

Population and Environment in Brazilian Ecosystems

Population and Environment in the Brazilian
Center-West: the challenge of sustainable
development

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Population and Environment in Amazônia:
from just the numbers to what really counts

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Environment and Population in the Semiarid
Northeast

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1. Introduction

A climatic characteristic (semi-aridity and droughts), and not the semiarid region (the area of the occurrence of droughts in the Northeast, characterized by a multiplicity of problems for those residing there), set the tone for all the discussions about this region, until the middle of the XXth Century. Technical contributions, essays, novels, and government policies have treated droughts as responsible, in the final analysis, for the underdevelopment of the Northeast. Exceptions to this are found in the of those like Djacir Menezes, with his *O Outro Nordeste* (The Other Northeast) (1937), published at the same year as *Nordeste*, one of Gilberto Freyre's classics, after *Casa-Grande & Senzala* (1933); and the classic *Solo e Água no Polígono das Secas* (1949), by Guimarães Duque, still today one of the most important studies about the areas affected by droughts, which include the territories known as "Polígono das Secas" (Droughts Polygon), "Zona Semi-Árida do Nordeste" (Semiarid Zone of the Northeast) or "Região Semi-Árida do FNE" (Semiarid Region of the FNE), to put it briefly: "Nordeste Semi-árido" (Semiarid Northeast).

The Semiarid Northeast-SAN reveals important particularities. Some refer to the physical limitations, others to the obstacles imposed by the social relationships of production. Those of the first type are related the climatic variations and to the availability of soil and water. Those of the second type relate to the set of factors which characterize the agrarian structure, understood here as embodying the agrarian structure, the relationships of production and the productive technical basis. In the SAN one is dealing with a territory with a significant shortage of natural resources, especially soil and water, a high poverty degree, and an extraordinary population density.

In relation to the soil resources it can be stressed here the processes of economic structure and the human occupation, which left accentuated marks on these the semiarid spaces in the Northeast. The environmentally degraded areas, found there, were used for cotton growing in of highly fertile soils; for subsistence or commercial farming, such as castor beans; or for farming endeavors of higher economic value. According to studies made by the Brazilian Agricultural Research Corporation (Embrapa), these areas cover surface area of more than 20 million hectares. This comprises 65.9% of the driest lands of the semiarid region, 21.9% of the surface of the SAN, and 12% of the surface of the Northeast Region. (Sá, 1994: 4-8.)

The limitation of hydric resources have impaired the water production for human consumption, with strong repercussions on the development of the agriculture (irrigated and rain fed) and animal husbandry, and, in the last 15 to 20 years, on the human supply. The degradation of local hydric resources occurred because of the destruction of the forest cover, resulting from the deforestation and burning (especially of the cilia forests), of the accumulation and uncontrolled use of water (inadequate management), and of the dumping of pollutants in the springs. The hydric resources are being used out of context, as there is not exist an adequate policy for water production, storage, management and conservation of these resources - neither surface level nor subterranean.

The Northeast counted, in 1996, on a population contingent in the state of poverty and indigence in the order of 19 million of its inhabitants (about 43% of the total population of the region, corresponding to 44 million individuals). In the category poor includes the people who cannot satisfy the needs of food, clothing, housing, education and personal expenses. And in that of indigent affects those who are not able to satisfy their needs for alimentation. (Rocha, 1995: 2-4). Poverty falls on approximately 40% of the population of the semiarid area (that is about 7.5 million individuals in 1996). In the cities, this incidence is of the order of 35% of the total population (3.5 million individuals). Poverty in the rural environment is in the order of 4.0 million individuals (45% of the total population). Rural poverty has been higher. In 1970, it reached the rate of 60% of the population of the semiarid region. (Albuquerque, 2000: 64)

The areas affected by the droughts in the Northeast are characterized by a high demographic density (with 21.59 inhab/km² in 2000, *vis-à-vis* the 28,67 inhab/km² of the Northeast and the 19.87 inhab/km² of Brazil). Therefore, they are considered among the most densely populated semiarid territories in the world. (Ab'Saber, 1999.) The demographic density in the SAN was 11 inhab/km² during the mid-1950s. (Duque, 1963.) Almost fifty years later, in 2000, this indicator has practically doubled, reaching the level of 21.59 inhab/km², which demonstrates the growing population increase in the areas affected by droughts in the Northeast. With such a density there is more pressure on the weak basis of natural resources, and more problems for the urban areas in the interior. The SAN constitutes, besides this, the geo-economic region with the largest physical-territorial size of the Northeast (about 53% of the total surface of the "Area of Action on the part of the Superintendence of Development in the Northeast -Sudende, *vis-à-vis* the other natural spaces (Litoral-Mata, Agreste, Meio Norte and Cerrados), which make up and structure the Northeast Region.

By a law passed 1989, the SAN (or Semiarid Region of de FNE) has a territorial surface of 895,254.40 km². It includes areas from the states of Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia, and part of the Minas Gerais area of "Droughts Polygon". It was inhabited, in 2000, by 19,326,007 individuals (40.53% of the population of the Northeast), of which 56.52% were living in urban areas and 43.48% in rural areas. It should also be noticed that the SAN also included, in 2000, 56.94% of the rural population of the Northeast and 26.39% of the entire rural population of Brazil, i.e. 8,403,637 inhabitants.

The economy of the SAN was structured around the activities related to the cattle-cotton-farming complex, at least until the beginning of the 1980's, when rupture with the cotton economy began. The drought of 1979-1983 had a determinant role in this respect, reinforced by the introduction, in 1983, of the boll weevil plague and the import of cotton from countries which sustained their cotton production by subsidies (Paraguay, Russia and Egypt). Without doubt, the economy of the semiarid is, at the moment, going through serious difficulties. New activities start, meanwhile, to engender the development of alternative economic initiatives. This is what is happening with the development of light industries, which are moving to the interior; with activities focused on the irrigated agriculture; and with urban activities brought about by the development of small urban businesses. There is also traditional commerce, reinforced by some segments of modern services. The transference of federal resources to states and counties (through participation funds) and the social welfare are important factors in sustaining the economies of the greater part of the counties of the semiarid hinterland. In any case, the development pattern observed in the region continues to present patterns of unsustainability, increased by the limited economic possibilities of vast rural areas and countless small towns of the SAN.

The problems of the droughts in the Northeast were responsible for the implementation of a varied assortment of public policies. In the mid 1950's, Celso Furtado said that, besides being a climatic phenomenon, drought constituted, a crisis of periodic production affecting the Northeastern economy. As understood by the Coordinator of the Working Group for the Development of the Northeast-GTDN and founder and first Superintendent of the Superintendency for Development of the Northeast-Sudene, the drought was considered more grave as a production crisis than the typical crises of the capitalistic economy, since it occurred from the collapse of effective demand, weighing on the whole economic system. Furtado said that the situation was different, in the case of droughts, since the impact of this phenomenon was concentrated on the weakest segment of the economic system, represented by the subsistence agriculture. This was the matrix for analysis and of the policies initially implemented by Sudene, headed by Celso Furtado. According to his vision, the only way to raise the productivity of the economy of the Semiarid Region consisted of integrating, through marketing, its typical unit of production. Afterwards, it would be necessary to define the real limits of sustainability, considering the increasing demographic pressure on the basis of the natural resources of the SAN. To understand the problems of the semiarid, Furtado combined the nature of its economy with its problems and particularities, highlighting the differences of the semiarid spaces, *vis-à-vis* those of the Northeast.

Because of the discontinuity of public policies that were carried out in the region, the existing conditions in the SAN continue to challenge the social institutions and actors involved in the struggle for the development and improvement of the living conditions for those living there. We consider that the problems of this region can be resolved both in medium and long term, if treated in a positive perspective of development, either economic or sustainable. Its solution lies in facing determinant challenges such as: demographic, environmental (especially

for the lack of hydric resources), economic and institutional. The development of the SAN, that is. coexistence with semiaridness, will tend to consolidated if the increasing inclusion of new beneficiaries would be based on the work of all.

In addition to this introduction, this text deals with the following items: Delimitation of the Semiarid Northeast, Specificities of the Semiarid within the National, Global, and Regional Context; Adopted Conceptions of Development; Climate and Natural Resources; Concepts of Development adopted; The Demographic Picture and Changes Observed in the period 1991-2000; Economic Activities; and Balance between Resources and Population.

2. Delimitation of the Semiarid Northeast

The Semiarid Northeast of Brazil presents remarkable specificities in relation to other semiarid areas in the world. It is the only semiarid region in the world that is situated in the Equatorial Zone of the Earth, characterized by having only one climatic rainy season, with two large rains, corresponding to the passage of two equinoxes (that of March and that of September).¹ The utilization of the rainwater is a second particularity of the Northeast Semiarid Region. In fact, 92% of all the rainwater falling in this territory is "consumed" by evaporation, and evapo-transpiration. Thus, only 8% of all the rain is utilized to feed the rivers, lakes, dams, and drainage systems in this region. This scene is very different in the temperate semiarid zones, such as in the semiarid regions of the United States and of Israel, where the "loss" of rainwater (evaporation, and evapo-transpiration) is in the order of 45%. The SAN is the "equatorial zone of the world where the climate is most anomalous". In addition, its predominant vegetation is that of *caatinga*, a growth cover considered as a "penultimate biophysical formation, before the appearance of the desert." (Botelho, 2000: 19-22.) The Semiarid Region of the Northeast distinguishes itself, further, as one of the most populated semiarid areas in the world. (Ab'Saber, 1999.)

The semiarid spaces in the Northeast present varied dimensions, both from the climatic and political point of view, since there are areas where the climate causes droughts to happen with a higher intensity than in other areas, stemming from the nature of the expansion and contraction process of the Semiarid Region, a fact which also is responsible for its attributed notoriety. It is possible, therefore, to say that this expansion/contraction process of its geographic limits have precise technical/scientific justifications.

These areas display a certain physical homogeneity. They have soils relatively more meager than those in the other geo-economical zones of the Northeast, such as the Zona da Mata, the Zona do Agreste or the Cerrados da Bahia, Piauí and Maranhão. The pluviometric precipitation in the semiarid areas is within the limits of 400 to 700 or 800 mm of rain annually.

The Brazilian semiarid region is an integral part the Northeastern Region. As treated here, the Northeastern Region corresponds to the operational area of the Superintendency of the Development of the Northeast-Sudene. This area includes territory of the States of Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe and Bahia, including the Minas Area of

the "Droughts Polygon". The Northeast of the Sudene comprises a surface of 1,662,947 km², ² while the Semiarid Northeast consists of a surface area of 895,254,40 km² (53.8% the total). (Carvalho, 1988.)

The Semiarid Northeast corresponds to the territory of drought occurrence in the Grand Northeastern Region. These spaces were, historically, delimited around two figures. In 1936, the area where the droughts occurred more frequently was determined, and became known as the Droughts Polygon. Afterward, in 1989, with the establishment of the Constitutional Financing Fund of the Northeast-FNE, the Semiarid Region of the FNE was delimited as the new official area of drought occurrences in the Northeast.

The Drought Polygon, created by Law n. 175, of the 7th of January 1936, regulated the provision in Art. 177 of the Brazilian Constitution of 1934. That law established that the systematic plan for defense against the effects of the droughts in the States of the North (or Northeast, today) should include works and services of normal and permanent execution, such as emergency work and services of assistance for the population, and during the climatic crises that require immediate aid to the population. The area of the first Drought Polygon had a geographical surface of 672,281.98 km², corresponding to 43.2% of the total area of the Northeast delimited by IBGE (Brazilian Institute of Statistics and Geography) (1,557,767 km²).

The dimensional changes of the area of the Drought Polygon became part of the responsibilities of Sudene, since 1959. From 1936 to 1989, the area of the Polygon was extended many times, until it reached the geographical area of 1,083,790.7 km², of which 121,490.9 km² belonged to the so called Minas Area of the Drought Polygon. While it was seen as an official area of the occurrences of droughts – a condition which prevailed until 1989 – the Polygon consisted of an area corresponding to 64.4% of the Area of Operation of Sudene (1.682.668,70 km²). The area of the Drought Polygon changed from 43.2% of the Northeastern area (IBGE), in 1936, to 64.4%, in 1989, related to the Area of the Sudene.

The institutionalization of the Drought Polygon, since 1936, represented the legitimating of the area of operation of the Federal Board of Works Against Droughts—IFOCS, created in 1919, to substitute the Board of Works Against Droughts-IOCS, which had been founded in 1909, and, afterwards, of the National Department of Works Against the Drought-DNOCS, created in 1946.

The areas most subject to the incidence of droughts were, during some time, grouped under the name of Semiarid Zone, including, in this case, the *natural regions of Sertão, Seridó, Curimataú, Caatinga, Carrasco and Cariris Velhos* (Duque, 1953) and the Minas Area of the Droughts Polygon. The area of the Semiarid Zone occupied 882,081 km², corresponding to 53.1% of the Area of Jurisdiction of Sudene. The name Semiarid Zone was also used by Sudene, until 1989, as category for analysis and planning of governmental interventions in the areas affected by droughts. Its draft was already part of the studies of the Working Group for the Development of the Northeast-GTDN, whose strategy was incorporated in the Master Plans of Sudene.

