1) State's share of Amazônia Legal
2) Conversion rate for comparison (August 1982): 1 US Dollar = 189 Cruzeiros
P.I.: Planned investments
P.J.: Planned jobs

Source: Kohlhepp (1984a, 665); author's calculations of data in: SUDAM (1983).

The establishment of a Free Trade Zone in and around Manaus in 1967 with an area of 10 000 km², administered by SUFRAMA, an autarchy with its own legal status controlled by the Ministry of the Interior, anticipated the strategy of development poles, implemented in the II National Development Plan for Amazonia (1975–1979) as a new strategy of regional development planning. The Free Trade Zone of the metropolitan area of Manaus had been developed by concerted efforts to create a pole of industrial development. Tax incentives and exemption of import customs had been implemented to cause a strong economic impetus to the central Amazonian urban centre in order to lift the Amazon region out of an economic isolation that it had fallen into. There was an expectation of very positive spread-effects on the surroundings and all the western region of the Amazon Basin.

Table 4: Source of investment funds in different economic sectors (August 1982)

Sector	Internal	Other	Re-invest-ment	From tax reduction	Total
Cattle-breeding	19.7	24.4	0.4	55.5	100.0
Agro-industry	20.3	21.5	6.5	51.7	100.0
Industry and mining	23.0	33.9	1.9	41.6	100.0
Tertiary sector	14.6	67.9	-	17.5	100.0
Special projects	33.9	24.5	1.5	40.1	100.0
Total	**21.1**	**33.7**	**1.6**	**43.6**	**100.0**
Composition of investment funds (%)					

Source: Kohlhepp (1984a, 665); author's calculations of data in: SUDAM (1983).

With the start of the industrial sector in 1973, many industrial companies accepted the new strategy and the unconventional location using the high state-subsidized allowances. Tax incentives and subsequent complementary legislation created comparative advantages in this area over other Brazilian regions. As a result, the Manaus Free Trade Zone attracted new investment to the area. Mostly subsidiary companies of southeast- and south-Brazilian enterprises initiated their activities almost exclusively as assembly plants of imported foreign semi-finished products. With the opening of a very well established industrial park with a good infrastructure on an area of 16 km², Manaus gained a specific quality as industrial site, improved by the existence of many cheap, but unskilled workers.

The number of industries increased rapidly and at the end of 1984[28] a labour force of about 45 000 was employed by 259 companies. In another 44 industries in construction or planned, more than 8000 people waited for a new job. This was an extremely positive situation on the labour market.

The Polamazônia programme was characterized by a shift of the main concentration of development activities to the private sector and the use of tax reductions making Amazonia attractive as an investment region. The periphery became increasingly dependent on the centre. The centre-oriented economic development of Amazonia failed in achieving socio-economically balanced regional development. Particularly since the discovery of numerous deposits of mineral resources, the dynamic progress of Amazonian economic development produced a stratification of regional planning priorities and economic interests proved to be predominant.

Government subsidies enabled the presence of industrial sectors in Manaus, normally producing at this site without any locational advantages. This is especially the case with the electrical and electronics industry with more than 25 % of investments and 38 % of the labour force available. In a labour-intensive operation or assembly of

28 In 1985, the site of the industrial park of Manaus was analysed and mapped by the author evaluating SUFRAMA statistics on individual projects of industrial enterprises approved. Table 5 is based on detailed calculations of the author according to project documents of SUFRAMA in Manaus, 1985 (Kohlhepp 1986, Fig. 12).

electronic entertainment products, colour televisions, video cassettes, magnetic tapes, tape recorders, radios, Hi-Fi-equipment, electronic calculators, and quartz watches were produced. Another range of products concentrated on motorbikes, bicycles and products of plastic and textile industry. Only the timber and food industries as well as construction were mainly based on regional or local raw materials.

