ENVIRONMENT AND POPULATION IN THE SEMIARID NORTHEAST

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1. INTRODUCTION

A **climatic characteristic** (the semiaridity and the droughts), and **not the semiarid region** (the space of occurrence of droughts in the Northeast, characterized by a multiplicity of problems for those residing there) set the tone for all the discussions realized about this Region, until the middle of the Twentieth Century. Technical contributions, essays, novels, and government policies have treated the drought as a theme responsible, as a last resort, for the underdevelopment of the Northeast. Since exceptions correspond to writings like those of Djacir Menezes, with his **O Outro Nordeste** (The Other Northeast) (1937), published at the same year in which became known **Nordeste,** one of Gilberto Freyre's classics**,** after **Casa-Grande & Senzala** (1933); and to the classic **Solo e Água no Polígono das Secas** (1949), by Guimarães Duque, up to now 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), [2] to briefly put it in one expression: "Nordeste Semi-árido" (Semiarid Northeast).

The **Semiarid Northeast–SAN** reveals important particularities. Some refer to the physical limitations, other to the obstacles imposed by the social relations of production. Those of the first type are related to 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 relations of production and the technical basis of production. In the SAN one is dealing with a territory with a high shortage of natural resources, especially soil and water, a high poverty degree, and an extraordinary populational densification.

In relation to the soil resources can be stressed here the different processes of economical structuration and the human occupation, which left accentuated traces on those existing in the semiarid spaces in the Northeast. The environmentally degraded areas, existing there, consisted of highly fertile soils, like those used for the cotton culture, for subsistence or commercial farming, such as mamona; and for farming types of a higher economical value. According to studies made by the Brazilian Agricultural Research Corporation (Embrapa), the environmentally most degraded areas of the SAN cover a surface larger than 20 millions hectares. This comprises 65,9% of the dryest 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.)

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[2] FNE = Financing and Constitutional Fund of Northeast (*Fundo Constitucional de Financiamento do Nordeste*).

The restriction of hydric resources have impaired the **water production** for human consumption, with strong repercussions on the development of the agriculture (irrigated and rainfed) and animal husbandry, and, in the last 15 to 20 years, on the human supply. Besides, there should be emphasized that the degradation of local hydric resources occurred because of the destruction of the forest cap, resulting from the deforestation and burning (specially of the ciliar forests), of the accumulation and uncontrolled use of water (inadequate management), and of the dumping of polluting agents in the springs. The hydric resources are being used out of context, since there still does not exist an adequate **policy for waterproduction, storing, management and conservation of these resources –** neither for the surface level nor subterranean.

The Northeast counted, in 1996, on a populational contingent in 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** are included the people who cannot satisfy the needs of alimentation, clothing, housing, education and personal expenses. And in that of **indigents** 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 (that is about 7,5 million individuals in 1996). In the cities, this incidence is in 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 already has been higher. In 1970, it reached the rate of 60% of the population of the semiarid. (Albuquerque, 2000: 64)

The areas affected by the droughts in the Northeast are characterized by a high demographic density (with 21,59 inh/km² in 2000, *vis-à-vis* the 28,67 inh/km² of the Northeast and the 19,87 inh/km² of Brazil). Therefore, they are considered integrants of one of the most densely populated semiarid territories in the world. (Ab'Saber, 1999.) The demographic density in the SAN was 11 inh/km² during the mid-1950s. (Duque, 1963.) Almost fifty years later, in 2000, this indicator practically has doubled, reaching the level of 21,59 inh/km², which puts in evidence the growing populational increase in the areas submitted to the droughts in the Northeast. With such a density there arises also more pressure on the weak basis of natural resources, and more problems for the urban areas in the interior. The SAN constitutes, besides that, the geo-economic region with the largest physico-territorial reach of the Northeast (about 53% of the total surface of the "Area de Atuação da Sudene), *vis-à-vis* the other natural spaces (Litoral-Mata, Agreste, Meio Norte and Cerrados), which make up and structure the Northeast Region.

By law of 1989, the SAN (or Semiarid Region of de FNE) has a territorial surface of 895.254,40 km². It enfolds 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 continued to include, 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-foodfarming complex (complexo gado-algodão-lavouras alimentares), at least until the beginning of the 1980's, when the disarticulation of the cotton economy started. The drought of 1979-1983 had a determinant role in this respect, reinforced by the introduction, in 1983, of the **bicudo** plague and the import of cotton from countries which sustained their cotton production at the cost of production subsidies (the cases of 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. Like what is happening with the development of light industries, which are being interiorized; with the activities focused on the irrigation agriculture; and with the urban activities brought about by the development of small urban businesses. Taking also into account the traditional commerce, reinforced by some segments of the modern services. The transference of federal resources to states and counties (through participation funds) and the social welfare act as important factors in the upholding of the economies of the major part of the counties of the semiarid hinterland. In any case, the development pattern observed in the region continues presenting traces of insustainability, 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 the varied assortment of public policies. Mid 1950, Celso Furtado said that, besides being a climatic phenomenon, the drought embodied 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 Superintendence for Development of the Northeast-Sudene, the drought was considered more seriously as a production crisis than the typical crises of the capitalistic economy, since it occurred from the colapse of the effective demand, spreading its load upon 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, commanded 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 unity of production. Afterwards, it would be necessary to define the real limits of the 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, emphasizing the differences of the semiarid spaces, *vis-à-vis* those of the Northeast.

