

## PERSPECTIVES ON SUSTAINABLE DEVELOPMENT IN BRAZIL

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### Summary

Brazil is a vast country characterized by a high biodiversity, a diversified economy, great social disparities, and deep regional imbalances. Its colonial history has been profoundly marked by the exploitation of natural resources. On the other hand, the twentieth century has been characterized by high economic growth rates, averaging 4.1 percent yearly, intense industrialization and a significant increase in the output of agricultural goods. Social inequalities were a consequence of economic growth and Brazil features one of the highest indexes of income concentration in the world, where the richest 1 percent earns as much as the poorest 50 percent of the population.

Economic growth has been achieved at a high ecological cost. The Atlantic rainforest has been reduced to 8 percent of its original surface and the Amazon loses 18,000 km<sup>2</sup> of forest every year. Erosion rates are very high in many agricultural regions and siltation is intense in most major rivers, while desertification is apparent in the semi-arid zone. In major cities, largely inadequate sewage schemes led to the degradation of water resources and very bad sanitary conditions for poor populations. The legacy of uncontrolled industrial activity is manifest by a still unknown number of contaminated sites.

However, natural resources are still abundant, albeit unevenly distributed. Brazil features the largest forest cover in the world, at approximately 4.8 million km<sup>2</sup>, corresponding to 55 percent of the national territory, while 12 percent of the world's freshwater surface flow originates in Brazil. Meanwhile, a number of social and health indicators, such as infant mortality, have shown a significant improvement in the last twenty years. Most important, democracy has established firm roots in Brazil, where

many civil society organizations flourish and effectively participate in, and influence, various decision-making processes. The government has been extremely slow in tackling sustainable development issues, but society has been much more dynamic.

## 1. The Natural Setting

The portion of the earth's surface situated in tropical South America that makes up the political entity called Brazil plays a key role in maintaining the planet's capacity to provide a safe and healthy future for its inhabitants. Covering 8,517,403 km<sup>2</sup>, Brazil is the biggest tropical country in the world and ranks fifth in surface area overall. Diversity is a key word to portray its natural environment. Brazil is believed to shelter 22 to 24 percent of the world's higher plant species and ranks first in diversity in the world's plants and amphibians, third in birds, and fourth in mammals and reptiles. The Amazon basin concentrates around 25 percent of the world's freshwater fish species, making Brazil the foremost country in biodiversity within this sub-group. One hectare of tropical forest contains about 600 plant species. About 30 percent of the world's remaining tropical forests are in Brazil, which retains the largest forest cover on the planet. No less than 12 percent of the world's freshwater surface flow originates in Brazil.

The landmass forming the Brazilian territory is mostly ancient. Roughly 50 percent of the country's surface is made up of crystalline rocks older than 570 million years, while the other half is mostly composed of the Phanerozoic sedimentary basins, among which the Amazon, Paraná, and Parnaíba are the largest. Coastal plains, limestone plateaux featuring karst relief, and the Pantanal swamp depression – forming the largest wetland on earth – add to a variety of landscapes and environments. Along the coast, coral reefs extend for 3,000 km.

Ranging from approximately 5°16'20" North to 33°45'03" South, and from 34°47'30" to 73°59'32" West (excluding oceanic islands), the territory stretches for 4,394.7 km in the north–south direction and 4,319.4 km in the east–west direction. An assemblage of lowlands, highlands, and mountain ranges provides the conditions for different climate types. Lowlands from sea level to 200 m cover 41 percent of the country's surface, while 51.71 percent of its territory lies between 200 and 800 m in altitude, with a mostly hilly to sub-mountainous topography; the remaining 7.27 percent are situated above 800 m. Significant mountain ranges are the Serra do Mar and its ramifications, accompanying the coast at a distance from 5 to 120 km from Rio Grande do Sul to Espírito Santo, and reaching a maximum altitude in Pico da Bandeira (2,890 m) in Espírito Santo; the Serra do Espinhaço, dividing the São Francisco river basin from coastal basins in Minas Gerais and Bahia states; and the northern ranges Imeri, Parima, and others, marking the border in Amazonas and Roraima states, where lies the country's highest peak, Pico da Neblina, at 3,014 m above sea level. Vast flat-topped mesetas, called *chapadas*, are a characteristic feature in Central Brazil's landscape (see Plate 1).



Plate1. As a typical chapada, Parecis, in Mato Grosso State is a vast sandstone plateau. Savanna (*cerrado*), the predominant vegetation, is under pressure for agricultural development, especially soybean monocultures. Photo: L. E. Sanchez.

An equatorial climate (hot and wet) is predominant in the north and most of Amazonian region. Tropical climates range from humid on the Atlantic coast to semi-arid in the north-east to a seasonally dry-wet climate in most of Central Brazil, from Minas Gerais to Mato Grosso. Subtropical to temperate climates are dominant in Southern Brazil. Intense solar radiation over a significant part of the country during most of the year makes solar energy a potentially vast, though as yet virtually untapped, resource.

Average annual rainfall for most of the territory is above 1,500 mm. Zones such as the Uruguai river valley and most of the coast receive rainfall in excess of 2,000 mm, with up to 4,000 mm in the Serra do Mar. In Western Amazon, average rainfall is above 2,000 mm, rising towards the Colombian border, where it reaches 3,500 mm. There is a semi-arid pocket in the north-east, where annual rainfall is below 800 mm, reaching indexes as low as 400 mm. Compared with rainfall in other parts of the world, this figure is not excessively low, but rains are irregular in the semi-arid zone, and concentrated in a few intense episodes. In addition, some years may be entirely dry.