In 1985, the capacity of the industrial park of Manaus containing 45 % of all industries of the Free Trade Zone had been exhausted. The implementation of a second industrial park planned had been delayed by the Brazilian economic recession in the beginning of the 1980s. The artificial upturn of this specifically structured and increasing import-oriented industrial sector in Manaus gave rise to a totally new situation on the job market. Suddenly, the job supply not only showed a depletion of the local labour potential, but triggered a significant pull effect that led to an enormous rural exodus from the surrounding areas as well as interurban mobility from the municipalities of central Amazonia that exceeded the job supply in Manaus.

It became clear that cancelling the fiscal locational advantages, guaranteed by law until 1997, would deprive the "extended workbench" of its site-specific right to exist. The consequences of such a situation would have been disastrous for the labour market in Manaus. The subsidiary branches either would automate the production or shut down the manufacturing sector. The working force would hardly find job alternatives because the workers only were trained for a specific manufacturing process and production run in many cases was geared for manual fitting.

In the mid-1980s, the "pole" Manaus achieved only a very limited impulse of positive spread effects in the regional development of central and western Amazonia. Much stronger was the suction effect of an increasing migration in the surroundings to the metropolitan area of Manaus. Another phenomenon bound up with the Free Trade Zone became evident in the city of Manaus. Numerous shops with duty-free goods were concentrated in the city (cf. Kohlhepp 1986, Figs. 12 and 13), offering Brazilian inland tourists to buy some hundred US Dollars' worth of products free of taxes, a very popular urge of spending. This increased returns of hotels and restaurants and made air services to and from Manaus fully booked.

Evaluating the locational quality of the industrial park in Manaus, doubts remained about the continuity of this development. The high degree of dependence of this site on state subsidies may not be able to stand up to a cost-benefit-analysis in the long run.[29]

The priority areas for regional development were fixed in the Polamazônia programme, the demarcation criteria had been very imprecise (Fig. 3). The public and private "development poles" had been so far concentrated on central, eastern, and south-eastern Amazonia. The more extensive lowlands of the Upper Amazonia west of the Madeira river have hardly been incorporated in the regional development plans.

The establishment of development poles, a basic element of the II National Development Plan, had intended to correct the imbalance between centre and periphery. Success of the measure depended on careful planning in the location of industries, on the volume of investment, the extent of regionally polarised development and the pull effect within the region.

29 See chapter II.6.3.1.

Table 5: Number of people employed and investment in industries in the Free trade Zone of Manaus (up to December 1984)

Industrial sector	**Existing Industries**			**Industries under construction and planned[1)]**			**Total industries**			
								Workforce		
	Number	Workforce	Investment share in%	Number	Workforce	Investment share in%	Number	absolute	in%	Investment share in%
Electrical	45	17442	25.8	17	3044	23.2	62	20486	38.6	25.3
Wood	43	5669	14.5	-	-	-	43	5669	10.7	11.6
Vehicle	12	3876	13.4	3	862	7.7	15	4738	8.9	12.3
Metal	18	1389	9.6	7	1526	2.7	25	2915	5.5	8.3
Watch, optical	19	2659	5.6	1	265	0.5	20	2924	5.5	4.6
Textile	8	2542	8.8	-	-	-	8	2542	4.8	7.1
Plastics	16	2538	4.8	-	-	-	16	2538	4.8	3.8
Beverages	7	1879	2.5	-	-	-	7	1879	3.5	2.0
Food	18	1361	2.0	1	232	0.1	19	1593	3.0	1.6
Stone & earth	5	417	0.2	3	931	56.8	8	1348	2.5	11.4
Paper	3	178	0.8	4	734	2.9	7	912	1.7	1.2
Machinery	11	737	2.4	2	129	0.4	13	866	1.6	2.0
Chemical	11	543	3.4	1	77	0.1	12	620	1.2	2.8
Furniture	9	526	0.7	1	40	-	10	566	1.1	0.6
Printing	5	270	0.3	1	152	0.3	6	422	0.8	0.3
Clothing	7	345	0.2	1	12	1.8	8	357	0.7	0.5
Leather	4	315	0.1	-	-	-	4	315	0.6	0.1
Others	18	2263	4.9	2	138	3.5	20	2401	4.5	4.5
Total	**259**	**44949**	**100.0**	**44**	**8142**	**100.0**	**303**	**53091**	**100.0**	**100.0**
			1.213 billion Cruzeiros			0.3 billion Cruzeiros				1.513 billion Cruzeiros
1) Submitted projects proposal										

Source: Kohlhepp (1986, 183, Table 2); author's calculation; data provided by SUFRAMA in Manaus in 1985.

