

PROBLEMS IN DEVELOPING AND MANAGING THE CERRADOS OF BRAZIL*

by

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INTRODUCTION

According to the Rome Club the potential arable land of the world is 3,200 million hectares of which roughly 40 to 50% is being used. Since world population of about 4.6 billion inhabitants will double in the next 30 years at current birth rates, this means, that at a world average of 0.4 ha/inhabitant all available land will be under cultivation by year 2010. Therefore it is urgently needed that new areas be incorporated to the production process while increasing productivity of areas already under cultivation, keeping in mind the need of improving the quality of the environment and the optimization of resource allocation and use, particularly those related to energy.

The greatest potential for expanding the world's agricultural frontier lies in the tropical rain forest and savanna regions, like the Cerrados of Brazil, dominated by acid, infertile soils classified mainly as Ultisols and Oxisols.

In spite of a widespread belief that Oxisols and Ultisols cannot support intensive and sustained agriculture in the tropics, there is ample evidence that they can be continuously cultivated and intensively managed for growing annual crops, pastures and permanent crops. This is also the case with Oxisols and Ultisols of Hawaii, and Ultisols of Southeastern United States and Southeastern China where they support large populations.

The paramount limiting factors preventing widespread agricultural development in these areas are low native soil fertility and the limited transportation and market infrastructure.

* Cerrados: Scrubland of low natural fertility but of generally good topography and soil structure, usually with adequate rainfall.

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Of the 1,6 million hectares of world potentially arable land, approximately 830 million belong to tropical areas. Of this, 240 million hectares are Cerrados also known as savannas or "llanos" located principally in Latin America and Africa.

The Cerrados, in Brazil, occupy approximately 21% (or 1.8 m of km², or 180 million hectares) of its territory, between 5 - 20° South latitude and 45 - 60° West longitude and an altitude ranging from 5 to 1,300 meters a.s.l. (Fig. 1). Topography is gently undulated and the physical properties of soil (bulk density about 1.0) favor mechanization and water infiltration (10-20 cm/hr) throughout the year. Solar radiation is adequate - annual average of 400 langleys/day - and mean annual temperatures range from 19.3° to 25.8°C. Total annual rainfall ranges from 1000 to 1800 mm, mostly occurring between September and April (rainy season) and characterized by dry spells of 10-40 days which may affect drastically crop growth due to shallow root development and low water retention of soils (10%). The dry season (May to August) hardly receives any rainfall. Relative humidity is always low, ranging from 35-70% as an average, which inhibits diseases incidence.

The soils are, in general, deep, sandy in texture, acids (pH 4.5 - 4.8), low in most of available nutrients, with medium content of organic matter (2.5 - 3.5%), low CEC (2-4 meq/100 cc). It is generally recognized that soil acidity, Al toxicity and lack of available phosphorus are the main limiting constraints to crop growth, at present levels of technology. Intensive utilization may induce the appearance of nitrogen and potassium as well as micronutrient deficiencies, sub-soil compaction due to agricultural machinery and implements and extensive erosion problems when soils with slopes higher than 5% are cultivated.

Agricultural development. Throughout its history, Brazil's development took place in the coastal areas, where about 85% still lives. The opening up of the Centre-West began during the colonial period, especially after gold discoveries were made in the mid-eighteenth century. Mining gave rise to the growth of small towns such as Goiás Velho and Cuiabá, an influx of settlers and the beginnings of a cattle ranching economy. By the date of the first population census in 1872, the regional population was roughly of 250,000.