Major Brazilian biomes are: (i) Amazon forest; (ii) a savanna-like vegetation known as *cerrado*; (iii) the scrubland *caatinga*; (iv) the Atlantic rainforest, and (v) the Southern grasslands. A number of local and regional variations, transition zones and enclaves create a mosaic of environments and habitats that explain the high biodiversity (see Plate 2).

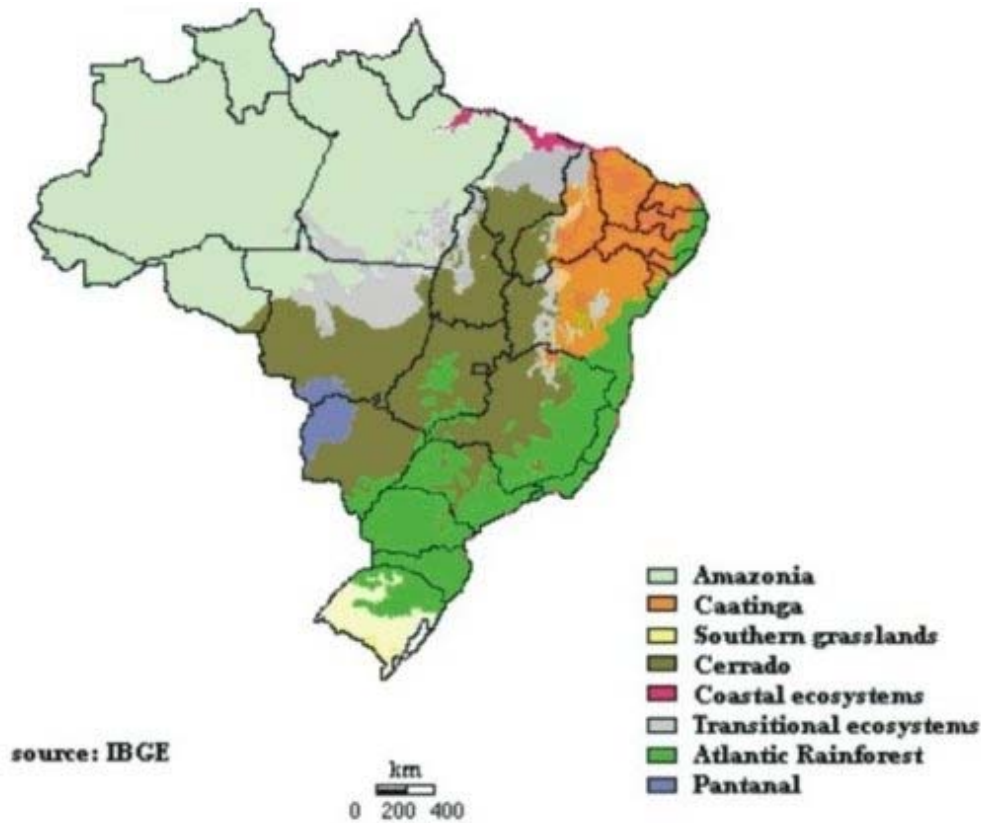


Plate 2. Major Brazilian biomes.

The Amazon forest covers about 3.7 million km<sup>2</sup> in Brazil. A major division of the Amazon environment is between seasonally flooded areas and those that are not (*terra firme*). Both shelter forest, but *terra firme* also features, among other vegetation types, *cerrado* (savanna) patches and *campinarana* (a kind of grass-land) over sandy soils occupying significant areas. The floodplain is 20 to 100 km wide, featuring marginal lakes and vegetation adapted to the water regime. The Amazon forest features high biomass (up to 500 tonnes/ha) and is believed to hold about 20 percent of the total quantity of carbon in the earth's atmosphere

Core *cerrado* areas once covered about 2 million km<sup>2</sup>, mostly in the central highlands. The savanna physiognomy is far from homogeneous, ranging from open grasslands (*campo limpo*) to closed tropical dry forest (*cerradão*); in between, biogeographers recognize different sets of woodland savanna with shrubs, small trees, and a well-developed herbaceous layer, all adapted to a marked wet-dry climate pattern. Large stretches of riparian vegetation (called gallery forests) are characteristic along creeks and rivers, while at high altitudes (above 1,000 m), a particular kind of open rocky grass-land called *campo rupestre* is known for its high plant endemism. Moreover, *cerrado* vegetation is considered to feature high levels of endemism: it is estimated that about 44 percent of its plant species are endemic.

The *caatinga* biome (from a Tupi language word meaning “white brush”) occurs over the semi-arid lands of the north-east. It is characterized by an irregular rainfall regime,

which supports plant species adapted to dry conditions. Originally this biome covered an area estimated at about 0.73 million km<sup>2</sup>.