The delimitation of the area of occurrence of droughts, for the purpose of planned intervention of the governmental operations in the Northeast, was modified

according to principles established in the Constitution of 1988, like those formulated by the Law n. 7.827, of September 27, 1989, which instituted the Constitutional Financing Fund of North Region-FNO, the Northeast Fund-FNE and the Central-West Fund-FCO. Section IV of art. 5º of the mentioned law defines as semiarid the region within the Area of Operation of Sudene, with an average annual pluviometric precipitation equal or inferior to 800 mm. It established, further, that the counties included under these conditions should have their selection published in "Sudene by-laws." The space integrated by these counties received the name of Semiarid Region of the FNE, since 1989. Their internal differences are similar to those which characterized the Drought Polygon, when seen from the natural, economic, social and environmental point of view.

The Semiarid Region of the FNE represents an expressive part of the northeastern territory, comprising various portions of the states situated in the Jurisdiction Area of the Sudene. Different institutions are operating in this area, such as the Bank of the Northeast of Brazil, the DNOCS, and the Company for Development of the Vale do São Francisco-Codevasf. The area of operation of the Bank of the Northeast has always been the same as that of the Sudene. That of the DNOCS was restricted to that of the Drought Polygon; and that of the Codevasf to that of the São Francisco River Basin. ³

From 1989, the Sudene stopped using the configuration of the Drought Polygon (Lins & Burgos, 1989) as reference for the officially recognized area of occurrence of droughts. The use of the category Semiarid Zone occurred more as a synonym of Drought Polygon, and as a way of not using names which could possibly represent conservative interests laid out by the so-called "industry of the droughts." From 1989 on, the Sudene started to work with the concept of Semiarid Region of the FNE, and elevated it to the category of officially recognized area of the occurrence of droughts and with reference to the measures of support for the strengthening of the economy of the areas affected by the droughts in the Northeast.

Consequently, the Semiarid Northeast will be considered in this study as corresponding to the Semiarid Region of the FNE. Map 2.1 in the appendix shows the limits of the Drought Polygon (original and final) and of the Semiarid Region of the FNE. This region was composed in 2000 of 1,042 counties, including a total surface area of 895,254.40 km². (Table 2.1, in appendix). Its population at that time was 19,326,007 inhabitants, of which 56.52% were living in urban areas and 43.48% in rural areas. Table 2.2 in the appendix provides information about the demographic dynamics in the Northeast and in the Semiarid Region of the FNE, for the years 1991 and 2000.

In this way, the Drought Polygon, Semiarid Zone, Semiarid Region of the FNE, or *Sertões do Nordeste*, the territory affected by droughts is characterized by expressive internal differences. Partly, the result of its physical particularities (the rocky crystalline substrata of its geology and the semiaridity of its climate, with sparse, temporal and sparse rain), they increased by the force of a set of certain social relations of production, by the logic and interests of the more dynamic centers of the Brazilian economy, articulated towards the interests of the main economic groups of the Northeast, especially of that less compromised with the capitalist advancement of the regional society.

3. Specificities of the semiarid regions in national, global, and regional context

The land area in the world totals approximately 145 million square kilometers. Of this total, about 55% (79,500 million square kilometers) consists of arid and semiarid zones. These lands are distributed in 2/3 of the areas of 150 countries in the world. Within them, are living a contingent of approximately 628 million individuals. Between 60 and 100 million of this total are directly affected by the productivity decrease of those lands. In those areas, about 6 to 7 million hectares of land fit for agriculture become non-productive each year, as a consequence of the erosion of the soil. Considering other forms of land degradation, the dry lands in the world are increasing and, consequently, the loss of agricultural production estimated is in the order of around US\$ 40 billion, in a couple of years. (IUCN, 1991, *Apud*: Veras, 1996).

Even more problematic is the verification that the arid and semiarid lands are in a process of transition. Thus, these spaces are acquiring greater proportions as potential sources of production of vital spaces and of economical forces. (Dregne, 1970: 11-12). But there are other differences between the life and development possibilities in arid and semiarid lands, among which stands out the endowment of resources (natural, physical and human). In relative terms, the limitations of development in the arid and semiarid lands, *vis-à-vis* the lands not subject to such restrictions, are more prominent in the arid lands than in the semiarid ones. (Amiram, 1970: 89-103)

According to international agro-ecological criteria, Brazil has only 3% of its territory in semiarid conditions, while 54% of the extension of Argentina is in an arid and semiarid climate, and for Chile this has the expressive number of 64%. Although there are droughts that affect farming and cattle-raising production in Argentina and Chile, the problem there is far from reaching the dimensions that exist in the Northeast of Brazil.

In the semiarid hinterland of the Northeast, the annual rains go from a minimum of 400 mm to a maximum of 800 mm per year, existing cases of areas situated in the isohyetal of 1.000 mm, as occurs in the small strips of the coast of the State of Ceará, where also can prevail situations of scarcity and inadequate distribution of rains.

From the point of view of the annual rain quantity, the variation is comparable to that which occurs in the interior of the Argentine Pampas, which is considered one of the granaries of the world. The big difference is that, while in that region the rains are distributed regularly during the year, in the Brazilian Northeast they are concentrated in a brief period of approximately three or four months, during which they occur as heavy cloudbursts of short duration.

The availability of rainwater, though concentrated in this short period, is one of the factors that explains the demographic densification of the Brazilian semiarid region. Historical factors, referred to relative isolation of the region and the permanence of socio-economic structures founded in the binomial large-landed-estate/small-landed-estate, contribute also to increase the demographic density of the northeastern semiarid region. A large part of the population that

migrates from there in the periods of droughts returns to their homes, even though the net result does not represent the maintenance of the initial population contingents.

Other aspects should be considered in the context of the semiarid regions in relation to the Northeast and to Brazil. In the first place, it is necessary to emphasize the discourse of those who blame the droughts as being the main cause of the afflictions of the region of Sertão. And, secondly, the discourse, now though, of those who only consider the prolonged droughts a pretext of the regional elites (from within and from outside the Northeast). Both the elites of the Northeast, and those of the Central-South fall in the commonplace of hiding the ecological, historical, and cultural specificities of the historical and territorial formation of Brazil. The reductionism of the droughts, either as the determinant factor, or being it the secular veil, cannot get to the core of the question about the backward state of the Semiarid Region. The backward state of this region resides in a complex articulation between environmental, socio-economic, and political conditioners, which confers on this conservative domain an odd role in the maintenance of misery of a hefty part of the Brazilian population. (Carvalho & Egler, 2002: 11.)

The northeastern question - of which the Semiarid Zone constitutes a fundamental component - is, actually, a question of Brazilian society's relation to its past. It is a transformed mode of the agrarian question, understood as the expression of the social form of appropriation of the original sources of wealth: land and labor. Land conceived here in its fullest sense, as the original natural conditions, where labor is materialized in production. And the submission of the laborer to the natural conditioners to obtain the minimally necessities for life support is the most primitive way of exploitation of the original sources of wealth. In this sense, what is questioned is the pattern of development itself, having been unable to promote economic growth with a minimum of environmental quality and social equity. (Egler, 1993.)

4. Climate and natural resources

In the areas subject to droughts in the Northeast, the Eco-systems of the Region of Caatingas and Florestas Deciduais (Deciduous Forests) of the Northeast predominate. These ecosystems comprise the specificities of the Morpho-climatic Dominion of the Caatingas, either of shrub or of tree type landscape. One of its particularities is the capacity of the plants existing there of losing there leaves in the dry season (without rains).

4.1 CLIMATE

The Brazilian Northeast is an anomalous region in tropical continents, because, in contrast with other regions of its latitude, it presents a semiarid climate in more than 50% of its territory. This is due to the relatively low values of pluviometric precipitations falling on an extensive part of the region, i.e. between 400 and 800 mm annually (in the semiarid areas) or less (about 400 mm) in some areas in

interior valleys. The coastal areas of the Northeast receive more than 1,600 mm a year.

The rains in the Northeast are of a predominantly convective character, which is typical for tropical regions, presenting a wide variability, both spatial and temporal. The region is covered by three principal regimes of rains: i) that of the southern part (comprising the West, Central-South, and East of Bahia and the South of Maranhão and Piauí); ii) that of the northern part (comprising the North and East of Piauí, almost all of Ceará and Rio Grande do Norte, the sertões of Paraíba, Pernambuco, Alagoas, Sergipe and the north-northeast region of Bahia), whose rain pattern is associated mainly with the Inter-tropical Convergence Zone (ITCZ) on the Equatorial Atlantic; and iii) that of the eastern part (comprising the Zona da Mata and Agreste of Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe and the northern Littoral of Bahia). (Nobre, Barros & Moura Fé, 1993.)

The largest part of the semiarid region is related to the portion North of the Brazilian Northeast, through the action of the ITCZ. The droughts happen there when this front attains its extreme latitudes more to the South, near the northern coast of the region, during the months of March and April. The ITCZ extends from the East to the West, across the Equatorial Atlantic, from Africa to South America. Normally, the ITCZ migrates seasonally from its displacement of the extreme North about 14° N, in August-September, to its extreme South position, about 2° S, in March-April. Years of droughts are associated with the ITCZ without traversing the Equator, in its migration towards the South, and inducing rainfall on the continent during a relatively short period. It continues its migration to the North in April. Thus, under these circumstances, the Brazilian Northeast is south of the region of heavy rainfall and in the region of predominantly descending movement, which inhibits pluviometric precipitations. (Nobre, 1994.)

4.2 SOILS

The soils of the northeastern semiarid region are wavy, leveled, often stony, eroded and of a low fertility. Exceptions are the areas of the lowlands along the margins of the rivers and creeks, always dry in summer, and the plains, not always with a suave topography. Compared with the other semiarid areas in the world, the soils of the semiarid Northeast present characteristics that give them an notorious specificity (Carvalho, 1988: 88), whatever it may be that "have a global deposit of soils that are much richer in mass and in grassy fields for cattle than that of the average of the known semiarid regions. (Ab'Saber, 1974.)

The Embrapa Soils study (CNPS)⁴ identified 172 geo-environmental units in the Northeast. Its specification was inferred by way of crossing of soil indicators and parameters - such as natural fertility, salt and sodium content, effective profundity, texture, relief, susceptibility to erosion, drainage, level of being stony and rocky - and climate (effective humidity index, hydric deficiency and average annual temperature), articulated according to the requirements of every culture

in relation to these aspects. (Silva; Riché; Toneeau; Sousa Neto; Silva; & Araújo Filho, 1993.)

The CNPS evaluated the Land Types for Irrigation in the Northeast, establishing six types of utilization capacity of the lands of the Region. According to this classification, the percentage of lands of each of these six types is distributed as follows:

- **Type 1 Lands** (0.25% of the territory of the Northeast, ⁵ or 4,157.37 km²). These are arable lands without restrictions on use;
- **Type 2 Lands** (6.35% of the region, i.e.: 105,597.13 km²). These are arable lands, with a moderate aptness for agricultural irrigation;
- **Type 3 Lands** (26.91% of the total of the region, or as, 447,499.04 km²). Arable lands, with more restricted suitability for irrigated agriculture than the Type 2 Lands, adapted to a restricted number of cultures;
- **Type 4 Lands** (10.68% of the territory, equivalent to 177,602.74 km²). Lands of a special type, the use of which requires more detailed studies, which could indicate the possibilities for utilizing its potential for irrigation;
- **Type 5 Lands** (8.2% of the total area, or, 136,361.65 km²). Not arable under natural conditions. They present serious deficiencies, requiring protection against floods, irregular topography or elevated positions; and
- **Type 6 Lands** (46.92% of the region, i.e. 780,254.73 km²). Non-arable lands and of difficult use under natural conditions. (Silva; Toneeau; Sousa Neto; Silva; & Araújo Filho, 1993; and Matallo Jr., Coord., 1994.)

Land and water for irrigation are scarce in the semiarid northeastern. Availability corresponds to 4.7% of total surface area of this region. Thus, it is easy to understand that "Land and water are good examples of the limits of natural resources. As much as technological advances may decrease the quantity of land necessary for the production of food, they cannot increase the land surface. And water, a basic element of life, already shows signs of its limits." (Hogan, 2001: 216.)

4.3 WATER RESOURCES

Water is the relatively most scarce resource in the Northeast; in second place comes soil resources. Therefore, these two natural resources have played restrictive roles for the development of its semiarid areas. The process of urban growth, as will be seen, makes it even more difficult to satisfy the demands of the water situation in the region. The balance between supply (availability) and demand of water is unfavorable in countless areas of the Northeast, especially in the semiarid areas of all the states of the region. The semiarid region of Bahia is

inclined to show a more balanced average, because of the water availability of the São Francisco River, but some of its basins are also lacking enough water.

We see some basic elements of the balance between supply and demand of water resources in the Northeast, from the following indicators: the potentiality of water resources; the availability of water resources; the capacity of water storage and the demand for water, according to different uses. The potential of water resources of one hydrographic basin is understood as the average natural discharge of water, or, the sum of water discharges at surface and at base level. The availability of water resources represents a portion of the potential, activated by dams, wells, etc. The capacity for water storage (at surface and at underground level) equals the nominal storage capacity of dams and wells. The guarantee level of water storage in one dam is defined from its effective availability, being the one that is defined by different kinds of consumption. The most frequently used guarantee level in the planning of water resources is that of 90%. (Vieira, 1994: 27; and Gondim Filho, 1994.)