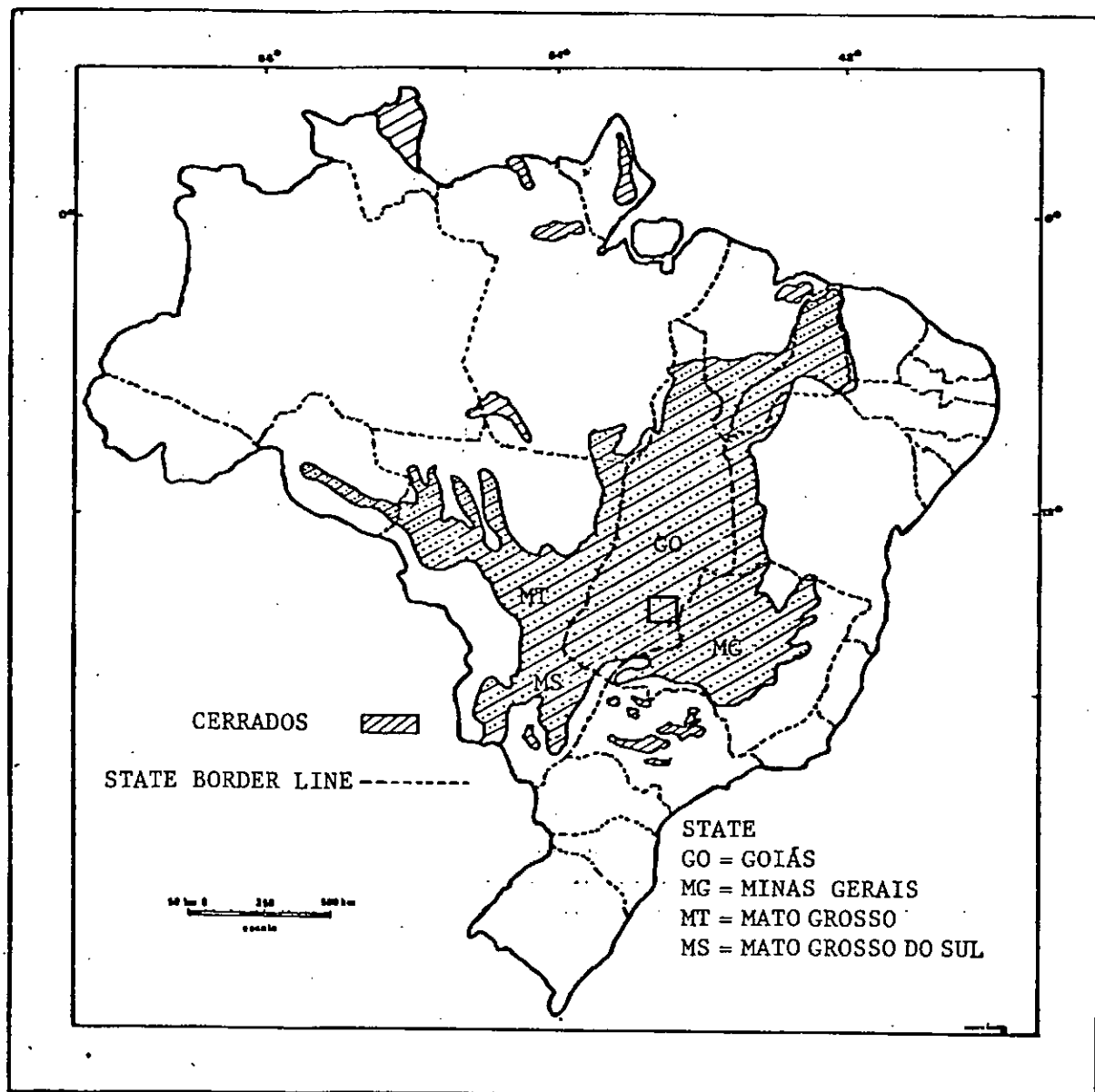


FIGURE 1 - DISTRIBUTION OF THE CERRADOS IN BRAZIL

Source: EMBRAPA/CPAC, Brasília, DF.

