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**The Development Process in the Northern Region of Brazil:
An Analysis of the Health Conditions**

by

**Ana Maria R. Pereira
B.A. (State University of Rio de Janeiro)**

**A thesis submitted to
the Faculty of Graduate Studies and Research
in partial fulfilment of
the requirements for the degree of**

Master of Arts

**Department of Geography
Carleton University
Ottawa, Ontario
September 1996**

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An Analysis of the Health Conditions"**

submitted by

Ana Maria R. Pereira, B.A.

in partial fulfilment of the requirements
for the degree of Master of Arts

Thesis Supervisor

Chair, Department of Geography

Carleton University

September 1996

ABSTRACT

Since the mid-1960s, governmental policies have been directed towards the integration of the Northern region into the mainstream of the Brazilian economy. That region has undergone deep transformations, through infrastructure development, new patterns of capitalist expansion, and large flows of internal migration. Economic objectives have predominated over people's well-being, particularly their health conditions.

The environmental impacts of these changes are important to infectious parasitic diseases, which have environmental vectors involved in their transmission. Such diseases that affected people living in the forest fringes had their occurrence increased. The disorganized growth of urban areas, incapable of providing housing and sanitation also kept the incidence of communicable disease high, in addition to the existing diseases of the life-style.

This research's main conclusions indicate that the government policies did not introduce significant improvements in the health conditions of the local population. The main recommendation is that policy implementation should guarantee health provision, and sanitation since health is worthy consideration, especially when it involves environmental change. The enhancement in health data is vital to orient policy and planning.

ACKNOWLEDGEMENTS

I would like to express my appreciation for the warm welcome I received from the Department of Geography. This research would not have been possible without all the professors, who made my return to the classroom a meaningful experience, and who made me look at the world through another perspective.

In particular, my sincere gratitude goes to Professor Ken Torrance, my thesis supervisor, whose patient guidance gave me confidence to pursue this work. Professor Torrance has greatly contributed to my development in the environmental field. His support was much appreciated since the early stages and throughout the development of this research.

Special recognition is accorded to Professor David Bennett, member of the advisory committee, who shares with me deep interests in health issues, for his valuable contribution and fruitful discussions toward this thesis research.

This academic endeavour has allowed me to meet other fellow graduate students that also brought a new vision of "our small planet". I thank many new and old friends for their warmth.

I am in debt of gratitude to my husband Allemander for his support and encouragement since the beginning, and for believing that I could face this challenge. Special thanks goes to my children Mariana and Allemander Neto for their encouragement and understanding.

My greatest thankfulness goes humbly to God for this new enlightening opportunity of growth.

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CHAPTER 1

INTRODUCTION

1.1 Overview

It is well documented that human health is influenced by physical and biotic environments as well as by socio-economic conditions. Hence, changes in the natural environment resultant from the developmental process may have a significant impact on the local peoples, with important health implications. Although economic development is recognized as a significant factor in social improvements, evidence has shown that the search for economic development, especially in Third World countries, quite often does not guarantee health and welfare improvements for a large share of the population. Economic goals that do not include environmental concerns, can expand or add new health risks for local populations. Conversely, environmental damage and poor health may compromise future development.

Brazil, in the last three decades, went from having one of the fastest-growing economies in the world (in the 1969/1979 period, the average annual growth in real gross national product - GNP - was 8.4 %) through a period of economic crises and growing debts which led to a decline in economic growth (in the 1979/1989 period, the average annual growth in real GNP was 2.7%) to the 1989-1993 period when the Brazilian economy showed almost no growth in GNP. The recovery process started in 1993 with an annual average

growth of 5.0% in the GNP. Over the same decades, the Brazilian population doubled (70 million in 1960, 93 million in 1970, 119 million in 1980 to 147 million in 1991) and became highly urbanized (44.67% in 1960, 55.92% in 1970, 67.59% in 1980 and 75.59% in 1991). The economic and social changes that occurred during this period brought enormous transformations to Brazil. However, the benefits of the great economic growth were not evenly distributed, either geographically or by income class (IBGE, 1993).

Since the mid-1960s, governmental policies have been directed towards the integration of the less populated and less developed regions into the mainstream of the Brazilian economy. These policies, associated with infrastructure development and new patterns of capitalist expansion, resulted in large flows of internal migration. During this period, the Northern region of Brazil, which includes most of the Amazonian region, has undergone more transformations than any other Brazilian region. Moreover, the development process in the Northern region has followed patterns which, in many cases, have proven both environmentally and socially, unsustainable in the long run.

Amazonia as one of the largest biomes in the world, the tropical rainforest, has been rapidly losing its forest cover due to the development process. The development plans for Amazonia have been conceived at macro-scale, clearly disregarding the local variations of the many ecosystems that constitute this not-yet-fully-understood environment. In this process, many ecosystems and the local people have been threatened.

Brazil has also experienced a process of rapid demographic transition, a shift from high to low death and birth rates, which resulted in the Brazilian population growth rate decreasing from 2.84% in the 1970s to 1.93% in the 1980s. The resultant structural change

in the age distribution has led to an epidemiological transition, involving a change of relative importance from infections to degenerative diseases (Omran, 1971 as cited in Learmonth, 1988). However, because of high speed at which this process has been occurring, the pre- and post-transitional stages coexist. The rising chronic-degenerative illnesses due to an aging population, new diets, pollution and environmental degradation coexist with high morbidity and mortality from infectious and vector-borne diseases. Because of high migration flows, the endemics are also recrudescant in the new frontier routes and in areas from which they had been eradicated. Consequently, this epidemiological transition will play a crucial role in defining health care requirements in the coming decades.

A challenge for Brazil is to set economic development goals that do not contribute to further environmental degradation and that address the needs of people. This requires a political commitment to development which takes into account the well-being of the population. In the health sector, it depends both on providing specific health care and sanitation, as well as on the interplay of social, economic and political factors. Since much of local people's future in the Northern region will depend on the policies applied to that region, this thesis aims to contribute towards a better understanding of the development process and health effect relationship.

1.2 Purpose of the Thesis

The main purpose of this study is to analyse the evolution of health conditions due to the development process that has occurred in the Northern region in the last three decades which brought significant impacts on the physical and human environments. To that end, a

comparative analysis will be done to assess the impact of development on the human environment, most specifically, on the population's health. Health is defined by the WHO as "a state of complete physical, mental and social well-being and not merely absence of disease or infirmity". Such a complete state of well-being is very hard to achieve and even harder to measure, particularly in that region, where data is not enough to fully address this subject. Therefore, this thesis work could not assess health as defined by the WHO due to the lack of proper data. However, efforts were made to ascertain whether or not improvements on health conditions occurred, by comparing patterns of disease, mortality and access to health care according to available data.

The major goal of this research work is to place into perspective the importance of the social aspect of development, which should include health conditions. Further comments will be made on the implications regarding how recently introduced economic activities, encouraged by developmental policies, have changed the physical environment and affected the human environment in the region.

This research will focus on the development process that has occurred in the Brazilian Northern region from the 1960s to the 1990s. It will examine economic, environmental, population and health impacts. No attempt will be made to quantify or assign values to project these impacts. The major constraints to this thesis work is related to health data availability. The distance between the researcher and the region also constitutes a constraint.

1.3 The Political and Economical Setting

Since World War II, Brazil has pursued ideals of national development. Such ideals

were encouraged by many of the United Nations' agencies and bilateral development aid agreements, principally with the United States, were signed from the mid-1950s onward. These developmental programs favoured the growth of major industries and the construction of new highways, aiming the modernization process to the other sectors of the economy, such as the agricultural sector and services. The military, which came to power in 1964, gave continuity to this policy, replaced the old politicians with technocrats and created many state-owned corporations to launch a market-oriented economy (Foresta, 1991). The promotion of "national integration" (among the Brazilian geographical regions, including the most remote areas such as the international frontiers) in economic and political meaning was the major goal to be achieved.

National planning played a major role in the process of continuous intervention of the State in the economy. Underlying nationalistic purposes such as "integrar para não entregar" (integrate in order to not forfeit) can be noticed in the various national plans (I, II and III Development National Plan / PND I, II and III) proposed by the government. These plans included a clear spatial intention contemplating the evolution of agricultural and mining poles in the Brazilian Northeast, Mid-West and in Amazonia. Urban development was also a concern in these national plans (Davidovich and Fredrich in IBGE, 1988).

The Northern region of Brazil is an area of 3,851,560 square kilometres, which represents 45.25% of the Brazilian national territory and encompasses the Amazon Basin. It is politically divided in the states of Acre, Amapá, Amazonas, Pará, Roraima and Tocantins (northern part of the former Goiás state, emancipated by the 1988 Brazilian Constitution) which are shown in Figure 1.1.

The First Development Plan for the Amazon (PDA I) came in the beginning of the 1970s, like the PND I and reflected concerns over the national sovereignty to the region and the military ideology of National Security. Through an intensive highway construction program, including the beginning of "Perimetral Norte" highway along the Northern international borders, it manifested clear geopolitical objectives.

Amazonia was also viewed as a solution to release social pressures for a land reform in the Southern regions of Brazil. The closure of agricultural frontiers, in the South and Southeast, and the modernization of agricultural practices displaced rural tenants and sharecroppers, thus generating an excess of rural labour. Slogans such as "Land without People for People without Land" were common by the time that a program for small-farm settlement was launched. These settlements were along the major highways in the region. PDA I also pursued other political and economic objectives (Goodman and Hall, 1990). These objectives would be even more clear in the subsequent developmental plans for the region, PDA II and POLAMAZONIA ("Programa de Polos Agropecuarios e Agrominerais da Amazonia" Program of Agricultural and Agro-Mineral Poles of Amazonia).

Reduced taxes and other fiscal incentives given by the government through SUDAM ("Superintendencia de Desenvolvimento da Amazonia" / Superintendency for the Development of Amazonia), especially from the PDA II onward, encouraged private investors from outside the region to invest in the north, especially in pasture formation and cattle-ranching. This activity was welcomed by entrepreneurs as an excellent opportunity to gain control of land, at relative low risk, if compared to agricultural projects. These incentives to the private sector also came from the various state governments, mostly as land concessions.

and from credit facilities, provided by international loans from the World Bank and other international organizations. These organizations used to encourage livestock as a good investment for development (Hecht, 1985). Shortly, large-scale corporate agri-business engulfed the small-farming colonization program, which had failed for lack of financial resources and inadequacy of the projects to the environmental conditions of the area, among other reasons. Only 8% of the initial plan to settle 100,000 families in rural communities along the Transamazon highway was accomplished. On the other hand, by 1975, 80% of the arable land of Rondonia state was owned by corporations from the South, due to SUDAM incentives (Branford and Glock, 1985 as cited by Goodman and Hall, 1990).

POLAMAZONIA as part of the PDA II in the late 70s, epitomized a new instrument of the State influence in the economy of the Northern region, expanding the favourable conditions to capitalist investments, such as large-scale agro-mineral activities, that could reproduce the capital. SUDAM, at the same time, still played a major role in establishing criteria, selecting priority areas and directing financial resources to specific projects. The availability of financial incentives gave way to acquisition of large tracts of land in the region. This fact, associated to high inflation rates, turned land into a commodity, where the profitability of the economic activity itself became irrelevant. Hence, the region considered resource frontier gradually was transformed in a perfect site for capital reproduction, where the large majority of the local population were marginal to this process (Magnano in IBGE, 1989). Although the population density in the Northern region was and is very low (0.9 inhabitants per square kilometre in 1970s and 2.66 in 1991) and irregularly distributed, the region was not "without people". The local people (Indians, rubber-tappers and peasants),

who are culturally attached to the region have been pushed from their lands in the process of land concentration by cattle-ranchers, mining and logging companies, and government projects. In developing countries, it is common to occur because of the prevalence of dominant elite groups, such as large corporations and major landowners, in policy formation (Graiger, 1993). However, these local people have been fighting for their subsistence and access to land. Thus, land disputes have occurred, sometimes with high doses of violence in frontier areas, which also involve rural labourers and "garimpeiros" (gold prospectors) who were attracted to the region. A large number of dispossessed people have ended up in the impoverished periphery of the urban areas (Botelho and Becker, 1988). In conclusion, the role of the State and the local political forces in the development process that occurred in the Northern Region in the last three decades has been more centred in the economic aspect than in the social and environmental aspects.

From the mid-1980s, an increasing awareness, both national and international, of the environmental and human consequences of the development process in Amazonia, has exerted pressure on the policy-makers to review the projects in Amazonia. Non-government organisations, rural trade unions and the Catholic church have also helped to articulate popular demands. International organisations such as the World Bank have tied their loans to specific requirements for environmental and human impact assessment. The result of this pressure have been felt in the recent Carajas iron-ore project, a mega-project in Para state and in the North-West development program for Rondonia and the north of Mato Grosso (POLONOROESTE).

1.4 Development, Environment and Health Interactions

"The maintenance and improvement of health should be at the centre of concern about environment and development. Yet health rarely receives high priority in environmental policies and development plans, rarely figures as an important item in environmental or development programs, despite the fact that the quality of the environment and the nature of development are major determinants of health" (WHO, 1992)

People's health, both individually and collectively, can not be dissociated from their living environments, which have more influence than heredity (Howe in Lenihan and Fletcher, 1976). Health also depend on the development stage, in particular whether people can have access to safe water, adequate food and proper shelter (WHO, 1992)

Developed and developing countries share serious environmental health problems, where in the latter, premature death and illnesses are mainly caused by environmental degradation of biological agents in water, food, air and soil. However, in order to consider environment and health, one must also take into consideration development, since these three factors, easily definable but largely unquantifiable, are closely connected and present complex interactions. Bradley summarizes these interactions with the diagram presented in Figure 1.2. He defines environment as everything external to an individual, capable of exerting some sort of influence and at the same time being influenced by this individual, since he or she has the ability to change it. The environment includes life support systems, such as air, water, food and shelter, and the whole range of stimuli and risks to which the individuals are exposed. That influence can be positive, such as safe and sufficient water, clean air and secure housing, or negative, such as polluted air and water, and poor housing. Therefore, the health status of the individual can be affected either positively or negatively by the environment.

Figure 1.2 Development, Environment and Health Interactions
Source: Bradley, in Cartledge, B. ed., 1994

The same connections exist between health and development, particularly as associated with the underlying development policies, whether or not they address people's needs, including health, and the use of new technologies. A large-scale development initiative, which normally brings environmental change, can have positive or negative health impacts. Dam construction for instance, can provide better health to local communities by simply increasing the availability of water for domestic consumption and use, thus allowing more personal and household cleanliness and hygiene. On the other hand, large dams can also be a source of proliferation of diseases such as schistosomiasis or diseases transmitted by mosquitos, which use stagnant water as a breeding site (IDRC, 1993).

Development is acknowledged as the process of improving all aspects of human life

which includes health (WHO, 1992). There is also a general consensus that development permits improvements in sanitation, public health, access to education, better incomes and nutrition, which consequently ameliorate the health status of a population. This situation can positively influence the development process as a whole. The opposite scenario is also true. A population which displays poor health can compromise the achievement of development by lowering its work capacity and productivity.

Since the mid-1980s, there is a growing realization that in many developing countries the relationship discussed above is not particularly clear. The World Bank (1993) and the WHO (1986, 1990) have pointed out that other circumstances besides economic development can affect the development/health connection in ways that allow major health problems to occur. These other circumstances can be represented by macroeconomic policies, specially structural adjustments, which impose cutbacks in public spending, the evolution of industrial and agricultural technologies that in many cases bring health hazards, and the inadequacies or lack of political responses to the rapid urbanization process and increases in poverty.

Therefore, it can be concluded that development improvements quite often lead to a "different" health, instead of a taking-for-granted "better" health (Phillips and Verhasselt, 1994). In many middle-income countries, the development process has lowered the rates of infant mortality and raised life expectancy (demographical transition), however other health problems pertaining to an aging population (epidemiological transition) emerged before old problems such as high incidence of infectious diseases were solved.

The development process in Brazil has not been equally distributed throughout its total population, both geographically and in terms of different social groups. The uneven

wealth distribution has adversely affected many people, and in 1990, 38% of the urban and 66% of the rural population lived below the poverty line (UN Human Development Report, 1995). These numbers rank the Brazilian situation worse than the Latin American average. According to Casas (1994), the 1985 report from the Regional Program of Employment for Latin America and the Caribbean (PREALC) estimated the poverty level at 30% of Latin American families. This situation has had major health implications, because it is well known that health is closely related to social, political and economic factors as well as to health care provision.

Besides the Brazilian socio-economic inequities, highlighted by the income share ratio of the highest 20% to the lowest 20% in the last decade of 32:1 (UN, 1995), the demographic transition with the resultant epidemiological transition have been of great concern. In fact rapid epidemiological transition can be an extra burden to the countries where it occurs. Planning for an increasingly aging population, with high incidence of chronic and degenerative diseases (such as cancer and heart diseases) is required while still dealing with a large number of infectious-parasitic diseases (Ramalingaswami, 1994). Hence, countries in these transformations are currently experiencing health problems characteristic of both developed and developing worlds. In the 1980's the main cause of death in Brazil was cardiovascular diseases and the country has the third largest number of reported AIDS cases in the world. Simultaneously, endemic diseases such as malaria were recrudescing. Outbreaks of previously eradicated dengue and cholera have also been occurring (IBGE, 1992).

It is important for developing countries to consider the influence of development policies on health, otherwise these policies may end up being an underlying cause of ill-

is adapted to the local average temperature (around 25° C) and torrential rains, well distributed throughout the year. The exception occurs on the upland areas, which have lower temperatures and higher humidity levels, and on the sloping areas which have drier conditions. The vegetation can be distinguished into major groups: the terra firme vegetation, the inundated vegetation, the savannah, the caatinga and other vegetation types which cover small areas. According to Pires and Prance (1985 in Prance & Lovejoy), the terra firme type of forest encompasses: Dense forest, a formation with a great biomass; Open forest, with or without palms, which has a lower biomass and where Brazil nut trees are common; Liana forest, a variety of open forest, but abundant in lianas; Dry forest, which is a transition forest in Southern Amazonia, and the Montane forest, influenced by altitude and rocky soils. The inundated forest consists of Varzeas (in areas flooded by muddy rivers), and Igapos (in areas flooded by clear and black-waters rivers without sediments). The savannah type of vegetation is comprised of open grassland areas without trees and other areas presenting some woody vegetation. The Caatingas is another type of vegetation that grows over pure leached white sand. This vegetation has adapted to a different soil moisture and nutrient availability.

Long time misconceptions in respect to this environment relate to the soil quality. The initial misconception about the humid tropical forest was that the soils which support such luxuriant vegetation must be very fertile and would readily support other forms of land use such as commercial agriculture. This was replaced by the alternate misconception that all soils in the tropical rainforests are poor, acid and leached, hence not suitable to sustain agriculture. Although controversy concerning the overall quality of Amazonian soils exists, increasing knowledge of this particular environment has shown that any development project

CHAPTER 2

THE BIO-PHYSICAL ENVIRONMENT

2. 1- Introduction

"The environment provides man with the essential life support systems but also presents him with a variety of hazards which may prejudice his health" (Howe, 1977).

The responses of an individual to these hazards are conditioned by the individual's genetic make-up. However, Howe suggests that environmental factors can be more influential to human health than genetics, since their forces can support or threaten it (1976). The nature of environmental impacts on health can be linked to three major aspects: the physical environment, the biological environment and the socio-cultural environment.

In general, the physical environment includes altitude, climate, and the chemical composition of the air, soil and water. While these can be determinants of health status, the physical and biological environment can in turn be influenced by human action, thus defining interactions where health depends on our ability to manage these interactions.

Since ancient times, people have been aware that climatic components such as solar radiation, air movements, precipitation and moisture can affect health. The effects of temperature can influence body functions, and extremes of both heat and cold can be harmful. In tropical climates, for instance, high temperatures can depress body functions, therefore predisposing the individual to infectious diseases. Climate is also capable of determining the

nutrition habits, the type of housing and other social factors, however, it can not be blamed as a single factor causing disease (Foster, 1992)

Similarly, an adequate supply of domestic water can bring substantial health benefits, by ensuring better hygiene. In contrast, water shortages, besides compromising the required hygiene, often affect water quality, by neutralizing its ability to break down or to dilute wastes. Wastes include a large variety of pollutants such as pesticides and herbicides from agriculture, lead, zinc, nitrates, arsenic, mercury, molybdenum, cadmium and other chemicals from urban and industrial effluent and natural sources. These contaminants in the water, soils and food can be detrimental to people's health. Their presence or abundance can be related to natural differences in the rock and relief of a specific region and to human interventions such as fertilizer plus pesticide use and industrial activity (Howe, 1977).

By using natural bodies of water such as rivers and lakes for bathing, washing clothes or working in, many people are far more exposed to microbial pollution of water and consequently to a large array of disease, than by having access to treated piped water. Water-born pathogens such as algae, bacteria, parasites, protozoa and viruses can cause life or health-threatening infections, therefore the importance that should be given to the water quality. The role of the water in diseases such as malaria, schistosomiasis and onchocerciasis should also be stressed

Although the socio-cultural environment cannot be dissociated from the physical and biological environments, it will receive more attention in the next chapters, since it involves human life-styles and access to medical care which are also very important health determinants. In order to better understand the physical environment of the Northern region

a review of the geographical characteristics, which includes the important elements cited above is necessary, because the physical environment is inextricably bound with health and can explain the ecology of certain diseases.

2.2 Physical and Biological Characteristics

"The Amazon includes a very large number of ecosystems, each related to the other, each having a distinct natural history, unique geophysical and chemical characteristics, and human populations that differ in their history, demography, social and political organization, and view of nature" (Moran, 1993)

The Northern region, also known as the Amazon region or Amazonia, is cut by the equator and is situated between the parallels 5N and 10S. The climatological and hydrological characteristics of Amazonia are strongly linked with the geomorphology and the geographical conditions of the region, wherein the Amazon basin is one of the most dense fluvial networks in the world (Appendix A). Spencer and Douglas (1985), note that tropical geomorphology emphasizes the peculiarities of tropical climate and vegetation, in a clearer way than it does the landform. In particular, there is evidence that the high biodiversity in Amazonia can be related to its geomorphology, the "refugia theory". According to this theory, in Amazonia, there are clusters of endemic species that were able to survive the cold dry periods of the Pleistocene. The topographical features of Amazonia are also important through their major direct effect on soil formation and on the type of soil that develops.