The imbalance between supply and demand of water resources in the Northeast can be demonstrated by comparing the availability of water in its hydrographic basins with the storage capacity (or that of wells and that of underground water) of all the reservoirs and wells constructed. According to studies carried out in 1991 by the Áridas Project, the Northeast counted on an availability of 97.3 billion cubic meters, for a well capacity of 85.1 billion cubic meters. (Gondim Filho, 1994: 10 and 78.) The difference, in average terms, amounts to more than 12.1 billion cubic meters. This number represents the average total surplus of local water resources at that moment. The volume of the supply can be increased by the utilization of other local water resources, mobilizing part of the potential of the existing water resources, or increasing the availability, by resorting, for example, to transposition structures for water from the hydrographic basins originating outside the Northeast, such as the Basins of Tocantins River and the São Francisco River.

The total demand for water resources in the Northeast, considered as a potential, maximal, theoretical demand for all kinds of usage, corresponded in 1991 to 21.8 billion cubic meters a year. (Gondim Filho, 1994: 78.) This aggregate includes the following types of demand: urban and rural populations; animal demand; demand for irrigation; agro-industrial; demand for agro-industrial industries; and ecological demands.⁶ The distribution of the wells and dams in the Northeast is extremely concentrated, in terms of the conditions that propitiate their construction - i.e. space for the installation of the massive constructions for the dams and water availability that needs to be accumulated. The water infrastructures in the Northeast, that really count, have fewer than 300 reservoirs (*açudes*) or sizeable dams.

The great majority of them were built by the DNOCS (Araújo, Coord., 1990: 292.), followed by those built by CHESF, by Codevasf and by the states of the region. Among the more than 300 dams and wells, there are 10 (about 3% of the total) with a storage capacity superior to 500 million cubic meters, that can gather about 73% (62 billion cubic meters of water) of the total storing capacity of the Northeast.⁷

Even though the supply is higher than the demand, this does not mean that all places in the Northeast have at their disposal the water they need. This is because the spatial distribution of the supply is not necessarily compatible with the location of the different types of demands. In fact, the spatial distribution of the demand reflects the dynamics of urbanization observed in the interior of the region, which reinforces the evidences of conflicts between supply and demand of water in various sub-regions of the Northeast. This imbalance is more the result of scarce availabilities of water resources and of the spatial distribution of the dams, than of the storing capacity. The concentration of a large part of the volume of storable water in a restricted number of dams constitutes an indicator of inadequacies of water distribution in various sub-basins of the northeastern semiarid region. The evidences, in this respect, are more effective than in the states that are characterized by the presence of deprived basins, which can be found in the States of Ceará, Rio Grande do Norte, Paraíba, and Pernambuco. The larger problems of water treatment demands are related to the supply of so-called diffuse rural demand (water for domestic and animal consumption, at the level of the large farms and of the municipal urban demand (water for domestic consumption and for urban services of the capitals and towns of the interior).

The large number of "carros-pipa" (water trucks) that circulate every year, in situations of drought or of normal rains, in the interior and in the towns of the semiarid regions or the Northeastern coast, reflects the degree of inadequacies between supply and demand of water in the region, both in temporal and in spatial terms. It comprises, therefore, a valuable indicator of the needs, the observation of which is being confirmed every year.

The water supply in the Northeast tends to require solutions that are complex and difficult to execute, principally if the roughly available water or produced water (available in dams or wells, or obtainable from the rivers like the São Francisco and distributed by groups of water containers and by pipelines) changes from public to private domain. There is a struggle developing in favor of the privatization of the water of the São Francisco, which did not become effective due to the power of important economic and political groups of the Northeast who are against the measure. In the forefront of these groups are important families, among which stand out the Coelho family, from Petrolina, Pernambuco, and politicians of Bahia, considered anti-privatists by some press organs. Thanks to these conflicts between different blocs of capital, a favorable "living together," can be observed, of a temporal character though, between representatives of workers and capitalists, which is of great economic and social interest for the Northeast.

4.4 NON-RENEWABLE NATURAL RESOURCES

In this category are included mineral and energy resources. The Northeast, in general, and the semiarid region, in particular, have an expressive endowment of these resources. Among the mineral resources found in the semiarid, the following stand out: apatite, barite, betonies, beryllium, limestone, calcite, cyanide, copper, lead, chromium, iron, fluorite, magnetite, manganese, gold, silver, titanium

(limonite), titanium/vanadium, titanium/zirconium, uranium, vanadium, zirconium, zinc, and nickel. The major part of these minerals is located in the semiarid region of Bahia.

The economic potential of the mining sector is related to the following uses: chemical industry (sulfur, titanium, rock salt, fluorite, bromium, iodine, and natural gas); the industry of fertilizers (mineral phosphates, potassium salts, and nitrogen minerals); and the industry of non-ferrous minerals (copper, lead, tin, zinc, magnesium).

4.5 BIODIVERSITY⁸

The environmental degradation in the semiarid regions is part of an assortment of concerns that transcends the limits of this region. This is related to the theme treated now in the context of biodiversity. The President of the World Watch Institute, from Washington, Lester Brown, said that the Professor E. O. Wilson, of Harvard University, in his book **Biodiversity** (Wilson, editor; Peter, sub-editor; Penna, coord., 1997.) "We are aware of the fact that we are now in a race against time, and that 'we' stands for humanity. Unfortunately, the only ones who are actively committed to the effort of preserving our rich evolutionary heritage of vegetal and animal life are a handful of scientists and environmentalists in action. To be in a vanguard position as to what the situation requires, many more people are needed to express their anguish and to work in favor of this issue." (Brown, 1997: 570.)

A lavish biodiversity is found in the semiarid region, revealing the existence of approximately 1,600 species of ligneous plants. During a long period, the inhabitants of the Sertão made use of the biodiversity in a variety of ways. The plants were used to attend to their needs for food, clothing, medicines, energy and housing, more in an extractive than in an organized manner.

When the regional market increased and became consolidated, since the decade of 1950's, many native plants used to produce oil, wax, rubber, resin, energy, forage, wood, tannin, pharmaceuticals, fibers and fruits were utilized in the structuring of the regional economy. Many species played an important role in regulating exportation, e.g. wax from carnauba, oil from oiticica, rubber from maniçoba and fiber from mocó cotton, as well as cashew nuts and lobsters. These products became, during decades, the main economic products of many states of the region. Some of them have still considerable importance in the local export situation.

The accelerated increase of the regional market and the population increase have contributed to produce significant changes in biodiversity. Many important species of flora and fauna of the semiarid region are in a process of extinction, some of them already extinct in certain areas.

There are native species of the semiarid region that play an important role in the alimentation of the inhabitants of the Sertão and, in the alimentation of animals, as well. The use of these species is still taking place in an extensive and predatory way. During more intensive droughts there is no formation of pastures. In these periods, the herds survive on fruits and beans, foraging the most resistant

shrubs and trees, like the juazeiro, the catingueira, and the jurema. Some cactaceae, like the mandacaru, the facheiro and the xique-xique are provided for cattle after the thorns have been burned off.

The effects of the process of traditional exploitation, given the low technological level of using the resources, are reinforced by the population increase and by the expansion of markets, conducive to an over-exploitation of the environment and to the virtual exhaustion of biodiversity. The extensive cattle breeding exerts a heavy burden on the local flora, both because of the elimination of the plants, and of making the soil more compact, due to excessive trampling. Because of inadequate management in the cattle breeding area, the *caatinga* is becoming exhausted. Generally, the breeders increase the number of cows, goats, sheep, etc., to higher limits than the supporting capacity of the ecosystem, which is very low. Ten to 25 hectares of native pasture are needed to feed one adult cow (or animal unit) in the rainy years, that being the case animal productivity is very low, between 5 and 10 kg of live weight per hectare.

The system of traditional exploitation of cattle is considered a factor of environmental modification, because of the changes which induce the flora composition of the native vegetation and the diffusion of the invading species without ecological value.

The traditional drought agriculture, with cultures such as maize, beans and rice, associated to the practice of extensive cattle breeding, also results negatively in the loss of the bio-diversity. The frustration of the harvests and the rapid exhaustion of the soils promote itinerant agriculture and the constant rotation of lands, with the excessive pasturing of the areas of fallow land. The problem is that many areas are left fallow when already in a state of advanced degradation. This fact can aggravate the problems of soil loss and natural fertility as a result of the proliferation of invading plagues. The result is the degradation of the soils, the increase of the over-exploitation of the resources by extractive methods - as a way of compensation for a better income -, and the resulting loss of the bio-diversity. In this case, the phenomenon of desertification presents itself, as in the case of some northeastern semiarid areas and in practically all of the semiarid areas in the world.

The fauna of the semiarid is constituted by small-size animals with nocturnal habits, with a low population density and a low endemism. In spite of more detailed knowledge about animal diversity - there is almost no information about the invertebrates, and what is available about the vertebrates is dispersed and very scarce -, the surveys point towards the existence of 17 species of amphibians, 44 of reptiles, 270 of birds and 83 of mammals. Generally, the animals do not manifest anatomic-physiological adaptations to support the local soil and climatic conditions. This is attributed to the high climatic variability and to the fact that the animals developed an adaptation of behavior as a way of compensation, using micro-habitats as places for refuge in times of drought.

The fauna has an important social role in the region, constituting one of the main sources of protein for the population of the Sertão, especially in the periods of prolonged droughts, when the agricultural harvests are frustrated. In addition, it has an economic function in supplying various sub-products, like skins, meat and animal fat.

4.6 *VEGETATION*

The adaptation capacity of the plants of the semiarid in its general ecological aspects is very great. Immediately after the first rains, following the drought period, the leaves of the trees and shrubs revive very quickly, like herbaceous plants, and the grassy plants of the pastures and fields. The Sertão transforms itself rapidly into a truly "green carpet." This phenomenon has been accompanied by the use of the "Vegetation Index." This index is proportional to the total quantity of the foliar region. Institutions dedicated to the study of climate, such as the Foundation for Meteorology and Hydric Resources from Ceará-Funceme, already possess systems of operational reception of the data produced by the Institute for Spatial Research—INPE, from São José dos Campos-SP, with which they calculate, fortnightly, this index. With the "Vegetation Index," it is possible to monitor the evolution of the vegetation condition and, consequently, identify the most critical areas related to farming and cattle breeding. (Nobre, Barros & Moura Fé, 1993.)

But the available studies about the vegetation in the Northeast are still limited, due to the scarcity of data. There are more complete and updated surveys only for the States of Rio Grande do Norte, Paraíba, Ceará, and Pernambuco, produced in the context of the Project conducted by the PNUD/FAO/IBAMA.⁹ The other states count on partial surveys, generally outdated, about the vegetal cover and its typologies. The availability of information about the socio-economic aspects of these resources, with emphasis on the quantification and qualification of the uses and destinations (internal consumption and exports), whose surveys have been restricted to the energy sector, is also scarce.

In any case, the available scheme about the vegetation of the semiarid is differentiated, finding there different levels of anthropization, like the different uses for the vegetation in terms of its different typologies. The situation causes apprehension, especially in the states of Ceará, Paraíba, Alagoas and Sergipe. In those, many native species (and this is also true for the fauna) are in a process of extinction. In some sub-regions of those states, the primary vegetation already had been totally used up, because of the over-exploitation induced by the cement factories (as occurs in Sobral, in Ceará, Mossoró, in Rio Grande do Norte, and in the interior of Maranhão), small metal works and brick factories of importance (as can be observed in the Seridó of the Rio Grande do Norte and in Maranhão). Instead of the primary vegetation there is now a very thin secondary forest. (Mendes, 1997.)

4.7 *ENVIRONMENTAL QUALITY*

The environment in the Semiarid Region of the Northeast presents a wide variety of problems, derived from the environmental impacts directly or indirectly caused by the action of man. Environmental impact, according to the National Council for the Environment-CONAMA, is "all and any alteration of the physical, chemical, and biological properties of the environment, caused by any material or energy means that is the result of human activity that, directly or indirectly,

affect: health, security, and well-being of the population; the economic and social activities; the biota; the esthetic and sanitary conditions of the environment and the quality of the environmental resources.”

The environmental impacts correspond, to the extreme, to alterations that can reduce the recovering capacity of the ecosystems. (Brasil. Presidência da República, 1991: 13-36.) Ecosystems of low density like the *caatingas* and the *carrascos*, have, in general, less diversity than those that are not submitted to hydric stress, such as exerted by the high-level swamps. They display, meanwhile, major resistance to the environmental perturbations. The *caatingas* and the *carrascos*, when subject to environmental surprises, tend to manifest a larger diversity of reproduction strategies. Thus, the decreasing order of resistance to the perturbations, presented by the northeastern formations, should be the following: *caatingas*, *cerrados*, *carrascos* and *brejos*.

The concept of environmental modification should be better qualified, as the result of the modifications resulting from the anthropic action. These modifications could mean the impossibility or reduction of the capacity natural response of the area. An impossibility that can make unfeasible, in the long run, the exploitation or the use of the resources. In this sense, the impacts, besides being negative, can:

- a. harm the sustainability, the permanence through time of the same activity or of other activities that could be in development or, potentially, became developed; and
- b. be it evolutionary in time and, eventually, in space, in terms of the execution of the activity that generates it, independent of its expansion and development capacity. (Matallo Jr., Coord., 1994: 87.)