However, this was but 2.5% of the Brazilian total (9.9 m) and apart, from the brief period of prosperity during the gold and diamond boom, the region remained of limited national importance until the early twentieth century. Then the growth impulses generated by São Paulo - based coffee boom began to make themselves felt. The increase in immigration to the region from other parts of Brazil was also a strong factor. Then starting with the decision to built Brasília (1957) and to transform it as the capital of the country, 1200 km west of the coast, a policy of occupation of the Cerrados began. This process took place in the late 60's as a result of several types of incentives provided by the government, the availability of technology and low cost of land.

The importance of the region is best represented by the 35% growth experienced by the rural population between 1971 and 1978 to about 9 million inhabitants, mostly distributed in the States of Goiás (GO), Minas Gerais (MG), Mato Grosso (MT), Mato Grosso do Sul (MS), and the Federal District (DF). Still this represents a relatively low population density of about 20 ha/inhabitant. Today, according to the 1980 Population Census, the region accounts for about 6.4% (of 119.1 m) of the total population of Brazil.

Agriculture and livestock are the dominant features of the regional economy, and in 1977 the rise in farm output was 7.6%, against 6.3% in Brazil as a whole. The most important crops are rice (30% of national output in 1978), beans (9%), cotton (8%) and maize (9%). The cattle population, at 27 m head in 1977, accounted for 28% of national herd of 95 m in that year. In 1975, figures of the Agricultural Census indicated the following on the Cerrados land use:

Rural establishment	-	146,423,849 ha
Native pastures	-	78,561,000 ha
Cultivated pastures	-	14,752,000 ha
Perennial crops	-	541,275 ha
Annual crops	-	5,498,450 ha

Industry is largely confined to the processing of farm products, especially meat and cereals; it recorded satisfactory growth in 1977 and industrial consumption of electricity increased by 34.7% and cement consumption by 7.6%. Exports from the Centre-West were valued at US\$ 47.1 m in 1977 (or 4% of the national total), up 22.5% on the figure for 1976.

The region's economic infrastructure is at an early stage of development, especially as regards transport and electricity. The road network in 1978 amounted to 80,000 km, of which only 2,000 km was paved, and electricity supplies are mainly for local consumption and are considerably more expensive than elsewhere in the country. In 1976, electricity production in the Centre-West amounted to 1,772m mwh, or 2% of Brazil's total. The region's largest hydro-electric plant is Cachoeira Dourada, operated by Centrais Elétricas de Goiás, which had a capacity of 85 mw at end-1978.

In general, productivity of agriculture is not very much different to the average of Brazil as a whole, which is low. However productivity of native pastures, expressed as net income per ha was in 1970, about half (0,52) of Brazil's average, due to its extensive character and low technology.

The Cerrados contain 50% reserves of limestone of the country (6,3 billion tons) in the Central-West States. Also the known reserves of sedimentary phosphate rocks in Araxá or Patos (Minas Gerais), amount to 160 million tons and recent estimations indicate that in Poços de Caldas (Minas Gerais) reserves of K_2O , as sienitic-nephelinic rocks, amount to 350 million tons. Brazil's consumption of lime, P_2O_5 and K_2O amount today 10, 1.8 and 1.3 million t., respectively.

Development of the Cerrados. In developing the Cerrados it has to be considered that from the 180 million ha, 150m would be available for agricultural purposes (annual and perennial crops, pastures and forests) and 30 million ha would be considered as not useful or not available. It is also assumed that 50 million ha, out of the 150m correspond at least to arable lands. To incorporate the Cerrados to agriculture would require:

- a) Knowledge of the natural resources of the area: soils and climate
- b) Development of appropriate technology for soils, plant and water management
- c) Increased rural credit, higher support prices and machinery adapted to Cerrados condition
- d) Infraestructure to allow for communications, storage facilities, transport, commercialization, food processing
- e) Improvement of life quality as electricity, drinking water, educational facilities, health services, housing and job opportunities
- f) Establish a colonization program.

Underlying the demographic changes are a series of economic developments which in turn have been largely prompted by the increased interest of the Federal Government in the region.