The Atlantic rainforest, which once covered about 1.1 million km<sup>2</sup>, has the highest diversity of all Brazilian biomes. Of about 20,000 plants, 30 percent are endemic; 160 out of 261 mammal species, 73 out of 620 bird species, 60 out of 200 reptile species and 253 out of 280 amphibians are deemed endemic. High rainfall is a common feature of this region, which follows the coast line for about 3,200 km from Rio Grande do Norte to the north of Rio Grande do Sul, and penetrates for about 1,000 km to the west in Paraná and São Paulo states to reach Mato Grosso do Sul. The coastal mountain range Serra do Mar rises to 1,000–1,800 m a few dozen kilometers from the coast line. In the Southern plateaus *Araucaria* woodlands, usually classified as part of the Atlantic rainforest, once covered 0.22 million km<sup>2</sup>. Here, sub-tropical to temperate climate and a well-distributed rainfall pattern give place to this forest dominated by the coniferous tree *Araucaria angustifolia* (see Plate 3).

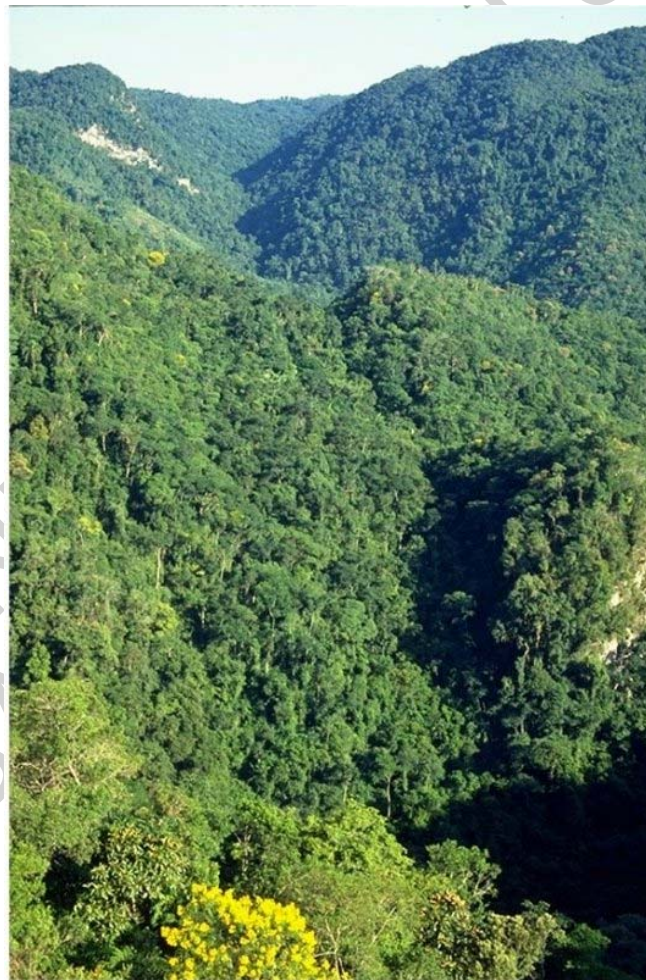


Plate 3. This aerial view of Serra do Mar in the Ribeira Valley, São Paulo State, shows remnants of rainforest protected as a State Park. The Atlantic rainforest is the most radically altered biome in Brazil, today restricted to about 8 percent of its original extent. Photo: L. E. Sanchez.

In the southernmost part of Rio Grande do Sul state, there occurs a prairie known as *pampa* in an area estimated at 0.17 million km<sup>2</sup>. The *Pantanal* wetland is a seasonally-flooded depression in the Paraguay river basin, spreading over 0.14 million km<sup>2</sup> (see Plate 4).



Plate 4. A jabiru (*jabiru mycteria*) in the Pantanal landscape. This interior wetland encompasses 138,183 km<sup>2</sup>. Cattle raising, commercial and sports fishing, and ecotourism are the main economic activities in this region. Being very rich in biodiversity it shelters many endangered species. Photo: L. E. Sanchez.

Transition environments cover as much as 0.71 million km<sup>2</sup>. These are areas featuring characteristics of two neighboring biomes. Examples include: (i) the dry forests of northern Mato Grosso, showing species common to both savanna and the Amazon forest, whose extension is estimated at 0.41 million km<sup>2</sup>; (ii) the *babaçu* woodlands of Maranhão, featuring this dominant palm tree (*Orbignya speciosa*) for about 0.15 million km<sup>2</sup>; and (iii) the dry forests which make up the contact savanna/*caatinga*, in the north-eastern region, occupying about 0.12 million km<sup>2</sup>.

Mangrove swamps and *restinga* (reefs) are vegetation types occurring in the coastal zone. Marine environments include shallow and deep sea sedimentary floors as well as coral reefs, whose most important areas are: the north-eastern coast from Maranhão to Alagoas, and the eastern and south-eastern coast from Todos os Santos bay in Bahia to Santa Catarina. Brazilian coral reefs are very rich environments, featuring a few endemic coral species and no less than 400 fish species, of which more than fifty are endemic.

Throughout the country most soils are acid, featuring low to medium fertility. Table 1 shows a classification of soils based on their agricultural potential. Approximately 50 percent of the country area is covered by soils of low aptitude for agriculture or livestock raising.