According to Salati (Salati et al., in Turner ed. 1990), Amazonia may be characterized as a great plain with distinct relief forms, all less than 200m in elevation. This great plain is 3,400 km long (east to west) and 2,000 km wide (north to south) and presents three major

subdivisions (1) current floodplain and swamplands consisting of Holocene sediments, (2) Pleistocene terraces, formed during several interglacial periods, and (3) the Amazon Plateau, formed of clay sediments and distributed throughout the Amazon basin. The great plain is located between the Guyanan and Brazilian shields, which are formed of pre-Cambrian rocks. The Andean Mountain Range, which forms a semi-circle opening towards the east, has been the main source of sediments for the Amazon Plain.

The incidence of solar energy, temperature and water vapour balance are factors which have a fundamental importance in the predominantly hot and humid climate of the Amazon region. Due to its proximity to the equator, the amount of solar energy reaching the upper canopy of the forest varies little throughout the year and averages $425 \text{ calories/cm}^2/\text{day}$. From this, approximately $210 \text{ calories/cm}^2/\text{day}$ are used in evapotranspiration processes and $215 \text{ calories/cm}^2/\text{day}$ are consumed in heating the air or are diverted into other processes (Salati, in Prance & Lovejoy, 1985). Both insolation rates and available energy are strongly dependent on cloud formation which, in turn, is influenced by humidity and the mechanism of cloud formation.

The average monthly temperatures vary little (around 25°C) especially in the central part of the basin, where there are no relief effects. Conversely, precipitation (average $2,200\text{mm/yr}$ to $2,400\text{mm/yr}$) varies from $1,500\text{mm/yr}$ to $3,500\text{mm/yr}$. In small watersheds in the dense forest, the return of water in the form of water vapour to the atmosphere after precipitation can reach 75% . 25% of this, is due to plant interception and direct evaporation and 50% is due to transpiration processes (Leopold, 1984 and Salati, 1980). These findings reinforce the importance of vegetation cover to the water balance and show the magnitude

of water recirculation within the region.

The influence of vegetation on the Amazonian climate is significant. The replacement of primary forest, with its great biomass and large numbers of species, by large expanses of annual crops or pastures lessens water absorption and its sub-soil accumulation and increases surface run-off, thus modifying the water and the energy cycles (Villa Nova et al, 1977, as cited in Lovejoy and Salati, 1983). As a consequence, deforestation leads to lower the annual precipitation and brings climatic changes. At the local level, these climatical changes will be noticed as longer dry-seasons and more accentuated temperature oscillations, which will cause changes in the flora and fauna and enlargement of savannah areas within the forest.

The Amazon Basin encompasses an area of 4 million Km² and its volume of water represents 20% of all fresh water on the planet (Moran, 1993). The Amazonian rivers vary in their physicochemical and biological characteristics. The white-water rivers, which have their headwaters in the Andean region, carry high amounts of sediments and are mineralogically rich. They support high biological activity and fish production. The fertility of the lands flooded by these waters, is also affected by their characteristics and indigenous peoples have been sustainably using these lands for generations. The black-water rivers and clear-water rivers are much less fertile and support much less biological activity. Overall, the complex aquatic ecosystems of the Amazonia support over 2,000 species of fish (Salati et al., in Turner, 1990).

A large variety of forest types with different indexes of biomass, which have developed on different soils and present high species diversity are enclosed by the Amazon Basin. It also contains non-forest ecosystems. The Amazon vegetation, for the most part,

is adapted to the local average temperature (around 25° C) and torrential rains, well distributed throughout the year. The exception occurs on the upland areas, which have lower temperatures and higher humidity levels, and on the sloping areas which have drier conditions. The vegetation can be distinguished into major groups: the terra firme vegetation, the inundated vegetation, the savannah, the caatinga and other vegetation types which cover small areas. According to Pires and Prance (1985 in Prance & Lovejoy), the terra firme type of forest encompasses Dense forest, a formation with a great biomass, Open forest, with or without palms, which has a lower biomass and where Brazil nut trees are common, Liana forest, a variety of open forest, but abundant in lianas, Dry forest, which is a transition forest in Southern Amazonia, and the Montane forest, influenced by altitude and rocky soils. The inundated forest consists of Varzeas (in areas flooded by muddy rivers), and Igapos (in areas flooded by clear and black-waters rivers without sediments). The savannah type of vegetation is comprised of open grassland areas without trees and other areas presenting some woody vegetation. The Caatingas is another type of vegetation that grows over pure leached white sand. This vegetation has adapted to a different soil moisture and nutrient availability.

Long time misconceptions in respect to this environment relate to the soil quality. The initial misconception about the humid tropical forest was that the soils which support such luxuriant vegetation must be very fertile and would readily support other forms of land use such as commercial agriculture. This was replaced by the alternate misconception that all soils in the tropical rainforests are poor, acid and leached, hence not suitable to sustain agriculture. Although controversy concerning the overall quality of Amazonian soils exists, increasing knowledge of this particular environment has shown that any development project

in the region should include a cautious analysis of the soil conditions at a site, prior to implementation. This is due to the fact that the soils in the Amazonia are not all of the same nature. Indeed, there are large differences in the soil groups present and in their quality (see Appendix B). The main limitations of the majority of the soils in the Northern region are nutrient deficiency, low pH (often with aluminum toxicity) and poorly drained or flooded conditions (Furley, 1990 in Goodman and Hall eds). The undisturbed forest is adapted to the soil and the climatic conditions by some specific environmental features which control nutrient losses and nutrient cycling. These features relate to the balance among temperature, moisture, weathering and leaching processes and the biotic interactions (Jordan, 1985, as cited by Furley in Goodman & Hall, 1990).

It is possible to practice agriculture sustainably in Amazonia, as the Amerindians and caboclo (people from Indian and European ancestry) have done for generations, by identifying the most suitable soils for cultivation. Modern soil surveys can also do this task. Natives have been growing a large variety of crops, which include many fruits, perennial shrubs and tree crops. The bulky plant cover contributes to maintaining and improving the soil fertility as well as preventing soil losses by erosion and runoff. This old technique is in accord with recent studies which demonstrate that multiple land-use development can better maintain the ecological balance of the region than can clear felling or monocultural land uses. Giving priority to using the most fertile soils for agriculture allows other areas to be left for conservation purposes (Furley in Goodman and Hall, 1990).

The Northern region of Brazil is located in one of the world's major biomes: the Amazon tropical rainforest. As such, the Amazon is thought to have about five million

different species of plants and animals, of which only a small part has been catalogued. It is estimated that 50 to 90% of all plant and animal species occur in tropical environments, and of that amount, 10% is believed to be in the Amazon region (Embrapa, 1994). The humid tropical forests have been devastated in a rapid fashion. Only in the last decade, 0.9% /yr of the remaining tropical forests in Latin America, 1.2% /yr in Asia and 0.8% /yr in Africa have disappeared (Recursos Mundiales, 92 / 93 in Embrapa, 1994). The Amazon region has been the focus of major concerns due its rapid deforestation of 3.04% by 1978 and 8.52% by 1991 (INPE, 1996). Considering that plant and animal species are not uniformly distributed across the region, but tend to have their distribution restricted to particular areas, deforestation can extinguish many species. This is the case in eastern Amazonia, one of the areas where the deforestation process is concentrated (Lovejoy and Salati, 1983). The consequential genetical losses which accompanies forest destruction also have the potential to jeopardize our contemporary biotechnological and pharmacological hopes. The real challenge for the Northern region is to reconcile resource use with the structure and function of the various ecosystems present there.

2.3 The Environmental Change Related to Regional Development

The environmental change in Amazonia, in which the Northern region is included, also called "environmental destruction" by Fearnside, has various components including deforestation, loss of flora and fauna, pollution from mining, flooding by hydro-electric dams and extinction of natives with their culture. These many forms of destruction have, however, either cause or effect linkages to deforestation, and their impact spread to soils, rivers,

climate, forest species, indigenous people and ultimately to the options for the sustainable uses of the forest (1990).

In the last three decades, the public policies for the Northern region, which promoted the use of Amazonian's vast resources, were central to the environmental issues that surged at the same time. The use of the forest, hydrological and mineral resources, along with the implementation of infrastructure programs were part of a broad governmental plan to include the Northern region in the process of capitalist expansion and to break its physical, political and economic isolation from the rest of the country. The construction of new highways and the government-directed colonization programs, sped up the natural migration flows to Amazonia, thus fulfilling the geopolitical objectives of demographic occupation of the region. Although deforestation intensified during this period, it was not a completely new phenomenon in the region. At the beginning of this century, immigrant farmers deforested an approximately 25,000 Km² area in Para that nowadays constitutes a landscape of bare soils (Pearce and Myers, 1990).

This process was intensified from the mid-70s, through the POLAMAZONIA program, with the encouragement of private investments. New areas were incorporated into production, and conversion of large tracts of forest to other land uses, such as ranching, commercial farming and mining activities, were common place. POLAMAZONIA, aimed the use of the potentialities of 15 different areas to cattle-raising, agro-forestry and agro-industry. Developmental programs for Amazonia have been the major underlying force causing environmental transformations, which are highlighted by the increasing deforestation in the region. The average annual deforestation rate was 2.18 million ha / yr from 1979 to 1990 in

the Legal Amazonia, according to the National Space Research Institute in Brazil (World Resources, 1992-93) It is pertinent to note that estimates of deforestation in the Legal Amazonia (which includes areas of the Brazilian Plateau for economic and political purposes) may vary according to the source The Brazilian Institute of Forestry Development (IBDF) has been frequently accused of underestimating the real extension of the cleared forest In addition, when considering the huge extent of the Legal Amazonia (4,975,567 km²), the amount of deforestation may seem not to be a reason for concern (Fearnside, 1990). It should also be recognized that isolated small areas cleared by small farmers, usually by slash-and-burn, are not detected by remote-sensing surveys (Pearce and Myers, 1990)

2.3.1 Deforestation

2.3.1.1 Cattle-raising and timber activities

The policies of fiscal incentives to investment in the Northern region, which allowed the process of land use change, contemplated the exploitation of the economic potential of the region The main beneficiaries of these policies were projects which encompassed between 10,000 ha and 100,000 ha, which represented more than half of all projects approved from 1965 to 1985 Accordingly, Legal Amazonia in 1985 displayed high land concentration, it had 1,085 of Brazil's 2,125 rural establishments over 10,000 ha (Figueredo in IBGE ed, 1993). Cattle pasture was the predominant land use in cleared areas of Amazonia This activity was highly encouraged at that time, even for international organizations such as the World Bank Other agribusinesses such as forestry, mechanized agriculture and associated industries occupied a small part of deforested areas in comparison to pastures Moreover, the

requirement for a high level of inputs for the maintenance of soil fertility plus pasture productivity, compromises the profitability of cattle-raising, unless highly subsidised. Most of Amazonian soils can be exhausted in about 10 years, especially in terms of phosphorus availability. Hence, subsidised ranching has been an important factor in deforestation (Fearnside, 1990)

Timber extraction, on the other hand, as an expressive cause of deforestation is quite a recent trend in the region. From the late 1980s, timber companies have been moving from south and southeastern Brazil, where the forests were almost decimated by this time, to Amazonia. Para became a major timber producer. Paragominas, a region in Para encompassing four municipalities, reached 2 million cubic metres a year, however, its reserves are already at the end. The lumber industries, many of them illegally established, spread their activities, to Rondonia, Acre and Roraima during the last two decades and recently received many promises of incentives and large areas to be exploited from the current governor of Amazonas (Veja, 1995). Lumber production in the region is directed to national markets and to international markets in Europe and in the United States, where the "noble woods" such as mahogany (*Swietenia macrophylla*) are highly appreciated. Brazil exported 116 525t of mahogany in 1991. A log of mahogany can be bought from the Indians for as little as ten US dollars by the logger traders, to later be sold abroad for US 3,600 dollars per log (Revista Visao, 1992 in EMBRAPA, 1994). Unfortunately, as long as the market for certain products exists while the lack of efficient surveillance persists in large areas of Amazonia, these facts will continue.

Fearnside points out that there is a serious risk of the increased lumber export

including wood-chips production, from Amazonia in the near future, as the tropical forests in Africa are practically decimated and the ones in the South-East Asia are rapidly proceeding along the same path (1990)

2.3.1.2 POLONOROESTE and the Great Carajas Project

Both the small-scale colonization programs and the large-scale projects have led to deforestation. This assertion becomes clear when one compares the environmental impact of programs such as POLONOROESTE and The Great Carajas POLONOROESTE. (The Northwest Brazil Integrated Development Program) linked for the second time in the recent development of Amazonia a penetration route to a colonization program. This program, which took place in the late 1970s and beginning of the 80s, stretched even further the deforestation process in the region. POLONOROESTE was an initiative covering an area of 410,000 Km², principally in Rondonia and Mato Grosso states, which involved a major planning of asphalt pavement of the BR-364 highway. This area is highly deforested by successive and disorganized occupancy of small-producers, migrants from Northeast and later from the South in a search of free land. Despite the inclusion of environmental concerns and consideration for conservation areas and Indian lands in the plans, it could not avoid a huge environmental impact.

POLONOROESTE plans underestimated the flow of migrants from other Brazilian regions, especially from the South. Deforestation of the land was a way to claim the land by showing that the land was being used "productively". Accordingly, the deforested areas in Rondonia jumped from roughly 3,000 Km² to 30,000 km² in just one decade (Table 2.1)

Table 2 1 Extent of Deforestation in Brazilian Legal Amazonia

Brazilian Legal Amazonia	Area (km ²)	Area Cleared (square kilometre)				
		Jan/78	Apr/88	Aug/89	Aug/90	Aug/91
Acre	152589	2500	8900	9800	10300	10700
Amapa	140276	200	800	1000	1300	1700
Amazonas	1567125	1700	19700	21700	22200	23200
Para	1248042	564000	131500	139300	142200	148000
Rondonia	243044	4200	30000	31800	33500	34600
Roraima	230104	100	2700	3600	3800	4200
Tocantins	285793	3200	21600	22300	22900	23400
Maranhao	257451	63900	90800	92300	93400	94100
Mato Grosso	881001	20000	71500	79600	83600	86500
Total	5005425	152200	377500	401400	415200	426400

Source Instituto Nacional de Pesquisas Aeroespaciais - INPE

Slash-and-burn was the main agricultural practice adopted by these migrants and this practice when used in a "pioneer" way, with the fallow period being usually shorter than necessary and with annual crops preferred over perennial crops, this practice led to rapid soil degradation (Fearnside in Goodman and Hall, 1990). A family-model of rural development failed, because loss of the soil fertility, lack of access to credit, or malaria. The takeover of small holdings by cattle-raising investors was quite easy, therefore enlarging the extent of deforestation.

In sum, the opening of penetration roads facilitated the occupancy of the area for squatters, ranchers, prospectors and loggers, who often invaded Indian lands. The resulting deforested areas, which neighbour the roads present a fishbone pattern that can be observed

in the satellite photos (INPE, 1994). (Appendix C)

Another government-directed program in the Northern region, with incentives to private investors and state enterprises, was The Great Carajas Project in Para. This predominantly mining program (iron, gold, copper and manganese) had major environmental impacts, of which deforestation was one. Regardless, the project brought significant economic improvements in the form of employment opportunities and diversification of activities to the region. It is very hard to quantify the environmental impacts of the Carajas operation, due to previous and simultaneous developments in Para (Redwood, 1993)

Carajas project involved three states (Para, Maranhao and Tocantins) and included industrial and agribusiness development poles. An 890 km railway and a port terminal were built for the transport and export of the products. Hydroelectric dams construction, of which Tucuruí is one, and power transmission lines, were also part of the program. The project, which attracted many people, led to rapid urban settlement, both oriented and spontaneous, which contributed to further deforestation (Appendix D). An urban centre for approximately 11,000 people (company-town model), Vila dos Carajas, was built with all infrastructure needed, however, another unplanned town of 25,000 people, Rio Verde, emerged 20 km away and took on the role of providing services to the planned town (Castelo Branco in IBGE ed. 1989)

The rapid deforestation around Carajas was also due to the demand for lumber to be used in the railway construction, in local construction, and as fuelwood. There was also the conversion of forested areas into pastures. The establishment of pig-iron and other metallurgical industries along the Carajas railway (Carajas corridor) were even more

damaging, in that they were charcoal-powered. Although the Great Carajas Program included in its plan a component of forestry-management and plantations for charcoal-producing, the production was inadequate to its needs. The unplanned spread of pig-iron activities along the Carajas corridor aggravated the problem, by increasing and spreading the demand for charcoal, which led to deforestation of native species (Redwood, 1993). In addition it must be noted that 2.000 enterprises were working in Para state in 1990, while in 1970 the number in the entire Legal Amazonia was only 292 (Veja, 1995). These operations also explain some of the increasing deforested areas in Para (See Table 2.1)

2.3.2 Other forms of Environmental Change in the Northern Region

The other forms of environmental change in the Northern region, involving soil, air, water and local flora and fauna are linked to the impact of deforestation. Nevertheless, the roots of environmental disruptions in the last three decades also lie in the use of Amazonian resources, (related to mining, agricultural and industrial activities) and in the disorganized growth of urban areas.

The loss of biodiversity is a major concern related to the disturbances in the Amazon tropical forest. Many species are endangered by destruction of their habitats or by predatory human practices. What makes this risk even more serious is that there is little knowledge of the taxonomic and nutritional-chemical characteristics of the large majority of these species, despite the recent increase in research. The great reservoirs of this knowledge, the indigenous people and the caboclos, are also at risk of extinction or of losing their culture under the pressure of modernization. Modern society may come to regret its lack of interest in this

indigenous knowledge

Forest burning is the most damaging cause of wildlife loss. Burning is a current practice used there, every time that a change in the land use is planned. In the burning season, which corresponds to the driest period of the year, the total extent of the fire can reach thousands of square kilometres. In addition to direct forest loss, burning can cause ecological imbalances with disruption of food-chains and prey / predator relationships. One undesired result is, that agricultural fields may suffer insect invasion as a consequence of loss of the insect's natural food source or the loss of its predator in the forest fire (Embrapa, 1994)

Wildlife is also jeopardized by predatory hunting and fishing practices. The increase in the urban population from the 1970s onward has tremendously increased the demand for fish, and along with the use of better technology for catching and conservation, has given a boost to commercial fishing (Goulding in Moran ed., 1983). Fish production from the Amazon region, nowadays, supplies the large cities in the region and some is exported to other Brazilian regions and abroad (Moran, 1993). Local populations, more than everyone else, know how dependent they are on this food source and they are aware on how their subsistence fishing is being threatened. For this reason, commercial fishing frequently encounters some hostility from the part of the caboclo (Wesche and Bruneau, 1990). Hydroelectric dam construction, such as Tucuruí and Balbina, also affected the fish productivity in the region. Both, the decomposition of flooded forest, which lowers the oxygen availability, and the disruptions in fish migration patterns have many consequences. However, the major threats to the maintenance of many fish species comes from the substitution of forest, principally in the floodplain, by pasture and other commercial

agriculture, such as paddy rice production, which changes the ecosystem and lowers the fish productivity. Mining activities aggravate this problem, by their potential to pollute the rivers, especially with mercury, and degrade their biotic characteristics (Golding, 1983 Moran, 1993). Moreover, high levels of mercury intake through fish consumption, which constitutes the major source of protein in the local diets, can be a serious health hazard. Other sources of pollution into the bodies of water in the Amazon basin include effluent discharges by local industries (principally sawmills) and sewage pollution from the urban areas.

Commercial interests, such as bird smuggling, the catch of large river turtle (*Podocnemis expansa*) and pirarucu (*Arapaima gigas*), which are protected species and have their catch prohibited because of the risk of extinction, and the legal catch of aquarium fish for export, also constitute hazards to wildlife. These activities go largely uncontrolled because of the lack of surveillance. Predatory logging is also a problem. For example, it is estimated that 6,000 "pau-rosa" trees are cut annually in order to reach the usual amount of 60 t of perfume essence, in a form of oil for export purposes. Since the "pau-rosa" tree is not planted and it does not reproduce easily, this specie is at risk (Veja, 1996).

The leading cause of environmental change altering the soil and the air quality is the clearing of native vegetation. The luxuriant vegetation of certain areas of the Northern region may hide poor soils. The bulk of the nutrients in these ecosystems is in the forest biomass, and the forest relies on the natural nutrient recycling mechanisms of the undisturbed forests for its survival. As soon as this recycling process is broken, very careful soil management is required, especially for agricultural uses, otherwise, lack of fertility, soil compaction and erosion will occur.

The burning of the forest, capable of releasing high amounts of pollutants into the air, had decreased since the beginning of the 1990's, however, in 1995 the burning of the forest returned, merciless. In the first two weeks of August, 1995, the satellite images revealed 72,219 different fire foci in Brazil, with the large majority concentrated in Amazonia (INPE in Veja, 1995). In Alta Floresta (North of Mato Grosso) on 24 of August, the pollutant (particulate) concentration in the air reached $900 \text{ mg} / \text{m}^3$, which corresponds to three times the level considered critical by CETESB, the Sao Paulo environmental monitoring company (Veja, 1995).

2.4 Conclusion

The external environment has the potential to affect human health and human beings are the only organisms capable of consciously modifying this environment on a large scale, in ways that can influence the health status either positively or negatively. Because the Northern region of Brazil has undergone more environmental changes in the recent years than any other Brazilian region and because the region falls within one of the major and still largely unknown of the world biomes, the tropical rainforest, there is reason to be concerned about these human impacts. The impacts of these recent environmental changes have not been fully assessed, especially the health aspect. Major difficulties in assessing health impacts are the lack of small-scale specific data and the high mobility of the people in the region over the last three decades. This review of the bio-physical characteristics of the Northern region has aimed to give a broad geographical picture, since that is the only level for which information is available for most of Amazonia.

CHAPTER 3

THE SOCIO-CULTURAL ENVIRONMENT

3.1 Introduction

The socio-cultural component of the human environment is essentially human-made and involves three major aspects: economy, society and habitat (Howe, 1976 in Lenihan and Fletcher eds). Cutting across the connections among these factors and considering the human capability to modify the natural environment, it can be argued that humans can powerfully influence their health and in so doing modify the ecology of certain diseases.