The impacts qualified in this manner are, mainly, the result of activities not reached, or reached with difficulty by the processes of environmental licensing and evaluation (according to the same CONAMA). Such impacts could potentially compromise the sustainability of the development of the semiarid areas, that would be, in the present and in the future, beyond the reach of the prevailing instruments of environmental management.

5. Adopted conceptions of development

A great variety of conceptions on development has been formulated in relation to the Semiarid Northeast. Almost all of them take for granted that the solutions for its problems should be found in the confrontation of the question of the climatic variability. Reference is made here to the following conceptions: hydraulic stage, strategy of the working Group for Development in the Northeast-GTDN and Living with Semiaridity.

5.1 THE HYDRAULIC STAGE

The stage of the hydraulic solution, put into practice in the Northeast, after the severe drought of 1877-1879 up to the mid XX Century, was characterized

by the construction of dams and by a discourse specifically favorable to the idea of irrigation. But irrigation, in the second half of the XIX Century, was restricted to the level of ideas and potentialities. The first work of the capturing and storage of water in the Region - the Dam of Cedro, in the County of Quixadá, in Ceará— was only finished in 1906. Few areas had been made fit for irrigation in that period. In this stage, the storage of water constituted the piece of resistance of the proposals and concrete measures that were taken. The hydraulic stage has also been surpassed by ideas related to the production of artificial rains and to the adaptation of “xerophilous plants”.

In the first half of the XX Century the institution that carried out the first and most important studies about the Northeast was created: the Board of Works Against Droughts-IOCS, in 1909, which was transformed ten years later into Federal Board of Works Against Droughts-IFOCS that became more autonomous in January 1945, with the name of National Department of Works Against Droughts-DNOCS. These entities have been responsible for the first and most far-reaching studies realized about the natural resources of the Northeast, and for the first experiences of irrigation put into practice in the semiarid areas.

In the years of greatest strength of the hydraulic stage, that comprised the period from 1900 to 1950, the Federal Government started the creation of a technical basis for agriculture in the semiarid spaces of the Northeast, mediated by the Agro-industrial Service connected with the IFOCS and, afterwards, with the DNOCS. The activities started in the 1930's, in Souza, in Paraíba, by the organ that became known as José Augusto Trindade Institute. In the period from 1909 to 1950 there have been built 133 public dams and 317 cooperative dams ¹⁰ in the Semiarid Northeast, representing more than half of the dams built until today, in relation to the two referred categories. This demonstrates the emphasis placed on the main actions carried out by the Union during the principal period of the hydraulic stage. Until 1950, the Federal Government set aside about 9,450 irrigated hectares in the semiarid Northeast. ¹¹ That result was about eight to ten times lower than that of the second half of the XX Century, which could be understood as resulting from the low emphasis put on irrigation, combined with the reduced enhancement of the technical progress related to engineering, agronomy and the planning of irrigation and irrigated agriculture. (Carvalho, 1988: 202-227.)

5.2 *STRATEGY OF THE GTDN*

Better elaborated than the former conceptions, thanks to the specific vision of Celso Furtado about the problems of Brazil and of the Northeast, the strategy of the GTDN had the view that the problems of the semiarid Northeast could be resolved effectively by the reorganization of its economy. For this, it would be necessary to promote its economic restructuring, increasing the productivity of the farming and cattle-raising activities practiced, or to be introduced, there, such as those related to irrigation, in order to free up rural labor forces. Once having reorganized the economy of the semiarid areas, it would be possible to reduce the population pressure on the scarce available natural resources

(especially those of soil and water), two of the central problems of this semiarid region with its extremely particular characteristics.

Facing the specificities of the northeastern semi-arid region, the studies and conceptions of the GTDN recommended the convenience of reducing the food production activity, promoting a demographic shift and good surplus utilization in areas of the agricultural border of Maranhão; in irrigation projects in the so-called "Humid Valleys" (Vales Úmidos) of the semi-arid area; and in agrarian reform projects in the Zona da Mata. "The document emphasized two important questions: i. that the ecological problem would impose the necessity of bringing together small properties rather than their fragmentation; that food production could only be viable, with certainty, through irrigation, implying enormous expenses and difficulties in the semi-arid area; and ii. that the area, therefore, should be rather dedicated to the expansion of export xerophilous plants (such as tree cotton) and to the livestock sustenance." It also underlined "that the human shift would cause a considerable decrease of the serious social effects of the drought, for the poorest sector of the population, and an improvement of the living conditions in the new settlement areas. (Cano, 2000: 108).

The conception of the GTDN allows reviving the meaning which the analysts of the economic development attributed to "sustainability" in the decade of the 1950's. At that time it was admitted that the "take off" for the development consisted in the capacity to interrupt the vicious circle of an economy, whose dynamics depended on the sporadic bursts of growth, and to reach the virtuous circle of self-sustained industrialization, in which the accumulation capacity would be endogenized by way of the consolidation of a heavy industry, able to internally guarantee its amplified reproduction. (Rostow, 1963: 134-160.)

Agriculture, according to this logic, would have to necessarily go through transformations that could enable it to provide the modern sector of the economy - in this case, urban industry and services - with a large quantity of food stuff, large markets and a reasonable volume of financial funds. The "sustainability," according to the classical theory of development, would be expressed by the expansion of one "modern" sector, *vis-à-vis* the "traditional," thanks to the growing participation of the voluntary savings in the national income. (Lewis, 1963: 134-160.) In other words, "sustainability" was a synonym for "industrial revolution."

5.3 LIVING WITH SEMIARIDITY

There is no finished strategy for living with the semiarid nature of the Northeast. There have been, and there are proposals to adopt the principles that could conduct this matter. It is, therefore, assumed that it is possible and desirable to promote sustainable development in the semiarid Northeast. Principally, living with the semiarid nature in the Northeast is a current task.

This way of "living-with" has existed since the times of colonization. Its main actors are the "sertanejos"-fazendeiros (ranchers, owners of a *fazenda*), farmers, laborers (employed for wages or under certain conditions) and members of the families (remunerated or not) especially women.¹² Those who earn their

living from farming or in function of it use scarce resources, water and soil; they do not always use technologies; they do not receive or can not pay technical assistance; they have limited access to loans; they know little about the rules of the market; and they accumulate a meager surplus, even in the years of a good winter. In an almost perfect symbiosis with the *fazendeiros*, farmers and laborers are the many kinds of merchants, who work according to the logic of the "old" mercantile capital, buying cheap to sell expensive, without making a difference between big, middle, or small traders.

The *fazendeiros* and farmers who live with the semiaridity of the Northeast could produce better harvests, have compensating returns and deal better with the shallow soils, working often to exhaustion, when they plant in areas of stony soil. In these places, the food production - of beans and maize, since rice and manioc can not be cultivated there - is a lottery, with the rules regulated by the climatic variability. The labor relations to which those who live there, in such unfavorable physical and technical conditions, are submitted, and the almost complete absence of social relations with those living in the same, or in other conditions, contribute in reducing even more the waning surplus produced by them. Cooperation is a very uncommon practice in the environment created by the *fazendeiros*, farmers and laborers in the semiarid region, irrespective of the fact of their having large or small or few possessions.

Effective living with semiaridity continues to constitute a task involving the new generations. Instruction and education for all is required, by formal methods (for the youngest ones) and less orthodox processes (for the older ones). A mentality change is required for the direct beneficiaries of the processes of technological innovation, dedication of those who become responsible for those changes and true social commitment on the part of the governing elite and the opinion formers. This living will tend to consolidate itself if the growing inclusion of new beneficiaries is carried out through the work of everyone; if only the utopia could become reality. A utopia based on technical know-how, but driven by wisdom. This should not necessarily be the work of poets, although those may be the ones who best understand this kind of enterprise. It is also a question of studying and reflecting about the work of scientists who were able to conceive this reality. Of scientists like Guimarães Duque, for whom "... education should rehabilitate the dignity, the greatness and the virtues of the rural drudgery." (Duque, 1973, 150.)

The task to foster this "living-with" is a monumental one. Important works have already been implemented on this topic. Among the conceptions already in practice, what deserve to be underscored are the initiatives destined to the production of specific technologies for "living-with" droughts, like the available holding tanks from **Embrapa Semi-Árido**.¹³ Although restricted to the domain of farming and cattle-herding in general, that center has produced technologies for the improvement of the water-storing system (for human and animal consumption and for productive activities); making feasible the cultivation of farming land and pasturage resistant to the drought; extend the breeding of cattle (of bovines, goats, sheep, and poultry) with species adapted to the semiarid conditions; producing alternative sources of energy; permitting the storing of the

production on the *fazendas* themselves; and, utilizing animal mechanization. (Fonseca, 1984; and Silva, 1984).

5.3.1 THE ÁRIDAS PROJECT

Only very recently, the Northeast became the object of a new conception for development, that could be characterized as included in the context of living with the semiaridity. The most relevant in this respect has been the Áridas Project, referred to hereafter, together with one of its most relevant experiences: that of the planning of the sustainable development of the Seridó of the Rio Grande do Norte.

In 1993/1994, various institutions of the federal government and of the state governments of the Northeast and non-governmental entities came together honoring the commitment to formulate a new strategy for development for the Northeast, oriented by the principles of sustainability. This effort, conducted under the sponsorship of the Áridas Project, was carried out with the financial support of governmental bodies of the states of Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Segipe, and Bahia, with the aid of the Support Program for the Small-scale Producer, the *Programa de Apoio ao Pequeno Produtor-PAPP* (Study Segment), financed with funds of de World Bank. The realization of the studies of the Áridas Project took place in the context of technical and institutional cooperation signed by the Inter-American Institute for Cooperation for Agriculture-IICA and these same States, in the context of the PAPP.

The Áridas Project formed one response to the recommendations of the Conference on the Impact of Climatic Variations and Sustainable Development in Semiarid Regions-ICID, held in Fortaleza-Ceará, in January 1992, in preparation for the work of ECO-92. This project was conceived in a way to make operational the sustainable development in the Semiarid Northeast. The Áridas Project sustained the thesis that the development policy of the Northeast needed to be reinvented. Therefore, new strategies should be adjusted by the use of the concepts and presuppositions of the sustainable development, applicable to long term planning. (Magalhães, 1993.)

The results of the experience of the Áridas Project are represented by the production of a Development Strategy for the Northeast (in 1994), and by the elaboration of various plans or strategies and programs comprising the states of Ceará, Bahia, Pernambuco, Paraíba and Rio Grande do Norte and six sub-regions of some of these States - Zona da Mata de Pernambuco, Sertão da Bahia, Sertão de Pernambuco, Zona Litoral-Mata da Paraíba, Sertão da Paraíba and Agreste-Brejo da Paraíba. These plans, strategies and programs were elaborated in the period between 1993 and 1997. (Miranda, Buarque, Araújo & Guimarães Neto, 1999.)

5.3.2 DEVELOPMENT PLAN OF THE SERIDÓ - RIO GRANDE DO NORTE

Apart from the state and regional plans, strategies, and programs mention before, the methodology of the Áridas Project was applied to one of the most

vulnerable semiarid sub-regions of the Northeast: the Seridó of the Rio Grande do Norte.

Based on the activities of the cattle-cotton-farming complex and on those of mining (lead by the exploitation of scheelite), the economy of the Seridó of the Rio Grande-do-Norte expanded considerably in the decades of 1930's and 40's. From these two means of support, the Seridó became one of the principal bases of the political life of the Rio Grande-do-Norte.

But that dynamical economy, for the conditions of the northeastern semiarid, came to confront the consequences of an unpaired crisis, at the beginning of the decade of 1980. A crisis caused by the drought of 1979-1983 was strenghtened, since 1983, by the introduction and generalization of the boll weevil plague (*Anthonomus grandis*, *Boheman*) in the region - a specific agricultural plague of the malváceas plants in general and of the cotton-plant in particular. Apart from these factors, "the policy of immoderate openness associated with the long phase of exchange super-valorization," in the 1990's, has left its trace of destruction in the Seridó. Those factors (drought of 1979-1983 and the occurrence of the boll weevil), reinforced by the this policy of economic openness, contributed in making cotton and scheelita unfeasible, which then, consequently, became import goods. So, the Seridó from Rio Grande do Norte witnessed the eroding, all at once, of the pillars of its regional economy. (Araújo, 2000-a).

The crisis was a long one. It lasted the whole decade of 1980's, and stretched to the middle of the next decade. But it was confronted with determination by the society of the Seridó. And it was well conducted in the context of the conception and implementation of the Dairy Program, conceived by the government of the State of Rio Grande do Norte. On the impulse of this Program, the agro-industry of derivatives of animal products was fortified, on traditional and modern bases. The same happened with the ceramic industry (tiles and bricks), with the fabrication of caps and with the handicrafts (of embroidery, laces and vegetal fibers - used in the production of hats). Trade and tourism were also supported, stimulating thus the "festivals of patron saints." The Feast of Santana, the patron saint of Caicó, the most important feast in the interior of the Rio Grande do Norte, could go on blooming.