Because of the discontinuity to which the public policies that were carried out in the region were submitted, the existing conditions in the SAN keep challenging the social institutions and actors involved in the struggle for the development and improvement of the life conditions for those living there. We consider that the problems of this region can be resolved both at medium and longterm, if treated along the positive perspective of the development, either economic or sustainable. Its solution lies in the confrontation and determining challenges like: the demographic, environmental (especially for the lack of hydric resources), economic and institutional. The development of the SAN, i.e. coexistence with the

semiaridity, will tend to be 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 in the National, Global, and Regional Context; Adopted Conceptions of Development; Climate and Natural Resources; Demographic Schedule 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 rain maximums, corresponding to the passage of two equinoxes (that of March and that of September). [3] The utilization of the rainwater is a second particularity of the Northeast Semiarid. In fact, 92% of all the rainwater falling in this territory is "consumed" by insolation, 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 tempered semiarid zones, such as in the semiarids of the United States and of Israel, where the "loss" of rainwater (insolation, 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 floristic coverage considered as "penultimate bio-physical formation, before the appearance of the desert." (Botelho, 2000: 19-22.) The Semiarid Region of the Northeast distinguishes itself, furthermore, as one of the most populated semiarid areas in the world. (Ab'Saber, 1999.)

The spaces submitted to the semiaridity in the Northeast present varied dimensions, both from the climatic and political point of view, since there are areas where the climate causes the droughts to happen with a higher intensity than in other areas. Stemming from this the nature of the expansion and contraction process of the Semiarid Region, a fact which also is responsible for its attributed fame. It is already possible, therefore, to underscore 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 situated within the limits of 400 to 700 or 800 mm of rain annually.

The Brazilian semiarid is integrally inserted in the Northeastern Region. As treated here, the Northeastern Region corresponds to the area of operation of the Superintendence

[3] There are four climatic seasons: one of them corresponds to the 1º solstice (21st of June), another to the 1º equinox (the 23st of September), a third to the 2º solstice (21st of March). During the 2º 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.)

of the Development of the Northeast-Sudene. This area comprises the 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, [4] while the Semiarid Northeast consists of a surface of 895.254,40 km² (53,8% of that total). (Carvalho, 1988.)

The **Semiarid Northeast** corresponds to the territory of droughts 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 established, and became known as the **Droughts Polygon**. Afterwards, in 1989, with the establishment of the **Financing and Constitutional Fund of Northeast-FNE,** the **Semiarid Region of the FNE** was delimited as the new official area of occurrences of droughts in the Northeast.

The **Droughts Polygon**, created by Law nº 175, of the 7th of January 1936, regulated the provision in the Art. 177 of the Brazilian Constitution of 1934. The referred law established that the **systematic plan for the defense against the effects of the droughts in the States of the North** (or Northeast, today) should comprise works and services of normal and permanent execution, such as emergency works and services of assistance for the population, and during the climatic crises requiring immediate aid to the people. The area of the first **Droughts 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 Droughts Polygon became part of the responsibilities of the Sudene, since 1959. From 1936 to 1989, the area of the Polygon was extended many times, until it reached the surface of 1.083.790,7 km², of which 121.490,9 km² belonged to the so called Minas Area of the Droughts Polygon. While it was taken as **official area of occurrences of droughts –** condition which prevailed until 1989 – the Polygon counted on a surface corresponding to 64,4% of the **Area of Operation of Sudene** (1.682.668,70 km²). The surface of the **Droughts Polygon** changed from 43,2% of the Northeastern area (IBGE), in 1936, to 64,4%, in 1989, related to the Area of Sudene.

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

The areas most submitted 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 surface of the **Semiarid Zone** took up 882.081 km², corresponding to 53,1% of the Area of Jurisdiction of Sudene. The name **Semiarid**

[4] 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, forced by Law nº 9.690, of July 15, 1998. These additional areas (97.714,30 km²) do not include counties characterized as 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 outline already appeared in 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**, with 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 nº 7.827, of 27.09.89, which instituted the Financing and Constitutional Fund of North Region-FNO, the Northeast Fund-FNE and the Central-West Fund-FCO. The interruption IV of art. 5º of the mentioned law defines as semiarid the region inserted in 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 Order." 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 figure of the Droughts Polygon, 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, comprehending variable portions of the States situated in the **Jurisdiction Area of the Sudene.** In this area different institutions are operating, 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 **Droughts Polygon**; and that of the Codevasf to that of the São Francisco River Basin. [5]

From 1989, the Sudene stopped utilizing the figure of the **Droughts 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 Droughts Polygon, and as a way of not using names which could possibly represent the 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 FN**E, a figure elevated 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**. The map 2.1 in the appendix shows a group of limits of the Droughts Polygon (beginning and end) and of the Semiarid Region of the FNE. This region was composed in 2000 of 1.042 counties, comprehending a total surface of 895.254,40 km ^{2}. (Table 2.1, in appendix). Its population at that date, was 19.326.007 inhabitants, of which 56,52% were living in urban areas and 43,48% in rural areas. The table 2.2 in appendix provides information about the demographic dynamics in the Northeast and in the Semiarid Region of the FNE, for 1991 and 2000.

[5] The hydrographic Basin of the River São Francisco has a surface of 640.000 km^2, 57% of which are inserted in the area of the Droughts Polygon of the Northeast.