In the mid-1980s, Amazonia faced the threat of a new cycle of exploitation with increasing interregional and intraregional disparities. 15 years of developing programmes for Amazonia resulted in a mentality of unlimited expectations of economic progress without taking in consideration its ecological consequences and the coordination of state and private development projects. Sectoral and regional planning did not meet social needs, nor did it create clear guidelines for the spatial organisation of dynamic development processes in a peripheral frontier region.

Corruption in land title registers (*grilos*) and excessive land speculation, violent conflicts with Indigenous populations, and the military strategy of "security and development" determined this critical phase. The enormous destruction of tropical rain forests by slash-and-burn clearing with irrecoverable damage for ecosystems had started and developmentism of the Military Government had not been willing to hear scientific warnings of a threatening ecological disaster.

1.2.5. The Jarí-Project: The dream of a multi-dimensional mega-project of an US tycoon

The Military Government tried to attract private capital to Amazônia Legal conceding enormous subsidies. Despite the framework conditions granted by the government, the room for manoeuvre of private investors remained very large. However, the Jarí project was an exception in terms of dimension, the establishment of an isolated enclave and the almost uncontrolled activities of the foreign owner in the Amazon region over 15 years.

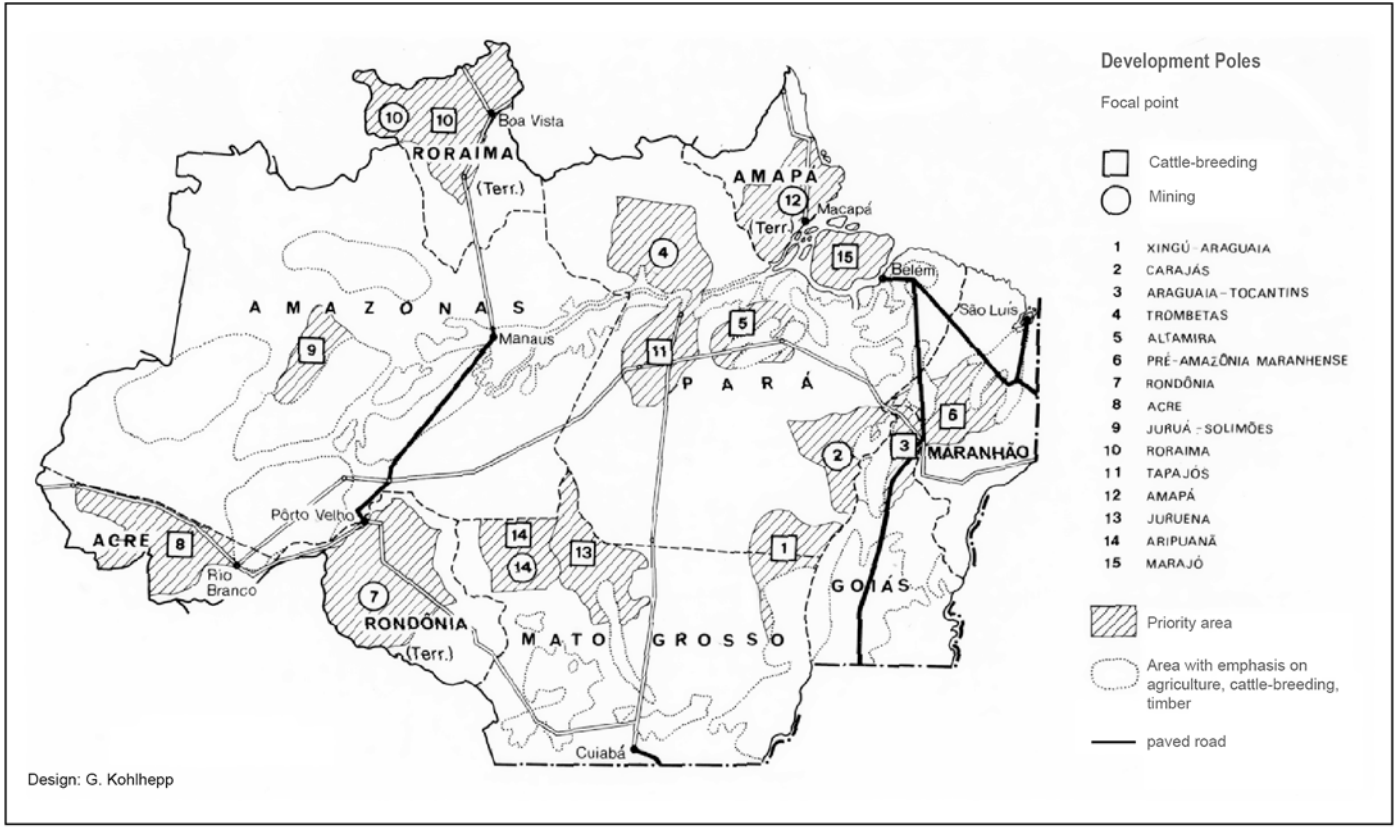