For the attained results, it is noteworthy that the Seridó of the Rio Grande do Norte counts on a network of secondary schools with a long tradition and of respectable quality. The region has also two Regional Centers of Higher Education, of the Federal University of Rio Grande do Norte, one in Caicó and another in Currais Novos. There exists a long tradition of work in the areas of social and community development, with the backing of the Catholic Church, for more than 50 years. This movement started in the decade of the 1940's, with the institution of the Service of Rural Assistance-SAR, oriented by D. Eugênio Sales, many years later promoted to the function of Archbishop of Rio de Janeiro. The SAR played an important role in the formation of community and political leaderships in the entire state. The importance of the Church in Rio Grande do Norte was also positive in relation to the efforts which lead to the creation of the Sudene, in 1959. Its mode of operation was of fundamental value for the realization of two important historical events: the First Meeting of Bishops of the Northeast, realized

in Campina Grande, the 25th and 26th of May, 1956 (Presidência da República, 1959); and the Second Meeting of Bishops of the Northeast, celebrated in Natal, the 24th and 26th of May, 1959. (Presidência da República, 1959). Both meetings received institutional support from government of President Juscelino Kubitschek.

It was with this background of knowledge and organizational spirit that the society of the Seridó mobilized to elaborate a Plan for Sustainable Development for its Region. In an area of approximately 13,000 km², endowed with a fragile basis of natural resources and an extremely irregular rainfall, there were about 290.000 individuals spread over 28 counties, in the period when the Plan was formulated (September 1999 to June 2000), The works of the Plan were backed by the state government and by the county governments and the leaderships of all the representatives of the Seridó. Formulated along the line of participatory development, The Seridó Plan counted on the collaboration of more than 1.200 leaders, mobilized during the county, sub-regional (Caicó, Currais Novos, and Serras Centrais) and regional (the entire Seridó) meetings, carried out during the process of its formulation.

The administration of the Plan is carried out by an Agency for Regional Development, with headquarters in Caicó. The first year of functioning of this agency was supported with funds allocated by the World Bank. The continuity of the work of the administration of the Plan, coordinated by the agency would depend on the financial backing of the counties and business sectors of the region.

According to the economist Tânia Bacelar de Araújo,¹⁴ "If nature did not endow the region with abundance of water and fertile soils, if the national policy ignores the non-dynamic areas, the society that was developed there did not give up living in that place, not even considering it to be its destiny of surrendering to the voracity of the implementators. It is constituted by individuals which have initiative, having solidarity with each other, could organize themselves to conquer what they believed to be important, without letting themselves be put down by the adversities. A people with a very spatial culture, that knows how to build its own routes, that knows what it desires. Just imagine how it would be if our national policy gave their support to those initiatives!" (Araújo, 2000-b)

The Seridó Plan constitutes initiatives with good possibilities of succeeding. It should be accompanied and studied, considering its applicability to other areas of the semiarid northeast.

6. Economic activities

The Semi-arid Region of the FNE constitutes an important political and cultural space, although its economy still presents fragility to be eliminated, but this has little effect on the northeastern economy. Its Gross Internal Product-GIP equaled, in 1970, US\$ 7.2 billion, at prices of 1998, raising to US\$ 23.6 billion, in 1998. The growth was US\$ 16.4 billion in absolute terms and 227.8%, in percent terms. The GIP of the Northeast in the same period changed from US\$ 25.5 billion, in 1970, to US\$ 109.3 billion in 1998. An absolute growth took place from US\$ 83,8 billion and a percent increase of 328,6%. The relative growth of the GIP of the Northeast Region, between these two years, was 100.8 percentage

points higher than that of the Semiarid Northeast. According to this indicator, the economy of the Northeast presented a considerable dynamism in relation with the economy of the Semiarid Region.

Examining this fulfillment in relation to the Gross Internal Product per capita, one sees that the situation is somewhat different. The GIP per capita of the Semiarid region changed from US\$ 654.59, in 1970, to US\$ 1,219.81 in 1998. In fact, its relation with the "Remainder of the Area of Sudene" diminished considerably between 1970 and 1998, decreasing from 64.61%, in 1970, to 40.32%, in 1998. A similar tendency can be observed when the GIP per capita of the semiarid is compared with the GIP per capita of the Northeast Region, in the same period: it changed from 74.67%, in 1970, to 53.19%, in 1998.¹⁵ One can notice, thus, that the conditions for living in the semiarid areas, when compared to other regions of the Northeast, deteriorated, in average terms, in the last 30 years. (See table 6.1, in the appendix.)

This relation presents a value still more significant, where it can be established that the participation of the GIP of the Northeast in the GIP of Brazil remains between the limits of 12 and 17% in the years of the period 1965-1999. (MI. Sudene, 2000.)

According to estimates of the IBGE and of the World Bank, elaborated by Vergolino (2001), the economy of the semiarid regions contributed, in 1970, 28.4% of the total GIP of the Northeast. This participation decreased to 19.8% in 1990, but increased a little in 1998, reaching a value of 21.6%. This alteration could indicate a greater relative independence of the economy of the semiarid region from the impact of droughts, considering the occurrence of five years of partial droughts between 1990 and 1998, corresponding to the years 1990, 1991, 1992, 1993 and 1998.

In a simplified treatment, it can be said that the economy in the Semiarid Northeast is integrated by traditional activities, dynamic activities and non-conventional activities. In the category of the so-called traditional activities, are included the age-old activities, characterized by low efficiency and low productivity. This is the case with the cotton economy and with extensive cattle breeding. That still predominate in some sub-regions of the northeastern semiarid regions, like some types of agro-industry, related with the processing of cotton and of some oleaginous types. These activities are going through economic restructuring processes, that have shown negative impacts on the employment levels.

It must be said that the population of the towns of the semiarid no longer live on the result of trading and of the agro-industry derived from the activities of the complex cattle-cotton-food farming. Today they live much more from the activities of the so-called "economy without production,"¹⁶ constituted by the pensions of retired workers and of the public employees, and also by the transfers of the Union to the city halls and to the state governments. The retirement income of the rural workers contributes, today, in maintaining a certain economic balance in the semiarid regions, by making possible the creation and maintenance of a flux of constant income, that sustains those who directly or indirectly depend for their living on the activities of this complex. The constitutional transfers (Participation Funds of the States and Counties) have made possible the constitution

of alternative economic activities, where these resources are administered with low economic efficiency, but still then providing space for the structuring of small non-agricultural businesses, rooted in the creativity of the population, especially of the residents of urban sites.¹⁷

Presently, the day of major commercial movement in the towns of the semiarid region is when the retirees of the Funrural receive their pension. In the drought period, it is when the workers on the list of the "emergency fronts" receive their small salaries or their "baskets of basics."

In the semiarid region are of a dynamical character some activities of supported industry, irrigated fruit-growing and modern animal farming (slaughter-cattle), exploited in areas gifted with the best soils, and not dominated by the rigors of the semiarid. But there are new dynamic activities, following the example of the bank services and of the so-called modern services, backed by computer science. In the same situation are included the health care services, realized on an excellent level in some towns of the semiarid region.

The restructuring of the activities of the complex cattle-cotton alimentary farming gave room for the constitution and/or reinforcement of some problems in the semiarid region. The best known are related to institutionalized violence, produced as the result of hold-ups of freight and passenger vehicles in semiarid areas of various states of the Northeast. This violence is complemented/reinforced by the cultivation and commercialization of marijuana (*Cannabis sativa*, Linn) in places gifted with the best soils and water resources.¹⁸

7. Demographic picture and changes observed in the period 1991-2000

The group of people living in urban sites in the semiarid region is already larger than those who live in rural areas. The increase rates of the urban population of the semiarid region are larger than those observed in the Northeast as a whole and in Brazil. As is already noteworthy, since the 1970s, this growth was a result of the crisis which affected the main economic activities of the region, particularly those that integrate the complex cattle-cotton-alimentary farming. It is also due to the fragile basis of natural resources, especially those of soil and water, unable to meet the demands of its growing population. The logic of the development programs put into practice in the region, between the decades of 1970 and 1980, oriented by fixation guidelines "from the human being to the field," contributed even more to reinforce the population dislocations from the fields to the towns. Under discussion here are questions related to the following topics: urban, rural and *rurban*, demographic dynamics, the poor of the semiarid region and technological capacity.

7.1 URBAN, RURAL AND RURBAN

Urban and rural in the semiarid region do not constitute autonomous spatial dimensions. The economic activities realized in these areas are gradually integrated, giving room for the construction of spaces characterized as *rurban*,

to use the expression invented by Gilberto Freyre, in 1956. Speaking for a group of teachers from Pernambuco who were graduating that year, Gilberto Freyre called attention to considering the urban problems that were piling up in the city of Recife, to the need for decentralization of the activities which were being concentrated more and more in the capital of Pernambuco.

What is needed in Pernambuco (...) is a social policy that does not go to extremes neither in regard to urbanization, nor to ruralization of the Pernambucan community, but taking great care of rurbanization. That is, of the balance, in this complex community, already age-old and ecologically and sociologically very diverse because of its various natural and cultural spaces that we should try to transform from antagonistic into complementary - agrarian, pastoral, industrial - the urban values and styles and the rural ones. More than balance: interpretation. Mingling We need to install and develop here a rurban mentality, in the sense of what can be called conjugal, of rurbanity. Consequently, rurban not just in the sense of (...) attributing it to situations in-between the purely urban and the purely rural, but in what (...) I am trying, in Brazil, to develop in order to characterize a mixed, dynamic and, I repeat, a conjugal, a fertile conjugal situation: a third situation developed by the conjugation of values of the two original situations and sometimes contrasting or disharmonic, when pure. (Freyre, 1961: 82.) (Bolds and parenthesis by OC.)

Various small important enterprises developing in the semiarid hinterland are comprised by urban businesses in urban areas and by urban businesses in rural areas. These are, therefore, opportunities conceived and constructed in rurban spaces. All of them thought and built in the shadow of the "cattle-cotton-alimentary farming" complex.

7.2 DEMOGRAPHIC DYNAMICS

The Semiarid Zone is characterized, since the 1960s, as a space with high rates of urban growth in the Northeast. These specificities had already been indicated by the Demographic Census of 1970. In the period 1970-1980, the agglomerate "urban population of the interior of the Northeast"—corresponding to the total urban population of the Region less the urban population of the capitals - increased 4.41% a year, compared to the 3.6% of the rate of the annual growth of the population of all the northeastern capitals. The rate of urban population growth in the semiarid Northeast, in the same period of 1970-1980, also amounted to 4.41% a year, the same then, as that of the agglomerate "urban population of the interior of the Northeast."

Outside the capitals, the "interior areas of the states of the Northeast" characterized by a larger urban growth are found in the States of Ceará, Rio Grande do Norte, Paraíba, and Pernambuco. They are exactly the ones with larger proportions of their territories included in the semiarid domains of the Northeast. The participation, in this respect, are the following: Ceará (92.51%), Rio Grande do Norte (84.66%), Paraíba (80.45%) and Pernambuco (64.97%). (Carvalho, 1988: 445.)

During the 1980's, the demographic dynamics of the Semiarid Northeast underwent profound transformations. Concomitant with the structural changes that occurred in the midst of a serious economic crisis, there was a fertility reduction, an improvement in the mortality conditions and an inversion of the northeastern migration flux, together with a change of the pattern of urbanization.

These alterations in the trajectory of the demographic dynamics do not resolve, by themselves, any social problem of the region, but create more favorable conditions for a solution of all of them. (Martine & Wong, 1994: 9.)

The expansion of the urban growth in the semiarid spaces had a continuity in the following decades, even though the global rates of demographic growth have been somewhat lower. The growth rate observed in the period 1991-2000 amounted only to 2.6% for the semiarid region and 2.45% for the Northeast as a whole. These results are synthesized in table 7.1, in the appendix.

7.3 POVERTY IN THE SEMIARID REGION

In 1966, the Northeast counted on a population contingent in conditions of poverty and pauperism in the order of 19 million of its inhabitants (about 43% of the total population of the Northeast, calculated as corresponding, in that year, to 44 million individuals). This covered, thus, 45% of the number of Brazilians in poverty conditions and 55% of those characterized as paupers. The following information will make this picture a little more exact:

- Poverty befalls about 40% of the population of the semiarid region (about 7.5 million individuals in 1966);
- In the towns of the semiarid region, 35% of the total population was poor (3.5 million individuals), and
- In the rural environment, poverty affected 4.0 million individuals (45% of the total). This impact already has been stronger. In 1970, it affected 60% of the population of the semiarid region. (Albuquerque, 2000.)

7.4 TECHNOLOGICAL CAPACITY

Next are given some aspect of this question, stemming from the contributions made by institutions for encouragement and development and research. The major part of the scientific and technological production about the Northeast and the semiarid region is the fruit of the action of public institutions like DNOCS, the Commission of São Francisco Valley-CVSF (later transformed into Superintendency of the Development of the São Francisco Valley-Suvale and Codevasf), the Sudene and the Universities (federal and state). The production of those entities (DNOCS, CVSF, Suvale and Codevasf) was not enough to attend the demands of the semiarid region, but constituted a remarkable heritage of the effort made by them, especially by the institutions established in the region since the 1930's, like the José Augusto Trindade Institute, operated by the IFOCS/DNOCS, the older

Agricultural Research Institute of Northeast-IPEANE, and the Agronomic Research Institute of Pernambuco-IPA.