As the Droughts 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 cristaline basement of its geology and the semiaridity of its climate, with sparse, temporal and spacy raining), 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 economical groups of the same Northeast, specially of the less compromised with the capitalist advancement of the regional society.

3. SPECIFICITIES OF THE SEMIARID IN NATIONAL, GLOBAL, AND REGIONAL CONTEXT

The emersed lands in the world total 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 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 major 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 the development in the arid and semiarid lands, *vis-à-vis* the lands not submitted 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 the arid and semiarid climate, and for Chile this has the expressive number of 64%. Although there are droughts which affect the farming and cattle-raising production in Argentina or in 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 scarcety 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 Pampa, that 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. 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. A large part of the population that migrates from there in the periods of droughts returns to their lands, even though the net result does not represent the maintenance of the initial populational contingents.

Other aspects should be considered in the contextualization of the semiarid 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 of being the main cause of the afflictions of the region of Sertão. And, second, again 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 to the droughts, being it 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-economical, and political conditionants, which confers on this conservative domain an odd role as to the maintenance of the misery of a ponderable 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 the Brazilian society related to its past. It is a transformed mode of the agrarian question, understood as expression of the social mode 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 conditionants to obtain the minimally necessary for his 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 the economical growth with a minimum of environmental quality and social equity. (Egler, 1993.)

4. CLIMATE AND NATURAL RESOURCES

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

4.1 CLIMATE

The Brazilian Northeast is an anomalous region in the tropical continents, because, in contrast with other regions of its latitudinal strip, 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 strips) 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 the 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 raining regime 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 is related to the portion **North of the Brazilian Northeast, t**hrough the action of the ITCZ. The droughts happen there when this Front attains its extreme latitudes more in 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 14º N, in August-September, to its extreme South position, about 2º 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 already in April. Thus, under these circumstances, the Brazilian Northeast stays South of the region of heavy rainfall and in the region of predominantly descending movement, which inhibits the pluviometric precipitations. (Nobre, 1994.)

4.2 SOILS

"The soils of the northeastern semiarid are wavy, levelled, 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 the Summer, and the plains, not always with a soft topography. Compared with the other semiarid areas in the world, the soils of the semiarid Northeast present characteristics that give them an acclaimed 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 (CNPS) [6] identified 172 geo-environmental unities 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, relieve, 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, [7] or as, 4.157,37 km²). These are arable lands without restrictions for being used;

- **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 potentialities for irrigation;

- **Type 5 Lands** (8,2% of the total area, or as, 136.361,65 km²). Not arable under natural conditions. They present serious deficiencies, requiring protection works against floods, irregular topography or elevated positions; and

- **Type 6 Lands** (46,92% of the region, i.e.: 780.254,73 km²). Not arable lands and of difficult use under natural conditions. (Silva; Toneeau; Sousa Neto; Silva;& Araújo Filho, 1993; and Matallo Jr., Coord., 1994.)

Land like water for irrigation are scarce in the semiarid northeastern. Its availability correspond to 4,7% of total surface 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 diminish 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.)

[6] National Center for Soil Research-CNPS.

[7] 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 km^2. (There is a round off error, in relation to the basic data, of 0,69%, corresponding to 11.474,33 km^2, which, when added to the other values completes the total of the territorial surface of the Area of the Sudene Northeast.)

4.3 HYDRIC RESOURCES

Water is the relatively most scarce resource in the Northeast; in a second place comes the soil resources. Therefore, these two natural resources have played such restrictive roles as to the development of its semiarid areas. The process of urban growth, as will be seen hereafter, makes it even more difficult to look after 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 hydric 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 hydric resources in the Northeast, departing from the following indicators: the potentiality of hydric resources, the availability of hydric resources, the capacity of water storage and the demand for water, according to different usages. With the **potentiality of hydric resources** of one hydrographic basin is understood the average of natural discharge of water, or, the sum of the water discharges at surface and at base level. The **availability of hydric resources** represents a portion of the potentiality, 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 **guaranty level of water storage** in one dam is defined departing from its effective availability, being the one on which can be actually counted for different kinds of consumption. The most frequently used guaranty level in the planning of hydric resources is that of 90%. (Vieira, 1994: 27; and Gondim Filho, 1994.)

The imbalance between supply and demand of hydric resources in the Northeast can be demonstrated by comparing the **availability of water** in its Hydrographic Basins with the **storing capacity** (or that of wells and that of underground waters) of all the reservoirs and wells constructed in them. According to the studies carried out in 1991 by the Áridas Project, the Northeast counted with 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 hydric resources at that moment. The volume of the supply can be increased by the utilization of other local hydric resources, mobilizing part of the **potentiality** of the existing hydric resources, or increasing the availability, by resorting, for example, to transposition structures for water from the hydrographic basins originating from outside the Northeast, such as the Basins of the Tocantins River and the São Francisco River.