Development Programs. To make possible a rational occupation of the Cerrados the Federal Government established in 1975 the Program for Development of the Centre-West (POLOCENTRO) which covered about 80% of the area of the Cerrados. POLOCENTRO consists of five sub-programs, to promote the following activities concentrated in 13 strategic localizations to promote diffusion of technology to all the region:

- a) Research
- b) Rural Extension
- c) Storage
- d) Transport
- e) Electricity

After 3 years, in 1978, the Program had made possible the incorporation of about 2 million hectares which show productivities much higher than the rest of the country.

The average size of the farm covered by the Program is of about 630 ha and the objective has been to help the establishment of family enterprise through the formation of cooperatives.

POLOCENTRO has been a way to concentrate and coordinate efforts of different Ministries (Interior and Agriculture), Federal Organizations like: Research (EMBRAPA), Rural Extension (EMBRATER), Storage (CIBRAZEM), Forestry Development (IBDF) and Governments of the States of Minas Gerais, Mato Grosso, Mato Grosso do Sul, Goiás and the Federal District.

Research and Development of Technology. Several factors have limited the development of the Cerrados: a) Extension and heterogeneity of the area (Fig. 1) in terms of soil, vegetation and climate; b) Lack of knowledge on the natural and socio-economical resources; c) Low soil fertility, mainly available phosphorus, and high soil acidity; d) Dry spells, occurring during the rainy season; e) Lack of adapted cultivars to environmental conditions; f) Highly erodible soils.

Therefore to overcome this problems the Government, through EMBRAPA, established starting 1975 several National Research Centers in the region like the Cerrados, Rice and Bean, Corn, Pastures, and Horticulture Centers and several research units at the State level with the main objective of developing technology and production systems for the region. As a result, in a short period of 7 years, research has shown that the Cerrados can produce economically food, fiber and timber with yields higher than the rest of Brazil, if technology is incorporated into the production process and large amounts of inputs, mainly fertilizers, are used. Research also showed that constant water supply to crops could increase its productivity, reducing risks for the farmer and also making land use possible all year round. Total resources of EMBRAPA allocated for the region amount to about US\$ 50 million/year.

Rural Extension. The extension program of POLOCENTRO is carried out for about 800 extensionists distributed in 106 offices. 89 field demonstration trials were installed in 1978 of which 58 were of annual crops and 31 of livestock, giving assistance to about 34,000 farmers. It is intended that through POLOCENTRO 50% of rural extension be carried by private institutions.

Storage. By the end of 1979 there were concluded facilities in the States of Goiás, Mato Grosso, Mato Grosso do Sul and Minas Gerais with a total of 596 thousands tons.

Transports. 3,955 km of roads, being 1,735 km in Goiás, 1,100 km in Mato Grosso and Mato Grosso do Sul and 1,120 km in Minas Gerais, were built up to 1979.

Electricity. 3,085 km of troncal lines, most of them in Minas Gerais with 2,035 km, were also built.

Credit. The following activities were financed through POLOCENTRO:

- a) Land opening, preparation and conservation
- b) Investments
- c) Corrective fertilization
- d) Livestock production
- e) Machinery acquisition

Financing by the Banco do Brasil is allowed according to an "integrated project" elaborated through the rural extension services. Interest rates ranged from 12 to 14%/year for general investments to be paid in 8-12 years with 4-6 year of grace.

For operational costs, interest ranged for 13-15%/year, to be paid in three years. In total, up to 1979 the Program financed, through the Banco do Brasil, 2,249 investment projects and 555 operational projects.

Colonization. Two types of colonization have been promoted in the Cerrados region: Official and Private. Among the first, which is of reduced dimensions in the Cerrados, exist the PIC (Integrated Colonization Projects) of:

- Alexandre Gusmão (DF) with 22,651 ha and 460 families;
- Sagarana (Minas Gerais) with 36,758 ha and 206 families;
- Bernardo Sayão (Goiás) with 96,800 ha and 853 families.

All of this Projects are supervised by INCRA (National Institute for Agrarian Reform and Colonization).