In the last 25 years, the supply of available technology in the Northeast has been considerably enlarged, thanks to the structure for research established and operated by the Embrapa, stemming from the 40 Research Centers founded in Brazil, after 1974. In these 40 Centers, there are 2,104 researchers, ¹⁹ of which 67 have undergraduate degrees (3.18% of the total), 1,019 possess a Masters degree (48.44% of the total) and 1,018 have a Ph.D. degree (48.38% of the total). The distribution of the panorama of the employees of Embrapa, by extended region, is as follows, as specified in table 7.2, in the appendix: North (12.9%), Northeast (20.3%), Southeast (17.5%), South (17.9%) and Central-West cover the largest number of Research Centers and researchers. The Southeast counts on nine Research Centers, followed by the Northeast and the South (each with seven centers) and by the North, where there six of the 40 Research Centers of Embrapa. (Carvalho & Egler, 2002: 89-90.)

Embrapa founded and operates in the Northeast seven Research Centers, specified here as follows:

- i) National Research Center for Cotton-CNPA (now denominated **Embrapa Algodão**, with its seat in Campina Grande-Paraíba);
- ii) National Research Center for Tropical Agro-Industry-CNPAT (Embrapa Agroindústria Tropical, headquarters in Fortaleza-Ceará);
- iii) National Center of Caprinos-CNPC (Embrapa Caprinos, headquarters in Sobral-Ceará);
- iv) National Research Center for Manioc and Fruit-growing-CNPMF (Embrapa MandiocaandFruticultura, headquarters in Cruz das Almas-Bahia);
- v) Agricultural and Livestock Research Center of the Middle North-CPAMN (Embrapa Meio Norte, localized in Teresina-Piauí);
- vi) Agricultural and Livestock Research Center "Tabuleiros Costeiros"-CPATC (Embrapa Tabuleiros Costeiros, headquarters in Aracaju-Sergipe); and
- vii)Agricultural Research Center of the Semiarid Tropics-CPATSA (Embrapa Semi-Árido, with seat in Petrolina-Pernambuco).

These seven Research Centers are run by 426 researchers, of which 14 are graduated (3.3% of the total); 261 with a Masters Degree (61.3%) and 151 with a Ph. D. degree(35.4%). Of those seven Centers, three of them do not operate formally in the semiarid region: the Embrapa Tabuleiros Costeiros (Aracaju), the Embrapa Agroindústria Tropical (Fortaleza) and the Embrapa Meio Norte (Teresina). But the Embrapa Agroindústria Tropical and the Embrapa Meio Norte have their focus of action centered in the semiarid region.

In addition to Embrapa and state companies for agricultural and livestock research, there are other institutions that carry out research programs of interest

for the semiarid region. This is the case of the Federal Universities of the different states of the Northeast and with some public state universities, for example, the State University of Ceará-UECE (located in Fortaleza), the Regional University of the Region Cariri-URCA (located in the town of Crato-Ceará); University Vale do Acaraú (in Sobral-Ceará); University of Fortaleza-Unifor; High School for Agronomy of Mossoró-ESAM; and the Faculty for Agronomy of the Sub-Mid São Francisco-FAMESF (with its seat in Juazeiro da Bahia-Bahia).

The semiarid region, thus, has a reasonable technical capacity in the field of science and technology at its disposal and that can be mobilized to increase technical progress in the region. But the stock of products and information has not reach the different users, for want of dissemination mechanisms or the lack of information about the demands for technology.

In fact, the information about the demand for technologies is still very restricted. Only very recently, a start was made with the work of technological prospecting. Its development is being made firm in the administration of Science and Technology (S&T), as the result of the maturation of the research investments and of the scarcity of resources for the financing of new public and private investments in productive activities. In fact, the identification of technological demands is problematic, in view of the difficulties the institutions of S&T should resolve, in the area of Research and Development. (Goedert, Paez, & Castro, Editores, 1994: 167-169.)

Hence the scarcity of quantitative information about the demand for scientific and technological services, both in the Northeast and in its semiarid areas. The formulation of this type of demand became, therefore, topic for discussion at meetings, symposia, seminars, and congresses of S&T. The entities dedicated to research and technology are on the alert about the problem, as is demonstrated by the initiatives put in practice by Embrapa, which is formulating its Research Projects from the demands that the producers have formulated. An identical observation can also be made for the associated with the diffusion of technology, starting from the most studied case: that of the application of new technologies in agricultural and livestock activities. This problem today is very critical, since there is no institution that operates, specifically, on the topic, in the national and regional spheres.

The major difficulties for technological prospecting tend to remain more restricted to the small producers, particularly those who produce minor supplies for the market, like those who live in the areas most deprived of resources of the semiarid region. These producers still depend heavily on the technicians responsible for the diffusion of technologies, members of the teams of the State Companies for Technical Assistance and Rural Extension-Emater, to have their demands specified. The situation is somewhat different, when dealing with technically more advanced farmers and livestock breeders, even when these may lack a precise perception in reference to the specific demands in the area of S&T, but they know how to localize the problems that limit the feasibility of their businesses. The connection between the modern farmers and the organizational research centers like Embrapa is now realized, by way of modern means of communication, like telephone and Internet. That is what happens with those

who are dedicated to the field of the irrigation business, mainly those of Petrolina-Pernambuco/Juazeiro-Bahia, Açu, in Rio Grande do Norte, and North of Minas Gerais.

The business people of the urban sector are also facing difficulties, especially those of micro and small businesses, though the particular nature of their problems may be different. Their problems are related to the payment capacities for the technical information services. The exceptions, that confirm the rule, are represented by the assistance given by Serviço Brasileiro de Apoio às Micros e Pequenas Empresas-Sebrae.

8. Survey on resources and population

The survey of the resources and of the population in the semiarid region is presented here, on the basis of the description of the following topics: the current desertification; present and potential use of the resources; perspectives for the relationship population/environment in the first half of the XXI Century; and the (re) structuring of public policies for the semiarid region.

8.1 THE CURRENT DESERTIFICATION

The use of the natural resources in the Semiarid Northeast took place in a very improper way, bringing about degradation processes arising from situations like the following:

- Elimination of the original vegetal carpet, then being substituted by a carpet consisting of invading plants; the processes of this type took place as reduction elements for the biodiversity and the genetic heritage;
- Partial or total loss of soils caused by the action of physical (erosion) and chemical (salinization/alkalization) phenomena, in areas where the losses are accompanied by the rise of the frequency of whirlwinds and even sand storms;
- Decrease of the volume and quality of the stored water resources, with implications for surface run-off;
- Reduction of the soil fertility in areas of agricultural livestock production and the abandonment of lands in areas of mining exploitation. (Rodrigues, 1987.)

The results of these processes already appear in some areas of the Northeast, considered to be submitted to desertification processes. One should be alert to the fact that the areas in the process of desertification in the Northeast do not present similarities with the desert areas which we are accustomed to see on film and television. The desert in the Northeast tends to be different. "It will be a non-typical desert, different from the typical Saharan desert, by the incidence of precipitation and the nature of its soils, but with the same implications of in-

inhabitability," of which will be a proof the "diminution of the potamographic network of the region." (Vasconcelos Sobrinho, 1974: 8.) In this sense, the current desertification in the Northeast is understood as an integrating phenomenon to economic, social and natural and/or induced processes, that destroy the balance among the soil, the vegetation, the air and the water, as well as the human life quality in the areas submitted to the semiaridity (soil-related and/or climatic). Among the most frequent causes of this process stand out the activities related to over-pasturing, to deforestation, mining, and to excessive cultivation, with or without irrigation, and the population concentration as the consequence of the land property system.

The identification of the areas in the process of desertification in the Northeast were realized, on the basis of the studies initiated in 1977 and coordinated by Sudene. These studies have been carried out with the objective of identifying the most affected areas and select those that could be considered the most critical ones, as pilot areas, for mapping purposes. The areas submitted to processes of desertification in the Northeast are represented by four nuclei of importance, situated in the counties of Gilbués, in Piauí; Irauçuba, in Ceará; Seridó, in Rio Grande do Norte; and Cabrobó, in Pernambuco, specified in table 8.1, in the appendix.

8.2 ACTUAL AND POTENTIAL USE OF THE RESOURCES

The inquiry on the capacity of the use of the resources that result from the interaction of the soil-climate-plant complex can be done in relation to two situations: that of the actual use (determined by the land occupation process) and that of the natural capacity of the resources (related to the possible and desirable potential of the use of the resources, in the context of the sustainability). This double approach, used in the studies about the environment and natural resources of the Áridas Project, allows the definition of both the actual and the desirable and potentially possible structure. It also allows, by the additional consideration of the variable technology, to establish the existing relations between these two situations.

For this reason, variables and parameters, quantifiable in units of surface (hectare or square kilometer), in the line of the methodology conceived by Estevam Strauss (1972), were utilized. Cross referenced with technological indexes, the variables and parameters can express the relationship man/land of one given area, or, the number of men necessary to plow, to fence off, to plant, to weed and to gather. In addition to these variables of demand, that can be obtained for each homogeneous micro-region (MRH) of the Northeast, another variable referring to the supply of labor is used, represented by the economically active population-PEA, which works in the agricultural and livestock sector. By comparing the relation between the variables that express the supply and the demand of labor, on the one hand, and the actual and potential use of the resources, on the other, three important coefficients can be defined, and specified, for each region, as follows:

- Coefficient of Use = Actual Demand/Potential Demand;

- Coefficient of Excess = Actual Supply/Actual Demand; and
- Coefficient of Saturation = Actual Supply/Potential Demand (Strauss, 1972.)

These coefficients were calculated in the studies already referred to of the Áridas Project, being related to the analysis of the structure of land use of each of the micro-regions of the Northeast. From the point of view of land use and of occupation of labor, four area categories have been selected:

- The Saturated Areas, according to which the coefficients of land saturation and use are substantially larger than the unit;
- The Areas in Balance, in which the mentioned coefficients are close to the unit;
- The Potentially Expansive Areas, according to which the coefficients are lower than the unit, although, in general, may be approximately larger than 0,2; and
- The Boundary Areas, in which the coefficients are very low. (Strauss, 1972: 56; and Matallo Jr., 1994.)

The application of this methodology to the Northeast allowed the verification of the occurrence of six possibilities:

- A.** Not yet saturated MRH in relation with its natural capacity, without population surplus, *vis-à-vis* its actual use structure being under-employed;
- B.** Non-saturated MRH in relation with its natural capacity, with population surplus in relation with its actual use structure being under-employed;
- C.** Non-saturated MRH in relation with its natural capacity, without population surplus in relation with its actual use structure being under-employed;
- D.** Saturated MRH in relation with its natural capacity, with population surplus in relation with its actual use structure being under-employed;
- E.** Saturated MRH in relation with its natural capacity, without population surplus in relation with its actual use structure being under-employed; and
- F.** Saturated MRH in relation with its natural capacity, with population surplus in relation with its actual use structure being under-employed. (Matallo Jr., 1994: 82-83.)

The found results indicate that the actual and potential use structure of the Northeast as a whole presents a low land utilization rate and a low labor absorption rate. The found coefficients (of use, excess and saturation) indicate a situation which could fit in the possibility **B** (non-saturated MRH with population surplus, however under-used).

Practically, this means being with the second situation which could have areas still to be occupied, such as areas with a population surplus, relative to the potential use. In this sense, the labor surplus is related to the actual use structure and not to the potential use structure. This means, also, to say that there exist unemployment and underemployment, but in a situation of wide labor absorption possibilities, expressed by a Saturation Coefficient equal to 0.44. (Matallo Jr., 1994.)

8.3 PERSPECTIVES FOR THE RELATIONSHIP BETWEEN POPULATION AND ENVIRONMENT IN THE FIRST DECADE OF THE XXI CENTURY

The situation of the population in the Northeast at the beginning of this century is very different of the one found 50 years ago. The living conditions of the people in the rural environment of the Northeast in the 1950's and migrated to the towns, even to the less important ones, could even be better-off today, when basing themselves on the relative access they have to information, to employment and to the basic services. However, the inequalities in the urban environment are accentuated.

A research realized by the UNDP and IPEA about the living conditions of the Brazilian population (Human Development Index-IDH and Living Conditions Index-ICV) demonstrates that the social indicators improved in some capitals of the country, in relation to the first half of the 1980's, considered as the "lost decade." But got worse in other capitals, with an increase of unemployment and of the inequality of income. Besides this, access to work deteriorated.

Among the twelve Brazilian capitals studied, Fortaleza occupied the eleventh place in the ICV, with 0.691, and the twelfth in the IDH, with 0.698. Recife found itself in the twelfth place in the ICV (0.690), and in the eleventh in the IDH (0.700). The situation of the two last capitals in the ranking of the 12 Brazilian capitals, besides being in disadvantage, they do not differ much one from the other. The situation is critical, since this refers to two of the three capitals of the economically most important states of the Northeast, from the economic point of view. (Ryff, 2001: C-8 to C-10.)