The **total demand for hydric resources in the Northeast,** considered as a potential, maximal, theorical demand for all kinds of usage, corresponded in 1991 to 21,8 billion cubic meters a year. (Gondim Filho, 1994: 78.) This aggregate comprehends the following types of demand: urban and rural population; animal demand; demand for irrigation; agro-industrial; demand for agro-industrial industries; and ecological demand. [8]

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

The distribution of the wells and dams in the Northeast is extremely concentrated, in terms of the conditions that propitiate its construction – i.e. space for the installation of the massive pieces for the dams and the hydric availability that needs to be accumulated. The hydric infrastructures in the Northeast, that really count, are integrated by little more than 300 reservoirs (*açudes*) and 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. Amongst the more than 300 dams and weirs, there are 10 (about 3% of that total) with a storing capacity superior than 500 million cubic meters, that can gather about 73% (62 billion cubic meters of water) of the total storing capacity of the Northeast. [9]

Even though the supply is higher than the demand, this does not mean that all the spaces in the Northeast have at their disposal the water they need. This because the spatial distribution of the supply is not necessarily compatible with the localization of the different types of demands. In fact, the spatial distribution of the demand reflects the dynamic of the 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 hydric 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 inadequateness of the water distribution in various sub-basins of the northeastern semiarid. 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 caring for the water demands are related to the supply of so-called **diffuse rural demand** (water for domestic and animal consumption, at the level of the *fazendas*) and of the **municipal urban demand** (water for domestic consumption and for the urban services of the capitals and towns of the interior).

The large number of "carros-pipa" (tank-cars with water) that roll every year, in situations of drought or of normal rains, in the interior and in the towns of the semiarid or the Littoral of the Northeast, reflects the degree of inadequateness between supply and demand of water in the Region, both in temporal and in spatial terms. It comprises, therefore, a precious 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 weirs 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 economical and political groups of the Northeast, that are against the measure. In front of these groups are important families, among which stands out the Coelho family, from Petrolina, in

[9] Among the ten dams and barrages, stand out: Sobradinho (that could 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).

Pernambuco, and politicians of Bahia, considered anti-privatists by some press organs. Thanks to these conflicts between different blocks of capital, a favorable "living together," can be observed, of a temporal character though, between representants of workers and of capitalists, which is of great economical and social interest for the Northeast.

4.4 NON-RENEWABLE NATURAL RESOURCES

In this category are included the mineral resources and the energy resources. The Northeast in general and the semiarid in particular have an expressive endowment of these resources. Among the mineral resources found in the semiarid, the following stand out: apatite, barite, bentonite, berilium, limestone, calcite, cianite, copper, lead, chromium, iron, fluorite, magnesite, manganese, gold, silver, titanium (ilmenite), titanium/vanadium, titanium/zirconium, uranium, vanadium, zirconium, zinc, and nickel. The major part of these minerals is located in the semiarid of Bahia.

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

4.5 BIODIVERSITY [10]

The environmental degradation in the semiarid 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 Worldwatch Institute, from Washington, Lester Brown, said that the Professor E. O. Wilson, of the Harvard University, in his book **Biodiversity** (Wilson, editor; Peter, subeditor; 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, much 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, admitting 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 their needs for food, clothing, medicaments, 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, many native plants used to produce oil, wax, rubber, resin, energy, forage, wood, tannin, pharmaceutics, fibers and fruits were utilized in the structuring of the regional economy. Many species played an important role in regulating the exportation, *e. g.* of wax from carnaúba, 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 economical

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

products of many states of the Region. Some of them have still a considerable importance on the local export situation.

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

There are native species of the semiarid that play an important role in the alimentation of the inhabitants of the Sertão and, in the alimentation for animals as well. The use of these species is still taking place in an extensive and predatory way. During the more intensive droughts there is no formation of pastures. In these periods, the herds survive on fruits and beans of the foraging species of the most resistent shrubs and trees, like the juazeiro, the catingueira, and the jurema. Some cactaceae, like the mandacaru, the facheiro and the xique-xique are provided to the cattle after the thorns have been burnt 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 the markets, conducing to an over-exploitation of the environment and to the virtual exhaustion of the 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 soils more compact, due to the 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., in higher limits than the supporting capacity of the ecosystem, which is very low. There are needed 10 to 25 hectares of native pasture to feed one adult cow (or animal unit) in the rainy years, being the case that the animal productivity is very low, situated between 5 and 10 kg of living weight per hectare.

The system of traditional exploitation of cattle is considered a factor of environmental modification, because of the changes which induce the floristic 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 on the loss of the biodiversity. The frustration of the harvests and the rapid exhaustion of the soils promote the 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 biodiversity. 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 and with nocturnal habits, with a low population density and a low endemism. In spite of more detailed

knowledge about the 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 amphibious, 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, taking the 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, specially in the periods of prolonged droughts, when the agricultural harvests are frustrated. In addition, it has an economical 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 fast, like the herbaceous plants, and the grassy plants of the pastures and fields. The Sertão transforms itself rapidly in 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 the 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 scarcety 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 conduced by the PNUD/FAO/IBAMA. [11] The other states count on partial surveys, generally outdated, about the vegetal cover and its typologies. The availability of information about the socio-economical 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 level of anthropization, like the different uses for the vegetation in terms of its different typologies. The found situation causes apprehension, specially in the States of Ceará, Paraíba, Alagoas and Sergipe. In those, many native species (and this also counts 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

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

Grande do Norte, and in the interior of Maranhão), small siderurgies 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 energetic 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 e brejos.*

The concept of environmental modification should be better qualified, as the result of the modifications resulting from the anthropic action. These modifications can allude to the impossibility or reduction of the natural response capacity of the milieu. 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 evolutional 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 licencing and evaluation (according to the same CONAMA). Such impacts could potentially commit the sustainability of the development of the semiarid, that would be, in the present and in the future, out of 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 the Semiaridity.