Class	Area (%)	Main limitations to agricultural utilization
Good	4.2	nil
Good to medium	4.0	nutrient deficiency
Medium to good	5.0	flooding and drainage
Medium	30.5	nutrient deficiency and excessive aluminum
Medium to restricted	9.2	nutrient deficiency, low depth, steep slopes
Restricted	9.4	steep slopes, high erosion susceptibility, nutrient deficiency
Restricted to unfavorable	2.4	excessive sodium, bad drainage, flooding
Highly unfavourable	35.3	most of the above

Table 1. Classes of soil based on agricultural potential

Water resources are abundant in Brazil but poorly distributed. Runoff depends on the intensity and distribution of rainfall, as well as on vegetation cover and soil permeability. Specific flows show enormous variation along the country, from 48.2 l sec<sup>-1</sup> km<sup>2</sup> in North Atlantic basins (eastern Amazon) to 2.8 l sec<sup>-1</sup> km<sup>2</sup> in the semi-arid zone. Table 2 shows the main hydro-graphic basins with their respective specific and mean annual flows. Total flow originated in Brazilian territory amounts to 177,900 m<sup>3</sup>/sec. While there is plenty of water in the sparsely populated Amazon, the densely populated areas along or near the coast have limited supplies in proportion to their needs.

Basin/region	Area (km <sup>2</sup> )	Average flow (m <sup>3</sup> sec <sup>-1</sup> )	Specific flow (lsec <sup>-1</sup> km <sup>2</sup> )
Amazon <sup>(a)</sup>	3,900,000	128,900	33.0
Tocantins	757,700	11,300	14.9
Parnaíba + N Atlantic	242,000	6,000	24.8
North-eastern Atlantic	787,000	3,130	4.0
São Francisco	634,000	3,040	4.8
Eastern Atlantic	242,000	670	2.8
Paraíba do Sul	303,000	3,170	12.2
Paraná <sup>(b)</sup>	877,000	11,200	12.8
Paraguai <sup>(b)</sup>	368,000	1,340	3.6
Uruguai <sup>(b)</sup>	178,000	4,040	22.7
Southeastern Atlantic	224,000	4,570	20.4

Table 2. Main hydrographic basins and their flows

The stock of groundwater is estimated at 112,000 km<sup>3</sup>. It is mostly concentrated in sedimentary basins, with the largest reserves found in the Paraná basin (50,400 km<sup>3</sup>), Amazon basin (32,500 km<sup>3</sup>), and Parnaíba basin (17,500 km<sup>3</sup>). The Guarani aquifer of the Paraná basin is considered one of the most important in the world.

The exclusive economic zone (EEZ) in the ocean amounts to approximately 4 million km<sup>2</sup>, while the coastline extends for 7,367 km, excluding inlets, bays and other features. The productivity of marine fisheries is relatively low, a common feature in tropical waters. Exceptions are the southernmost part of the coast, under the influence of the Falkland current, and the North Atlantic, due to the large nutrient input from the Amazon waters.

## **2. A sense of history: occupation of the territory**

History books used to differentiate between two broad types of colonies in the Americas: settlement and exploitation colonies. European immigrants established settlement colonies in temperate North America during the seventeenth and eighteenth centuries. After an initial period of exploration and fur trading, colonists arrived, fleeing famine, misery, and religious intolerance, or simply trying to thrive in an adventurous New World. In contrast, tropical America remained for a long time a source of natural resources, furnishing precious metals, in the case of Spanish colonies, or wood, other forest products (e.g. native peppers, richly colored birds), and sugar cane, in the case of Brazil.

The country's name derives from the tree *Caesalpinia echinata*, known as brazil wood, called *pau-brasil* by the Portuguese, which was intensively exploited for the extraction of its red pigment. Etymologically the name brazil comes from the old French "breze" (*braise* in modern language, meaning ember), because of the red color of its wood. Former names attributed to the new lands, such as the Land of the Holy Cross, of obviously Catholic origin, were dropped in favor of the more pragmatic and commercial name of Brazil, the land where the red tree comes from.

*Pau-brasil* is said to have been very abundant along the coastal forest, the Atlantic rainforest ecosystem. However, its intense and selective exploitation, in which Portuguese, French, and other European traders exchanged its trunks, cut down by native populations, for mirrors, combs, whistles, hoes, and knives, led to a scarcity as early as the late sixteenth century, prompting the Portuguese Crown to enact a regulation in 1605 trying to restrict its exploitation.

When Cabral, the first Portuguese to officially land in Brazil, went ashore on April 22 1500, it is estimated that the territory which today makes up the country counted around 5 million indigenous people. Even though the population was sparse it made an impact on the environment. Those living in the Atlantic facade, the first to meet and to suffer from the Europeans' arrival, were semi-nomads practicing slash-and-burn agriculture, hunting, fishing, and collecting mussels, fruits, and other resources. But they had no domestic grazing animals and hence the area needed for subsistence was relatively small when compared to the area need to sustain European settlements during that time.

A conventional manner of describing the economic history of Brazil is to refer to "cycles" or the predominant activity (in terms of export earnings) in each period. The most important cycles include sugar cane, gold, coffee, and rubber, all of them named after a natural resource. Of the agricultural products it is interesting to notice that only rubber is a native plant.