Private colonization has been far more effective in the Cerrados. All of the 31 projects are located in the States of Mato Grosso and Mato Grosso do Sul. They include an area of 575,188 ha where 11 private institutions participate.

Irrigation Program. With the objective to save approximately US\$ 900 million in wheat imports, to increase crop yields to even higher levels, to reduce climate risks for the farmer and to utilize all farmer resources year round, the Federal Government established in 1981 a program of adquisiton of irrigation equipments (PROFIR) using wheat production as head crop. Through financing of equipment the goal has been to incorporate 1.0 million/ha/year of Cerrados to crop production. PROFIR has resources of about US\$ 200 million and covers about 80% of Goiás and Minas Gerais. To pay for the loans it is given 6 years to the producer with 2 of grace and interest rates of 45%/year.

At the same time, the Ministry of Agriculture is carrying out studies to install electric energy in the region with resources of 30 million dollars. Also the Research and Extension Services are providing accelerated training for extensionists.

Under this program, three types of sprinkler irrigation equipments are being financed: Central Pivot, Auto-Propelled, and Conventional. Two crops a year and three production systems can be produced: wheat-soybeans, wheat-maize, wheat-edible beans. If seven yield levels for each crop and four planning horizons (six, nine, twelve and fifteen years) were considered, a total of 1,764 possible alternative projects, would result. For each these projects, its gross income, cost of production and net income were estimated. Next, also for each project, its present value and its internal rate of return were calculated. The results show: 1) for the Central Pivot and for a project of nine or more years, most of the yields combinations of crops are economically feasible; 2) for other irrigation equipments, six years are sufficient to indicate economic feasibility for most of the yields combination of crops. These results are now being presented to farmers by the extension service.

Special Development Program. As a result of the phasing out of POLOCENTRO by the Government in 1980, another program was created: PRODECER - Program for the Development of Cerrados. This Program was created as result of the Brazil-Japan Cooperation Program and can be divided into two areas:

- Research, to develop technology for the region and
- Financial, to create a private type organization CPA-Campo to establish a pilot project of farm management in the region. Through this organization 58,754 ha were bought in 1978. From these, 38,020 ha were divided into three lots to be colonized by 94 families. It is also planned to create a large agriculture enterprise of 10,000 ha. Brazil's Government resources are of US\$ 25 million and the Japan Government enters with US\$ 25 million, to be used for land acquisition, infrastructure and credit for the farmers.

In 81/82 soybean, wheat and rice harvested in the area amounted to 1,200, 395 and 361 t respectively. The Japan government through (JICA) has agreed to increase investments up to US\$ 400 million in view of the success of the Program. The Program has already generated 5,000 direct jobs at a cost of US\$ 7,700 each, which is far less than the cost shown by industry of US\$ 20,300 in Bahia.

Conclusions

An extraordinary agricultural development is taking place in the Cerrados of Brazil. In spite of soil characteristics like extremely low fertility, high acidity, low water and nutrient retention capacity, satisfactory harvests have been obtained as a result of development of suitable technology for soil, plant and water management by research centers located in the area as result of Government planning. Government is also making a big effort in allocating resources for credits at subsidized rates, to allow for investments and adquisition of fertilizers and irrigation equipment. However, to develop the area will require large amonts of fertilizers and liming materials, irrigation equipments, seeds, pesticides and trained personnel that may limit further expansion of agriculture. Intensive agriculture may result also in soil erosion or nutrient leaching of considerable magnitude.

Several other problems has to be faced as a result of present and future development like storage of products, rising costs of transport, building of roads, improvement of communications, migration of farmers from the south, rural extension and credit facilities.

Adoption of traditional technology, based on the use of natural soil fertility and organic matter will deplete the soils and promote erosion resulting in low productivity, degradation of the environment and new migration processes. Therefore, planning and zoning of agriculture according to its inputs and environmental requirements may be essential for a balanced growth of the region.

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