The high growth rates of the urban population of the Semiarid Zone constituted a notable characteristic of this zone, from the 1970's on. Its growth originated, to a great extent, from the de-structuring process through which its economy went. The occupational opportunities diminished, principally in relation to the traditional activities. In addition to reduced occupational opportunities for the labor force that came to the market, the mechanisms of population absorption propitiated by the extra-regional migrations stopped functioning. To make this scene even worse, returning migrations began to develop, with northeastern people who went to the Central-South returning to the Northeast (semiarid or not). (Martine & Wong, 1994.)

From then, the poorest came to adopt survival strategies that included the alternative of migration to the capitals of the states of the Northeast Region. This mechanism had a relative functionality until the end of the 1970's and the beginning

of the 1980's, when the displacements in that direction were intensified by the impacts provoked by the drought of 1979-1983. Gradually, these possibilities also became exhausted. Consequently, the migrations of a rural origin and with an urban destiny began to flow in the direction of the towns of the same semiarid hinterland. In this situation, the problems encountered by the migrants became more serious, since their places of destiny did not have working opportunities either to offer.

Certainly, other factors also directed this process, but the particularities of the urban growth in the Semiarid Northeast continue to be connected with its fragile basis of natural resources and to the expansive role fulfilled by the socio-economic and political-institutional impacts of the droughts. In fact, the number of towns and hamlets in the semiarid region has increased, but there are few small towns whose population grows as a result of the dynamism of its economical activities. The evidences are thus reinforced that the economy of the areas affected by the droughts is being structured and sustained by governmental transfers and by the economic dynamism (relative) of the capitals of the States of the Northeast and by a very few towns that benefit from the power of certain public investments, like those applied to projects for hydric infra-structure and for hydro-agricultural improvement of irrigable lands.²⁰ That is what, in particular, is happening in the agro-industrial poles of Petrolina-Juazeiro, in lands of Pernambuco and Bahia, of Açu, in Rio Grande do Norte, and in the North of Minas Gerais.

The current urban growth in the semiarid region will continue in the first decade of the XXI Century, at least in the rhythm observed in the period 1991-2000 (2.6% per year). It could start increasing again, in the absence of policies oriented towards the strengthening of the dynamic activities that have been implemented in the region or for the backing and expansion of the activities related to small non-agricultural businesses, that already are being implemented both in the rural, and in the urban areas. The relation between population and natural resources could be environmentally favorable in the exact measure in which the government programs, calibrated by the social participation, contemplated adequate administrative mechanisms for the surface and underground hydric resources.

8.4 (Re) ALIGNMENT OF PUBLIC POLICIES FOR THE SEMIARID REGION

It is fundamental to endow the Northeast with effective instruments, both for development and for planning, financing and administration. The different policies conceived and put into practice in this region, after the decade of the 1960's, allowed the injection of a considerable volume of resources in its economy and infrastructure. Although there have been positive results in some areas, the public policies from that time were characterized by some basic errors. Standing out, in this respect, those who commanded the conception of the policies oriented to the fixation of the man to the field, in a territory endowed with a recognized fragile basis of natural resources. The errors were, besides this, reinforced by the effects of various droughts that occurred in the years of the decades of 1970,

1980 and 1990, and also by the economic crisis that affected the economically more dynamic regions. The consequence was a growing displacement of people towards the capitals of the Northeast and the towns of the semiarid hinterland.

Even then, it is possible to admit that the demographic transition of the semiarid region still has not been completed, considering the observed transition in the Northeast and in Brazil. The demographic transition in the semiarid region will tend to be complete, in a socially more just way, when the development policies for this region contemplate initiatives able to privilege a greater access to employment in the urban environment and to the essential services.

In this sense, it will be fundamental to look at and revise the strategy of the GTDN, to conceive a more adequate Development Strategy for the Northeast and its Semiarid Region. The strategy of the GTDN, keeping within proportions of time and space, has been the one that best articulated, up to now, the problems and the global and sectorial possibilities of development in the Region, in the context of its different spaces. This reappearance can constitute a bridge from the not very remote past to the present and to the future of the semiarid region.

The document "Nordeste: uma Estratégia para Vencer o Desafio da Seca e Acelerar o Desenvolvimento" (The Northeast: a Strategy to Overcome the Challenge of the Droughts and to Accelerate Development), produced and circulated by Sudene in 2000 (Albuquerque, 2000), represents the last effort of regional planning conceived specifically with the aim of promoting development in the Northeast. This document can be more than just a reference concerning the problems and development possibilities in the Region, even in the absence of Sudene.

The Northeast still has at its disposal material basis and know-how, that could be used for the conception of new development strategies for the Region as a whole, and for its semiarid areas, in particular. Sudene became extinct, but the institution meant to take its place - the Agency for Development in the Northeast-Adene, formally installed on the 14th of February, 2002 - still has not really started functioning. The creation of a new "institutionality" to contemplate the development of the Northeast - be it named Adene or Sudene - constitutes today the main priority of the region. The creation of the new institution could not only indicate the direction given to the development, but also its content.

The (re) alignment of public policies for the semiarid region should be approached in the context that privileges, in the last instance, the determinants of the economic restructuring through which the Brazilian economy is going, without leaving aside the factors that command the current development process in the Northeast. In the first place, it should comprise the socio-cultural, environmental and political-institutional particularities of the Semiarid Northeast, without leaving aside the progress achieved in the matters of science and technology.

The resulting strategy should be oriented to take care of two types of requirements: those of survival and those of transformation/development of the semiarid region. The Survival Strategy should comprehend initiatives for immediate assistance to the poorest population, including the current programs and other more dynamic ones, made compatible with the local demands and potentials.

The proposals in this respect could be structured starting from criteria such as: i) a stronger participation of the beneficiaries; ii) involvement of the beneficiaries in productive activities, agricultural or non-agricultural, that may add to their future improvement; and iii) the use of technologies that could make possible a more intensive use of the existing unemployed manual labor.

The Transformation/Development Strategy should comprise initiatives that contribute in transforming and strengthening the economy of the semiarid region, taking into account its sectorial (agricultural, secondary, and services), multi-sectorial (productive chains, agropoles and clusters) and spatial (contribution for the improvement of the living conditions of the people of the most needed sub-regions or to de-concentrate income, interiorizing the development process) expansions. This kind of strategy should comprise programs like those of agrarian reform, irrigation, construction of hydric infra-structural works, research and technology and initiatives that articulate the development of agricultural and non-agricultural activities, in the areas made dynamic by industry and agricultural.

The (re) alignment of public policies for the semiarid region, in the line of this double expansion, should be guided by orientations meant to guarantee the realization of activities that create employment, reinforced by clear specifications as to the growing use of technical progress. Technical progress that privileges the initiatives based on the principles of endogeneity. (Haddad, 1994.) The new initiatives should have meaning and opportunity compatible with the nature of the problems and possibilities of the semiarid region. This means having to articulate effectively the participation of the governmental, private and non-governmental sectors in the execution of the identified and collectively formulated programs.

The solutions for the problems of the semiarid region should be conceived and treated in the positive perspective of development. In this sense, development becomes the name for "living together with the droughts and semiaridity." The required transformations will not be put into practice by way of magic. They will depend on their being adequate to the different environments and on their continuity in time and in space. They require participation and negotiation between the different social actors. The contribution of the public sector continues to be fundamental. But it is necessary to consider that private sector capable of making investments and on social organizations structured around the problems and possibilities of that region can already be counted on.²¹

Particularly, the (re) alignment of public policies for the semiarid region should have structuring projects, oriented towards the creation of a new front of economic expansion, that propitiates the generation of more income and more employment. It is necessary to take a step ahead to what has been done already in relation to the activities of the stimulated industry, to tourism and to irrigated fruit-growing, as can be found today. The new front of economic expansion could result from the execution of an effectively structuring enterprise like the Project for Water Transference from the São Francisco River.

This project offers again, in relation to other enterprises that are considered important for the Northeast Region, the possibility to produce, distribute and administer adequately the hydric resources needed to respond to the growing

demands for water in the Northeast, with the initial emphasis on the water storing problems faced by different consumers of the states of Ceará, Rio Grande do Norte, Paraíba and Pernambuco. It also renews that which relates to the possibilities of enlarging the irrigated areas in the Northeast, making the agricultural, industry and the mining-metallurgic industry more dynamic, and strengthening modern services.

The Project for Water Transference from the São Francisco River will be integrated by a succession of canals, aqueducts, tunnels, and reservoirs that will start from two holding tanks located downstream from the Barragem of Sobradinho (dam). The set of two axis and their ramifications will have an extension of approximately 700 km. The first of capturing water, that will attend the Northern Axis, will be located close to the town of Cabrobó. The second, serving the Eastern Axis, will come from the Itaparica Dam. A third axis, in the direction of the semiarid region of Piauí, is already being planned. (MI. ACS, 2001.)

The studies that are necessary for the feasibility of the enterprise are adequate from the technical, environmental and economic point of view. The "political engineering" remains to be resolved, negotiating the project better with the states of Minas Gerais, Bahia, Sergipe, and Alagoas. It is also necessary to better discuss the "financial engineering," with the public sector and the national private sector, and with the multilateral financing organs, such as the Inter-American Development Bank and the World Bank.

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Notes

¹ There are four climatic seasons: one of them corresponds to the 1^o solstice (21st of June), another to the 1^o equinox (the 23st of September), a third to the 2^o solstice (21st of March). During the 2^o equinox, the "sun again turns around the equator. When in the Northern Hemisphere it is Spring, in the Southern Hemisphere it is Autumn. As a result, the phenomena of the four seasons are only observed regularly in the two temperate zones." (North and South). (Botelho, 2000: 35.)

² Not included were the areas of the States of Minas Gerais (that integrate parts of the Vale of Jequitinhonha) and Espírito Santo (counties of the northeast of this state), that became part of the Area of Operation of the Sudene, dictated by Law nº 9.690, of July 15, 1998. These additional areas (97.714,30 km²) do not include counties characterized as semiarid.

³ The hydrographic Basin of the River São Francisco has a surface of 640.000 km², 57% of which is within the area of the Droughts Polygon of the Northeast.

⁴ National Center for Soil Research-CNPS.

⁵ Considered as corresponding to the territories of the States of Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia and north of Minas Gerais, equivalent to 1.662.947 km². (There is a round off error, in relation to the basic data, of 0.69%, corresponding to 11,474,33 km², which, when added to the other values completes the total of the territorial surface of the Area of the Sudene Northeast.)

⁶ The ecological demand, according to the studies of the Áridas Project was considered as corresponding to 10% of the available surface drainage.

⁷ Among the ten dams and barrages, stand out: Sobradinho (that can accumulate 34,7 billion cubic meters of water) Itaparica (with approximately 15 billion cubic meters of water), Xingó (with about 5 billion cubic meters of water), Armando Ribeiro Gonçalves (with 2.2 billion cubic meters of water) and Orós (with 2.1 billion cubic meters of water).

⁸ For the elaboration of this item the author, partially, made use of the descriptions realized by Matallo Jr., 1994: 13-15.

⁹ United Nations Development Program/Food and Agricultural Organization/Brazilian Institute of Environment and Renewable Natural Resources.

¹⁰ Partnership realized, normally, between the Federal Government (by means of the IOCS, IFOCS or DNOCS) and large land owners, by means of the concession of a credit-awards equivalent to 50% of the costs of the dams.

¹¹ This information was obtained in the site of DNOCS: www.dnocs.gov.br

¹² In the role of the families that integrate the economically most fragile segment of the economy of the semiarid region, the role of women should be underscored, for the extraordinary effort they have to make in the periods of droughts. They are the companions of the men who enlist themselves in search for employment or migrate to the towns, from within the area of the Northeast and from abroad, and who assume the care of the families, in the absence of their husbands who are in search of working alternatives and an income outside the *fazendas* of the

semiarid areas. The women assume this labor in conditions of extreme insecurity, since the husbands who migrate do not always return to their homes; or they stay away from their residences for prolonged periods, the duration of which they can never know beforehand. In these periods, the women live as if they were "widows of living husbands." This situation was aggravated seriously during the droughts of the last decades of the XX Century, in a certain way due to the changes introduced by the government through the assistance programs for the population scourged by the droughts. The modifications carried out contributed to reduce the number of opportunities for employment and/or assistance in the actual region of the affected families.

¹³ Known during a large part of its existence as Center for Agricultural-Livestock Research of the Semiarid Tropic -CPATSA.

¹⁴ Who integrated the Team of Consultants of the Seridó Plan, together with Otamar de Carvalho, Leonardo Guimarães Neto, Waldecy de Urquiza e Silva, Rodolfo Teruel, Mardone Cavalcante França, Eleonora Beaugrand, Antônio Ronaldo de Alencar Fernandes, Dinah S. Tinoco and João Matos Filho, as well as various other professionals of the Seridó and of the State of Rio Grande do Norte.

¹⁵ In 1998, the relation between a dollar and a real was US\$ 1.00/RS\$ 1.30. That is why, the absolute values of the GIP presented here (for the Northeast and its Semiarid Region) seem to be high. In June 2002, with the dollar having the value of 2.70 reais, those values should be much lower. Thus, the comparisons made in percent terms make much more sense.

¹⁶ To use the expression of Gustavo Maia Gomes (2000: 148).

¹⁷ As mentioned in the previous item 5, the weight of the small non-agricultural businesses in the economy of the Seridó of the Rio Grande do Norte is very expressive in this respect.