Sugar cane was initially planted on the coastal lowland in the state of São Paulo, but only became a commercial success in the north-east, mainly in Pernambuco. Fundamental to this enterprise was the traffic in African slaves, the workforce behind the riches created by exports of sugar to Europe. The Portuguese settlers who ruled the business followed indigenous agricultural techniques, cutting and burning the forest, a practice that furnished nutrients to the new plants but was short-lived, as new areas had continuously to be opened for plantation. Sugar cane is still planted today in the north-east's "Wood Zone" (*Zona da Mata*), an area deforested a long time ago. In the 1930s sociologist Gilberto Freyre called attention not only to the almost complete destruction of the Atlantic rainforest in the sugar cane belt, but also to soil erosion, water pollution due to wastewater from sugar mills, and the almost complete substitution of native fauna and flora by imported elements, to the point where mangos, coconut trees, and cane fields, alongside cattle and horses, seemed as "natural" in that landscape as the men and women resulting from mixed European, African, and American inter-breeding, whereas, in fact, native Indians had been almost completely wiped out.

When coffee was introduced in Rio de Janeiro around 1780, after unsuccessful attempts in the state of Pará, the same primitive cultivation technique was used, slash-and-burn, moving on to new areas when soil fertility dropped and soil became eroded. In the hilly region of Paraíba do Sul valley this happened quickly. A coffee track can be followed going upstream the valley, and then, in the late nineteenth century, turning north and north-west in the state of São Paulo, towards the southern part of Minas Gerais and the northern part of Paraná, during the twentieth century. Several travelers in the early nineteenth century noticed the ravages, particularly Auguste de St. Hilaire, who published extensively on what he saw in his several trips along the country (see Plate 5).



Plate 5. Coffee beans left to sun drying in a traditional farm in São Paulo State. This exotic plant played a very important role in Brazilian history, as its cultivation needed a large workforce composed essentially of European immigrants. Capital accumulated by the "coffee barons" is at the origins of the country's industrialization in the late nineteenth and early twentieth century. A vast network of railways has been established to export coffee, and thousands of square kilometers of native vegetation have been cut to plant it. Photo: L. E. Sanchez.

Gold mining began in the late seventeenth century, when nuggets were found in Sabará, in what was to become the state of Minas Gerais (literally, the “general mines,” for its richness in mineral resources, later confirmed for many other minerals as well). The gold cycle had two major political and economic consequences. First, the capital was moved from Salvador, in the north-east, to Rio de Janeiro, at that time a small town, but much closer to the mining region, and one of the few harbors through which the gold could be embarked. A second consequence was the expanding settlement in the mining area. Environmental consequences included deforestation for mining purposes, and indirectly, as land clearance for agriculture and cattle raising to sustain the growing population. Abundant water was the driving force for dissociating ore bearing strata, and many channels have been built to carry water to the mines. Mato Grosso and Goiás also had their gold boom, but not with the same impetus as in Minas Gerais. When production peaked around 1750, Brazil was the biggest gold producer in the world, but the rudimentary technology, the virtually absent knowledge of ore deposits’ geology, and a colonial government whose interests did not go beyond collecting the 20 percent tax, led to an inexorable decline.

Agriculture, cattle raising, and human settlements were certainly the main driving forces of environmental change in Brazil until the early 1900s. Cattle ranching, today an extensive activity occupying millions of hectares at very low productivity, and subsistence agriculture, sustained a low-growth population rise. The semi-arid region in the north-east had been used for ranching since the seventeenth century on lands unsuitable for sugar-cane plantations. After the decline of gold production, the population living in the mining regions began to disperse through central Brazil, again having extensive cattle and small agricultural plots as the basis for subsistence. The southern grasslands, naturally adapted to cattle, were initially occupied by settlers from São Paulo, who engaged in producing leather to supply the growing demand of the mining zones.

After independence in 1822, the population of the whole country was still heavily concentrated along the north-east coast and around Rio de Janeiro, with a few centers in Minas Gerais, Goiás, and Mato Grosso, as well as along the south coast as far as Santa Catarina, where immigrants from the overpopulated Azores islands had settled in the second half of the eighteenth century. Most of the country was sparsely populated, and native populations had been decimated by diseases, captured as slaves, or simply killed by colonists. A policy of induced immigration had been timidly initiated by the Portuguese government in the previous century, but a firm immigration policy was launched only after independence (1822), and especially during the second half of the nineteenth century.

To gain control over southern Brazil, the new government offered to settle central European colonists. The first German colony, São Leopoldo in Rio Grande do Sul, was founded in 1824, followed by others in this state and in neighboring Santa Catarina. While the grasslands had been used by the Portuguese and their descendants for raising livestock since the seventeenth century, the forests remained practically untouched (and inhabited by remaining indigenous populations). These forest lands were offered to the new colonists, who followed the traditional indigenous slash-and-burn technique and, in contrast to the big cattle ranches, established small rural properties. Since land plots

were too small to support subdivision, the second generation had to search for new lands as a continuous process, the modern version of this being the settlement of Goiás and Mato Grosso, in the savanna, as well as Rondônia and South Pará, in the Amazonian region, during the 1970s and beyond.