5.1 THE HYDRAULIC STAGE

The stage of the **hydraulic solution,** put into practice in the Northeast, after the strong 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, has been restricted to the level of ideas and potentialities. The first work of impounding 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 was created the institution that carried out the first and most important studies about the Northeast: the Board of Works Against the Droughts-IOCS, in 1909, which was transformed ten years later into Federal Board of Works Against the Droughts-IFOCS that became more autonomous in January 1945, with the name of National Department of Works Against the 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 with irrigation put into practice in the semiarid.

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 concerned started in the 1930s, 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 dams in cooperation [12] in the Semiarid Northeast, representing with these numbers 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 implanted about 9.450 irrigated hectares in the semiarid Northeast. [13] That result was about eight to ten times lower than the one obtained in the second half of the XX Century, which could be understood as resulting from the low emphasis put on irrigation, combined with the reduced

[12] 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-prize equivalent to 50% of the costs of the dams.
[13] This informations were obtained in the site of DNOCS: www.dnocs.gov.br

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 (Grupo de Trabalho para o Desenvolvimento do Nordeste) [14] 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 economical restructuration, increasing the productivity of the farming and cattle-raising activities practised 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, it would be possible to reduce the population pressure on the scarce available natural resources (specially those of soil and water), two of the central problems of this semiarid with its extremely particular characteristics.

Facing the specificities of the northeastern semi-arid, the studies and conceptions of the GTDN recommended the convenience of reducing the food production activity, promoting the demographical 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; 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 the food production could only be viable, with certainty, through irrigation, implying enormous expenses and difficulties in the semi-arid; 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, there in the new settlement areas. (Cano, 2000: 108.)

The conception of the GTDN allows rescuing the meaning which the analysts of the economical 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 virtuoso circle of the 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 go obligatory through transformations that could enable it to provide the modern sector of the economy – in this case, the urban industry and services – with a large quantity of aliments, 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

[14] Working Group for the Development of the Northeast.

income. (Lewis, 1963: 134-160.) In other words, "sustainability" was a synonym for "industrial revolution."

5.3 LIVING WITH THE SEMIARIDITY

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

This way of "living-with" exists 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) specially women. [15] Those who earn their life from farming or in the function of it; they use scarce resources, as to water and soil; they use not always adequate 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 markets; and they accumulate a meagre 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 up 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 to reduce even more the wanting excedents produced by them. Cooperation is a very uncommon practice in the environment created by the *fazendeiros,* farmers and laborers in the semiarid, irrespective of the fact of them having major or minor possessions.

The effective living with the semiaridity continues to constitute a task involving the new generations. Instruction and education for all is required, by formal methods (for the

[15] In the role of the families that integrate the economically most fragile segment of the economy of the semiarid, the role of the women should be underscored, for their 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 for working alternatives and an income outside the *fazendas* of the semiarid. The women assume this labor in conditions of extreme insecurity, since the husbands who migrate not always return to their homes; or they stay away from their residences for prolonged periods, the duration of which they could never know beforehand. In these periods, the women live as if they were "widows of living husbands." This situation 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 the assistance in the proper region of the affected families.

youngest ones) and less orthodox processes (for the more 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 much social commitment of the governing elites 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 utopy could become reality. A utopy 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 "The 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, deserve to be underscored the initiatives predestined to the production of specific technologies for the "living-with" the droughts, like the available returnings by the **Embrapa Semi-Árido**. [16] 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 resistent to the drought; extend the breeding of cattle (of bovines, caprine goats, sheep, and poultry) with species adapted to the semiarid; producing alternative sources of energy; permitting the storing of the production in 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, conduced 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 still 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.

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

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, as the preparation for the work of the ECO-92. The referred 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, the new strategies should be adjusted by the use of the concepts and presuppositions of the sustainable development, applicable to longterm 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 comprehending 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. The referred 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 alimentary cattle-cotton-farming complex and on those of mining (leaded by the exploitation of scheelita), the economy of the Seridó of the Rio Grande-do-Norte expanded considerably in the decades of 1930/1940. Departing 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 invigorated, since 1983, by the introduction and generalization of the **bicudo** 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 **bicudo**), reinforced by the referred policy of economical openness, contributed to make the cotton and scheelita unfeasible, which then, consequently, became import goods. So, the Seridó from Rio Grande do Norte saw destroyed, all at once, the pillars of its regional economy. (Araújo, 2000-a).

The crisis was a long one. It took the whole decade of 1980, prolonging itself to the mid of the next decade. But it was confronted with determination by the society of the Seridó. And it was well conduced 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 basis. 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 incentivated, stimulating thus the "festivities of the padroeiras." The **Feast of Santana**, the patron saint of Caicó, the most important feast of 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 teaching with a long tradition and of respectable quality. The region has also two Regional Centers of Higher Education, of the Federal University of the Rio Grande do Norte, one in Caicó and another in Currais Novos. There exists a long tradition of working 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 1940s, with the institution of the Service of Rural Assistance-SAR, oriented by D. Eugênio Sales, many years later promoted to the function of Arch-Bishop of Rio de Janeiro. The SAR fulfilled an important role in the formation of community and political leaderships in the entire state. The importance of the Church of the Rio Grande do Norte was also positive in relation with the efforts which conduced 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 got mobilized to elaborate a **Plan for Sustainable Development for its Region.** There, in an area of approximately 13.000 km², endowed with a fragile basis of natural resources and an extremely irregular rainfall, were living, in the period when the Plan was formulated (September 1999 till June 2000), about 290.000 individuals, spread over 28 counties. The works of the Plan were backed by the state government and by the county governments and the leaderships of all the representative instances of the Seridó. Formulated in the line of participative development, The **Seridó Plan** counted on the collaboration of more than 1.200 leaderships, 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.