It is indisputable that the most economically developed countries have managed to raise the living standards of their populations, by providing better water supplies, sewage disposal, and housing (with their following improvements in hygiene) and better nutrition and education. All these factors had a favourable impact on health status. On the other hand, the industrialization process, new technologies applied to agriculture and increasing urbanization, which have accompanied economic development, have also introduced environmental hazards, which have negatively affected health. Other factors affecting health, include the size of the country's population, the population density, the availability of natural and financial resources and resource distribution among the population (Howe, 1977).

In the Northern region, where many transformations occurred in the last three decades, the social-cultural environment is organized in a very diversified fashion, but can however be broadly categorized into two groups. One is represented by the social organization directed toward the capitalist production, which presents a great extra-regional

influence, the other is linked to the traditional socio-economic structure, highly influenced by the local society.

3.2 The Population Perspective

For most of its human history, the traditional people of Amazonia have been the major resource managers of this special biome, the tropical rainforest. Since the XVI century the traditional people have been sharing the territory with people of European origin and since about 1900 they have been a minority. Considering the fact that the Amazonian environment is not homogeneous, the indigenous relationship to nature (which includes the "caboclo", that have Indian and European ancestry) involves specific strategies appropriate to the local ecosystems. The native's traditional ecological knowledge, their adaptation to and management capacity within their ecosystems have not been included in the recent development plans for the region. Their relationship to the environment can be of inestimable value, but much of their knowledge has been lost especially during the last three decades.

The infrastructure program for the region such as highway and hydro-power dam constructions in the late 1950s and early 60s marked the beginning of growth-oriented development plans for Amazonia. Colonization schemes, cattle ranching and mining activities were also part of a broad policy of "integration" of the Northern region with the national economy. This process attracted many people from other Brazilian region, and also changed the local patterns of human occupation through internal migration flows. The environmental impacts of the policies for the region have been subjects of concern, globally and locally, for the unpredictable nature of its consequences. In addition, conservation measures are slow in

coping with the environmental degradation. According to Foresta (1991), most of the rainforest environments in the world were naturally "protected by its remoteness, vastness and inhospitality to society", until the 1950s. However, as technology advanced and migration to those areas increased, this situation has changed.

During this century, four different phases can be identified related to conservation measures in Brazil. The first phase extended from the beginning of the century to 1960, with the creation of Indian lands, grouped as reserves and colonies, and Conservation Unities such as parks and forests. In the second phase, from 1961 to 1980, these Conservation Unities became more diversified to include forest reserves and biological reserves along with the Indian lands which included Indian parks and Indian areas. From 1981 to 1988, federal legislation brought millions of hectares of Amazonia under protection as Environmental Protection Areas, Reserves and Ecological Stations. From the 1988 Constitution onward a first Extractive Reserve was created and a time frame was established for the demarcation of Indian lands (Une and Louro in IBGE ed. 1993). Unfortunately, these conservation measures that were instituted by legislation did not receive enough provisions and personnel to enforce them in practical ways.

The Indian communities face another serious problem in the Northern region. Many development programs in the region, such as POLONOROESTE, Calha-Norte (situated along the Northern Brazilian boarder) and more recently the PMACI (Environmental and Indian Communities Protection Project) which encompasses the area of influence of the highway BR-364 in Rondonia, totally or partially overlap onto Indian lands. The same applies in Roraima, Tocantins and Maranhao, under the Carajas domain. The Indian territories are

also vulnerable to new land uses such extractivist activities, mineral prospecting and hydroelectric dam constructions (Une and Louro in IBGE ed, 1993)

Peasant farmers and rubber tappers have been displaced from their original areas by corporate mining and agribusiness enterprises in this development phase of Amazonia, during the last decades. These activities, which require large deforested areas, heavily impacted Brazil nut extraction in Para with the clear cutting in nut trees areas. Rubber extraction in Acre was also affected, with an accentuated decrease in the quantity of rubber produced. According to Bakx (in Goodman and Hall ed, 1990), in Xapuri, one of the extractive areas in Acre, rubber extraction decreased from 1,132 tonnes in 1971 to 679 tonnes in 1981. In order to correct this situation, which became evident as the result of many land conflicts, extractivist reserve areas were created in the 1990's. The Chico Mendes Extractivist Reserve in Acre is the largest, with 970, 570 ha.

As the development process in the region seems to be irreversible, an ecologically sound form of development could be the answer. Although the task of administering large areas and forests is very difficult, the development model should include conservation provisions and should pursue the well-being of local people as a major goal. This model should also respect the rights of the traditional inhabitants of Amazonia, and associate new technologies with research in their management practices that have been suitable for the local environment.

3.2.1 Traditional Inhabitants of Amazonia

The Amazon region, because of its vast extension and not fully understood ecosystem,

has been surrounded by many myths. One of these myths is to define it as an immense and uninhabited region. Although the region has low population density, its forest has been occupied by Indians, river people (also called caboclo, which is an ethnic group of Indian and European ancestry) and more recently by people who live from vegetal extractivism such as rubber tappers and nut-collectors. This myth of empty wilderness encouraged, in the past, governmental policies such as "a land without people for people without land" (Le Breton, 1993). This kind of approach clearly disregards the presence of the Amazonian Indians, the most ancient inhabitants of the region and undervalues their traditional ecological knowledge. The caboclos, riverine people who hold the original native expertise in resource use, receive the same treatment.

It is estimated that over 5 million natives lived in the Brazilian territory, at the time of European arrival. Today their number is around 200,000. Of these, 140,000 live in the Amazon region in different levels of integration with the Brazilian society. In the recent past many Indian groups have been displaced from their lands and many became extinct. According to Ribeiro (1970), at least 87 Indian groups have become extinct in Brazil during this century, showing a tremendous human and cultural loss. Many "caboclos" and "extractivists" were also expelled from their lands, in a process of marginalization whereby their cultural identity also was lost.

3.2.1.1 Traditional Ecological Knowledge

Anthropological research in Amazonia has demonstrated that Indian knowledge, accumulated during millennia, includes the plant-animal-environment relationship. This

knowledge made possible the creation of ecological models for different sites, often using long-term strategies, which permitted soil conservation, biological diversity enhancement and crop protection against disease. Posey's studies on the Kayapo, in Para state, reinforce this point (1983). He noted that the Kayapo's knowledge is an integrated system of belief and practice, which encompasses the following main awareness:

1 - recognition of ecological zones, and association of different biological communities with soil types. They identify three major divisions such as grasslands, mountains and forest, with many subdivisions.

2 - detailed knowledge of animal behaviour, including small insects, and what plants are associated with them.

3 - perception of resources, such as wild plants and domesticated plants, encompassing also domesticated medicinal plants (The Kayapo cultigens offer much information about plant genetic variation for botanic research and experimentation).

4 - utility of "natural corridors" between fields to allow natural refuges for plants and animals, thus preserving the bio-diversity for future resource use.

5 - utilization of limited size of the fields to prevent crop disease.

6 - management of "abandoned fields" in their slash-and-burn system, which in reality are not abandoned at all since some species continue to produce harvests for 6, 12, 20 or more years.

The Indians in the "varzea" or floodplain of Amazonia also demonstrate extensive ecological knowledge particularly of the fish species and their nutritious properties. Many taboos are associated with fish consumption, and these have also been incorporated by the

caboclos. Ill people and postpartum women are not supposed to eat "remoso" fish, which coincides with the most fatty species. On the other hand, healthier species such as the "tambaqui", which are light in fat, have their consumption encouraged. The same criteria is used for hunted meat and domesticated animals (Moran, 1993).

The varzea agricultural practice of the indigenous people, which involves zonation, also shows a profound knowledge of their environment. It is common practice to subdivide varzea areas into horizontal zones and plant different crops according to their water requirements. This indigenous use of the floodplain has proven sustainable, since it does not rely on the use of chemicals and does not cause large increases in deforestation. Observation of animal behaviour, especially birds, allows them to forecast flood patterns and crop harvest. On the other hand, large-scale agriculture if implemented in these areas, would cause substitution of the natural vegetation, would require chemical additions, and would affect the fish productivity in the region. Some Amazonian fishes, such as the "tambaqui" (*Colossoma macropomum*), feed when adults almost exclusively on fruits and seeds derived from the flooded forest. Any disruption in the fishery production in the region would negatively impact the rural and urban populations through loss of the main source of protein of their diets. Another factor to be considered is the role of these fish species as seed dispersal agents which contributes to the maintenance of biodiversity (Goulding in Prance and Lovejoy, 1985).

3.2.1.2 Adaptation

The highly adaptive capacity of the traditional inhabitants of Amazonia to their particular ecosystem can be noticed throughout the region. However, the "blackwater

people" are the ones who best demonstrate the precise response to a specific environment. Blackwater rivers of Amazonia are the darker-coloured rivers, such as Rio Negro, which have their headwaters in a podzolic type of soil of flooded forests, carry large amounts of humic compounds and are very acidic. Consequently they are the poorest mineralogically and biologically and have the lowest fish productivity in the region (Salati, 1985). The watersheds of these rivers in the northwest of Amazonia characterize the blackwater ecosystem, which presents the most critical limitations in the region. According to Moran (1993), the indigenous people living in that ecosystem display adaptive strategies such as

1 - adjustment of the population size to the environmental constraints (the lowest population density of the region and dispersed settlement patterns are found there)

2 - high reliance on bitter manioc, a variety that can be grown in the low pH soils. They have the knowledge on how to neutralize the natural toxicity of this root.

3 - specialized fishing techniques which deal with the poor biological conditions and poor optical resolution of the dark-coloured rivers.

4 - high degrees of hierarchy associated with territorial control over resources.

The constraints of the blackwater ecosystems although, have allowed the native peoples to retain this territory, because it has been seen as too poor to be commercially exploited. Historically, the area has also served as a refuge for other displaced natives. However, it is essential to remember that displacement from their lands, which is increasingly common in Amazonia today, is very detrimental to indigenous people (Le Breton, 1993). Their knowledge is usually appropriate to a specific ecosystem and their strategies may not

be useful in the new ecosystem to which they are displaced. Rappaport calls it adaptive effectiveness, which also includes supernatural components, whose supposed existence directs the actors to behave in ways that are appropriate to their biological well-being and to the ecosystems in which they dwell (1979). In a high biodiversity environment such as Amazonia can be hard even for them, when they must move to unfamiliar areas, to identify certain species as indicators of the best site to practice their swidden agriculture.

3.2.1.3 Ecological Management

"We know that the soils need to rest. We are not like the settlers who came in here and cut everything. We clear small gardens and we plant our sweet potatoes and yams and manioc. Then we pull up the undergrowth and the weeds, and chop down the trees. Before the rains we do the burning. Then we plant corn, cotton, beans, tobacco, and squash. We grow watermelon, papaya and pineapple. We put in banana trees and medicinal plants which we can harvest after the soil is exhausted and we have moved the gardens." Kulina, an Amazonian Indian (Le Breton, 1993).

Swidden agriculture, quite often viewed as simple and primitive, is one of the best ecological management practices used by the natives in Amazonia. This practice is well adapted to tropical conditions, especially in the ways in which it has been used for subsistence purposes and in its utilization of native plants that are adapted to nutrient availability. Indigenous agriculture relies on small and dispersed fields, which minimize soil exposure to intense weathering, leaching and erosion processes, and do not compromise wildlife. This technique also reduces vulnerability to pests. The benefits of this system will not prevail if the forest is slashed and burnt in large plots, as is encouraged by the developmental approach. This is particularly the case if the area is to be used for monoculture purposes and if the

nutrient requirements of the chosen crop are different from the ones that the soil can provide

The general survival ethic of the Amazonian indigenous populations, as hunters, gatherers and subsistence agriculturalists, includes complex forms of ecological management. Like other tribal societies that have been studied by Rappaport (1979), many Amazonian understandings are encoded in rituals and myth. By examining the Kayapo, a native group of Para state, Posey (1985, 234) suggests a serious approach to indigenous myth. According to him, the Kayapo recognize certain co-evolutionary complexes that are encoded in myth for cultural transmission. This very symbolic way of transmitting social and ecological knowledge also transmits management practices from past generations. Ethnographic research could provide better management practices for the various ecosystems which composes the Amazon region.

3.2.2 Demographical Aspects of the Northern Region

Most of the interior of the Northern Region was scarcely populated in the 1950s (0.56 inhabitants for Km^2) (IBGE, 1989). Indians, subsistence farmers and people working on extractivist activities were the main dwellers of the most remote areas, while the largest human concentrations were in Belem, the capital of Para, and Manaus, the Amazonas capital. The main activities were non-predatory, in the sense that they were adapted to the natural and economic conditions of the region (Magnano, in IBGE ed, 1989), (Table 3.1 and 3.2).

The beginning of the urbanization process in the region can be traced to the foundation of Belem by the Portuguese, in 1616. At that time, Belem's strategic location could protect the coastal area from European invasions and serve as a departure point for

journeys into the interior. By 1800s, the city's population was over 10,000. Missionaries, especially Jesuits, played an important role in establishing settlements among the Indian groups along the rivers.

Table 3.1: Population in the Northern Region 1950 - 1991

Geographic Regions	Population in the Northern Region 1950 - 1991				
	1950	1960	1970	1980	1991
Brazil	51,941,767	70,070,457	93,139,037	119,002,706	146,825,475
Northern	1,834,185	2,561,782	3,603,860	5,880,268	10,030,556
Acre	114,788	158,184	215,299	301,303	417,718
Amapa	36,972	67,750	114,359	175,257	289,397
Amazonas	507,628	708,459	955,235	1,430,089	2,103,243
Para	1,119,790	1,529,293	2,167,018	3,403,391	4,950,060
Roraima	17,834	28,304	40,885	79,159	217,583
Rondonia	37,173	69,792	111,064	491,069	1,132,692
Tocantins	-	-	-	-	920116

Source: IBGE Demographic Census of 1950, 1960, 1970, 1980 and 1991 Anuario Estatístico do Brasil, 1992

Note The municipalities which formed the Tocantins state were part of Goias state up to the 1980 Census

Table 3.2 Population Density in the Northern Region, 1950-1991

Geographic Regions	Population Density in the Northern region 1950 - 1991					
	Area (Km ²)	1950	1960	1970	1980	1990
Brazil	8,511,916	6 10	8.23	10.94	13.98	17.25
Northern	3,851,560	0.48	0.67	0.93	1.53	2.60
Acre	153,698	0.74	1.03	1.40	1.96	2.72
Amapa	142,359	0.26	0.48	0.80	1.23	2.03
Amazonas	1,567,954	0.32	0.45	0.60	0.91	1.34
Para	1,246,833	0.90	1.23	1.74	2.73	3.97
Rondonia	238,379	0.16	0.29	0.46	2.06	4.75
Roraima	225,017	0.08	0.13	0.18	0.35	0.97
Tocantins	277,321	-	-	-	-	3.32

Source IBGE Demographic Census of 1950, 1960, 1970, 1980 and 1991 Anuario Estatístico do Brasil 1992

Although the missionaries were expelled by the late 1700s, many of their settlements developed into villages. In the early 1800s, African slaves were introduced into the region to cultivate cocoa, coffee and tobacco in land holds donated by the Portuguese crown to the colonizers. Extractivism and cattle raising intensified at that time.

The rubber boom in the late 1800s, generated a population increase in the region, the enlargement of many urban areas and the creation of new urban centres. Large number of migrants from the Northeast region came to Amazonia in the search for jobs as rubber tappers, thereby intensifying the demographical occupation of the North. The economic vitality introduced lasted until the 1920s when rubber producers from other parts of the world began to compete in the international market, thus reducing the demand for Amazonian

rubber. An economic stagnation followed this period and only in the 1960s would the region experience another wave of economic and population growth.

Together with the infrastructure program started in the 1950s, the federal government's decision in the mid-60s to integrate the Northern region into the Brazilian economy brought tremendous change to the area and is identified by Fowerakers (in Judith Lisansky, 1990) as the pre-capitalist stage of Amazonia. An important aspect of this change was the program of highway construction, which allowed greater mobility in the region. In addition, the job opportunities created by the construction and the land made available by government-oriented colonizing programs constituted the main pull factors to intra-and inter-regional migration flows. The migration process was intensified from the 1970s and almost tripled the cumulative number to that time. However, the most recent census has shown that urban areas in the Northern region have absorbed 55,3% of these migrants, therefore displaying a common phenomena of other Brazilian regions (See Table 3.1 and Table 3.2) (Barcellos and Costa, in IBGE eds, 1989). Wage and temporary rural labour are also responsible for the enlargement of urban areas, since they do not get any permanent link to the land.

3.2.2.1 Migration

Although migration in the search for unclaimed land and spontaneous colonization always occurred in the Northern region, government-oriented colonization schemes and, since the 1970s, private colonization and large-scale development have been the major forces behind social and environmental change in the region (Moran, 1990). In-migration was

encouraged by the governmental policies to provide labourers to the planned economic transformations, since the region was and still is disproportionally under- populated in relation to its area. Moreover, by the late 1960s, staple crops were substituted by export ones such as soya beans in the Southern regions of Brazil, hence the need to expand crops for internal consumption and reconcile agrarian questions

One of the main consequences of the rural mechanization, the result of a significant availability of capital to the sector at that time, was the displacement of rural labour. The demands for human labour diminished, while typically capitalistic relationship which reached the farmlands brought enormous changes to the semi-feudal system of certain areas. Structural changes and mechanization in Brazilian agriculture eroded access to land for the rural poor (Foweraker, 1980). Traditional share croppers and tenant farmers practically disappeared in the South, giving place to temporary salaried farm workers. The internal resident labour force was also expelled from the large estates (Goodman in Bacha and Klein, 1989). This new relationship broke the rural poor's links to the land, decreasing their security and as a consequence they commonly moved, in search of better salaries and better work conditions.

Furthermore, the primary objective of the capital flow to agriculture was the production of "industrialized" agriculture directed to export crops. The main idea at that time in Brazil, was that cash-crops needed large areas of cultivation to be feasible. For that reason, only large farms were eligible for the credits. Hence, the main effect was land concentration. Many small farms were sold to big landowners. Government policies towards "Modernization" in the Southern Region left small farmers and rural workers out of this

process. The resources were not equally distributed, consequently powerful interest groups were favoured.

Another effect of new governmental policies was an expansion of cultivated lands which closed the agricultural frontier in the South, particularly in Parana State, which had been a recipient of migratory flows for many decades. As new agricultural land became scarce and as peasants were displaced from sharecropping and tenant arrangements, land conflicts arose. First, the federal government decided to divide some State-owned lands and distribute them to release strong pressures from the displaced farm workers who did not have the skills needed to be absorbed by the industrial sector. The second political decision was to open up other agricultural frontiers in the Mid-West and Northern Regions. This process emphasised an incremental approach of policy-making in Brazil, where the main objective was to avoid radical changes such as deeper land reform. A further consequence was that, when land became scarce in the Southern Region its price increased very quickly. Speculation took place and some arable lands were left unproductive by large landowners just waiting to make larger profits.

Therefore, displaced rural workers were attracted by the opportunities being advertised in the Amazonian new frontier. Unemployed or sub-employed people from other regions also were attracted by the intense government propaganda. The Brazilian State planned to settle 100,000 families along the Transamazon Highway (part of the 5,400 Km road construction in the territory) in the first five years of the program, to produce food staple crops. However, the policies on credit, the lack of environmental surveys and soil surveys at the appropriate small scale, prior to the project implementation, undermined the results of

these colonizing programs along the Tranzamazon highway. Other reasons also contributed to the failure in reaching the proposed objectives: the soils in many areas were too poor to support small farm agriculture, certain sections of the road were impossible to use during the rainy season and this prevented commercialization of the products, disease, especially malaria, became a common problem, and inexperience of the migrants. In this model of family colonization, malaria can be a very disruptive factor, which often jeopardizes the farmer's ability to survive economically (Martine, in Goodman and Hall eds, 1990). Moreover, many of the settlers that were attracted by the new opportunities had no farm experience and this was aggravated by the absence of technical and structural support. The failure at farming led them to abandon the land and again migrate to urban areas in small towns and cities. It is important to note that urban growth often accompanies areas of agricultural settlements, by spontaneous migrants who aim to provide goods and services to the region. The migratory flows urban-to urban and rural-to rural also were predominant in the region according to census data (Barcelos and Costa in IBGE eds, 1989) (Table 3.3, Table 3.4 and Table 3.5).

Table 3 3 - Brazil, Urban / Rural Population, 1960-1970

Geographical Regions	Brazil, Urban / Rural Population, 1960-1970			
	1960		1970	
	Urban	Rural	Urban	Rural
Brazil	31303034	38767423	52084984	41054053
Northern	957718	1604064	1625600	1977260
Northeastern	7516500	14665380	11752977	16358950
Southeastern	17460897	13169831	28964601	10888897
Southern	4360691	7392394	7303427	9193066
Mid - West	1007228	1935764	2437379	2635880

Source IBGE, Demographic Census of 1960 and 1970 Anuario Estadístico de 1992

Table 3 4 Brazil, Urban / Rural Population, 1980-1991

Geographical Regions	Brazil, Urban / Rural Population, 1980-1991			
	1980		1991	
	Urban	Rural	Urban	Rural
Brazil	80436409	38566297	11099025	35835222
Northern	3330592	3288560	5921837	4108719
Northeastern	17566842	17245514	25776279	16721261
Southeastern	42840081	8894044	55225983	7514418
Southern	11877739	7153423	16403032	5726345
Mid - West	4821155	1984756	7663122	1764479

Source IBGE, Brasil em Numeros, 1994

obs The 1980 figures for the Northern Region include the municipalities of Tocantins incorporated in the region by the 1988 Brazilian constitution

Table 3.5 Brazil Urbanization, 1960-1990 (%)

Geographical Regions	Brazil Urbanization, 1960-1990 (%)			
	1960	1970	1980	1990
BRAZIL	44.67	55.92	67.59	75.59
Northern	42.34	45.12	50.32	59.04
Northeastern	33.89	41.81	50.46	60.65
Southeastern	57	72.68	82.81	88.02
Southern	37.1	44.27	62.41	74.12
Mid - West	34.23	48.04	70.84	81.28

Source: IBGE Brasil em Numeros, 1994

According to Moran (1990), the lack of land availability seems to be the major constraint to the rural poor, but technical support and time for the migrants to adapt to the new environmental and socio-economic circumstances are also vital. The estimated time for adaptation is, at least, 10 years. Without this technical support and time to adapt the colonizing schemes are unlikely to succeed.