Colonization policy in the southern states proceeded by attracting Italian, Polish, Ukrainians, and other peoples. In the 1870s the highlands of Rio Grande do Sul and the woodlands of southern Santa Catarina were settled by Italians, while Poles and others settled mainly in Paraná. Other colonies were established elsewhere, such as in Espírito Santo, Rio de Janeiro, and Minas Gerais. As geographer Leo Waibel noticed, although the slash-and-burn techniques used by the early Portuguese settlers in their large rural land holdings led to decreasing yields, abundant land allowed for the reproduction of this method as long as other production factors – capital and labor – were scarce. For small properties, however, this approach was clearly unsustainable, leading to poverty among colonists. Amazingly, the association of raising livestock with small-scale agriculture and the use of manure as fertilizer, so common in Europe, was seldom employed by these pioneers. Another consequence of the itinerant slash-and-burn system, according to Waibel, was the economic and spatial segregation of agriculture and cattle raising, characteristic of the Brazilian countryside. A different model was adopted for the coffee growing areas in São Paulo, where colonists (many of them Italians) were not attracted to settle on their own plots, but to act as a workforce. The expansion was led by coffee growers, whose major strategy was, again, to cut down forests to open new lands.

Deforestation in the southern region soared in the mid-twentieth century. In Paraná, the original forest cover is estimated at 84.72 percent of the state's surface area, or 16.8 million hectares. Data compiled by Bacha show that in 1930 forests still covered 65 percent of the total state area, and 40 percent in 1950. In other words, in the middle of the century, Paraná still had about half its forest cover, but the area declined quickly to 19 percent in 1970 and 5 percent in 1992. Most of what remains belongs to parks or other protected areas. In Santa Catarina, the advent of the railway linking São Paulo to Rio Grande do Sul in the early twentieth century opened up a huge area for logging. As a result, from the original forest cover, estimated at 81.49 percent of its surface, Santa Catarina, which still featured 78 percent of such cover in 1912, had no more than 30 percent in 1959, and only 16 percent in 1990.

Other immigrants followed. On June 18 1908 the first liner bringing the Japanese landed in Santos harbor. Subsidized by the Brazilian government until 1922, early immigration was also intended to furnish labor to coffee farms, but many colonists chose to abandon such jobs and to establish themselves either as sharecroppers or tenants, or later in small family-owned properties. From 1925 onwards the Japanese government played an active role in organizing emigration and subsidizing colonization companies which acquired extensive tracts of land, especially in São Paulo and northern Paraná, to resell to immigrants, thereby laying the foundations for familiar small plot agriculture. After the Second World War the pattern of immigration changed, attracting skilled industrial workers, mostly from Europe, desperately needed by a booming industry.

Land has never been scarce for large rural activities, but land access was never

facilitated for small-scale agriculture. When the slave trade was halted, and it was only a matter of time until slavery was abolished in Brazil, the government passed the 1850 Lands Act, establishing that public lands would no longer be freely granted to individuals: they could only be sold, which obviously prevented liberated slaves from acquiring land. The historical consequences of such policies – on social, economic, and environmental plans – still pervade Brazilian society today. Many of the rural poor were expelled from the countryside, and the development of familiar agriculture was hampered, thus making the development of an internal market much more difficult. Internal capital accumulation has been slow, causing a chronic dependence on external capital, the reimbursement of which drains financial resources and in turn prompts more natural capital to be transformed in marketable resources.

An exception was the industrial development in São Paulo, which grew from capital accumulated by coffee production and trade. Unlike other export-oriented economies, in São Paulo textiles, food processing foundries, metal works, and other factories began to flourish in the late nineteenth and early twentieth centuries. In other parts of the country, industries were born, but nowhere else was their continuous growth sustained at that time. Later on, during the two world wars, some Brazilian industrialists profited from the shortage of imported goods and new industries appeared in other parts of the country, such as Santa Catarina and Rio de Janeiro.

The establishment of heavy industries was due to government initiatives, beginning during the first Vargas government (1930–45). The large Volta Redonda steelworks were inaugurated in 1945, while oil prospecting was undertaken by the state-owned company Petrobrás. During the period of military rule (1964–85), chemical and petrochemical plants, more steelworks, and other heavy industries were established.

A significant development in the industrialization process was the initiation of the automobile industry. This was actively stimulated by President Kubitschek (1956–60), whose development plan (*Plano de Metas*) included transferring the federal capital from Rio de Janeiro to the new and specially built Brasília (inaugurated in 1960). This sector demanded an increase in the extraction of raw materials and the production of capital goods and had a major impact on the economy. Such a policy choice brought serious social and environmental consequences similar to what happened in other parts of the world. Brazil is today the world's eighth biggest car producer, with a fleet of 29 million vehicles.

Industry played a significant role in shaping contemporary Brazilian society. Industrial growth incited urbanization, which in turn prompted a construction boom in southeastern cities, supplying millions of rural workers who settled in an urban environment. New civil rights movements arose from the new urban-industrial culture, including a strong trade unionism bred in the metal industries and automobile centers near São Paulo, since the late 1970s.

### **3. Economy and society**

Although Brazil has reached a relatively high level of economic development, occupying eleventh position in terms of gross domestic product, income per capita is

relatively low – \$4,400 – placing the country in the group of medium income economies. The growth of the Brazilian economy has been significant in the twentieth century, averaging 4.1 percent a year. However, much of the progress obtained during the fast-growing period 1950 to 1980 has come to a halt in the last two decades. Whereas the share of revenue generated in Brazil as a percentage of world revenue grew, from 0.7 in 1900 to 3.49 in 1980, it dropped to 2.83 by 1999. Furthermore, while per capita income had experienced a steep increase from 1930 to 1980, it has since stagnated; in 1980 Brazilian per capita income corresponded to 36 percent of average per capita income of rich countries, but this figure was reduced to 27 percent by 1999. Thus the gap between the standard of living of an average Brazilian citizen and that of a person who lives in a rich country deepened. Actual per capita income decreased in Brazil between 1980 and 1990, showing a slight recovery in the 1990s.