As said by the economist Tânia Bacelar de Araújo, [17] "If nature did not endow the region with abundancy of water and fertile soils, if the national policy ignores the non-dynamic areas, the society that was developed there did not give up to live 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, being solidary among each other, could organize themselves to conquer what they believed to be important, without letting themselves 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. ECONOMICAL ACTIVITIES

The **Semiarid Region of the FNE** constitutes an important political and cultural space, although its economy still presents fragilities to be eliminated, but this has little effect on the northeastern economy. Its Gross Internal Product–GIP equalled, in 1970, to 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 percentual 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 percentual increase of 328,6%. The relative growth of the GIP of the Northeast Region, between the two referred years, was 100,8 percentual points higher than that of the Semiarid Northeast. According to this indicator, the economy of the Northeast would present 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 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, descending 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. [18] One can notice, thus, that the conditions for living in the semiarid, when referred to other regions of the Northeast, deteriorated, in average terms, in the last 30 years. (See table 6.1, in the appendix.)

[17] 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.

[18] In 1998, the relation between a dollar and a real was US$ 1.00/RS$ 1,30. That's 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 reals, those values should be much lower. Thus, the comparisons made in percentual terms make much more sense.

This relation presents a value still more significant, when 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 contributed, in 1970, with 28,4% of the total GIP of the Northeast. This participation descended to 19,8% in 1990, but increased a little in 1998, reaching a value of 21,6%. The referred alteration can indicate a greater relative independence of the economy of the semiarid from the impact of the 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, dynamical activities and non-conventional activities. In the category of the so-called traditional activities, are included the age-old activities, such as characterized by its low efficiency and low productivity. This is the case with the cotton economy and with extensive cattle breeding. That still predominates in some sub-regions of the northeastern semiarid, like some types of agro-industry, related with the processing of cotton and of some oleaginous types. These activities are going through economical restructuration processes, that have shown negative impacts on the employment levels.

It must be said that the population of the towns of the semiarid do not live anymore of 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 of the activities of the so-called "economy without production," [19] constituted by the yields of the retired workers and of the public employees, and also by the transferences of the Union to the city halls and to the state governments. The retirement income of the rural workers is contributing today to maintain a certain economical balance in the semiarid, 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 transferences (Participation Funds of the States and Counties) have made possible the constitution of alternative economical activities, where these resources are administered with low economical efficiency, but still then providing space for the structuration of small non-agricultural businesses, rooted in the creativity of the population, specially of the residents of urban sites. [20]

Presently, the day of major commercial movement in the towns of the semiarid is when the retired 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 are of a dynamical character some acivities of the incentivated 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

[19] To use the expression of Gustavo Maia Gomes (2000: 148).
[20] 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.

are **new** dynamical 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.

The destructuration of the activities of the complex cattle-cotton alimentary farming gave room for the constitution and/or reinforcement of some problems in the semiarid. 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 marihuana (*Cannabis sativa,* Linn) in the spaces gifted with the best soils and water resources. [21]

7. DEMOGRAPHIC PICTURE AND CHANGES OBSERVED IN THE PERIOD 1991-2000

The group of people living in urban sites in the semiarid is already larger than those who live in rural areas. The increase rates of the urban population of the semiarid are larger than those observed in the Northeast as a whole and in Brazil. As already became noteworthy, since the 1970s, this growth was a result of the crisis which affected the main economical 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, specially those of soil and water, unable to take care of 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 populational dislocations from the fields to the towns. Under discussion here are questions related to the following topics: urban, rural and *rurban,* demographic dynamism, the poor of the semiarid and technological capacity.

7.1 URBAN, RURAL AND RURBAN

Urban and rural in the semiarid do not constitute autonomous spatial dimensions. The economical 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, 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,

[21] Gustavo Maia Gomes presents a good description about the logic of these "new" activity, in chapter 7 of his book **Velhas Secas em Novos Sertões.** His intuitive description would have, though, more explicative power if he could have used the power of the theory and of the evidences on the action of the m**ercantile capital** in the Northeast, instead of slipping towards the seemingly well-humored argument on 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.)

already age-old and ecologically and sociologically very diverse because of its various natural and cultural spaces that we should try to transform from antagonical into complementary – agrarian, pastoral, industrial – the urban values and styles and the rural ones. More than balance: interpretation. Convincement. 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 fecundly conjugal situation: 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 DEMOGRAPHICAL 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 thus, 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 find 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 participations, 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 1980s, the demographical dynamics of the Semiarid Northeast underwent profound transformations. Concomitant with the structural changes that occurred in the midst of a serious economical crisis, there was a fecundity reduction, an improvement of 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 demographical dynamics do not resolve, by itself, 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 for demographical growth have been somewhat lower. The growth rate observed in the period 1991-2000 amounted only to 2,6%

for the semiarid 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

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, with 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 (about 7,5 million individuals in 1966);

- In the towns of the semiarid, 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. (Albuquerque, 2000.)