In the mid-1970s the Amazonian development efforts were reoriented from the government-directed small farms to privately-sponsored colonization schemes and large corporate investments, especially cattle-ranching. Many projects reached the dimension of over 100,000 ha. during the 70s (Figueredo, IBGEed, 1993). Such projects, supposedly, would be more economic and technologically fit for developmental purposes. Many small farmers from the settlements along Transamazon Highway were incapable of dealing with the problems such as lack of credit and technical support, and decline in soil fertility sold their

lands. These people along with other migrants were used to clear land for pastures, the most labour-intensive phase of cattle-raising. Due to the fact that this activity does not absorb much labour when in operation, and lasts only a short period of time, the majority of small displaced farmers, largely unskilled, moved to urban areas or other areas in the search for available land. Rondonia, which had the reputation of better soils, experienced very high in-migration (Tables 3.6 and Table 3.7). Many of these migrants ended up in urban areas of small towns, which were also unable to provide enough jobs and services.

Table 3.6 Migration in the Northern Region - 1970

Northern Region	Migration in the Northern Region 1970		
	In-Migration	Out-Migration	Balance
Acre	24,285	26,888	-2,603
Amapa	35,881	6,649	29,232
Amazonas	59,558	67,835	-8,277
Para	153,358	118,806	34,552
Rondonia	45,694	6,809	38,885
Roraima	7,530	2,990	4,540

Source: Demographic Census of 1970

Table 3 7 Migration In the Northern Region - 1980

Northern Region	Migration in The Northern Region 1980		
	In- Migration	Out-Migration	Balance
Acre	15,086	17,081	-1,995
Amapa	21,319	9,147	12,172
Amazonas	65,463	40,084	25,379
Para	347,303	117,121	230,186
Rondonia	262,750	16,648	246,102
Roraima	17,825	3,921	13,904

Source Demographic Census of 1980

The government encouraged "capital" to assume the task of developing the region which, according to Foweraker, initiated the capitalist stage of Amazonia occupation with large-scale agribusiness implantation and acquisition of large land holdings. Agro-ranching activities seemed, at that time, to be best suited to the region's characteristics, therefore large Southern corporations received fiscal and financial incentives to support livestock production in order to generate export earnings. Mining activities were also encouraged by infra-structural development and governmental incentives (1980).

Both the lack of documented title to the land (although Brazilian legislation gives right to land through continuous occupation), and government commitment to capital-intensive development of the region undermined the peasants' ability to hold onto their lands, which they had used mostly in subsistence forms or for non-timber forest extraction. As Wood (1983) argues, speculators, cattle-ranchers, and other groups who strive for land in frontier

areas, constitute a real threat to the peasantry (Goodman and Hall eds, 1983) Therefore, the traditional rural class of these frontier areas also enlarged the migratory flows

In Acre state, where in the 1970s more than 5 million ha of land changed hands, the displaced caboclos joined these flows to other rural areas or to the cities, even crossing the border to Bolivia (Bakx, 1990) Just a small percentage of them managed to stay in the rural areas The strong rural to urban migration in Acre is linked to the decrease of rubber production and the expansion of cattle-ranching From 1972 onward, many Acrean rubber plantations were sold to Southern companies and transformed into pastures The majority of these lands turned into unused pasture, with speculators just waiting for them to increase in value The social consequence of this land-use transformation in Acre was the enlargement of the Acrean capital (Rio Branco), especially its shanty towns (Barcellos and Costa in IBGE: eds, 1989), (Bakx, 1990)

In demographic terms, the Northern region grew an average of 3.47% per year from 1960 to 1970, while Brazil at the same time grew 2.89%. From 1970 to 1980, the region registered an incredible growth of 5.04% per year compared to the Brazilian average of 2.48% (IBGE, 1989) These numbers clearly reflect the result of governmental policies toward human occupation of the region The diversity of opportunities in agriculture, timber extraction, mining, mineral prospecting and construction of road, and hydro-electric schemes had attracted many people to the area The intra- and inter-regional movement in the Northern region, that up to the 1970s had involved 654,157 people and a further 1,778,060 in the 80s (Barcelos & Costa, IBGE), provided a more effective occupation of the area but occurred in a disorganized form despite the colonizing schemes

The bulk of population growth in the Northern region, did not occur in a homogeneous way throughout the region. In certain areas like Rondonia, it had achieved an annual average of 15.75% from 1970 to 1980, due to migration. Rondonia received many people from the South, Southeast, Mid-West and Northeast attracted by the agricultural and mining developments in the last three decades. Moreover, the agro-industrial capitals had changed many agrarian social structures in the Southeastern region, generating a surplus of rural labour (Godman in Bacha and Klein, 1989). Hence, the main characteristic of these migration flows were their rural destination.

Since the 1960s, this influx of people was first motivated by the highway constructions and later by the colonization programs (Barcelos and Costa in IBGE, 1989). A network of urban centres also were spread along these highways to give support to the new economic activities. These centres provided consumer goods, equipments and services.

Para state is another area which received large migration flows. In the 1970s, Para had incorporated almost 50% of the total migrants to the region (See table 3.6). In contrast, Amazonas state only received a small share of the total migrants to the region in the same decade. These people were mostly attracted by the job opportunities in the industrial area of the Manaus free-trade zone.

In conclusion, the profound modifications that the Northern region has experienced in demographical terms in the last three decades, were highly determined by the governmental policies toward economic integration with the other Brazilian regions and to occupation of empty spaces. While the intra-regional and inter-regional migrational flows have intensified, the increased population has not been evenly distributed and is still mainly concentrated in the

areas along the highways and the rivers and in the urban areas of the state capitals and small towns

3.2.2.2 Land Conflict Background

The main causes of the increasing land conflicts that have occurred in the Northern region were the Brazilian land structure, with large land holdings, often unproductive, the inflationary economy of the last decades, which gave way to land speculation, the government incentives to large enterprises to invest in the Northern region which quite often have spread their domains over land previously occupied by Indian groups, small land owners ("posseiros"), and rubber-tappers (Magnano in IBGE ed., 1989). However, this situation of conflict can not be blamed just on the military governments from 1964 to March 1985 (Martins, 1990). To some extent, it repeats the patterns of previous land struggle in other regions of Brazil, mostly caused by the seasonal swing in rural labour, with rapid increase in temporary wage-agriculturalists (Hoffman in Bacha and Klein eds. 1989).

Indians in the Amazonia, for instance, have the longest history of land struggle and the new democratic governments from 1985 could not solve the problems either. Even though the 1988 Constitution established a time frame for the bureaucratic stages toward the regularization of the Indian lands, it was poorly implemented. The National Land Reform Program, from October 1985 displays the same slow implementation. In addition, the underlying social causes of migratory movements aiming at better opportunities and the prevalence of large landowners in the political elites still persist.

The economic model used in the Northern region, in the last three decades, was

mainly focused on the incorporation of large areas into production. In the decade of 1970 alone, the agricultural establishments grew 18,337,275 ha in the Northern region. From that 3,293,371 ha, represented pastures and 1,126,524 ha had other agricultural uses. In 1980, 82% of all land holdings under production were of less than 100 ha, and occupied 17.40% of the total area. At the same time, the productive entities of 1,000 ha or more only accounted for 1.10% of holdings but occupied 52.60% of the total productive area (Paiva, Carreira and Mattos, 1989). These numbers clearly show the underlying goal of land speculation to the detriment of objectives to increase production.

Although most Brazilian agricultural policies from the 1950s favoured the larger rural establishments, principally in credit availability, it is meaningful to highlight the importance of the small producer in domestic food production and agro-industry. The 1980s agricultural census shows that the rural establishments of less than 50 ha produced in that year the following percentages of the national production: 78.0% of cassava, 66.2% of beans, 55.9% of corn, 27.8% of rice, 57.9% of potatoes, 79.4% of onions and 59.6% of tomatoes. According to the same source, these properties encompassed 70.3% of hog raising and 69.4% of poultry (Mesquita e Silva, in IBGE eds, 1988).

Different social groups, with conflicting objectives, take part in the struggle for access to the land in the region. Beside Indians are the mineral prospectors, in the search for new areas of mineral occurrence, especially gold (for that reason, called gold prospectors) or to find a job in the already established areas of extraction, and the "sem-terra" group (that means landless people), which encompasses displaced peasants, rural workers, rubber-tapers, nut-collectors and other dispossessed people who migrated to region. These groups also clash

with the interests of large landowners, cattle-ranchers and mineral companies, to whom policies tend to favour (Grainger, 1993). Therefore, where new economic activities were imposed, and caused rapid deforestation, these areas also were latent for conflict. Especially, in areas which the forest represents the main source of subsistence (Magano, in IBGE ed, 1989). The number and area of the conflicts in the region differ from the various sources, even among the official agencies in charge such as INCRA and MIRAD (Ministerio da Reforma e do Desenvolvimento Agrario), according to the data provided by the latter, there were estimated 892 land conflicts in Amazonia in July of 1986 (Almeida, in Goodman and Hall eds., 1990)

3.2.2.3 Gold Prospectors

Gold prospectors ("garimpeiros") have been stepping for centuries on the mineral ore s in the Amazon region, while the first gold mining companies just started their activities in 1940. The number of mining companies, national and international, largely increased from the 1970s, bringing many changes in the local process of mineral prospecting. However, these companies are responsible for only 3 out of the 12 gold ore bodies found from 1980 to 1990 in Amazonia. All others ores were found by "garimpeiros" in their constant search. In the last 10 years, it is estimated that they extracted more than 1000 tons of gold from that region. Alluvial deposits of desagregated rocks form most of the mineral reserves in Amazon. This peculiar geological characteristic simplifies the "garimpeiros" work, since it does not require sophisticated machinery or advanced technology to spot a new mineral ore. However, these men, which had their number increased many times from the 70s, and became largely

exploited by the "garimpeiro entrepreneurs". struggle to survive in the jungle. They are often illiterate, unskilled and come from many different regions of Brazil forced by adverse socio-economic situation "Garimpeiros" fight against incredible odds walking sometimes 300 Km a week through a dense forest in groups composed by three to five people (Veja, 17Nov93) For this reason, it is very difficult to keep those men out of the Indians territories and other areas such as claimed mines and small farmers properties

Brazilian laws authorize cooperative systems to carry out mineral prospection in Indian reserves under certain conditions (Brazilian Constitution - 1988, art 231, par 3) This issue, which is closely related to the demarcation of Indian lands, was discussed by the Congress during the process of Constitutional revision and had divided opinions (O Globo, 17Oct93) The Brazilian Environmental Defence Commission, international media and environmentalist-indigenous NGOs lobbied for the acceleration on the process of Indian land demarcation In opposition, Northern states governors like Ottomar Pinto of Roraima and Gilberto Mestrinho of Amazonia affirmed that "garimpeiros" and Amazon peasants could not be left out of the process of demarcation More than 250,000 people from 6 different municipalities would be displaced just with the demarcation of one tribe comprised of 14,000 Indians (tikunas) in Amazonia State (Veja, 17Nov93)

The spontaneous migration toward the vicinity of mineral prospection areas, creating new urban concentrations, which are also the destination for unemployed "garimpeiros", often invading Indian lands as it has occurred in Para, Roraima and Rondonia, heating up contends

It is worth to point out that the spread of mineral prospecting in Amazonia, especially when carried out by "entrepreneurs", who utilize "balsas" in the river and machinery such as

hydraulic and suck pumps in the banks, besides causing environmental disruption also can lead to a rapid exhaustion of the resource base, therefore increasing pressure to further exploration in preserved areas (Bezerra in IBGE, 1989). The work relationship among "garimpeiros" and entrepreneurs is often based in labour exploitation, such as debt service (peonage), and the work conditions very precarious, thus provoking many social conflicts

3.2.2.4 Peasantry in the Northern Region

Nevertheless some colonization projects encouraged small settlements, peasantry was not part of effective policies in the region. In certain ways, agrarian policies were very unequal, since they allow peasantry eviction from the lands which they traditionally occupied (Martins, 1990). Hence, the acquisition of large land holdings by local and extra-regional investors, which tremendously increased the number of rural properties, created a process of growing concentration of land ownership. Figures in table 3.8 and table 3.9 exemplify this statement. In Amapá, landowners, which represents 44.54% of the rural producers occupied 90.20% of the total area used as agricultural establishments, while other producers who do not display the land ownership share less than 10% of this land use. Therefore land concentration associated with patterns of tenancy and the increase in land prices, give way to many conflicts. The peasantry in the Northern region includes people engaged in vegetal extraction, rural workers, "posseiros" and also small land owners of less than 5 ha (Magnano in IBGE, 1989). Due to a lack of land tenure by the majority of these small agriculturalists they became easy targets for all sorts of violence. Fraudulent land sales, burning of their houses or plantations, and eviction are just some of them, even victimizing besides rural

workers, Indians, union leaders and priests (Almeida, in Goodman and Hall eds., 1990)

The peasants in the region do not have a long history of political organization. At the beginning of the military government, the Land Statute was approved to disarticulate the country's rural organization of the Peasants' Leagues, a movement linked to left-wing political groups. Moreover, the Land Statute and the policies from the World Bank, aimed at the creation of a rural middle-class (Martins, in Goodman and Hall, 1990). However, the policies of fiscal incentives re-oriented these objectives, stimulating large capitalists from the South and abroad to take over the industrialization of the agro-systems. The New Republic (from 1985 onwards) followed this trend and the highly subsidized investments in the Amazon were abolished just at the beginning of the 90s. Therefore, the peasants' struggles were, predominantly, a form of isolated defence to abuses perpetrated against them. These abuses were quite often seen as "natural" in frontier zones. The efforts of rubber-tappers to maintain their extractive areas in Acre, preserved against deforestation and pasture formation can exemplify this. After many disputes, in 1990 were created Extractivist Reserves, the conservation areas, which the ecological and social importance was taken into consideration.

Table 3.8 Rural Land Tenure - 1980

Northern Region	Agricultural Establishments		Landowners			
	Establishments	Area (ha)	estab	%	area ₁	%
Total	408173	41559420	191,471	46.9	2744019	66.02
Acre	27371	5679527	7,960	29.08	2104329	37.05
Amapa	4304	735129	1,917	44.54	663080	90.20
Amazonas	100623	7009573	41,886	41.63	4112672	58.67
Para	223762	20448422	119,859	53.57	1691625	82.72
Rondonia	48371	5223629	19,504	40.32	2773056	53.08
Roraima	3742	2463106	345	9.22	870748	35.35

Source IBGE Censo Agropecuario - 1980

Table 3.9 Rural Land Tenure - 1980

Northern Region	"Posseiros"				Tenants			
	establ	%	area ⁽¹⁾	%	establ	%	area ⁽¹⁾	%
Total	181,396	44.44	1699294	26.45	28,607	7	2954101	7.10
Acre	12,098	44.2	1490539	26.24	7,292	26.64	2070796	36.59
Amapa	2,372	55.11	68621	9.33	8	0.19	2973	0.40
Amazonas	46,113	45.83	2425434	34.6	11993	11.92	418110	6.25
Para	92,853	41.5	3039687	14.87	7376	25.78	387684	13.12
Rondonia	24,569	50.79	2382760	45.62	1937	4	44349	0.85
Roraima	3,391	90.62	1585853	64.38	1	0.63	2	0.06

Source IBGE Censo Agropecuario - 1980

⁽¹⁾ The areas in the table are represented in ha

The Catholic Church, in the last 30 years became the peasantry's voice, committed to their struggles and denouncing the crimes suffered by them, principally during the military government, when left-wing political parties, which encouraged land reforms were outlawed. The Church assumed the role of mediator in the countryside, creating The Pastoral Land Commission. This initiative was due to the fact that local police and the judicial system are quite often controlled by the large landowners. Nowadays, although the political rights are re-established, "the new estates of modern enterprises" have in many cases adopted relations of exploitation, such as the almost slaving work of debt peonage, against which the Church has fought (Martins, in Goodman and Hall eds. 1990). Particular militia is another resource used by these landowners to impose dominance by force. The Church also filled the gap left by the political parties of the new democratic regime, from whom the rural social movements seem not to receive much support.

In sum, the problems which surface in Amazonia, as a frontier region, just display the lack of a real government commitment through effective policies for the most vulnerable groups in society. Policies that should curtail onward migration, by providing conditions for small farming, that in the view of many researchers to Amazonia seems to be the most environmentally and socially appropriate for a sustainable development (Moran, 1980, 1993, Barrow, 1990). Migration also increase the risks of disease, by creating disturbances in this special environment. Since the region is endemic for many diseases, this back-and-forth movement facilitate the spread of disease.

3.2.3 Education in the Northern Region

Since the 1930s, access to educational opportunities has spread more evenly throughout the Brazilian population, with the intent of achieving universal access. The development ideology from the 1950s strengthened this approach by trying to deliver education at all levels with the objective of improving the labour market. Governmental policies reinforced these tendencies, during the 1970s. In all, the elementary level of education was extended from 4 to 8 years and it became mandatory from 7 to 14 years of age, while the secondary level was professionally oriented. The eradication of illiteracy was a major goal.

Although the delivery of education in Brazil has experienced major growth, it has not happened in a uniform fashion, either geographically or in terms of equity. Regional and intra-regional (rural and urban) disparities occur and are reflected in enrollment rates, availability of all educational levels, expenditures per student, and quality of the instruction delivered. In the Northern Region, for instance, the expenditure per enrollment corresponds to 65% of the national average (Castro in Bacha and Klein, 1989).

The literacy rates have increased through time in Brazil (Table 3.10) in the last fifty years, although in certain regions low rates have persisted. In the Northern and Northeastern regions, for instance, the literacy rates were around 50% in 1980. Moreover, in areas of frontier expansion, it is hard to measure the real improvements since in-migrants can mask the results.

Table 3 10 Literacy Rates in Brazil - Age Ten and Over, 1940-1988

Brazil	Literacy Rates (%)		
	Total	Men	Women
1940	43 0	48 2	38 0
1950	48 4	52 6	44 2
1960	60 6	64 0	57 3
1970	66 6	68 9	64 4
1980	74 5	75 6	73 5
1988 ¹	81 5	81 6	81 4

Source IBGE Adapted from Castro in Bacha and Klein, 1989

¹ Data for 1988 figures FLACSO, 1994

The first level of education in Brazil, composed of 8 grades (equivalent to the Elementary school and Junior school) is the one which reaches the greatest number of students in all regions. In 1970, according to statistics of IBGE, student distribution among the three levels of education were as follows: 93.92% in the first level, 4.36% in the second level (secondary school) and 1.70% in the third (graduate and undergraduate level). In 1980, these numbers were 89.22%, 8.32% and 2.44%, respectively, hence indicating an increase in the proportion proceeding to the second and third levels. Table 3 11 presents a regional elaboration of school enrollment. It is important to note that, although education is mandatory for children between 7 to 14 years of age, there is a discrepancy between legislation and law enforcement and the provision of equal opportunities.

Table 3.11 Selected Aspects of Brazilian 1st Level of Education 1970 - 1980

	Selected Aspects of the Brazilian 1st Level of Education (1970 - 1980)					
	Brazil	Northern	Northeast	Southeast	South	Mid-West
Access to School ¹	30.5 (U)	21.7 (U)	19.5 (U)	42.8 (U)	41.9 (U)	26.6 (U)
	20.4 (R)	17.6 (R)	14.9 (R)	30.0 (R)	33.8 (R)	19.4 (R)
School Progress ²	43.6 (U)	36.5 (U)	30.5 (U)	57.1 (U)	57.1 (U)	44.1 (U)
	31.3 (R)	27.1 (R)	22.0 (R)	54.4 (R)	46.6 (R)	33.9 (R)
Enrollment ³	67.0 (70)	60.0 (70)	50.1 (70)	77.9 (70)	74.0 (70)	63.4 (70)
	66.3 (80)	58.2 (80)	47.9 (80)	79.4 (80)	74.5 (80)	67.5 (80)
Conclusion ⁴	18.17	13.9	8.77	24.39	21.65	18.13

Source: MEC Statistics in Education. IBGE Census Adapted from Strauch IBGE, ED, 1988

¹ Percentage of the population of age 7 years attending Grade 1 of Elementary School in the total population attending Grade 1 in 1980

² Percentage of previous year's Grade 1 students who proceeded to Grade 2 in 1980

³ Percentage of population of 7 to 14 years of age enrolled in school from the total population of 7 to 14 years of age

⁴ Percentage of students who started grade 1 in 1977 and finished grade 8 in 1984

The low percentage of students starting grade 1 at the proper age (the Northern region presented the second lowest percentage in Brazil in 1980) brings many negative consequences. One is the high heterogeneity in terms of age among students, which brings pedagogical problems. Considering the poor qualification of the teachers, especially in rural areas, this problem is very serious. In the Northern region in 1980, only 12.93% of the teachers held a university degree. This lowest figure in the Brazilian rank confirms the spatial inequality of education. In addition, late enrollment also may reduce the years of children in school in the long range, besides contributing to the high rates of failure and withdrawal.

at the end of the first grade (Strauch, 1988) The figures in Table 3 11, which indicate the proportion of students who passed the 1st grade, substantiate this statement The Northern region also shows the second lowest capacity in Brazil to deliver the complete first level of school to its students

This brief analysis of Brazilian education over the last two decades, especially in the Northern region provides ground to conclude that, although improvements have been made, education is not adequate to meet the development hopes of the last 50 years The results of education are still incompatible with a developed society It also confirms the fact that the developmental initiatives supplied to the Northern Region were not enough to ameliorate the social conditions of its population, for which education constitutes a powerful indicator The links of improved education, especially women's education, to lower rates of fertility and infant mortality, and also better child care have been recognized world wide (Price, 1994) Therefore, improvements in education in the Northern region would also convert into health benefits

3.3 The Economic Perspective

3. 3. 1 The Economic Development Process in the Northern Region of Brazil

As was discussed in Chapter one, most political decisions regarding the development process of the Northern region, in the last three decades, have been taken by the national government This pattern of centralization and policy-making repeated the colonial pattern, in which decisions were made by outsiders, usually without enough knowledge of the particular characteristics of this environment In addition, the Northern region has been seen

as a "frontier" in the economic development that was pursued during the same period of time in Brazil (see Table 3.12 for Brazilian figures). The region was viewed, predominantly, as a commodity supplier, especially of minerals, wood products and meat, to other regions of the country and to foreign markets (Magnano in IBGE, 1989). Such exogenous influence in the area is long-standing and has been principally directed toward the demand for Amazonian products, availability of investment resources and national policies for the region (Mahar, 1983). The external politics must also be considered. The availability of foreign loans in the late 1960s and throughout the 1970s, provided the means to seek economic development and growth. However, it turned into a financial crisis during the 80s when the service of the debt sharply increased due to changes in the international economy.