¹⁸ Gustavo Maia Gomes presents a good description about the logic of these "new" activities, in chapter 7 of his book *Velhas Secas em Novos Sertões*. His intuitive description would have, though, more explicative power if he would have used the power of the theory and of the evidences on the action of the mercantile capital in the Northeast, instead of slipping towards the seemingly well-humored argument of which the author of the present text "offers an interpretation in certain aspects interesting [to explain the reasons of the backwardness of the economy of the semiarid], even when his analysis is prejudiced by the abuse of ideologically sonorous concepts, like 'dominance of the mercantile capital' and the like, but scientifically useless, if not detrimental". (Maia Gomes, 2001: 260, footnote 89.)

¹⁹ Situation in December 2001.

²⁰ The economy of the Northeast is today fixed in 25 urban nucleus. Of these, three are National Metropoles (Salvador, Recife and Fortaleza); six are Regional Centers (São Luis, Maceió, Natal, Teresina, João Pessoa and Aracaju); seven are Level 1 Sub-Regional Centers (Ilhéus/Itabuna, Caruaru, Juazeiro do Norte/Crato, Petrolina/Juazeiro, Campina Grande, Feira de Santana, and Vitória da Conquista); and nine are Level 2 Sub-Regional Centers (Montes Claros, Governador Valadares, Mossoró, Arapiraca, Jequié, Sobral, Parnaíba, Barreiras and Garanhuns). (Andrade & Serra, 2000.)

²¹ The analysis realized by Viola, in relation to the non-governmental organizations connected with environmental matters, adds an important contribution in this respect. (Viola, 1992.)

Appendices - Tables and Maps

Table 2.1

Semi-arid Region of the FNE, according to the delimitation of the Sudene. Number of counties, area, total population, urban and rural in 2000 (Inhabitants)

State	Number of Counties	Area (km ²)	Total Population	Urban Population	Rural Population
Piauí	108	126.544,40	855.078	379.238	475.840
Ceará	132	119.956,70	3.735.542	2.173.353	1.562.189
Rio Grande do Norte	129	48.443,00	1.491.633	997.577	494.056
Paraíba	170	48.611,60	1.964.257	1.231.782	732.475
Pernambuco	131	85.979,80	3.182.862	1.867.518	1.315.344
Alagoas	49	11.941,70	789.265	416.717	372.548
Sergipe	30	11.038,50	390.596	207.946	182.650
Bahia	252	387.526,30	6.320.019	3.327.533	2.992.486
Minas Gerais	41	55.212,40	596.755	320.706	276.049
Total	1.042	895.254,40	19.326.007	10.922.370	8.403.637

Sources of the basic data: i) Lins & Burgos, 1989; ii) Ministério da Integração Nacional. Sudene (1999)- *Região Nordeste do Brasil em números*. Recife, Sudene, 1999; e iii) IBGE. *Censo Demográfico de 2000; characteristics of population and households- results of the universe*.

Table 2.2

Total population, urban population and rural population of the northeast and of the semi-arid region of the fne, in the years 1991 and 2000

Year	Urban Population/ Total Population	Population (Inhabitants)		
		Total	Urban	Rural
NORTHEAST, 1991	60,52	43.751.261	26.477.750	17.273.511
NORTHEAST, 2000	69,04	47.679.381	32.919.667	14.759.714
Growth rate of the Population of the Northeast: 1991-2000 (%)		0,96	2,45	-1,73
SEMIARID REGION OF THE FNE, 1991	48,56	17.847.287	8.666.912	9.180.375
SEMIARID REGION OF THE FNE, 2000	56,52	19.326.007	10.922.370	8.403.637
Growth rate of the Population of the Semi-arid Northeast: 1991-2000 (%)		0,89	2,60	-0,98

Sources of the basic data: IBGE. Censo Demográfico de 1991 e Censo Demográfico de 2000.

Map 2.1
Semi-Arid Region of the Northeast
Limits of the Droughts Polygon and Semi-Arid Region of FNE

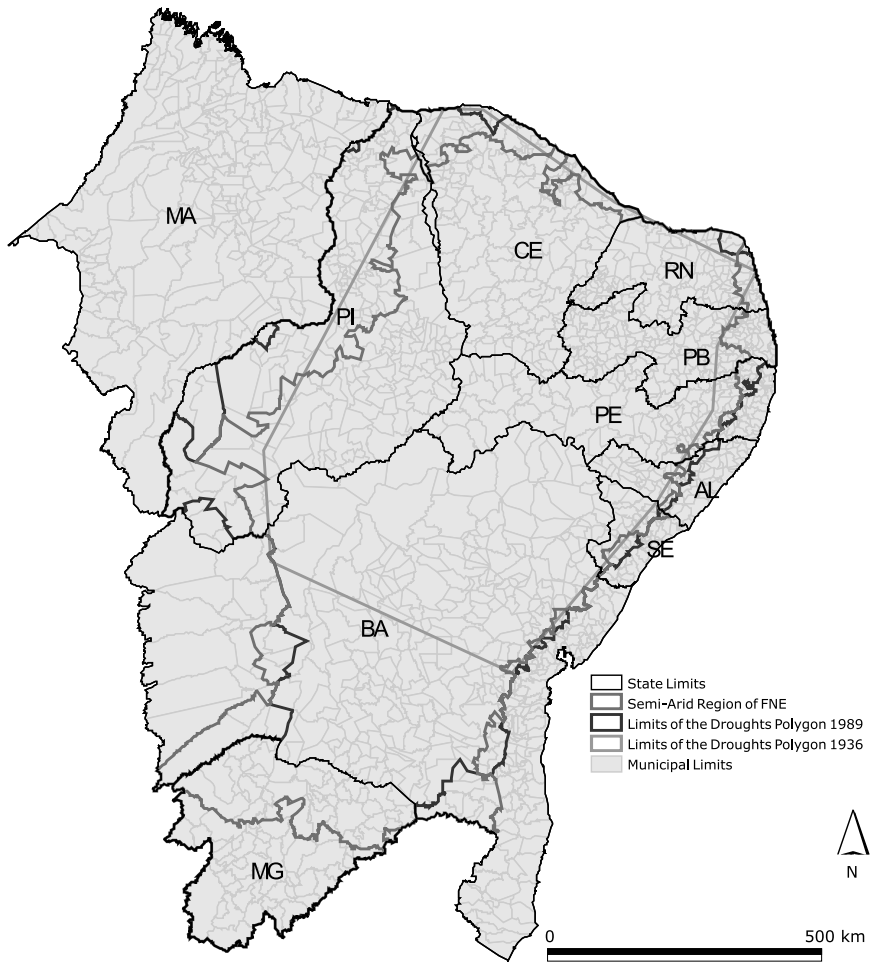


Table 6.1

PIB (Gross Internal Product) of the Northeast and some of its sub-regions in 1970, 1980, 1990 and 1998 (in US\$ 1,00 and their percentual values)

Geographic Area	PIB in 1970		PIB in 1980		PIB in 1990		PIB in 1998	
	em US\$ 1.00	(%)	em US\$ 1.00	(%)	em US\$ 1.00	(%)	em US\$ 1.00	(%)
SEMIARID REGION OF THE FNE	7,252,588,547	28.4	16,621,373,469	25.6	16,115,473,162	19.8	23,574,106,841	21.6
Annual Growth Rate of the PIB (%)			1970-80	8.65	1980-90	-0.31	1990-98	4.87
REMAINDER OF THE AREA OF SUDENE	18,271,854,759	71.6	48,334,852,719	74.4	65,112,905,058	80.2	85,771,174,658	78.4
Annual Growth Rate of the PIB (%)			1970-80	10.22	1980-90	3.02	1980-90	3.50
TOTAL OF THE NORTHEAST OF THE SUDENE	25,524,443,306	100.0	64,956,226,188	100.0	81,228,378,220	100.0	109,345,281,499	100.0
Annual Growth Rate of the PIB (%)			1970-80	9.79	1980-90	2.26	1980-90	3.79
PIB PER CAPITA (US\$ 1.00)								
Semiarid Region of the FNE	654.59		1,275.18		902.96		1,219.81	
Remainder of the area of Sudene	1,013.11		2,107.04		2,513.63		3,025.08	
Northeast of Sudene	876.68		1,805.63		1,856.60		2,293.35	

Source of the basic data: i) IBGE and the World Bank. The basic data of the PIB was organized by VERGOLINO, J. R. (2001)- **Estimates of the PIB of municipalities of the Northeast**. Fortaleza, Banco do Nordeste, 2001. Xerox; e ii) Table 4.2 (for the data on population). APUD: CARVALHO, Otamar de & EGLER, Cláudio A.G. (2002)- **Alternatives for development of the Semiarid Northeast**. Fortaleza, Banco do Nordeste, 2002, p. 37. Xerox. (Preliminary Version.)

Note: the PIB **per capita** for 1990 and 2000 was calculated, taking in consideration the population, respectively, of 1991 and of 2000.

Table 7.1
Demographic Indicators of the Northeast and of Its Semiarid Region

Specification	1970	1980	1991	2000	Annual growth rate of population in the period 1970-80 (%)	Annual growth rate of population in the period 1980-91 (%)	Annual growth rate of population in the period 1991-2000 (%)
URBAN POPULATION (Inhabitants)							
Semiarid Region	3,224,712	4,966,682	8,666,912	10,922,370	4.41	4.01	2.60
Northeast	12,034,559	18,072,026	26,477,750	32,919,667	4.15	3.53	2.45
RSA/Northeast	0.27	0.27	0.33	0.33			
Brazil	52,084,984	80,436,409	110,990,990	137,953,959	4.44	2.97	2.45
RURAL POPULATION (Inhabitants)							
Semiarid Region	7,854,861	8,067,805	9,180,375	8,403,637	0.27	-0.26	-0.98
Northeast	17,080,443	17,902,156	17,273,511	14,759,714	0.47	-0.32	-1.73
RSA/Northeast	0.46	0.45	0.53	0.57			
Brazil	41,054,053	35,566,297	35,834,485	31,845,211	-1.42	0.07	-1.30
TOTAL POPULATION (Inhabitants)							
Semiarid Region	11,079,573	13,034,487	17,847,287	19,326,007	1.64	2.90	0.89
"Remainder of the Area of Sudene"	18,035,429	22,939,695	25,903,974	28,535,374			
Northeast	29,115,002	35,974,182	43,751,261	47,679,381	2.14	1.80	0.96
RSA/Northeast	0.38	0.36	0.41	0.41			
Brazil	93,139,037	119,002,706	146,825,475	169,799,170	2.48	1.93	1.63
DEMOGRAPHIC DENSITY (Inhabitants/km²)							
Semiarid Region (área=895.254,40 km ²) (*)	12.38	14.56	19.94	21.59			
Northeast (area=1.662.947 km ²) (**)	17.51	21.63	26.31	28.67			
Brazil (8.547.403,5 km ²)	10.90	13.92	17.18	19.87			
URBANIZATION INDEX (% of the Total)							
Região Semiarid Region	29.11	38.10	49.39	56.52			
Northeast	41.33	50.24	60.52	69.04			
Brazil	55.92	67.53	75.59	81.25			

(*) The surface of the Semiarid Region of the FNE corresponds to the area of the 1.042 counties which integrated it, in 2000, equivalent to 895.254,40 km².

SOURCE OF BASIC DATA: IBGE, Censos Demográficos de 1970, 1980, 1991 e 2000 e Anuário Estatístico de 1999, and table 6.1. APUD: Carvalho & Egler (2002)-
Alternativas de desenvolvimento para o Nordeste semi-árido. Op. cit., p. 48.

Table 7.2

Distribution of the Research Centers and of the Researchers of the Embrapa per Region

Centers and Researchers	Regions					Total
	North	Northeast	South-East	South	Center-West	
Number of Research Centers	6	7	9	7	11	40
Nº of Researchers in the Centers	271	372	369	377	506	1,895
Researchers provided to State Research Enterprises of the Northeast	-	54	-	-	-	54
Researchers provided to Other Units, considered in the Headquarters	-	-	-	-	71	71
Researchers ascribed to the Headquarters	-	-	-	-	84	84
TOTAL OF RESEARCHERS	271	426	369	377	661	2,104
Distribution of the Researchers per Region (%)	12.9	20.3	17.5	17.9	31.4	100.0

Source: EMBRAPA. Department of Personnel. (Situation in December, 2001). APUD: Carvalho & Egler (2002)- **Alternativas de desenvolvimento para o Nordeste semi-árido**. Op. cit., p. 90.

Table 8.1

Desertificated areas and of high risk

Areas	Surface (km ²)	Population (Inhabitants)	Cause of desertification and/or of degradation
1. Gilbués-Piauí	6,131	10,000	The region was devastated by mining companies
2. Irauçuba-Ceará	4,000	34,250	The disordered occupation ruined the soils
3. Seridó-R.G. do Norte	2,341	244,000	The caatinga was destroyed for the extraction of clay and firewood
4. Cabrobó-Pernambuco	5,960	24,000	The fragile soil did not support the livestock and the agriculture (farming).
Total	18,431	312,250	

Source of the basic data: Ministry of Environment. APUD: GUSMÃO, Marcos (1999)- "O Sertão Virou Pó". Journal **VEJA**, São Paulo, Edition 1.613, Ano 32, nº 35, 1º.09.99.