With official approval in 1967, Daniel K. Ludwig, the US-American owner of National Bulk Carriers, the largest merchant fleet worldwide, and of a ramified economic empire, purchased a huge area at the Jarí river, a tributary of the Amazon river, in Pará and the former Territory of Amapá. Only US$ 3 million were paid for an area of at least 16 000 km², but Jarí claimed 36 500 km² – nearly the area of Switzerland – in an application to SUDAM in 1975.[30] Ludwig had made the biggest land purchase ever registered to a private individual. Controversial data of this estate demonstrate the uncertainty and the dubious quality of land titles in the Amazon region. Land purchase had been realized before passing of a law in 1971, regulating acquisition of land by foreigners. According to this new law, a maximum of 25 % of a municipal area was allowed to be in foreign hands, only 40 % from this to one owner.

The Jarí Forestry and Agricultural Enterprises were a combined enterprise of silvicultural plantations, associated with an industrial complex of cellulose production, a mining project, and an agricultural part with cattle-breeding and mechanised rice cultivation and water buffalo ranching in the floodplain (*várzea*). In the beginning, Jarí had been discussed by planners and politicians to be a "model" of regional economic development with the nationalistic background of having a future solution for the economic exploitation of Amazonia. The lack of information and of published research on the economic and ecological viability of this project as well as "the company's tight access to the area" (Fearnside and Rankin 1980, 146) was a characteristic of Jarí.[31]

30 The area had been covered by 170 land titles of 52 different sellers, in 1976 32 titles had been legalised (Fearnside and Rankin 1980, 155).