Brazil, considered a middle-income country in terms of Latin America (per capita product ranging from US\$ 1,500 to US\$ 2,500 per year) had to transfer abroad a significant part of its earnings to service the debt. The percentages with regard to the Gross Domestic product were respectively: 1.6 in 1970, 3.5 in 1975, 5.8 in 1980, 4.4 in 1985 and 1.2 in 1990 (ECLAC in Instituto de la Mujer ed. 1995). The burden of over indebtedness during the 1980s, negatively impacted on society, since structural adjustment measures imposed by the International Monetary Fund (IMF) generated social cutbacks and a wage squeeze. The economic crises of the 1980s also threw millions of workers previously employed in the formal sectors into the informal sectors of the economy and into poverty.

Table 3 12 Growth of Total and Per Capita Gross Domestic Product (GDP), 1970-1992

BRAZIL	GDP	
	T GDP¹	P/C GDP²
1970	106,328 1	1,109
1975	171,777 5	1,590
1980	243,500 5	2,008
1985	257,327 7	1,898
1990	283,327 7	1,903
1992	283,466 5	1,839

Source ECLAC based on official figures

1 Total Gross Domestic Product (In 1980 US\$ millions)

2 Per Capita Gross Domestic Product (In 1980 US\$)

From the 1960s, the Federal government, relying on the availability of international funds, encouraged settlement in the Northern Region through infrastructure development and support for internal migration which would provide the labour force to the development purposes. Infrastructure development included highway construction such as Belem-Brasilia, Transamazonica, Cuiaba-Santarem and Cuiaba-Porto Velho highways, and hydro-power implementation, such as Tucurui and other planned hydro-electric facilities (Appendix E). This was accompanied by fiscal and financial incentives to agribusiness and mineral extraction. Macro-scale development strategies have followed in the 1970s and 1980s, with the most important being

(1) First Development Plan for Amazonia (PNDAM I) 1972 - 1974

The PNDAM I was part of the major national plan "Programa de Integracao Nacional", which aimed to expand the interconnections of the various regions of the country.

It was coordinated by the planning agency to Amazonia, "Superintendencia de Desenvolvimento da Amazonia" / Superintendency for the Development of Amazonia (SUDAM), and the national organization for the land reform and land questions, "Instituto Nacional de Colonizacao e Reforma Agraria" (INCRA)

The plan gave priority to colonization schemes, principally along the recently-built highways. The plots were given to small farmers with the objectives of increasing the population in the region, while releasing land pressures in other areas in Brazil and encouraging agriculture for internal market. At that time, a serious drought in the Northeast region also served as a push factor for spontaneous migration. This program did not succeed as it was hoped. The reasons for the failure were mainly related to the lack of soil surveys prior to the settlements, the shortage of technical and financial assistance to the small agriculturalists dealing with an unfamiliar environment, the deficiency of road conservation, and distance to the markets. These were aggravated by the inadequacies of the program to the local environmental conditions and by outbreaks of malaria. Consequently, many colonists were impelled to sell or abandon their lots, and migrate again in the search for employment in mining activities and corporate agriculture enterprises (Mahar, 1979)

(2) Second Development Plan for Amazonia (PNDAM II) 1975 - 1979

A second plan for Amazonia was proposed to mitigate the effects of the PNDAM I failures, and to contribute to the Brazilian international trade balance as a "resource frontier" providing foreign exchange and limiting imports (Mahar, 1979). The PNDAM II was directed toward large-scale private investments, through the creation of development poles

in the region (POLAMAZONIA) related to specific economic potential, mostly in mining, lumbering, cash-crops or livestock. The increase in cattle-ranching activities, which received support from international development agencies and thus joined Brazilian ranchers to international companies, dates from that time.

SUDAM took over the PNDAM II and progressively coordinated its implementation, by selecting projects which gave priority to certain areas, such as Para and Amazonas states, and liberated financial resources (Magnano, IBGE, 1989). Priorities were given to activities according to the availability of resources to be exploited and proximity of existing transportation facilities. The large number of new industries located in Amazonas was due to the existence of a Free Trade Zone in its capital, Manaus, created in 1967 and to the processing of regional raw materials. The governmental incentive to industrialization was also in accord with its policy of import-substitution and the provision of employment to the rapidly growing urban populations. The subsidized credit and fiscal incentives, paradoxically, encouraged capital and land accumulation to the detriment of labour absorption (Mahar, 1979). Table 3.13 presents the number of the projects approved by SUDAM in the period of 1975 to 1986 in the Northern Region.

(3) Third Development Plan for Amazonia (PNDAM III) 1980-1985

The PNDAM III also had the objectives of stimulating occupation of the Northern Region and the commercial exploitation of its natural resources. Although it contains some environmental and human concerns, especially related to indigenous populations, it fell short in providing policies to reinforce such guidelines (Mahar, in Moran ed. 1983).

Table 3 13: Projects Approved by SUDAM in the Northern Region 1975 - 1986

Northern Region	Projects Approved by SUDAM in the Northern Region 1975 - 1986						
	Projects	Mining	Timb	Agri Catti	Aggro-indust	Service	Indust
Total	1887	43	408	485	152	109	690
Acre	31	-	1	23	-	1	6
Amapa	63	2	4	44	4	2	7
Amazonas	630	8	48	65	13	38	458
Para	1000	21	284	321	109	64	201
Rondonia	133	12	66	17	22	3	13
Koraima	30	-	5	15	4	1	5

Source: SUDAM in IBGE, 1988

The most representative enterprises of the 1980s were the Carajas Program and POLONOROESTE. The Carajas program was a large capital-intensive, export-oriented development scheme. It involved iron ore extraction (estimated at 18 billion tons) in a mining-metallurgical complex and included a railway and a port to export the product. The Tucuruí Hydropower plant to provide energy for the metallurgical activities was also part of the project. POLONOROESTE was oriented to small-scale agriculture in Rondonia and part of Mato Grosso, a state in the mid-west of the country. This scheme was characterized by private settlements, and spontaneous migration to the area.

GDP figures for the Northern region states and the comparison to the other regions during the time of the three development plans to Amazonia help to show the impact of these plans on the regional economy (Table 3 14 and 3 15).

Table 3 14 Gross Domestic Product. Brazil, Geographical Regions and Northern States.

1970-1985

Geographical Regions	Gross Domestic Product: Brazil, Regions and Northern States(Cr\$)			
	1970	1975	1980	1985
Brazil	149,563	802,295	11,176,639	1,261,978,619
Northern	3,348	17,822	389,062	54,924,024
Acre	201	681	13,558	1,869,822
Amapa	174	521	9,670	1,515,110
Amazonas	1,069	6,444	128,354	17,862,910
Para	1,698	8,853	181,552	24,483,276
Rondonia	155	1,033	31,886	6,689,006
Roraima	51	290	4,810	850,392
Tocantins ¹	-	-	19,232	1,653,508
Northeastern	17,957	92,563	1,354,534	174,447,365
Southeastern	97,218	510,875	6,947,213	794,634,029
South	25,481	146,580	1,928,265	215,668,543
Mid-West	5,559	34,455	555,565	67,274,658

Source: IBGE. Anuario Estatístico, 1992

¹ The municipalities which formed the state of Tocantins in 1988 were included in the figures from 1980

Table 3 15 Gross Domestic Product in Percentage Values. Brazil, Geographic Regions and Northern States, 1970-1985

Geographic Regions	Gross Domestic Product, Brazil, Regions and Northern States (%)			
	1970	1975	1980	1985
Brazil	100.00	100.00	100.00	100.00
Northern	2.24	2.22	3.48	4.35
Acre	0.13	0.08	0.12	0.15
Amapa	0.12	0.06	0.09	0.12
Amazonas	0.71	0.80	1.15	1.42
Para	1.14	1.10	1.62	1.94
Rondonia	0.10	0.13	0.29	0.53
Roraima	0.03	0.04	0.04	0.07
Tocantins ¹	-	-	0.17	0.13
Northeastern	12.01	11.54	12.12	13.83
Southeastern	65.00	63.68	62.16	59.40
South	17.04	18.27	17.25	17.09
Mid-West	3.72	4.29	4.99	5.33

Source: IBGE Anuario Estatístico, 1992

¹ The municipalities which formed the state of Tocantins in 1988 were included in the figures from 1980

3.3.2 Economically Active Population (EAP) of the Northern Region

In economic terms, the land factor constituted the main physical foundation to the majority of productive activities implemented in the Northern region, historically and by the recent development plans. Similarly, the population constituted the potential work force for

these activities, as they evolved through time and included forestry, natural extraction, rubber production and more recently, livestock and industry. The frontier development strategy of the last decades, based on extensive cattle-raising and mining, made few contributions in terms of rural employment and fixed settlements, therefore making few linkages to the local economy. Furthermore, the profits made by the corporations, which constituted the large share of the investors in the region, are more likely to return to the corporations' places of origins (Mahar, 1979). The population in metropolitan Manaus more than doubled from 1970 to 1980, due to the work opportunities generated by the Free Trade Zone's implementation (Carneiro, in IBGE ed. 1989) which provided opportunities in industry, commerce and services. It is also important to point out that the policies for the Northern region in the last decades, although controversial in terms of the physical and human environments, brought many changes in terms of diversification of the regional economy.

The Brazilian Institute of Geography and Statistics (IBGE), in its censuses and household surveys, assesses the Economically Active Population (EAP), which encompasses the population of 10 years old or over who are engaged in salaried work or in any form of non-monetary income. These numbers also include all unpaid jobs of more than 15 hours a week such as unsalaried family workers and resident labourers, but household work is not included. It also includes unemployed people, who were looking for a job in the last 12 months. The analysis of EAP provides valuable information about participation in the different sectors of the economy, also by gender, however, statistical limitations exist, especially pertaining to women's activities in rural areas and to the informal sector as a whole.

According to IBGE surveys (Table 3.16 and 3.17), the EAP of the Northern region

in 1970, (1,028 660) represented 28% of its total population, while in 1980 this figure had increased to 31% (1,812,404) indicating some growth in the work force of the region, principally as a result of women's participation. It was at a lower level than the overall Brazilian EAP, which was 36%. Women's participation in the labour force in Brazil expanded from 20.9% in 1970 to 27.4% in 1980. In the same period of time, the female EAP in the Northern region jumped from 16% of the total EAP to 21.02%, in response to the expansion of women's labour in the secondary and tertiary sectors of the economy.

Table 3.16 Economically Active Population (EAP) in the Northern Region 1970 - 1980

Economic Sectors	Economically Active Population (EAP)					
	1970			1980		
	Total	Men	Women	Total	Men	Women
Total EAP	1,028,660	859,309	169,351	1,812,404	1,431,4	380,950
Primary	585,875	535,561	50,314	775,128	704,032	71,096
Secondary	117,443	108,907	8,536	320,826	279,012	41,814
Tertiary	325,342	214,841	110,501	676,880	421,241	255,639

Source: IBGE, Demographic Censuses of 1970 and 1980 in Barcellos and Costa in IBGE (1989)

Table 3 17 EAP Variation in the Northern Region from 1970 to 1980 figures

Northern Region	EAP Variation 1970 /1980 (%)			
	Total	Primary	Secondary	Tertiary
Total Region	76.19	32.3	173.18	108.05
Acre	44.2	8.59	101.66	118.27
Amapa	68.8	-3.54	85.4	111.03
Amazonas	65.29	9.3	213.99	111.78
Para	65.54	26.93	150.72	90.14
Rondonia	405.7	460.27	446.2	311.99
Roraima	133.1	73.27	220.63	168.02

Source IBGE. Demographic Censuses of 1970 and 1980 Adapted from Barcellos and Costa in IBGE ed (1989)

The transformations which occurred in the economy of the Northern region can be noticed by the sectorial structure of employment. The primary sector, which encompasses agriculture, cattle-raising, fisheries and vegetal extraction activities, had its relative participation in the EAP of the region from 1970 to 1980 decline, despite its holding the largest share of the working population (Barcellos and Costa, in IBGE ed. 1989). The program of intense road building provided access for migration flows of unskilled poor workers, in the search for opportunities which the primary sector was not able to provide. The capital entering in the primary sector, was mainly diverted to the implementation of agro-industry even reduced employment opportunities in that sector. Natural extraction activities also have been in decline since the 1950s. According to Mahar (1979), the number of displaced rubber tappers was over 25,000 during the 1960s. Rondonia, constituted the exception to this trend, by having the EAP's in the primary sector increase during this period.

as a consequence of the implementation of the colonization programs of POLONOROESTE

The EAP in the secondary and the tertiary sectors of the economy presented the largest relative growth, due to the increase in mineral extraction activities and the growth in industry. The dynamism of these sectors was also related to the rising urbanization of the labour force and the developmental approach of the public sector in the region. Moreover, this follows a Brazilian pattern. Employment in industry and services grew on average 5.12% annually from 1950 to 1980, in comparison with the primary sector, which grew 0.82% annually (Faria in Bacha and Klein, 1989). It is important to note that urban population growth was higher than the growth in urban employment, therefore enlarging the peripheral areas (Mahar, 1979). Another relevant fact is that the proportion of families with two or more income earners also increased in the region, while the proportion of families with no income or just one income earner decreased. The latter follows the Brazilian pattern, which displayed a decrease from 72% in 1970 to 57.7% in 1980 (Hoffmann, in Bacha and Klein ed. 1989).

Children's participation (10 to 14 years) in the 1980 EAP was slightly higher in the Northern region than was the Brazilian average (Table 3.16). The highest figures, in Rondonia (8.06%) and Acre (6.67%), reflect family participation in agricultural activities, which constitutes the major sector absorbing children's labour (Barcellos and Costa in IBGE ed. 1989).

Despite the growth in the EAP in the Northern Region from 1970 to 1980 and the changes in the internal structure of the productive sectors of the economy, the increase in the average income was modest when compared to the other Brazilian regions (Table 3.19). The

trend of increasing inequality also shows up when the Gini index and the percentages of income concentration (corresponding to the 50% poorest and 10% richest) are assessed during the same period (Table 3 20) The level of inequality was even more evident in rural areas, where inequality in land ownership was tremendously high (Bacha and Klein, 1989)

Table 3 18 Economically Active Population - Ages 10 to 14 - 1980

Geographic	Economically Active Population		
Region	EAP (total)	EAP Ages 10 to 14	A / B %
BRAZIL	43,235,712	2,059,948	4.8
Northern	1,812,404	91,426	5.0

Source: IBGE Demographic census of 1980

Table 3 19 Distribution of families according to family incomes, 1970-1980

Geographical Regions	Average (1)		
	1970	1980	Change (%)
Brazil	2.56	4.83	89
Northern	1.95	3.71	90
Northeast	1.31	2.61	99
Southeast	3.55	6.25	76
South	2.34	4.76	103
Mid-West	2.12	4.76	125

Source: Adaptation of Hoffman and Kageyama, 1984 in Bacha and Klein, 1989

(1) Average in multiples of the minimum wage of August 1980

Table 3.20 Distribution of families according to family income in Brazil Gini index and percentages of income of the 50% poorest and the 10% richest, 1970-1980

Geographic Regions	Gini index		50% poorest		10% richest	
	1970	1980	1970	1980	1970	1980
Brazil	0 608	0 597	12 1	12 2	48 3	47 1
Northern	0 529	0 562	17 1	14 2	43 3	44 9
Northeastern	0 593	0 614	14 1	11 9	49 7	50
Southeastern	0 585	0 564	12 9	14 2	45 5	44 2
South	0 547	0 560	15 9	14 5	43 9	44 2
Mid-West	0 573	0 604	14 8	12 4	47 3	49 1

Source Adapted from Hoffmann and Kageyama, 1984 in Bacha and Klein, 1989

3.4 The Health Perspective

The outstanding Brazilian growth in GNP which averaged 7.4% per annum between 1950 and 1980 (IBGE, 1993) brought many structural changes to the country. The predominantly rural society of the immediate post-war period (only 36.2% urban) gave way to an increasing urban society (67.6% urban in 1980), reflecting the growth in the industrial sector of the economy (IBGE, 1994). This Brazilian experience of growth and transformation was reflected in expenditures on health. The share for health expanded from 1 or 2% of the GDP in the 1950s to 5% in the 1980s (Greevey and Vianna in Bacha and Klein, 1989). Despite the promise that these figures display, the fact is that the fruits of growth were not equally distributed, but rather generated many social imbalances that can be identified when the health status of the population is examined.

Since the health perspective is the component of the social-cultural environment in the Northern region to receive major consideration in this thesis work, it will be addressed in the following chapter

CHAPTER 4

HEALTH SYSTEM ANALYSIS

4.1 Introduction

Most of the policies applied to the Northern region in the last three decades aimed to break the isolation of the region, either physically, or in terms of bringing the developmental conditions to the level of the rest of the country. The Brazilian government, through its policies was central to the implementation of many programs toward that end. This analysis of the health status of the population in the Northern region tries to assess whether or not the development process produced health benefits to the local people. The major source of information in the present analysis is the statistical data gathered by the Instituto Brasileiro de Geografia e Estatística (IBGE), a government agency in charge of the census and household surveys. IBGE also publishes health data from the Centre for Epidemiology of the Health Ministry.

The availability of health data is one of the major constraints to any study in this field in Brazil. In particular, the situation of the Northern region of Brazil imposes additional problems to gather accurate information. Sometimes the data available refers just to Amazonas and Pará (the most populous states in the region), sometimes they do not include the rural areas and in some cases they just present data gathered in the state capitals. Another limitation for health research in that region is related to the way and time frame in which these data are collected and presented. Periodicity and standardization are vital elements to allow

a consistent statistical analysis. However, this present analysis attempts to overcome such difficulties and present a contribution to the understanding of health conditions resulting from the development process in the Northern region, by comparing available data with that from other Brazilian regions.

4.2 Overview of the Health Care System

Brazil has had government supported social and health care services since 1920. Although throughout the years the health sector has become more directed toward universalization and expansion of the services, it is still far from achieving an ideal condition. Health services in Brazil are delivered by both public and private sectors, with the latter highly subsidized by the former. By the early 1980s private contractors accounted for about 80% of the hospitalizations and 70% of medical consultation; this was financed initially by the social-security-funded health system and later by the Unified Health System (SUS) (World Bank, 1990).

The portrait of inequality is evident in the spatial and social discrepancies that can be found in the availability of health services in Brazil. These discrepancies are between rural and urban areas, from region to region, and between places within the same cities. The regional inequities in terms of access to health provision are due to the fact that the majority of the financial resources went to the more populous Southern and Southeastern Brazil, which made the bulk of the financial contributions to the social security system by taxation. The social security system, INAMPS (National Institute for Medical Assistance and Social Security) was responsible for the great majority of all health expenditure, providing personal

and curative health services. The Health Ministry was oriented to public health provision. From the 1988 Constitution onward, these two systems were merged through the creation of the Unified Health System (SUS), which allocates social security, federal, state and municipal financial resources. It became decentralized to the state and local levels (World Bank, 1990).

The Unified Health System (SUS) encompasses a network of hospitals and health centres, privately owned or public (administrated by the federal, state or municipal governments), where the SUS covers their expenditures. Despite its universality, it is estimated that the system provides health care to only 80% of the Brazilian population. The other 20% rely on private health insurance.

Health policies in Brazil from the 1970s have given priority to hospital-based curative systems, with high levels of specialization, which more often manage sickness than provide health preservation. Medical specialization is also predominant in the outpatient facilities of the hospitals. The demand for high-technology procedures has also increased, which has increased health care costs. The medical-hospital system delivers a number of very expensive services, such as renal dialysis, coronary bypass surgery and intensive-care units, for a relative few patients (Mc Greevey, Piola and Vianna in Bacha and Klein, 1989). In addition, a major decline in federal expenditure for preventive programs and primary health care can be noticed since the beginning of the 1950s, compared to the expenditures to hospital curative-care, at the same period of time (Table 4.1). This discrepancy in the allocation of resources became most evident in the 1980s. The reduced budget for basic-care, also related to the pressures to reduce public spending in health and other sectors due to fiscal austerity, also affected the

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control of infectious and parasitic diseases. According to Almeida et al (1988), only a small portion of the financial resources in the 1980s (2% of the total budget) were diverted to combat infectious-parasitic diseases. Therefore, it is not a surprise that incidence of these diseases increased in the same period.

Table 4.1 -Federal Health Expenditure (% distribution), 1949-1982

Year	Federal Health Expenditure -1949-1982	
	Hospital-based (curative care)	Basic-care (preventive care)
1949	12.9	87.1
1965	35.8	64.1
1975	70.2	29.7
1980	84.5	15.5
1982	84.6	15.4

Source: IPEA in Almeida, Strauch and Oliveira

The lack of attention to primary health care has been pointed out as a major flaw in the Brazilian Health System by authorities from the WHO and the Pan American Health Organization (PAHO). They also argue that of every 700 cases which go to hospital emergency, 500 cases could have been treated at centres for primary assistance (Folha de Sao Paulo, 12/05/96). The World Bank also has asserted, in its report of 1990, that the Brazilian expenditure of US\$130.00 per capita per year by the health sector, which is the second highest in Latin America (LA), is not consistent with the poor performance (below the average of LA) in various health indicators (Folha de Sao Paulo 13/05/96).

This aspect of primary health care/prevention just recently has been addressed by the

SUS, and some municipalities have been activating local solutions, in an attempt to curtail local problems such as a high incidence of infant mortality. In its preventive care, the system recently implemented a program of community health agents, with 40,000 members, to provide assistance to 6 million families in 1,150 municipalities. The SUS also launched a program of family health by forming 687 groups of doctors, nurses and assistant nurses, to provide services to 380 municipalities. This action has taken place in the most needy areas, especially in the Northeast region (Folha de São Paulo, 12/05/96).