However, average figures hide the great disparities in Brazilian society. Income is highly concentrated in Brazil: 43.4 percent of national income is in the hands of 10 percent of the total population, while the poorest 20 percent have only 3.4 percent of national income. The poorer 40 percent share 10.4 percent (IBGE data, 1996), less than the upper segment represented by the richest 1 percent, who shared 13.1 percent of the national income in 1999, almost the same proportion as the lower 50 percent segment (14 percent). Income distribution is affected by race: Brazilians of African descent, who make up 45.33 percent of the population, are on average 2.5 times poorer than whites (who comprise 54 percent).

Economic development has been achieved at a social and ecological cost. In terms of the human development index (HDI), Brazil ranked only in the seventy-fourth position in 1998, according to data compiled by the United Nations Development Programme. A historical and persistent characteristic of Brazilian society is the disparity between rich and poor, between the educated and the illiterate, between those who have access to health services and those who do not. Regional and local estimates of HDI also mirror such disparities. Using 1991 census data, it was calculated that eighty municipalities, in which were concentrated 20 percent of the country's population, had a high HDI (> 0.8), while 40 percent of the total population lived in municipalities with low HDI (<0.5). Moreover, a detailed study for Belo Horizonte showed that its richest neighborhood had a HDI of 0.908 while the poorest had a HDI of 0.502.

In spite of deeply rooted social differences and a growing concentration of wealth, some social indexes show an improvement in living conditions for a significant portion of the population. If HDI is retrospectively calculated, as shown in Table 3, progress can be noticed, as the index rose from 0.639 in 1975 to 0.747 in 1998. Infant mortality, an important indicator of sanitary and health conditions, fell from 85.6 deaths per thousand in 1980 to 34.6 in 1999 (Figure 1); in this year infant mortality in the north-eastern states was 53.0, while in the southern states the rate was 20.7. There are, of course, important variations related to household income, mortality rates being higher among poorer families. Life expectancy at birth averages 67.6 years, ranging from 70.2 in the south to 64.5 in the north-east.