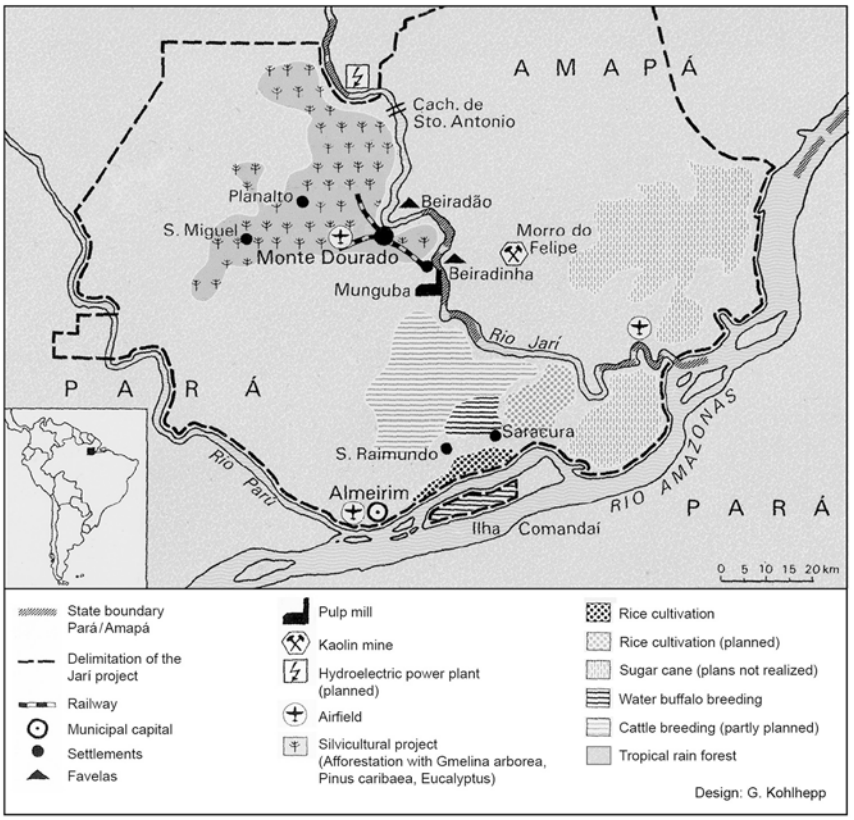
31 After two refused attempts to visit the Jarí project during the Ludwig era, the author had only a chance of a field trip to the area in 1986, after the project's taking over of a Brazilian group of large

Fig. 3: The Polamazônia concept and regional priority areas in Amazonia



Source: according to documents of SEPLAN (1974) and SUDAM/SUDECO (1975); published in Kohlhepp (1978a, 12).

Fig. 4: The Jarí Project



Source: Kohlhepp (1987a, 34).

Jarí had the advantage to be financially and technically very well endowed. Headquarter of the project's administration and technical staff was located at the small town of Monte Dourado on the Jarí river. Basis of Ludwig's Jarí enterprise was the production of cellulose, and silvicultural plantations, necessary to feed the pulp mill planned. Since most of the rain forest timber was not suitable for paper production because of the large number of different species and heterogeneous timber quality, the original forest had been cut down on an area of more than 110 000 ha (= 6 % of Jarí's native forest) and replaced by problematic monoculture tree plantations of non-regional exotic species. Before clearing started, good timber of more than 40 species had been extracted for house construction and manufacture. Forest clearing using heavy bulldozers damaged topsoil and nutrients, removing the forest cover hardened the lateritic soil. Workers from Northeast Brazil recruited by subcontractors for four months became employed for manual land clearing. During felling activities, about 4000 workers lived in camps. Some communities in the project area lost their land to the plantations. About 2000 squatters lived in the Jarí area causing fire problems in the plantations when they

companies. Interviews with different staff members in all projects could be realised, documents on the economic activities, statistics and maps were consulted (cf. Kohlhepp 1987a, 34 f.), cf. Fig. 4.