A recent study by Brazilian economists, including representatives of the World Bank, shows that large amounts of financial resources are wasted by the Unified Health System (SUS). They point out that the system is constantly defrauded by the hospitals enrolled, since the system is totally unable to exert proper control. Among the most common frauds they listed were: the fake number of the patients attended, the financial up-grade of the services delivered and the consequential overcharge, and the decrease in the service quality in order to raise the profits. They also argue that the people in charge of the health decisions many times do not have enough political power to make decisions according to social needs. Quite often, they act in favour of the interests of the most organized groups, such as physicians and hospital owners (Tabak in Jornal do Brasil, 23/05/96). This power imbalance is one of the main reasons for the decrease through the years in preventive care. Financial investments in primary health programs would diminish causes-of-death such as tuberculosis, pneumonia, diarrhoeal diseases, maternal mortality, and a large number of infectious and parasitic diseases. The report exposes a serious problem, considering that from the 14,583,191 hospitalizations paid by INAMPS in 1992, 76.6% were to the private sector, 6.1% to

University hospitals and 17.2% to the public hospitals (IBGE, 1994)

4.3 Health Indicators

"It is commonly assumed that when a country is going through its demographic transition, the changes in its health indicators are primarily a function of declines in mortality. In fact both the age structure and the cause-of-death structure are strongly influenced by the rapid decline in fertility" (World Development Report 1993: Investing in Health)

Over the past three decades, significant improvement in health has occurred in Latin America as a whole. However, there are important differences between countries and many people remain without basic sanitary conditions and proper health care (ECLAC, 1995). In Brazil, progress, such as better incomes and education associated with vaccination programs and health care availability, principally boosted by the urbanization process, had an impact on the mortality structure. The crude mortality rates had declined and moved towards higher age groups, therefore modifying the age structure of the population. The Brazilian age structure figures from 1950 to 1990 demonstrate the demographic transition that the country has been through (Table 4.2)

At the same time that a demographic transition has taken place (the crude birth rates declined from 33 per thousand in 1980 to 25 in 1991, while the death rate was 6.5 per thousand in 1991), an epidemiologic transition has also taken place, in which the main causes of death became degenerative diseases, such as heart disease, malignant tumours and cerebrovascular disease. Nonetheless, Brazil has not managed to get rid of large numbers of deaths related to poverty, such as infectious and parasitic diseases, nutritional diseases, increasing number of AIDS patients, and high rate of maternal mortality. The prevalence of

infectious and parasitic diseases relative to degenerative diseases is also differentiated by region. On average, the number of in-patients with infectious diseases in São Paulo (Southeastern) represents 5.5% of the total, while heart attack patients account for 11% of hospitalizations. In Roraima (Northern), in contrast, these percentages are 17% and 22% (Folha de São Paulo, 12/05/96)

Table 4.2 Brazilian Age Structure, 1950 - 1990

Brazilian Age Structure, 1950 - 1990 (% of the total population)				
Year	0 - 4 age group	5 - 14 age group	15 - 49 age group	50 years and older
1950	16.9	25.1	48.4	9.6
1970	15.2	27.1	46.6	11.1
1990	11.8	22.6	52.0	13.6

Source: CELADE

4.3.1 Life Expectancy at Birth

Life expectancy at birth is a good indicator of the population's health condition. The increase in life expectancy at birth in Brazil has occurred at a slower pace than in other countries in Latin America. It descended from the ninth position in 1950 to fifteenth in the 1990-1995 period, when it was estimated at 68.7 for women and 64.0 for men (CELADE, 1995). In Brazil, the life expectancy for women has risen slightly favourable than for men (Table 4.3). Women over 60 years old in Brazil, represented 6.7% of the total population in 1981 and 8.2% in 1990, while men represented 6.2% in 1981 and 7.2% in 1990 (IBGE, 1994).

Life expectancy also has disparities between geographical regions, between rural and urban areas, and among different earning groups. These disparities can be very great when the better-off group of the urban areas is compared to the lowest income group of the rural areas (Table 4.4). In terms of the Northern region, this health indicator can not be considered truly representative, since it only includes the states of Amazonia and Para (Table 4.5).

Table 4.3 Life Expectancy at Birth in Brazil, according to Sex, 1950-1995

Life Expectancy at Birth in Brazil, according to Sex, 1950-1995			
	1950-1955	1970-1975	1990-1995
Women	52.8	62.2	68.7
Men	49.3	57.6	64.0

Source: CELADE in FLACSO, 1995

Table 4.4 Life Expectancy at Birth, according to Earning Groups in Brazil in 1984

Family Income ¹	Life Expectancy by years		
	Total	Urban	Rural
Up to 1	57.5	58.2	56.9
Over 1 up to 2	62.0	63.4	59.8
Over 2 up to 3	67.6	69.2	62.7
Over 3 up to 5	69.7	70.3	66.7
Over 5	73.4	73.3	71.3

Source: IBGE, PNAD, 1984

¹ Family income as multiples of minimum wage, monthly earned

Note: In Brazil the minimum wage is monthly based

Table 4.5 Life Expectancy at Birth in Brazil and Regions, 1940 to 1980

Geographic Regions	Life Expectancy at Birth in Brazil and Regions, 1940 to 1980				
	1940	1950	1960	1970	1980
Brazil	42.74	45.90	52.37	52.67	60.08
Northern	40.44	44.26	52.62	54.06	64.17
Northeastern	38.17	38.69	43.51	44.38	51.57
Southeastern	44.00	48.81	56.96	56.89	63.59
South	50.09	53.33	60.34	60.26	66.98
Mid-West	48.28	51.03	56.40	55.96	64.70

Source: IBGE, Census Data

Note: Northern region figures just consider data gathered in Amazonas and Para States

4.3.2 Infant Mortality

Despite a reduction in rates, both infant mortality (rates of death of younger than one year per 1,000 live births) and mortality in children under five (rates of death per 1,000 inhabitants from 1 to 5 years old), are still high in Brazil (Table 4.6). This health indicator is also differentiated by region and by rural and urban areas, thus reflecting the social conditions of its population (Table 4.7 and Table 4.8). The Brazilian figures are also higher than the Latin American average of 38.0 for the infant mortality rate and 11.2 for children under 5 in 1990 (CELADE, 1995). In certain areas in Brazil, especially in the Northeast, infant mortality rate can be very high, as in Jaramataia in Alagoas where in 1994 for 1,000 live births, 350 died. After intentional measures were taken in 1995, this rate dropped to 176 and in the first 4 months of 1996, from the 37 children born in that locality, just one child had died, hence projecting a annual rate of 37 (O Globo, 16/06/1996).

Table 4.6 Infant Mortality and Mortality in Children Under 5 Years of Age in Selected Countries, 1970-1995

Infant Mortality and Mortality in Children Under 5 Years of Age in Selected Countries ¹						
	Infant Mortality			Mortality in Children Under 5		
	1970-75	1980-85	1990-95	1970-75	1980-85	1990-95
Brazil	90.5	70.7	57.7	27.7	20.9	17.0
Argentina	48.3	32.2	24.3	12.1	7.7	5.8
Chile	68.6	23.7	15.6	17.2	5.7	3.7
Costa Rica	52.6	19.2	13.7	13.6	4.9	3.3
Mexico	68.4	49.3	36.0	20.3	13.0	9.5

Source: CELADE

¹ Selected Middle - Income Countries of Latin America

Table 4.7 Infant Mortality Rates in Brazil and Regions, 1930 - 1980

Geographic Regions	Infant Mortality Rates				
	1930-1940	1940-1950	1950-1960	1960-1970	1970-1980
Brazil	158.27	144.73	118.13	116.94	87.88
Northern	168.42	151.70	117.14	111.39	72.31
Northeastern	178.71	176.34	154.94	151.18	121.36
Southeastern	152.82	132.62	99.97	100.24	74.50
South	127.37	114.31	86.88	87.19	61.80
Mid-West	134.81	123.56	102.17	103.90	70.32

Source: IBGE, Census data

Note: In 1988 the IMR were: Brazil 47.5, Northern 47.8, Northeastern 79.6, Southeastern 33.9, Southern 29.9 and Mid-West 38.0 (IBGE/UNICEF/INAN, 1992 in Almeida 1992)

The figures for the Northern region just consider data gathered in Amazonas and Para

Table 4.8 Probability of Death in the First Year of Life in the various Brazilian Regions

	Probability of Death in the First Year of Life (%)					
	Total		Urban		Rural	
	1970	1980	1970	1980	1970	1980
Brazil	11.38	8.79	11.22	8.56	11.50	9.38
Northern	10.91	7.43	9.44	7.44	11.66	7.41
Northeast	14.63	12.45	15.10	12.70	13.52	12.21
Southeast	9.83	7.16	9.67	7.24	10.31	6.87
South	8.81	6.09	8.87	6.23	8.78	5.89
Mid-West	9.23	7.35	9.37	7.42	8.32	7.31

Source: IBGE. In Almeida and al., 1989.

Note: The figures for the Northern region just consider data gathered in Amazonas and Para.

The Ministry of Health in Brazil, based on statistics of the IBGE, estimated the Brazilian infant mortality rate would be 40.0 in 1996. This figure is controversial, because birth and death go largely unreported in many municipalities. The fees to get a birth certificate or a death certificate cost R\$17.00. Considering the current minimum wage of R\$112.00 per month, many families cannot afford to get these certificates which are so vital to statistical accuracy. In addition, clandestine cemeteries have been found in many communities (Folha de São Paulo, 13/05/1996) (O Globo, 16/06/1996).

In order to achieve the goal of reducing the infant mortality by half between 1995 and 1998, the Health Ministry introduced a program of reduction of mortality in infancy (PRMI) in 1995 in the highest risk areas, such as Jaramatãia. PRMI concentrates its actions on primary health care, nutrition (such as food distribution during the drought periods

complementary nutrition for pregnant women, and promotion of breast-feeding), sanitation, vaccination campaigns and pre-natal assistance, through community health agents and family doctors. The preliminary evaluations estimated a 30% reduction in the IMR in the municipalities where the program was implemented (Folha de Sao Paulo, 13.05.96). This program, under the coordination of the Health ministry, joins efforts from the federal, state and municipal levels and clearly shows that political will is necessary to bring positive social transformations.

The problems of data collection and reliability are very serious in the Northern region especially the data related to health, which depends on statistics of the Health Ministry. The infant mortality rates, for example in the region might not be truly representative of the reality, since just consider the states of Para and Amazonas.

4.4 Health System Resources

The health system resources of a country include human resources such as physicians and medical assistants, and physical infrastructure such as hospital beds available to its population, which are used as socio-economic development indicators. In Latin America despite a general increase of human resources devoted to health from the 1970s onwards, a deterioration in the physical infrastructure is evident when one examines the decrease in the hospital bed availability, a fact that is also true in Brazil from 1980 to 1990 (ECLAC, 1995) (Table 4.9).

Table 4.9 Health System Resources in Brazil and in Latin America 1970 - 1990

Health System Resources in Brazil and in Latin America 1970 - 1990						
	1970		1980		1990	
	Brazil	L A ²	Brazil	L A ²	Brazil	L A ²
Physicians p. 10 000	4.8	6.2	12.2	8.9	13.6	14.9
Medical assistants p. 10 000	3.4	16.7	6.5	23.0	32.9	19.6
Hospital beds p. 1 000	3.7	3.1	4.2	2.7	3.6	2.4

Source: ECLAD, 1993; PAHO, 1994

¹ Includes registered nurses and nursing aids

² The Latin America figures represent simple average

The World Health Organization (WHO) establishes 5 hospital beds and 1 physician for 1 000 people as a minimum acceptable rate for a developing country (IBGE, 1992). While the health-care growth in percentage figures, in terms of hospital beds and physicians, was significant in most of the Northern region from 1970 to 1980 (Table 4.10) only Roraima, Rondonia and Acre had close to the acceptable number of hospital beds in 1980. These states met 79% to 88% of the need in 1980, while Amapa met 64% and Para and Amazonas less than 50%. The ratio of 1 physician for 1 000 people was met only in Roraima, was 64% of acceptable in Amapa and in the remaining states of the Northern region ranged from 46% to 22% (Almeida, Strauch and Oliveira, 1988) (Table 4.11).

Although the numbers of hospitals and health care centres have increased in the last three decades, and universal access to health was assured by the 1988 Brazilian Constitution, health availability is not evenly distributed throughout the country. In the less developed regions, including the Northern region, the availability of medical assistance is less than in the other regions and it is also more concentrated in the state capitals than in the rural or small

urban areas. The two to four times higher per capita levels of hospital bed availability in the South and Southeast than in the North and Northeast at the end of the 1980s also illustrates this. (See Appendix F)

Table 4.10 Population and Health Care Growth, 1970 to 1980

	Population and Health Care Growth 1970-80 (%)		
	Population	Hospital-beds	Physicians
Brazil	28	44	113
Southeastern	30	30	138
Northern	63	49	234
Acre	50	70	110
Amapa	53	66	300
Amazonas	50	7	325
Para	57	55	185
Rondonia	342	191	857
Roraima	94	80	609

Source: Adapted from Almeida et al in IBGE eds. according to the Demographic Census of 1970 and 1980 and Health Statistics.

Table 4 11 Health Care Availability, 1970 - 1980

Health Care Availability in 1970 - 1980 (% of the minimum acceptable level ¹)				
Brazil and Northern Region	1970		1980	
	Hospital bed	Physicians	Hospital bed	Physicians
Brazil	76	49	86	82
Acre	56	14	79	22
Amapa	51	24	64	64
Amazonas	65	14	43	39
Para	48	25	50	46
Rondonia	91	19	81	41
Roraima	97	27	88	99

Source Adapted from Almeida and all in IBGE eds. 1989, according to the Demographic Census of 1970 and 1980 and Health Statistics

Note ¹ The minimum acceptable level (100%) would be 1 physician and 5 hospital beds 1000 population

The growth in hospital beds and physicians in the Northern region was greater in most of the states than the population growth, from 1970 to 1980. However, this increase loses a lot of meaning when compared to what happened in the other Brazilian regions, which were not the focus of any specific development policy (Table 4 12). Actually, the Northern region displays the poorest performance in terms of medical assistance in the long range. The region was also the only one where the rate of hospital beds for a thousand people consistently decreased, from the 1970s through the 90s, instead of increasing or being stable (Table 4 13). Restrictive budgetary policies from the central and local governments has reflected on the overall worsening in health infrastructure measured by the availability of hospital beds per inhabitants.

Table 4.12 Physicians Availability, 1970 - 1980

Physicians Availability in 1970 - 1980				
Brazil and Regions	1970		1980	
	Physicians	Phys 1,000	Physicians	Phys 1,000
Brazil	45,614	0.5	97,081	0.8
Southeastern	29,013	0.7	58,852	1.1
Southern	7,123	0.4	14,005	0.7
Northeastern	6,820	0.2	16,232	0.5
Mid-West	1,886	0.4	5,413	0.7
Northern	772	0.2	2,579	0.4
Acre	31	0.1	65	0.2
Amapa	28	0.2	112	0.6
Amazonas	132	0.1	561	0.4
Para	549	0.3	1,562	0.5
Rondonia	21	0.2	201	0.4
Roraima	11	0.3	78	1.0

Source: Adapted from Almerda and all in IBGE eds. 1980 according to the Demographic Census of 1970 and 1980 and Health Statistics

Table 4 13 Hospital beds in Brazil, Regions and Northern States, 1970 - 1994

	Hospital Beds in Brazil, Regions and Northern States					
	1970		1980		1994	
	Beds	Beds / 1000	Beds	Beds / 1000	Beds	Beds / 1000
Brazil	354,373	3.8	509,104	4.3	503,461	3.2
Southern	64,027	3.8	96,539	5.1	85,284	3.7
Southeastern	214,236	5.3	277,798	5.3	229,595	3.5
Northeastern	53,671	1.9	87,835	2.5	127,787	2.8
Mid-West	12,495	2.4	32,144	4.3	38,619	3.7
Northern	9,944	2.8	14,788	2.5	22,176	2.0
Acre	606	2.8	1,029	3.4	1,507	3.2
Amapa	294	2.6	487	2.8	770	2.4
Amazonas	3,107	3.3	3,310	2.3	4,111	1.7
Para	5,234	2.4	8,135	2.4	8,233	1.4
Rondonia	504	4.5	1,468	3.0	3,022	2.4
Roraima	199	4.9	359	4.5	813	3.4
Tocantins	-	-	-	-	3,720	3.6

Source Demographic census of 1970 and 1980 and Health Statistics. Figures for 1994 data are adapted from Folha de Sao Paulo (1996), Fundacao Nacional de Saude, 1994

Note 1 Tocantins was considered part of the Mid-West region in 1970 and 1980

2 The Brazilian population in 1994 and the population in the various regions were calculated according to the annual growth rates presented from 1980 to 1991. The populations in the Northern region states were calculated by the growth of the region as a whole (3.85 per annum).

The rates of physicians per thousand population represent a comparison parameter applied by the World Health Organization (WHO) since in reality the population is not equally distributed. Attention should also be paid to another parameter like physicians per square kilometre shown in Table 4 14. This spatial view, although hypothetical, regarding physicians

availability per square kilometre brings an interesting comparison about how difficult it would be for one physician in 1980 to provide health care over an area of almost 1,500 km². In this case, the dimension of the Northern region that nowadays includes the state of Tocantins (the new area of the Northern region is 3,851,560 km²) should not be forgotten in health care planning and provision, since populous centres such as Manaus and Belem coexist with very low population density areas.

Table 4.14. Physicians Availability / Population / Area, 1980

	Physicians Availability / Population, / Area, 1980			
	Area (Km ²)	Physicians	Physi/1000	Area/Physi
Brazil	8,511,996	97,081	0.8	100 Km ²
Northern	3,574,238	2,579	0.4	1,429 Km ²
Northeastern	1,556,001	16,232	0.5	100 Km ²
Southeastern	924,266	58,852	1.1	17 Km ²
South	575,316	14,005	0.7	50 Km ²
Mid-West	1,882,173	5,413	0.7	333 Km ²

Source: IBGE Demographic Census of 1980

Note: The state of Tocantins was part of the Mid-West region in 1980

4.5 Housing and Access to Clean Water and Sanitation

The large migration flows to urban areas, resulting from the structural changes in the productive sectors of the economy, have generated the spread of informal settlements on the periphery of major cities. The living conditions in the large majority of these settlements are precarious, lacking adequate sanitation and safe water, thus providing an environment

favourable to disease proliferation. Migratory movements to the Northern region in the last three decades followed the patterns in the rest of the country. The productive sectors of the economy, especially the primary sector (agriculture), were not able to absorb these people, therefore, a large share of them migrated to the urban centres, enlarging the major cities or spreading urban nuclei in rural areas.

The urban areas of Southern Brazil have been privileged with more investments than other locations and have experienced disproportionate growth. Even in this region, the infrastructure services in the urban fringes, such as piped water and sanitation, are not always provided or are deficient compared to the inner cities. Other regions in Brazil, especially rural areas, also require improvement in potable water and sanitation provision and basic health care services, particularly so in the Northern Region (See Appendix F). Rural areas and peripheral areas of the cities, where health status is the lowest, are regions where the health care needs are the greatest. As Phillips and Yola Verhasselt (1992) have pointed out, unequal distribution of resources, poorly implemented development policies, socio-political conflicts, under nutrition and malnutrition, are factors that associated with poverty, undermine health and the chances of its improvement. In the series of transformations which Brazil and the Northern region went through in the last decades, all these factors cited above can be identified. Unless the policies directed to the region recognize the local socio-economic realities, and the need for public health actions involving preventive health programs and basic sanitation, the endemic problems are likely to persist.

In 1990, the majority of Brazilians lived in individual houses (83%), with residential apartments essentially restricted to larger urban centres where the population concentration

is higher (IBGE,1994) The total number of households, in rural areas has remained practically unchanged since the 1960s, despite Brazil's major population growth and reflects the urbanization process that has occurred (Table 4 15) The urbanization has taken place mostly in a disorganized manner, and in the large majority of cases the urban centres could not provide enough potable water or adequate sanitation The Northern region has had the poorest performance in providing potable water The number of households without sewerage system, septic tanks or any other form of hygienic deposition also increased, in contrast to the rest of the country Considering that the Northern region has had continuous population growth in the rural area from 1960 to 1990 (and from 1980 to 1990 was the only Brazilian region to present such growth), and the fact that the country as a whole presents significant urban-rural differences in providing basic sanitary conditions, the Northern region figures accent the lack of measures specific to the region (Table 4 16)

Another figure used to evaluate the socio-economic and welfare condition of a population is the domestic garbage destination, whether it is collected and hygienically deposited or just thrown away and piled up somewhere, constituting a health hazard The same spatial inequities occur in the Brazilian situation in terms of garbage disposal (Table 4 17) This situation is aggravated by the industrial concentration in Manaus, specially of electronic industry, where garbage and wastes are not recycled or properly treated by the local municipality due to the lack of adequate technology and economic feasibility (Ribeiro and Almeida, IBGE,1993)

Table 4 15 Households in Brazil, 1940 - 1990

Households in Brazil, permanently occupied, 1940 - 1990		
	Urban	Rural
1/9/1940	2,509,639	5,388,130
1/7/1950	3,730,368	6,315,831
1/9/1960	6,350,126	7,147,697
1/9/1970	10,276,340	7,352,359
1/9/1980	17,770,981	7,439,858
1/9/1990	27,250,878	7,663,935

Source IBGE in Brasil em Numeros, 1993

Table 4 16 Characteristics of the Households, by Region, 1970 - 1990

Characteristics of the Households, by Regions, 1970 - 1990 (%)									
Geographic Regions	With piped water ¹			sanitary deposition ²			without sanitary dep ³		
	1970	1980	1990	1970	1980	1990	1970	1980	1990
Brazil	32 81	54 99	70 71	26 57	39 97	52 39	39 45	22 25	14 67
Northern	19 22	39 28	44 70	8 76	20 95	25 78	37 97	20 90	21 24
Northeastern	12 37	31 67	52 73	7 96	18 49	23 97	70 94	52 75	37 68
Southeastern	51 56	72 66	84 80	43 89	64 65	74 03	22 10	8 64	4 44
South	25 27	52 04	70 81	30 07	41 16	53 37	28 67	10 18	6 07
Mid-West	19 90	41 76	66 05	15 00	22 19	34 80	49 53	25 08	10 48

Source IBGE Demographic Census of 1970, 1980 and 1990

Note ¹ In this category were considered all households served by piped water system with or without internal pipes² In this category were considered the households served by sewerage system or septic tanks³ In this category are listed the households without any form of waste disposal, even open ditches

Table 4 17 Domestic Garbage Destination in Brazil in 1988

Domestic Garbage Destination in Brazil in 1988 (% of Households)			
	Collected	Burned/buried	Thrown away
Northern	53.3%	27.3%	19.4%
Northeastern	34.9%	9.2%	55.9%
Southeastern	75.4%	11.4%	13.2%
South	59.0%	27.3%	13.7%
Mid-West	54.7%	24.6%	20.7%

Source: IBGE, PNAD adapted from Branco and O' Neill, 1993

4.6 Assessment of the Basic Health Conditions in the Northern Region

In a country where the burden of disease is still high, the years of life lost per thousand of population was calculated at 26 years in 1990¹ (World Development Report, 1993). Communicable disease plays an important role in killing a large proportion of the population and in being responsible for ill-health. To assess the health conditions in the Northern region involves a major difficulty related to data collection. Up to the beginning of the 1980s published data on diseases was limited to certain diseases of compulsory notification. Another available source was the death statistics by the main causes. However, most of the published data was related only to Amazonas and Para (especially Manaus and Belem) or to the capitals of the Northern states, which presupposes an underestimation of the real numbers. Even in 1996, reliable data is a major problem in accessing the health of the

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¹The years of life lost conveys the burden of mortality in absolute terms. It is composed of the sum of the year lost to premature death per 1 000 population. Years of life lost at age x are measured by subtracting the remaining expected years of life, given a life expectancy at birth fixed at 80 years for men and 82.5 for women.

region's population. Disease also can go largely unreported due to the high mobility of some social groups, such as "garimpeiros", who can go back and forth through the forest as independent gold prospectors, and temporary rural workers (the landless group). Indian groups do not escape from "white men disease", since they have their lands often invaded. However, the notification of the occurrence of disease depends on the degree of acculturation to the Brazilian society. Because of data availability, the importance of infectious and parasitic diseases to the Northern populations, and the way which these diseases relate to the local environment will be addressed in this section.