7.4 TECHNOLOGICAL CAPACITY

Next are given some aspect of this question, departing from the contributions made by institutions for encouragement and development and for research. The major part of the scientific and technological production about the Northeast and the semiarid is the fruit of the action of public institutions like DNOCS, the Commission of São FranciscoValley-CVSF (later transformed into Superintendency of the Development of the São FranciscoValley-Suvale e 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, but constituted a remarkable heritage of the effort made by them, specially by the institutions established in the Region since the 1930s, like the José Augusto Trindade Institute, operated by the IFOCS/DNOCS, the older Agricultural Research Institute of Norteast-IPEANE, and the Agronomic Research Institute of Pernambuco-IPA.

In the last 25 years, the supply of available technology in the Northeast had been considerably enlarged, thanks to the structure for research established and operated by the Embrapa, departing from the 40 Research Centers founded in Brazil, after 1974. In these 40 Centers are working 2.104 researchers, [22] of which 67 are graduates (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 the 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 of researchers. The Southeast count on nine Research

[22] Situation in December 2001.

Centers, followed by the Northeast and the South (each with seven centers) and by the North, where are localized six of the 40 Research Centers of the Embrapa. (Carvalho & Egler, 2002: 89-90.)

The 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 Mandioca e Fruticultura,** 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: 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.

In addition to the Embrapa and state companies for agricultural and livestock research, there are other institutions that carry out research programs of interest for the semiarid. This is the case with the Federal Unversities 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, thus, has control of a reasonable technical capacity in the field of science and technology, that can be mobilized to increase technical progress in the region. But the

stock of products and information did not reach the different users, for want of divulgation mechanisms or for lack of information about the demands for technology.

In fact, the information about the demand for technologies are 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 scarcety 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 scarcety 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 demonstrate the initiatives put in practice by the Embrapa, which is formulating its Research Projects departing 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 excedents for the market, like those who lives in the areas most deprived of resources of the semiarid. These producers depend still 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 as referred 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 the 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, specially 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. SURVEYS ON RESOURCES AND POPULATION

The survey of the resources and of the population in the semiarid is presented here, departing from 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 the public policies for the semiarid.

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 out of 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 reducing elements for the biodiversity and the genetic heritage;

- Partial or total loss of soils caused by the action of physical (erosion) and chemical (salination/alkalination) phenomena, in areas where the losses are accompanied by the rise of the frequency of whirlwinds and even tempests of sand;

- Decrease of the volume and quality of the stored hydric resources, with implications for the slipping away of the surface;

- Reduction of the soil fertility in areas of agricultural livestock production and the abandonment of lands in areas of mine 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 accostumed 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 saharian desert, by the incidence of precipitations and the nature of its soils, but with the same implications of uninhabitability," 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 economical, social and natural and/or induced processes, that destroy the balance between 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, besides 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 to identify 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 Nucleus** 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 with 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, were utilized variables and parameters, quantifiable in unities of surface (hectare or square kilometer), in the line of the methodology conceived by Estevam Strauss (1972). Conjugated 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 this 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, like 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, have been selected four area categories:

- 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 Expansible 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 posibility **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 RELATION 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 1950s 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 1980s, 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 1970s on. Its growth originated, to a great extent, from the de-structuration process through which its economy went. The occupational opportunities diminished, principally in relation to the traditional activities. In addition to the 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 1970s and beginning of the 1980s, 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 the 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 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 transferences and by the economical 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. [23] 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 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 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 1960s, 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 economical 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 demographical transition of the semiarid still has not been completed, considering the observed transition in the Northeast and in Brazil. The demographical transition in the semiarid will tend to be complete, in a socially more just

[23] 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.)

way, when the development policies for this region could 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 see 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, kept to the due 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.

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 to promote the 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 the 14th February, 2002 – still did not start really 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 institutionality could not only indicate the direction given to the development, but also its content.

The (re) alignment of public policies for the semiarid should be approached in the context that privileges, in the last instance, the determinants of the economical restructuration 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. 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 potentialities. 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 hand labor.

The **Transformation/Development Strategy** should comprise initiatives that contribute in transforming and strengthening the economy of the semiarid, 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 the income, interiorizing the development process) expansions. This kind of strategy should comprise programs like those of the 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 the industry and agricultural industry.

The (re) alignment of public policies for the semiarid, 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 the 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. 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 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 adequation 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 already can be counted on a private sector capable to make investments and on social organizations structured around the problems and possibilities of that region. [24]

Particularly, the (re) alignment of public policies for the semiarid should have structuring projects, oriented towards the creation of a new front of economical expansion, that propitiates the generation of more income and more employment. It is necessary to make 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 structured today. The new front of economical 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

[24] 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.)

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 State of Ceará, Rio Grande do Norte, Paraíba and Pernambuco. It also renovates that what relates to the possibilities of enlarging the irrigated areas in the Northeast, making the agricultural, industry and the mining-metallurgic industry more dynamic, and strengthen the 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 watermills localized downstream from the Barragem of Sobradinho. The set of two axes and their ramifications will have an extension of approximately 700 km. The first impounding of water, that will attend the Northern Axis, will be implanted 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 of Piauí, already is being studied. (MI. ACS, 2001.)

The studies that are necessary for the feasibility of the enterprise are adequate from the technical, environmental and economical point of view. The "political engineering" remains to be resolved, negotiating better the Project with the States of Minas Gerais, Bahia, Sergipe, and Alagoas. It is also necessary to discuss better 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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APPENDICES-TABLES AND MAPS

TABLE 2.1
SEMIARID 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;** características da população e dos domicílios - resultados do universo.