prepared land for planting. Resettling of squatters had been hindered by lacking legal confirmation of Jarí's land claims. Many families migrated to more remote areas, or to near towns. Afforestation began in 1969 with the rapidly growing *Gmelina arborea*, a species from Southeast Asia, and *Pinus caribaea* from the Caribbean. As growth of *Gmelina* depended very much on soil quality in different locations, the normal time of cutting *Gmelina* trees had to be shortened from 6–7 to 4 years, *Pinus* from 12 to 8 years. Additionally, insect and plant diseases attacked the plantations so that *Pinus caribaea* and later *Eucalyptus deglupta* – frequently with uneven growth – and *Eucalyptus urophylla* became more important. *Eucalyptus* pulp only achieved a lower market price and *Eucalyptus* had been planted to a large extent in other parts of Brazil with lower costs. Fear of shortfall of wood supply for the pulp mill and concern over the growth of newly planted seedlings started fertilizing of *Gmelina* and *Eucalyptus* in 1982 (Fearnside and Rankin 1985). In 1986, the share of the plantations in the replanted area was about one third of each tree species, reafforestation of *Gmelina* had diminished by 50 %. Ludwig made efforts to contract the best professionals for Jarí's forestry staff, but the forestry plantations continued to cause enormous epidemiological problems and costs, not to mention the ecological consequences of the enormous destruction of the native forests and the disastrous effects on biodiversity.

In 1978, Ludwig ordered a pulp mill and power plant built in Japan to be shipped as a floating complex in two sections over 21 000 km to Brazil and towed to the Jarí river port Munguba. Reports in national and international newspapers and magazines flooded the press with sensational stories about this spectacular event.[32] Pulp production with a capacity of 750 t/day required 4000 m³ of pulpwood per day, using the three replanted species according to the rhythm of wood cutting dependent on annual rainfall distribution. The installation of the pulp mill attracted many people looking for work. The energy problem initially could be solved by burning more than half a million m³ per year of wood in a steam engine. An urgently needed hydroelectric project was not approved by Eletronorte, the government-owned company holding the monopoly on power supply. Exports of bleached pulp to Europe started in 1979 and a biologically treated sewage disposal was installed.

The Kaolin mine with reserves of 50 mt was a very important deposit. A railway and port facilities made the Jarí open pit mine an excellent site for transport and exports. Kaolin, a fine white clay used to coat paper with the gloss necessary in printing, was important in ceramics, cosmetics, and medicine. There was a great demand for high-grade Kaolin on the world market, 80 % of the production of 240 000 t/a (1986) had been exported to Germany (47 %) and Japan (30 %) during the first years of mining.

The infrastructure included a 65 km railroad, a deep-water river port up to ships of 40 000 tdw, more than 5000 km of roads, and the town Monte Dourado with hundreds of houses for the working force, a well-equipped company town for the staff and qualified employees, shops, schools, a hospital, medical services to all residents, a police station, and three small airports. Heavy construction and harvesting machinery and an enormous number of trucks and cars had been imported. In the beginning of the 1980s, population in Jarí estate rapidly increased. About 8500 people were employed there, only 40 foreigners as staff members. More than 30 000 people were living inside

32 "Jarí: A billion-dollar gamble"; "Ludwig's Amazon empire"; "A giant pulp mill for the Amazon wilderness"; "Ludwig's mystery in the Amazon jungle"; among others McIntyre (1980).

the Jarí territory, many at the border in a shanty town called Beiradão. *Favelas* with houses on stilts along the Jarí river with numerous social problems, widespread prostitution, drugs, violence, and very poor sanitary conditions caused increasing security problems from the point of view of Jarí executives. They did not feel responsible for this problem but blamed the political institutions of Amapá for lacking infrastructural measures and administrative organisation. Security forces were recruited to keep about 3000 *garimpeiros* outside the Jarí borders, according to information of the Jarí staff.

Besides the main projects of afforestation with the pulp mill and the kaolin processing, Jarí started two agricultural initiatives with innovation potential: Rice cultivation and water buffalo ranching in the floodplain. Rice production in the *várzea* near São Raimundo used new rice varieties developed at the famous International Rice Research Institute (IRI) in the Philippines. As natural soil fertility sedimentation in the *várzea* by annual flooding had been interrupted by diking, the nutrients had to be supplied through fertilization, sprayed with herbicides and pesticides by small airplanes. Different high-yielding varieties had prolonged tests in getting resistance to insects and weeds. Highly mechanized cultivation with hydraulic installations was very expensive and economic profitability seemed to be low in the beginning. A very modern rice mill had been imported. The adaptation of large-scale rice production techniques to the *várzea* had been the most far-reaching innovation (Gall 1979). A two-crop cycle per year was expected to yield exceptional 9 t/ha/year. It became difficult to find a second crop for crop rotation in the rice fields of 4000 ha. Plans to expand the cultivated area to 14 000 ha as originally planned depended on solutions for persistent biological problems, special equipment, water management, building of canals, and training of workers for specific control in the fields. The cultivation of sugar cane originally planned was not realised.