Microorganisms are a natural part of rainforest environments. Some, such as the soil fungi and the mycorrhiza, play a vital role in the recycling of nutrients. Some of the microorganisms are pathogenic (cause diseases) and some of these are totally unknown. The recent outbreak of *Ebola* virus in Africa called attention to the fact that deforestation and population increase in tropical environments can cause biological disruptions. Although many uncertainties surround the *Ebola* and other emergent viruses, Morse, an American virologist, argues that certain viruses may move from their natural hosts, such as monkeys and rodents which are not seriously harmed by them, to humans who experience high levels of virulence and morbidity (Veja, 1995).

Amazonia is a large reservoir of life in many different forms and increasing disturbance may bring unexpected health risks. Brazilian scientists estimate that Amazonia has at least 50 different viruses, which like *Ebola* are rare but potentially lethal. An example is the *Sabua* virus, which causes haemorrhagic fever and was first detected in Brazil in 1990. Cases of infections caused by *Hantavirus* and the *Rocto* virus, that have claimed almost 100 lives in

the last decade, have also occurred in Brazil. Most of the cases were in the Southeastern region, in a highly deforested area of the Paraíba vale. These viruses have been added to the WHO data bank (O Globo, 1995). Technicians from the Centre of Disease Control in the US joined efforts with Brazilian physicians to diagnose a virus-caused epidemic of a mysterious "red fever" that occurred in the interior of Amazonia in 1994, and affected tens of adults and claimed four children's lives (Veja, 1995).

The awareness of the epidemiological consequences of changes in forest cover and human occupancy of forested areas can be traced from the beginning of the century. An early example, is the transmission of sylvan yellow fever in the African tropical forests, where the disease probably originated. The virus, which causes sylvan yellow fever, naturally circulates in the blood of some species of monkeys, specifically the ones which inhabit the crown layer of the rain forests. This disease is transmitted to wood collectors, and other people who enter the dense forest, by the mosquito *Aedes africanus*, which also lives in the canopy of forested areas. In the forest fringes the disease is transmitted by another species of mosquito, the *Aedes simpsoni*. People's migration from the forest fringes to the urban areas where the *Aedes aegypti* (the classical vector of yellow fever) is prevalent, creates the risk of serious epidemics. Similar patterns of disease transmission occur with sylvan yellow fever in the Brazilian Northern region and with other arbovirus-caused (arthropod-borne viruses) illnesses. In sum, forest edges in the tropical environments can be a reservoir of many infections.

The higher prevalence of malaria and leishmaniasis in the Northern region of Brazil is also concentrated in areas where the natural environment was disturbed by new settlements, mining operations (garimpos), timber extraction, etc (Bradley in Cartledge ed. 1994). In

these areas people are exposed to high density vectors, aggravated by environmental changes which normally provide favourable breeding conditions to the vectors. The human presence also lowers the wild animal population, which constituted the source of blood-meals in the undisturbed forest (Sawyer, 1993)

In the particular case of malaria, the reported cases have been rising and the large majority of them has occurred in the Legal Amazonia or can be traced to there (Table 4.18). The living conditions of the new settlers, or of the "garimpeiros", in shelters inappropriate to prophylactic measures, such as residual spraying, favour this increase. The health care availability, which is far from the ideal, the lack of education on how to prevent the disease and the high mobility of the population have also contributed to that end.

The general relationship between specific disease agents and physical and human environments is well known. The endemicity of certain diseases, such as cholera, malaria, yellow fever and many forms of encephalitis, are highly affected by environmental conditions. Malaria exemplifies this, in that, high temperatures, the topography of the area and the presence of bodies of water constitute the perfect environment for the prevalence of malaria, because of the overlapping high densities of the *Anopheles* mosquitoes vector, the causal agent (a protozoa *Plasmodium*) and the human host.

In fact, "disease in any given locality is the result of a combination of geographical circumstances, which bring together disease agent, vector, intermediate host, reservoir and man at the most auspicious time" (Howe, 1977, p. 8). Since the relationships among these elements are complex, any modification on the environmental condition may affect health, either positively or negatively. Certain human-induced environmental changes, such as the

use of residual house spraying against mosquito proliferation, for example, will result in lower numbers of mosquito-transmitted diseases, such as malaria, yellow fever, and dengue. However, other land uses that require deforestation of large tracts of land can increase the number of encephalitis or other virus-transmitted diseases by disruption of the natural environment. Because many viral encephalitis illnesses have an animal reservoir, possibly monkeys, and have mosquitos as vectors, the occurrence of these viral diseases may increase by disruption of the ecological web in the deforestation process.

Table 4.18 Blood Tests Positive for Malaria in the Northern Region, 1980-1985-1991

Northern Region	Blood Tests Positive for Malaria in the Northern Region					
	1980		1985 ¹		1991	
	Abs. #	% Pop	Abs. #	% Pop	Abs. #	% Pop
Brazil	169,871	0.14	399,462	0.30	533,360	0.36
Northern	123,129	2.09	326,954	4.11	360,408	3.59
Acre	6,192	2.06	10,120	2.81	13,977	3.35
Amapa	1,731	0.99	7,461	3.21	9,093	3.15
Amazonas	4,447	0.31	11,198	0.63	32,317	1.54
Para	38,023	1.12	113,649	2.72	107,842	2.18
Rondonia	59,178	12.05	168,690	20.78	168,009	14.86
Roraima	13,558	17.13	15,836	10.67	24,972	13.87
Tocantins	-	-	-	-	4,198	0.46

Source: IBGE, Ministerio da Saude, Fundacao Nacional de Saude, Centro Nacional de Epidemiologia.

¹ The 1985 population was calculated by interpolation of the 1980 and 1991 populations.

Note: In 1970 Brazil had the total 52,460 reported cases of malaria.

Leishmaniasis is another disease, which presents increasing cases in Brazil and in the Northern region. The human disease is caused by a parasitic protozoa, the *Leishmaniae braziliensis*, which has a sandfly vector. The most common Leishmaniasis in Brazil is the cutaneous form, which causes skin and mucous membrane lesions. Its visceral form is not so common in Brazil, and the only reported cases occurring in the Northern region are localized in Tocantins. Leishmaniasis is related to forest clearing, and most of its victims are lumbermen and pioneer settlers (Learmonth, 1988) (Table 4.19).

Table 4.19 Reported Cases of Leishmaniasis in Brazil and Northern Region, 1980-1991

	Reported Cases of Leishmaniasis					
	1980		1985		1991	
	Abs #	% Pop	Abs #	% Pop	Abs #	% Pop
Brazil	4,408	0.00	13,697	0.01	21,790	0.01
Northern	2,082	0.03	6,086	0.08	6,319	0.06
Acre	41	0.01	214	0.05	234	0.06
Amapa	127	0.07	719	0.33	359	0.12
Amazonas	1,355	0.09	3,428	0.20	1,461	0.06
Para	258	0.00	1,374	0.03	3,176	0.06
Rondonia	301	0.06	279	0.05	474	0.04
Roraima	N A	N A	72	0.08	552	0.25
Tocantins	-	-	-	-	63	0.00

Source: IBGE, Ministerio da Saude, Fundacao Nacional de Saude, Centro Nacional de Epidemiologia.

Note: Rondonia in the 1987-89 period displayed figures over 3,000 per year. The state populations in 1985 were calculated according to the rate of population growth (3.85) during the decade.

Another point to consider is that warm climates favour the life cycle development of animal parasites, especially protozoa and helminths, outside an individual. Water contaminated by infected sewage, for example, becomes a source of disease spread. In the Northern region, where most of the households do not have access to hygienic disposal of excreta, the same body of water is often used as a source of drinking water and a location for sewage disposal. An outbreak of cholera, transmitted by *Vibrio cholera* in Brazil, started in the Northern region in 1991 and then spread to other regions (Table 4.20). The physical characteristic of the region with numerous bodies of water, the common use of untreated water, poor hygiene and high consumption of fish facilitated the spread of this resurgent epidemic. Indeed, the condition of poverty, which involves poor nutrition, housing and sanitation provides the perfect environment for health problems.

Table 4.20 Notified Cases of Cholera, 1991-1992

	Notified Cases of Cholera	
	1991	1992
Brazil	2,102	5,366
Acre	-	-
Amapa	165	118
Amazonas	1,359	327
Para	522	1,395
Rondonia	46	11
Roraima	1	-
Tocantins	-	-

Source: Fundacao Nacional da Saude, Centro Nacional de Epidemiologia, IBGE, 1992

Mougeot (in Goodman and Hall, 1990) has called attention to the risk that schistosomiasis become endemic in the region. All cases of schistosomiasis, but 5, in the Northern region in the 1980s, occurred in Para state (717 in 1980, 2,090 in 1985 and 1,289 in 1990). These cases may be associated with the program of hydro-power dam construction, such as Tucuruí. Schistosomiasis is a "water-based" disease since the parasite depends on the presence of an intermediate host (an aquatic snail *Biomphalaria*) to be transmitted to humans, the definitive host, who disseminate the disease by contaminating the water with their excreta. The cercaria-carrying snail has been spotted in the Tucuruí area and the reduction of acidity in the reservoir and local tributaries is, according to Mougeot's views, practically certain to occur due to lime addition associated with agricultural practices in their margins. In addition, many migrant settlers and construction workers came to the region from the Northeastern region of the country, where schistosomiasis is endemic. The lack of adequate sanitation increases the odds. Learmonth (1988) shares this view and goes beyond by raising concerns about increasing risks not only of schistosomiasis but also of yellow fever, malaria, leishmaniasis, filariasis, onchocerciasis and hookworm and bowel worm parasitism as a consequence of Amazonian basin impoundment projects.

According to statistics from the SUS, infectious-parasitic diseases are the second major cause of hospital internment in the Northern region (19%), representing 20% of all deaths in hospitals in 1994. The major single cause is maternal complications from pregnancy and delivery, including complications from abortion (31%) (Folha de São Paulo, 22.05.96). Pneumonia, measles, dengue, sylvan yellow-fever, tetanus, leptospirosis, meningitis, AIDS, pertussis, diphtheria, tuberculosis and leprosy also occur in the Northern region. Table 4.21

and Table 4.22 display the evolution of leprosy and tuberculosis in the Northern region, from 1971 to 1990

Table 4.21 Notified Cases of Leprosy in the Northern Region, 1971-1980-1990

	Notified Cases of Leprosy in the Northern Region					
	1971	% Pop	1980	% Pop	1990	% Pop
Northern Region	901	0.03%	2,437	0.04%	5,500	0.05%
Acre	114	0.05%	170	0.06%	356	0.09%
Amapa	21	0.02%	97	0.06%	85	0.03%
Amazonas	291	0.03%	1,242	0.09%	1,555	0.07%
Para	442	0.02%	761	0.02%	2,182	0.04%
Rondonia	31	0.03%	142	0.03%	571	0.05%
Roraima	2	0.00%	25	0.03%	101	0.05%
Tocantins	-	-	-	-	650	0.07%

Source: IBGE, Census Information and Ministerio da Saude, Fundacao Nacional de Saude Centro Nacional de Epidemiologia

Note: Brazil has the second world most numerous cases of Leprosy. In 1995, it presented 160,617 new cases (O Globo, 31.03.1996)

Table 4.22 Notified Cases of Tuberculosis in the Northern Region

	Notified Cases of Tuberculosis in the Northern Region					
	1971	% Pop.	1980	% Pop.	1991	% Pop.
Northern Region	4,486	0.12%	6,312	0.10%	5,936	0.06%
Acre	68	0.03%	186	0.06%	320	0.07%
Amapa	1,438	1.26%	200	0.11%	151	0.05%
Amazonas	197	0.02%	1,693	0.11%	1,511	0.07%
Para	1,312	0.06%	3,694	0.10%	3,180	0.06%
Rondonia	1,439	1.29%	426	0.08%	729	0.06%
Roraima	32	0.07%	113	0.14%	45	0.02%
Tocantins	-	-	-	-	NA	NA

Source: Ministerio da Saude, Fundacao Nacional de Saude, Centro Nacional de Epidemiologia

Note: Brazil had 75,000 notified cases in 1995, presenting a rate of 5 death for 100,000 population (O Globo, 31/03/96)

Examination of the crude death and the mortality rates in Manaus from 1960 to 1980, reveals that infectious diseases exceeded all cardiovascular causes of death. Intestinal disease alone, especially in Manaus in 1969, contributed to a very large proportion of the deaths that occurred (Table 4.23). These figures include dysenteries of many aetiologies (protozoa and several bacilli). By comparison, in Southern and Southeastern Brazil in 1969, the mortality rates caused by intestinal disease ranged from 2.5 in Porto Alegre (Rio Grande do Sul) to 81.8 in Belo Horizonte (Minas Gerais), both in 1969. Belem followed the same patterns of Manaus' mortality. The mortality rates decreased through time, but still presented high prevalence of infectious and parasitic diseases (Table 4.24).

Table 4.23 Death and Mortality Rates ¹ by Selected Causes in Manaus, 1960 - 80

Selected Death Causes	Death and Mortality Rates ¹ by Selected Causes in Manaus, 1960 - 80							
	Manaus							
	1960		1969		1975		1980	
	Death	M R	Death	M R	Death	M R	Death	M R
Total Causes	2,281	1,300	2,457	1,050	3,565	990	4,902	773
Infect-parasitic ²	390	233.8	817	326.8	838	233.7	1,317	205.8
Intestinal diseases	86	49.2	514	220.1	532	148.4	1,040	163.4
Tuberculosis	148	84.9	160	68.5	103	28.7	79	12.5
Malaria	38	21.8	2	0.9	20	5.6	N A	N A
Leprosy	-	-	1	0.4	16	4.4	N A	N A
Viral Encephalitis	-	-	2	0.9	-	-	N A	N A
Leishmaniasis	-	-	-	-	1	0.3	N A	N A
Malign Neoplasms	98	56.2	179	76.7	262	73.1	370	58.4
Cardiovascular Dis	260	149.2	400	171.3	545	152.0	964	152
Pneumonia	68	39.0	99	42.4	152	42.4	174	27.4
Maternal Mort ³	44	5.6	12	1.8	21	5.9	N A	N A
Nutritious deficien	-	-	12	5.1	23	1.1	16	2.5
Undefined Causes	51	29.3	53	22.7	172	48.0	244	38.5

Source: Servico de Estatistica da Saude. Anuario Estatistico do Brazil, 1970, 1976 and 1983

¹ The mortality rates are for 100,000 of population.

² Total death by infectious and parasitic diseases

³ The mortality rates in this case are out of 1,000 born alive

Note: In the Anuario Estatistico do Brazil of 1970, the death data was listed by state capitals. From the Northern region just Manaus (capital of Amazonas) and Belem (capital of Para) figures were available

Table 4 24 Death and Mortality Rates ¹ by Selected Causes in Belem, 1960 - 80

Selected Death Causes	Death and Mortality Rates ¹ by Selected Causes in Belem, 1960 - 80							
	Belem							
	1960		1969		1975		1980	
	Death	M R	Death	M R	Death	M R	Death	M R
Total Causes	4,442	1,111	4,350	826.5	5,513	716.7	7,083	759
Infect-parasitic ²	850	212.6	1,133	226.6	1,233	164.7	1,479	158.5
Intestinal diseases	106	26.5	446	84.7	682	91.0	1,086	108
Tuberculosis	414	103.6	313	59.0	275	36.7	153	16.83
Malaria	20	5.0	11	2.1	11	1.5	N.A.	N.A.
Leptosy	-	-	-	-	-	-	N.A.	N.A.
Viral Encephalitis	-	-	-	-	-	-	N.A.	N.A.
Leishmaniasis	-	-	-	-	-	-	N.A.	N.A.
Malign Neoplasms	220	55.0	374	170.6	469	62.5	609	65.3
Cardiovascular Dis	360	90.1	860	162.3	1,235	164.6	1,743	186.8
Pneumonia	441	110.3	386	72.8	551	73.5	470	50.4
Maternal Mort ³	40	4.9	22	1.1	47	6.11	76	N.A.
Nutritious deficien	N.A.	N.A.	24	4.5	12	1.6	47	5.04
Undefined Causes	162	40.5	249	47.0	152	20.3	174	18.7

Source: Servico de Estatística da Saude - Anuario Estatístico do Brasil, 1970, 1976 and 1983

¹ The mortality rates are for 100,000 of population.

² Total death by infectious and parasitic diseases

³ The mortality rates in this case are out of 1,000 born alive

Note: In the Anuario Estatístico do Brasil of 1970, the death data was listed by state capitals. From the Northern region just Manaus (capital of Amazonas) and Belem (capital of Para) figures were available

Maternal Mortality rates in 1980 could not be calculated by the lack of born alive data

Improved sanitation is the most efficient way to eradicate ill-health and mortality, including infant-mortality, caused by intestinal diseases. The Northern region, throughout the 1970s and 1980s, displayed one of the worst figures in Brazilian terms of piped water availability and sanitary faecal disposition. Just 19.22% of the households were served by piped water (including the ones without internal pipes), and 8.76% were served by any form of sewerage system or septic tank in 1970 (See Table 4.16). Therefore the high mortality rates by intestinal diseases, infectious and parasitic diseases and infant mortality are not surprising.

The data from the capitals in 1977 (Table 4.25 and Table 4.26) besides the lack of improvement in Manaus, shows a disproportionally high numbers of unknown causes of death in Porto Velho (Rondonia) and Rio Branco (Acre). Considering the increase in population in these two capitals from 1970 to 1980 (Table 4.27), and the physician availability that was of 19% in the entire state of Rondonia in 1970 and 41% in 1980, and 14% in Acre in 1970 and 22% in 1980, it can be argued that the high number of undefined causes are related to the lack of medical assistance (data from the demographic censuses of 1970 and 1980 in Almeida and all, IBGE, 1989).

Table 4 25 Death and Mortality Rates ¹ by Selected Causes in Manaus, Belem and Porto Velho, 1977

Selected Death Causes	Death and Mortality Rates by Selected Causes in Manaus, Belem and Porto Velho in 1977 ¹					
	Manaus		Belem		Porto Velho	
	Death	M.R.	Death	M.R.	Death	M.R.
Infect /Parasitic ²	1,194	314.5	1,463	181.9	221	182.2
Intestinal diseases	943	248.3	939	116.8	102	84.1
Tuberculosis	77	20.3	201	25.0	35	28.9
Malaria	-	-	10	1.2	9	7.4
Leprosy	4	1.1	3	0.4	-	-
Viral Encephalitis	-	-	4	0.5	-	-
Leishmaniasis	-	-	-	-	2	1.6
Malig. Neoplasms	317	83.5	536	66.7	25	20.6
Cardiovasc. dis	810	213.3	1,541	197.7	99	81.7
Pneumonia	285	74.3	715	88.9	62	51.1
Nutritious def	21	5.5	15	1.9	7	5.8
Maternal Mort ³	30	7.9	37	4.6	11	9.1
Undefined Causes	334	88.0	186	23.1	562	463.4

Source: Servico de Estatística da Saude - Anuario Estatístico do Brasil

¹ The mortality rates are for 100,000 of population

² Total death by infectious and parasitic diseases

³ The mortality rates in this case are out of 1,000 born alive

Table 4 26: Death and Mortality Rates by Selected Causes in Rio Branco, Boa Vista and Macapa in 1977

Selected Death Causes	Death and Mortality Rates by Selected Causes in Rio Branco, Boa Vista and Macapa in 1977 ¹					
	Rio Branco		Boa Vista		Macapa	
	Death	M R	Death	M.R.	Death	M R
Infect /Parasitic ²	138	132.6	93	201.5	113	91.4
Intestinal diseases	61	58.6	44	95.3	50	40.5
Tuberculosis	1	1.0	6	13.0	12	9.7
Malaria	18	17.3	11	23.8	11	8.9
Leprosy	-	-	-	-	-	-
Viral Encephalitis	1	1.0	1	2.2	-	-
Leishmaniasis	-	-	-	-	-	-
Malig. Neoplasms	40	38.4	18	39.0	45	36.4
Cardiovasc. dis.	93	89.4	54	117.0	90	71.9
Pneumonia	19	18.3	56	121.3	27	21.9
Nutritious def.	2	1.9	9	19.5	7	5.7
Maternal Mort ³	6	5.8	2	4.3	6	4.9
Undefined Causes	154	148.0	41	88.8	123	99.6

Source: Servico de Estatistica da Saude - Anuario Estatistico do Brasil/9

¹ The mortality rates are for 100,000 of population

² Total death by infectious and parasitic diseases

³ The mortality rates in this case are out of 1,000 born alive

Table 4 27 Population in the State Capitals of the Northern Region, 1960 - 1991.