TABLE 2.2
TOTAL POPULATION, URBAN POPULATION AND RURAL POPULATION OF THE NORTHEAST AND OF THE SEMIARID 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 Semiarid 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

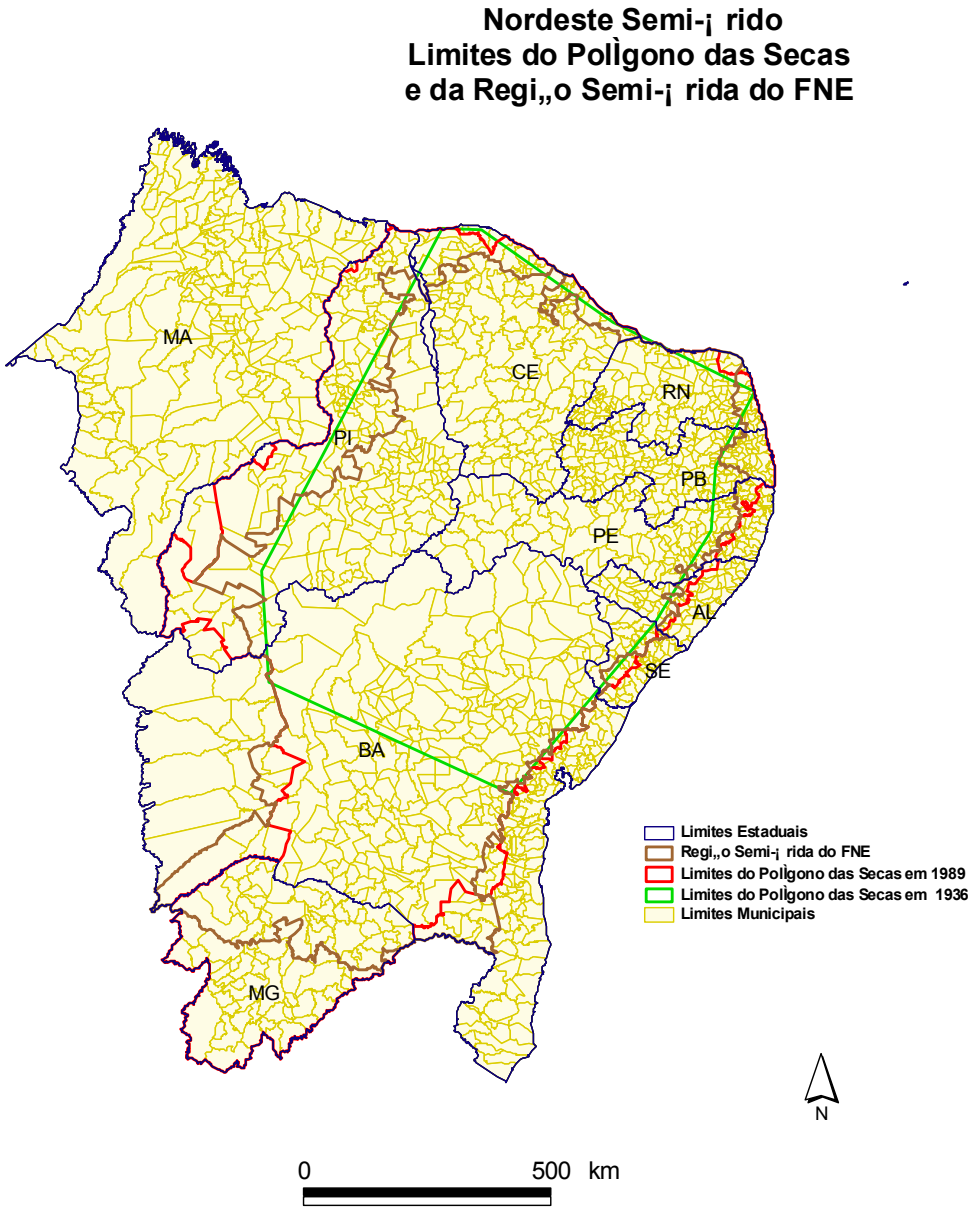
Nordeste Semi-¡ rido
Limites do Polìgono das Secas
e da Regi„o Semi-¡ rida do FNE
MA
CE
RN
PI
PB
PE
AL
SE
BA
MG
Limites Estaduais
Regi„o Semi-¡ rida do FNE
Limites do Polìgono das Secas em 1989
Limites do Polìgono das Secas em 1936
Limites Municipais
N
0
500 km

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)- **Estimativa dos PIB municipais do Nordeste.** Fortaleza, Banco do Nordeste, 2001. Xerox; e ii) Table 4.2 (for the data on population). APUD: Carvalho & Egler (2002)- **Alternativas de desenvolvimento para o Nordeste semi-árido.** 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
POPULAÇÃO TOTAL (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 km²) (*)	12,38	14,56	19,94	21,59			
Northeast (area = 1.662.947 km²) (**)	17,51	21,63	26,31	28,67			
Brazil (8.547.403,5 km²)	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					
	NORTH	NORTHEAST	SOUTH-EAST	SOUTH	CENTER-WEST	TOTAL
Number of Researches 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 Unities, 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 (km²)	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.