In 1986, a herd of more than 9000 water buffalos – very common on Marajó Island – was grazing in the floodplain of the Jarí estate. Buffalos grow faster than cattle and can be slaughtered after 2 ½ years. In Monte Dourado a slaughterhouse had been installed. Buffalo meat achieved 30 % of daily meat consumption in Jarí. Processing of buffalo cheese was one of the new production lines. Corresponding to 70 000 ha of pastures in the Jarí *várzea*, an extension of the buffalo stock to 30 000 had been considered. Cattle ranching of 3000 nelore bulls on *terra firme* area was of secondary importance. Pastures, mainly with Guinea grass (*Panicum maximum*), were planted to demonstrate Jarí's claim to land against squatters in the region.[33]

The Military Government initially supported Ludwig's plans as a possible "model" to exploit economically the natural resources of the rain forest region by exclusively foreign investing in high-grade modernisation of development projects. The Jarí project was given tax reductions and allowance for tax-free imports, but Ludwig did not use loans of the Brazilian National Development Bank (BNDES) or private Brazilian bank transactions. In the beginning of the 1980s with the first indications of a redemocratization process, government officials began to criticize the extent of land ownership, the exemption of taxes and the lacking communication of the project's management with national and regional authorities. Ludwig became a special enemy of the National Information Service (SNI) under military control, opposed to foreign landowners and

33 All statistical data mentioned had been given to the author by Jari's staff in October 1986.

projects without state-controlled decisions (*Veja*, January 13, 1982, p. 73). Nationalizing Jarí was the central political objective of the military hardliners.

Scientists of different disciplines analysed the Jarí project and evaluated biological problems of reafforestation with monocultures of non-regional species, of soil fertility on *terra firme* areas, and ecological consequences of large-scale rain forest clearing and forest fires. Studies criticised failures in regional development planning, rated the economic viability of the individual projects and working conditions of people, especially those recruited by subcontractors (Fearnside 1987; Fearnside and Rankin 1980; 1985; Garrido Filha 1980; Valverde 1981; Gall 1979; Kohlhepp 1987a).[34] Non-governmental organisations (NGOs), in particular environmentally oriented groups, achieved a scientific level in their critical evaluation of government policies.

Newspaper reports started an intensive nationalist campaign against Jarí, criticising "the US colonisation of the Amazon," "the American invasion," "sell out of Amazonia," the obscurity of the project's activities and the impossibility to visit the area without permission of the project's management. Social tensions and the enormous ecological impact of far-reaching project's procedures, still in a test phase, were open to attack.[35] Some of the accusations were justified, others wrong or exaggerated (slave labour, project-owned army, smuggling of gold, timber etc.), but the anti-foreign public pressure in Brazil increased and the Military Government became extremely worried about the situation. Succeeding the Generals Médici and Geisel, supporters of Jarí, President General Figueiredo (1979–1985) had to organise the transition to democracy, being aware of the public anti-military mood and hostility towards foreign influence in Brazil.