Northern Region	Population in the State Capitals of the Northern Region, 1960 - 1991.			
	1960	1970	1980	1991
Macapa	46,777	86,097	137,451	179,952
Rio Branco	47,437	83,977	117,103	196,871
Manaus	173,703	311,622	633,492	1,010,544
Belem	399,222	633,374	933,287	1,244,688
Porto Velho	50,695	84,048	133,898	286,471
Boa Vista	25,705	36,464	67,047	142,902
Palmas	-	-	-	24,261

Source IBGE Census Data Anuario Estatístico do Brasil, 1992

In 1980, infectious and parasitic disease in the capitals of the Northern region, excepting Belem, claimed more lives than cardiovascular diseases. The number of deaths by intestinal diseases was also particularly high. Undefined causes of death have their higher figures in Rio Branco and Macapa, hence denoting poor medical services even in the capitals. In Macapa this is particularly striking. This category represents almost 1/5 of the total mortality rate (Table 4.28). In 1980 in Amapa, of which Macapa is the capital, the total number of physicians just represented 64% of the minimum acceptable level of one physician per thousand population.

Table 4.28. Death by Selected Causes in Porto Velho, Rio Branco, Boa Vista and Macapa, in 1980

Selected Death Causes	Death by Selected Causes							
	Porto Velho		Rio Branco		Boa Vista		Macapa	
	1980	M. R.	1980	M R	1980	M R	1980	M R
Total Causes	916	683	848	724.8	391	583.6	736	537.2
Infect /Parasitic ²	284	211.9	168	143.6	87	129.9	122	89.1
Intestinal diseases	158	117.9	107	91.5	63	94	88	64.2
Tuberculosis	14	10.4	12	10.3	5	7.5	9	6.6
Malig Neoplasms	58	43.3	47	40.2	14	20.9	44	32.1
Cardiovasc dis	140	104.5	126	107.7	63	94	107	78.1
Pneumonia	45	33.6	37	31.7	24	35.8	28	20.4
Nutritious def	14	10.4	-	-	3	4.5	10	7.3
Undefined Causes	29	21.64	164	140.2	34	50.7	137	100

Source: Ministerio da Saude, Divisao Nacional de Epidemiologia, Anuario Estatistico do Brasil, 1983

¹ The mortality rates are for 100,000 of population

² Total death by infectious and parasitic diseases

Note: The Anuario Estatistico do Brasil of 1983 do not present the separate figures for malaria, leprosis, viral encephalitis and leishmaniasis

The mortality data of the Northern region during the 1980s can give a broad idea of the main health problems there. Again, limitations of data availability exist (the number of casualties by infectious and parasitic diseases is not listed in the Anuario Estatistico of 1993 and, this figure is not available by states or geographic regions in the edition of 1992). The figures of the Southeastern region are used here to allow comparison, since it is the Brazilian region which has the best health resources.

In comparison, Brazil as a whole and to the Southeastern region, the Northern region had lower mortality rates in the 1980s. To understand this, it is important to note that mortality in Brazil has been moving toward higher age groups, and the Northern region in its population structure presents a relatively younger population than Brazil and the Southeastern region. In 1980, the Northern region had 46.06% of its population from 0 to 14 years of age, 49.66% from 15 to 59 years, and 4.17% over 60 years; these figures in the Southeastern region were respectively, 34.13%, 59.36% and 6.44% (IBGE, Census data). (Table 4.29, Table 4.30 and Table 4.31)

The mortality patterns in the 1980s in the Northern region do not display much change in terms of death causes, compared to the previous decades (Table 4.29). The striking number of undefined causes of death, on average 27% of the total deaths, are still high, especially in comparison to the Southeastern region of Brazil, where this figure averages 9.0%. Intestinal diseases still victimized many people (12% of the total death in 1980, 8.0% in 1985 and 5.0% in 1989). (Table 4.30). In the Southeastern region these figures corresponded to 5.0%, 2.0% and 1.0%. The overall improvement in the death caused by intestinal diseases might be related to the spread of oral re-hydrate technique.

The lack of information on infectious and parasitic diseases on regional levels, does not permit an evaluation of the evolution of this important group of diseases in the Northern region, since other sources of information (SUS in 1994) have listed infectious and parasitic diseases as the cause of 20% of all deaths that occurred in the hospitals there. In addition, the total figures for this group of diseases in Brazil lead to a conclusion that somewhere in the country it is still high (Table 4.31). The difference between the total deaths and the total

death by the listed causes in the Northern region may hide large numbers of death caused by infectious and parasitic diseases. Drowning, as a cause of death is listed separately, due to the relevance to the geographical characteristics of the region. Large number of rivers increases the casualties. Poor availability of health personnel seems to aggravate the problem.

Table 4.29 Death and Mortality Rates by the Main Causes in the Northern Region, 1980/89

Death and Mortality Rates by the Main Causes in the Northern Region, 1980 -1989 ¹						
	1980		1985		1989	
	1980	M R	1985	M R	1989	M R
Total cases	28,754	4,356.7	33,367	4,119.4	35,422	3,728.6
Cerebral-vascular disease	1,328	201.2	1,913	236.2	2,316	243.8
Pulmonar-circulatory-heart di	1,472	223	1,632	201.5	1,829	199.2
Heart stroke	699	106	932	115.1	1,121	118
Pneumonia	1,214	183.9	1,463	180.6	1,172	123.4
Motor-vehicle accident	951	144.1	1,126	139.1	1,420	149.5
Homicide	604	91.5	1,107	136.7	1,782	187.6
Neonatal respiratory prob	840	127.3	1,125	138.9	1,329	139.9
Premature-fetal problems	658	99.7	672	83	420	44.2
Intestinal Infections	3,574	541.5	2,633	325.1	1,831	192.7
Malaria	413	66.6	617	76.2	678	71.4
Hypertension	295	44.7	358	44.2	360	37.9
Drowning	234	35.5	389	48.1	516	54.3
Undefined causes	7,723	1,170.1	9,175	1,132.7	9,826	1,034.3

Source: Ministerio da Saude, Divisao Nacional de Epidemiologia, Anuario Estatistico do Brasil, 1993

Note: The Northern region population in 1985 and 1989 was calculated according to the average annual growth rate of 4.06% between 1980 and 1991.

Table 4 30 Death and Mortality Rates by the Main Causes in Southeastern, 1980 -1989

Death and Mortality Rates by the Main Causes in Southeastern, 1980 -1989 ¹						
	1980		1985		1989	
	1980	M. R	1985	M R	1989	M R
Total cases	375,821	7,269.3	387,694	6,874	413,124	6,828.5
Cerebral-vascular disease	37,869	732.5	42,993	762.3	43,171	713.6
Pulmonar-circulatory-heart di	26,959	521.5	30,252	536.4	32,855	47.2
Heart stroke	24,412	472.2	27,706	491.2	32,157	531.5
Pneumonia	21,902	423.6	19,559	346.8	19,970	330.1
Motor-vehicle accident	10,531	203.7	12,041	213.5	13,845	228.8
Homicide	8,687	168.1	11,051	196	15,528	256.7
Neonatal respiratory prob	12,997	251.4	12,167	215.7	11,269	186.3
Intestinal infections	17,880	345.8	7,970	141.3	5,945	98.3
Diabetes	7,418	143.5	8,958	158.8	10,823	178.9
Hypertension	8,267	159.9	9,129	161.9	9,922	164
Other violent death	8,711	168.5	8,463	150.1	9,787	161.8
Undefined causes	36,017	696.7	36,850	653.4	34,427	569

Source: Ministerio da Saude, Divisao Nacional de Epidemiologia, Anuario Estatistico do Brasil, 1993

¹ The mortality rates are for 100,000 of population

Note: The Southeastern region population in 1985 and 1989 was calculated according to the average annual growth rate of 1.76% between 1980 and 1991

Table 4 31 Death and Mortality Rates by the Main Causes in Brazil, 1980 -1989

Death and Mortality Rates by the Main Causes in Brazil, 1980 -1989 ¹						
	1980		1985		1989	
	1980	M. R	1985	M R.	1989	M R
Total cases	750,727	6,308.6	788,231	5,904.4	815,774	5,661.2
Infect-Parasitic Diseases ²	69,553	584.5	49,946	374.1	N. A	N. A
Cerebral-vascular disease	62,371	524.1	73,205	548.4	77,474	537.6
Pulmonar-circulatory-heart di	49,008	411.8	52,755	395.2	56,717	393.6
Heart stroke	37,212	312.7	44,461	333.0	51,038	354.9
Pneumonia	35,436	297.8	32,730	245.2	32,084	222.7
Motor-vehicle accident	19,851	166.8	24,298	182.0	28,839	200.1
Homicide	14,741	123.9	19,747	147.9	28,757	199.6
Neonatal respiratory prob	22,452	188.7	22,057	165.2	21,177	147.0
Intestinal Infections	41,357	347.5	23,355	174.9	18,063	125.4
Diabetes	10,072	84.6	12,840	96.2	16,506	114.5
Hypertension	12,712	106.8	14,749	110.5	15,440	107.1
Other violent death	14,489	121.8	13,361	100.1	13,433	93.2
Undefined causes	161,246	1,355.0	166,609	1,248.0	149,282	1,036.0

Source: Ministerio da Saude, Divisao Nacional de Epidemiologia, Anuario Estatistico do Brasil, 1993 and Anuario Estatistico do Brasil 1992 (²)

¹ The mortality rates are for 100,000 of population

Note: The Brazilian population in 1985 and 1989 was calculated according to the average annual growth rate of 1.93% between 1980 and 1991

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

"If the purpose of development is to increase the total sum of human welfare, then health is worthy consideration in any significant programme that involves environmental change" (Bradley, 1994)

5.1 Introduction

In the last three decades, public policies for the Northern region, which promoted the use of Amazonia's forest, hydrological and mineral resources, have had an impact on environmental quality and public health. The implementation of infrastructure programs, such as the construction of new highways, the government-directed colonization programs, and the new job opportunities created in the mining and industrial sectors have increased the natural migration flows to Amazonia, sharply increasing the population of the region and have changed its distribution.

In this context of change, the existing local activities, principally focused in vegetal extractivism, fishing and subsistence agriculture, were disrupted, giving way to new forms of resource use such as commercial agriculture, cattle-raising, timber extraction and charcoal production for the pig-iron companies, and mining and mineral prospecting in general. This frontier development strategy made few links to the existing local economy, since activities such as cattle raising and mining made few contributions to rural employment and existing settlements. Many local people, who lived in the affected area but did not have land ownership lost the access to "free-land". The same occurred to native groups who did not

have their lands demarcated and regulated. The major social result of the land use transformations in the Northern region was rural-to-urban migration of basically unskilled people, mainly to shanty-towns on the fringes of the cities.

The environmental impacts of these changes included deforestation, loss of soil fertility, water and soil pollution due to mining. Most of the activities used technologies that were transplanted from other regions, and were inadequate to the local environment. In the development process, the traditional knowledge of the local people was totally disregarded. The environmental disruptions and demographic changes have had consequences for the health of the people.

5.2 Major Findings

The environmental transformations which the region has experienced in the last three decades show two different major trends, each of which has had major implications for public health.

1. Environmental disruptions, of which deforestation is the most evident, have provoked changes that are particularly important to infectious diseases, which have insect or other animal vectors involved in their transmission. Settlers, "garimpeiros", lumbermen and other people who live on the forest edges or in small clearings in the forest are exposed to an array of diseases pertinent to this particular environment. The highest prevalence of malaria and leishmaniasis in the Northern region are concentrated in areas where the natural environment was disturbed by new settlements, mining operations ("garimpos"), timber extraction, etc. In these areas

people are exposed to situations where the environmental changes associated with the development have provided favourable breeding conditions to the vectors, especially those for malaria and leishmaniasis. The reported number of new cases of malaria in Brazil jumped from 52,469 in 1970 in Brazil to 533,360 in 1991; 360,408 of these new cases in 1991 occurred in the Northern region, principally in Para and Rondonia where population growth has been greatest and environmental disruption intense (IBGE, 1992). Leishmaniasis tripled in the region, principally in Para State where the lumber industry was intensified. Schistosomiasis also has increased in Para, where the Tucuruí dam, with its large water reservoir has been constructed. Overall, it can be concluded that the increasing disturbance of this special environment has had the effect of increasing health risks, especially for vector-transmitted diseases. Emergence or resurgence of less common serious diseases, such as viral encephalitis and haemorrhagic fevers has also occurred.

2 The disorganized growth of cities and other urban settlements that has accompanied development in the Northern region has aggravated health risks. Despite the rise in the number of economically active people, principally in the secondary and tertiary sectors of the economy, the average income in the Northern region has persisted as the second lowest in the country (IBGE, 1989). This financial situation has been reflected in the living standards. Poor migrants to the agglomerations on the urban fringes, usually live in crowded conditions without proper sanitation. These conditions facilitate the transmission of disease, as well as

keeping an active reservoir of communicable disease. The resurgence of cholera and the high incidence of tuberculosis and leprosy in the shanty-towns reflect this situation. The humid equatorial climate of the Northern region favours the development of animal parasites such as protozoa and helminths, which have part of their life-cycle outside the human body. The inadequate provision of hygienical deposition of the excreta worsens the occurrence of intestinal disease. Exposure to industrial pollutants, stress and new diets exacerbates the risk of death and ill-health caused by cardiovascular diseases and many forms of neoplasm. The evolution of mortality in large centres such as Manaus and Belem shows that, despite the increasing importance of cardiovascular diseases and neoplasms, the high mortality caused by diseases related to underdevelopment (infectious and parasitic diseases, pulmonary infections and intestinal diseases) is unacceptable.

In the Northern region during the last decade, the great number of deaths by undefined causes (averaging 27% of the total death) clearly shows a serious problem within the health system (IBGE, 1993). Such large numbers indicate a situation where either death occurs without proper medical assistance or the previous health history of the individual is unknown. In this situation, the emergence of a lethal agent of disease may go undetected. This large number of deaths by undefined causes also makes the health statistics very hard to analyse, because you have no certainty as to how these deaths might distribute. This could greatly change the apparent problem as it is the largest category.

Despite the growth in the Brazilian GDP (94% from 1970 to 1985), it can be

concluded that the increase in health resources has not matched this growth. In terms of physician availability per thousand population, the Northern region displays the lowest rate in Brazil (0.4 per 1000 in 1980), and this deficiency is aggravated by the large geographic area that must be serviced, since the region is the largest in Brazil and has the lowest population density. A further symptom of the inadequacy of health provision is that the number of hospital beds per capita, which is a good indicator of the health facilities, decreased 28% from an already inadequate level between 1970 and 1994 (IBGE, 1989 and O Globo, 1996). Therefore, if in 1970 the region was not able to provide enough hospital beds, the situation has become even worse. The high infant mortality and maternal mortality can also reflect the poor educational levels of the population, since the evidence of these links have been proved (Price, 1994).

5.3 Conclusion

The development process in the Northern region cannot be reversed, and the population growth, which has been facilitated by the new routes of penetration, has enlarged the existing urban centres, particularly the state capital cities. The comparative analysis of the health conditions in the Northern region in the last three decades suggests that the government efforts to bring the Northern region to the level of the country have not adequately considered the potential impacts of the economic objectives on the physical and social environments. The full extent of the health consequences of development policies have been either disregarded or underestimated. The large dimension of the region, the complexity of the equatorial ecosystems and the weakness of available data have also contributed to the

inadequate consideration of health. At this time, development relative to the rest of Brazil while gains have been made, the Northern regions is still far behind.

5.4 Recommendations

- Provision of basic sanitation, treated water and garbage collection should be a priority in the region to compensate for the actual deficit and deal with the increasing demands in the near future. Pulmonary and intestinal diseases are very hard to deal with, without improvements in the general life-standards, of which water and sanitation are major components. Low-income housing policies in urban areas would avoid the spread of slums and squatter areas, where these components are normally missing. Rural areas should also not be forgotten. Creative solutions, according to the local characteristics, with a community involvement in their design, implementation and conservation, can minimise the costs. This kind of community participation in local problem-solving increases the probability of success.
- Availability of health resources needs to be brought to recommended per-capita levels, in order to diminish the inequality among regions in terms of access to health. The poorest regions have the greatest health problems and endemicity of disease. Resources applied there, such as the spread of ambulatorial primary health care and growth in the number of health agents would decrease the occurrence of preventable disease. In those areas, multiple-disease approach seems to be more valuable than to attack a single-disease. Regions of the size of Amazonia, also need local solutions.

such as boat-hospital to facilitate the attendance in sparsely populated areas, using the natural river network to access more areas.

- Investments in health education, to provide basic knowledge on disease transmission and prevention should diminish malaria cases, premature death and infant mortality among others. Toward this end, encouragement of breast-feeding and provision of food supplements to pregnant women and children with low weight are also extremely important
- Improvement of the quality of health data for the Northern region is vital. At present, inconsistencies and incompleteness in the spatial range and time periods of data compilation constitute major constraints to analysing the information-base, a task which any policy-maker or health planner must complete in order to make good decisions. More coordination among the agencies in charge of data collection, such as IBGE, FUNAI (in charge of the Indian affairs), the Department of Epidemiology of the System National of Health of the Health Ministry, and increasing the availability to the public of health information is essential
- All development projects should be evaluated in terms of their impact on environment and health. Local populations and the ways that they relate to their local environment must be considered. This is the case of mercury pollution. High amounts of mercury, used to amalgamate fine particles of gold, are dumped in the rivers systems.

in the Northern region, making mercury contamination in fish a serious health hazard to the local population

- Access to land and land titling to the local peasantry must be facilitated, to avoid temporary rural work or unemployment, which favour chronic migration. In the Northern region, to prevent continuous internal migration, which increases exposure to undisturbed environments and the spread of diseases is very important

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APPENDIX A

AMAZON RIVER BASIN

**Source: Ministerio dos Transportes, Departamento Nacional de Portos e Vias
Navegaveis, Brasil.**

MAPA 4
REGIÃO NORTE

Com uma área superior a 6 milhões de km² e uma extensão navegável da ordem de 20 mil km, a gigantesca Bacia Amazônica apresenta a maior, a mais rica e mais densa rede fluvial do mundo (Extração do Ministério dos Transportes - MT, Departamento Nacional de Portos e Vias Navegáveis - DNPNV).

APPENDIX B

SOIL DISTRIBUTION OF THE AMAZONIA REGION

Source: Nicholaides et al in Furley (Goodman and Hall Ed., 1990)

Table 13.1 Soil distribution of the Amazon region at the greater groups level.
tentative classification

Order	Sub-order	Great group	Million (ha)	% of Amazon
OXISOLS	Orthox	Haplorthox		28.5
		Acrorthox		14.0
		Eutrorthox	37.8	0.1
			67.5	
			0.3	
	Ustox	Acrustox	6.6	1.4
		Haplustox	4.8	1.0
		Eutrustox	2.0	0.4
	Aquox	Plinthaquox	0.9	0.2
ULTISOLS	Total Oxisols		219.9	45.5
	Udults	Tropudults	83.6	17.3
		Paleudults	29.9	6.2
		Plinthudults	7.6	1.6
		Plinthaquults	12.2	2.5
	Aquults	Tropaquults	7.1	1.5
		Paleaquults	0.7	0.1
		Albaquults	0.1	0.1
		Rhodustults	0.5	0.1
	Ustults			
	Total Ultisols		141.7	29.4
ENTISOLS	Aquepts	Fluvaquepts	44.8	9.3
		Tropaquepts	6.7	1.4
		Psammaquepts	2.8	0.6
		Hydraquepts	0.6	0.1
	Orthents	Tropeorthents	6.9	1.4
	Psammments	Quartzipammments	5.5	1.1
	Fluents	Tropofluents	4.7	1.0
	Total Entisols		72.0	14.9
ALFISOLS	Udalfs	Tropudalfs	16.5	3.4
	Aqualfs	Tropaqualfs	3.3	0.7
INCEPTISOLS	Total Alfisols		19.8	4.1
	Aquepts	Tropaquepts	10.6	2.2
		Humaquepts	0.5	0.1
	Trobepts	Eutrobepts	4.3	0.9
		Dystrobepts	0.6	0.1
SPODOSOLS	Total Inceptisols		16.0	3.3
	Aquods	Tropaquods	10.5	2.2
		Arguodolls	2.8	0.6
		Haplaquolls	0.9	0.2
MOLLISOLS				
VERTISOLS	Total Mollisols		3.5	0.8
	Uderts	Chromuderts	0.5	0.1
Total orders			484.0	100.00

Source: Based on Nicholasides et al. (1984).

APPENDIX C

DEFORESTATION IN RONDONIA - SATELLITE PICTURE

Source: Instituto Nacional de Pesquisas Espaciais - INPE, Brasil 1994.

APPENDIX D

TUCURUI DAM

Source: Instituto Nacional de Pesquisa Espacial - INPE, Brasil 1994.

APPENDIX E

BRAZILIAN AMAZON RESOURCE USE

**Source: Grainger, Controlling Tropical Deforestation. London: Earthscan
Publication Ltda, 1993.**

Brazilian Amazonia, showing main highways, ranching and resource exploitation locations

APPENDIX F

HOSPITAL BED DISTRIBUTION IN BRAZIL - 1991

Source: Instituto Brasileiro de Geografia e Estatística - IBGE, 1992

SAÚDE · ATENDIMENTO HOSPITALAR

(Leitos por 1000 Habitantes)

1990

Obs: A OMS (Organização Mundial de Saúde) estabeleceu 5 leitos para cada 1000 habitantes

FONTES: Censo Demográfico, 1991; Estimativas Preliminares 1992
Estatísticas de Saúde, Ministério da Saúde, Brasília, 1990-1992

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