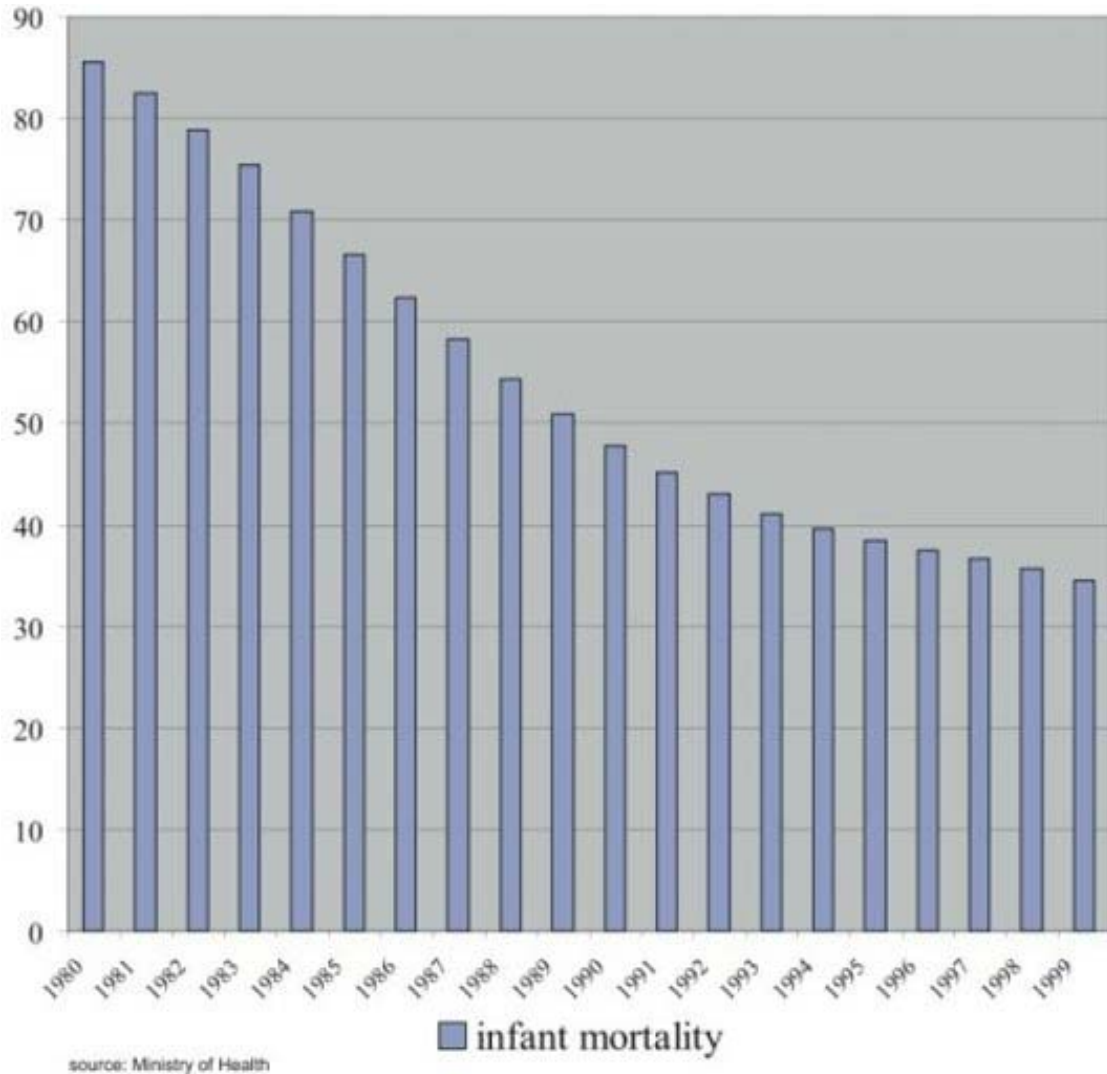


Figure 1. Infant mortality in Brazil 1980-1999

1975	1980	1985	1990	1998
0.639	0.674	0.687	0.706	0.747

Table.3 Evolution of human development index in Brazil

A major hindrance to development is the lack of education. In Brazil, the average number of years a person attends school is only 5.4, with important regional discrepancies, shown in Table 4. Comparatively low spending on educational programs usually combines with a high drop-out rate, especially in rural areas, and extremely low salaries for teachers in elementary and high schools. An innovative experiment was launched in the mid-1990s by the district government in Brasília, by which low-income families who maintain their children in public schools are “compensated” by receiving a monthly allowance, a program later copied by several state and local governments. For the whole country, the rate of school attendance for poor children between seven and fourteen years old rose from 74.5 percent in 1992 to 92.5 percent in 1999, a sign of improvement. Formal illiteracy fell from 17.2 percent to 13.3 percent between 1992 and

1999, but functional illiteracy (corresponding to less than four years of school attendance) is still 29.4 percent on average and reaches 53 percent in Piauí state. Illiteracy is higher among women, a rate as high as 22.8 percent.

Region	Years of school attendance		
	Average	Male	Female
Brazil	5.4	5.3	5.6
Northern	5.4	5.2	5.5
North-eastern	4.0	3.8	4.3
South-eastern	6.2	6.1	6.2
Southern	5.9	5.9	5.9
Central-western	5.7	5.4	5.9

Table4. Years of school attendance, population over 10 years old

Uneven development hits minorities, which contribute enormously to the richness and diversity of Brazilian society. Illiteracy also reflects race disparities: the average illiteracy rate is 8.3 percent among whites, but as high as 19.8 percent among blacks, and school attendance is 4.5 years for blacks and 6.7 years for whites. In recent years a significant step towards recognizing the cultural heritage of Brazilians of African descent has been the acknowledgement of the rights of traditional communities who fled slavery in the eighteenth and nineteenth centuries, and established themselves in remote areas (known as *quilombos*), to the lands they use. About 81,000 people live today in about 700 such areas, of which thirty-one have been officially recognized by the government (as of 2000).

The remaining 300,000 indigenous people, from an estimated population of about 5 million in the sixteenth century, still fight for wider social recognition of their rights to ancestral lands and full cultural identity. There are today 343 recognized Indigenous Areas, occupying 757,161 km<sup>2</sup> (8.9 percent of national territory), while 143 other areas are claimed, corresponding to 47,979 km<sup>2</sup> (according to data compiled by *Instituto Sócio-Ambiental*, an NGO). The vast majority of indigenous reservations (98 percent) are situated in the Amazon, like most of the 215 remaining indigenous societies, whose members speak 170 different languages, an immense cultural treasury still little studied, and whose ecological knowledge is still largely ignored.

Social and cultural diversity, together with biological and geographical diversity, are valuable assets in building sustainable societies, and Brazil has no shortage of them.

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### **Biographical Sketch**

**Luis Enrique Sánchez** graduated in Mining Engineering (in 1980) and in Geography (in 1984) both from the University of São Paulo, Brazil. After working for the Ministry of Mines and Energy, he undertook postgraduate studies in Mining in the École des Mines de Nancy, France and received his Ph.D. in the Economics of Natural Resources and Development from the École des Mines de Paris, France, in 1989. His thesis dealt with the roles of environmental impact assessment of mining projects. Having worked as an environmental consultant in São Paulo, he joined the Department of Mining Engineering of the Escola Politécnica, University of São Paulo, in 1990, teaching environmental planning and management. In 1996–7 he worked as invited lecturer with the Department of Geography, University of Montreal, Canada.

Professor Sánchez has published papers on subjects such as the effectiveness of environmental impact assessment, corporate strategies to tackle sustainable development challenges, environmental indicators, environmental liabilities, contaminated soils, caves and karst environments, the environmental impacts of mining, and acid mining drainage. He authored a book on environmental liabilities arising from decommissioning industrial plants (published in Portuguese in 2001 by the University of São Paulo Press, Edusp). He lectured at the UNESCO short courses on Geological Aspects of Environmental Protection, held at the State University of Campinas, Brazil, in 1995 and 2000, and wrote several chapters of the companion book (in Spanish).

He is a member of national and international professional organizations, including the International Association of Impact Assessment, where he acted as director from 1998 to 2001. He is also a fellow of Lead – Leadership for Sustainable Development. As a caver and environmental activist he participated in several campaigns in Brazil in the late 1970s and early 1980s.