Bureaucratic restrictions, the government's banning of the construction of a hydroelectric plant at the Sto. Antônio falls of Jarí river (Fig. 3), the blocked import of a newsprint industry and incentives refused for reafforestation – granted to Brazilian competitors – and for infrastructure and housing development scheme contributed to Ludwig's decision to stop the Jarí project. The official order to sell pulp, kaolin, and rice with state-controlled "frozen" prices (Plano Cruzado) inside Brazil caused severe financial losses and finally speeded up the end of Jarí. After mutual apportioning of blame, in 1982 Ludwig – at the age of 85 years – frustrated and annoyed handed over his Jarí project to a consortium of 27 Brazilian companies, a "roundtable of the big Brazilian capital" (*Veja*, January 13, 1982, p. 70).[36] After having invested US$ 1.3 billion,

34 National and international scientific conferences discussed the Jarí experiment, e. g., in the multinational event of ADLAF (German Association for Latin American Research) at the Institute of Geography at Tübingen University in 1986, with an important participation of Brazilian scientists (cf. Kohlhepp and Schrader 1987).

35 Pinto (1984); Sautchuk *et al.* (1980), McIntyre (1980), among others.

36 Arranged by Planning Minister Delfim Netto, the powerful and internationally respected entrepreneur Antunes at the age of 75 years was in charge of this complicated agreement. The companies involved in 1982 had property assets of US$ 8 billion and 0.65 million employees. 10 banks, 3 insurance companies, 9 industrial and mining groups, 4 large construction companies and one agro-industrial group formed this unusual conglomeration. The holding of the new Companhia do Jarí controlled three enterprises: The forestry, the mining, and the agro-industrial group. For US$ 40 million, the Antunes group became owner of the Kaolin mine, establishing the Cadam company. In Amapá, manganese mining had also been controlled by Antunes (cf. chapter I. 1.2.2). The idea of a takeover of the Jarí project by the mining giant Cia. Vale do Rio Doce (CVRD) had not been realised because of ongoing planning of the Grande Carajás Programme.

Ludwig did not receive any money, but the consortium took on the company's debts of US$ 280 million. BNDES supported the consortium with a US$ 180 million loan. Ludwig received a gradually diminishing amount of the possible profits of the operations for 40 years. As he had no heirs, the profits were to be transferred to his Swiss-based Daniel Ludwig Foundation for cancer research.

Ludwig was an exceptionally successful entrepreneur, but an egomaniac, stubborn, and controlling the last details. Obviously, he was unwilling to understand the project's huge environmental and social impacts, the political climate for foreign-owned operations in Amazonia, and his increasingly dependent situation in view of democratic governments to be expected. He detested public appearance, avoiding public relations, and causing mythmaking. With his rough treatment of his staff, he had fired 29 directors of the Jarí project and decided everything essential by himself, visiting Jarí several times a year (*Veja*, January 13, 1982; Pinto 1984; 1986). The press campaign against Ludwig and his project reminded of the press reports against Volkswagen's activities in cattle-breeding at the same time in Pará.

The Jarí project was the largest private enterprise ever realised by a single entrepreneur. The Brazilian public never had any influence on what happened in Jarí during the Ludwig era. With the ownership in the hands of Brazilian companies, the government approved projects which had not been granted before to Ludwig. The transition of owners caused dismission of workers.

Finally, it must be emphasised that a large-scale forestry project with a goal of monoculture plantations of non-native species in inner-tropical forest regions was a highly problematic experiment with extremely negative biodiversity impacts. It became clear that it could not serve as a model case for an adequate ecological and socioeconomic use in ecosystems of tropical rain forests. Even with economically optimal prerequisites, a foreign-owned project of this dimension was likely to create problems for internal policy and questions of national sovereignty. An enclave with a total lack of communication with the home country's government easily came under pressure by the Military Government.

The project never had been supervised by state-controlled institutions to evaluate its regional influence. The Brazilian government neither had the funds for this mega-project, nor were the highly qualified experts available in Brazil in the 1970s. The overambitious project without any chance of a regional multiplier effect caused a clash of social structures: Self-confident foreign representatives of modernised exploitation of natural resources and unskilled regional working force, dependent on profit-oriented decisions and lacking impetus or even interest in regional development outside the project's area. Besides the huge Ford rubber plantation in Fordlândia (1928–1945) at the Tapajós river, the Jarí project turned out to be the second US-financed setback in Amazonia.