

DESERTIFICATION IN THE TROPICS

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Summary

This chapter analyzes two processes: desertification and sandization. The proposal is to discuss the concepts, their origins, the area of occurrence, the policies and experiences of control of these processes.

The discussion about the process of desertification and the first international initiatives relative to its control began in the United Nations (UN) Conference on the Human Environment (Stockholm, 1972) and in the conference held in Nairobi, Kenya, in 1977 that established the United Nations Environment Program (UNEP). The later defined that: "desertification is the diminution or destruction of the biological potential of land, and can lead ultimately to desert-like conditions. It is an aspect of the widespread deterioration of ecosystems, and has diminished or destroyed the biological potential, i.e. plant and animal production, for multiple use purposes at a time when increased productivity is needed to support growing populations in quest of development". The UN considers desertification as a global problem, being evident in more than 100 countries. The regions where arid, semi-arid and dry sub-humid climates occur and make up approximately 37% of the surface of the continents, and are the settings for more than a billion people (1/6 of the world population).

The sandization process occurs in the southwestern sector of Rio Grande do Sul State, south of Brazil, especially in the sub-region known as *Campanha Gaúcha*. The origin of this process is the reworking of non-consolidated surface sands, by water and wind. These sediments are constantly mobilized, which in turn, hinder the vegetation from fixing itself. The reworking of such

quaternary deposits resulted from morphogenetic dynamics, where surface runoff, particularly the concentrated flows in gullies, expose, transport and deposit the sand. After this hydrological process there is the wind action in this sand deposit.

The sandization process has been associated to desertification since the 1970's. However, sandization is a single phenomenon associated to hydrological and wind processes, and associated to climate regimes that are different from those that characterize the desertification process.

1. The desertification process and its area of occurrence



The discussion on the process of desertification and the first international initiatives relative to its control originated from the United Nations (UN) Conference on the Human Environment (Stockholm, 1972) and, particularly, the conference held in Nairobi, Kenya, in 1977, establishing the United Nations Environment Program (UNEP). The later conference defined that "Desertification is the diminution or destruction of the biological potential of land, and can lead ultimately to desert-like conditions. It is an aspect of the widespread deterioration of ecosystems, and has diminished or destroyed the biological potential, i.e. plant and animal production, for multiple use purposes at a time when increased productivity is needed to support growing populations in quest of development. (UNEP, 1978)". Dregne, 1986.

This subject, therefore, comes to the debate "when the United Nations Conference to Combat Desertification (UNCCD) recognizes that desertification as an environmental problem with high human, social and economic cost" (Hulme & Kelly, 1993). Figure 1



Figure1. The world's arid lands
Source: UNESCO - 1979

According to these authors, the conference drafted a worldwide 20 year Convention to Combat Desertification (CCD) action plan. In the evaluation of the preceding authors, there are many indications that, after 16 years, this plan has had little success. The UN assessed the results of this plan at the Conference on Environment and Development (UNCED), the first Earth Summit – RIO 92. The CCD was adopted in June 1994 and opened for signature in Paris, October 1994.

The concern for this issue has its origin in the trend of decreasing precipitation, revealed in the Sahel (Africa). For many authors, this trend in the African region could be associated to continuous soil degradation, observed in decades prior to the 1960s.

Other scientists, such as Nichelson (1978), analyzed the degradation of this

region by combining Chad Lake water level data, landscape descriptions and historical data, concluding that a dry up of one or two decades has been a characteristic of the Sahel climate, meaning that the present situation has been observed at other moments, during the last millennium.

The UN considers desertification a global problem, being evident in more than 100 countries. The regions where arid, semi-arid and dry sub-humid climates occur make up approximately 37% of the surface of the continents, and are the setting for more than a billion people (1/6 of the world population). The regions that are subject to desertification are those that present an arid index of up to 0.65. The arid index is defined by the ratio between precipitation and potential evapotranspiration, it being it an indicator to identify aridity around the world. Based on this index, the more arid the region is the smaller the arid index value, and greater is the risk of desertification, Figure 1. Besides this index, in recent studies, there are other factors to consider, that is, desertification is also associated to soil erosion and degradation, with damaging results to the fauna and flora of the afflicted areas (IBGE, 2004).



Figure 2. Map of areas at risk of desertification
Source: The United Nations Conference on Desertification – 1977

2. The origin (1940) and the renewal (1970) of the concept of desertification



While searching for the comprehension of the origin and basics that assembled the definition of desertification, two principles are essential to its study: geographic space and the time of its occurrence. Besides these principles, the worry over this phenomenon has been to define the forced alterations to the dynamics of the environment, including those changes of human organization and activities.

On analyzing these two principles and the forced alterations to human societies, significant differences may be identified in the concept of desertification, as well as for the proposals to combat the phenomenon.

As for the conceptual bases of the process called desertification, according to Dregne 1986, "about 18 percent of the arid region of Africa is severely desertified, and most of that represented by grazing lands and rain-fed cropping lands on the south side of the Sahara. The other large area that is severely affected is the mountain slopes and the plains of North Africa. Moderate to high salinity affects about 30 percent of the irrigated land in Egypt (Aboukhaled et al., 1975). Ethiopia, Kenya, and the Maghreb countries of Algeria, Morocco, and Tunisia have been subjected to especially serious water erosion, whereas wind erosion has been most damaging in sub-Saharan West Africa".

According to the map in Figure 2, in addition to the distinctive tropical regions, other areas, in other latitudes, are associated to the desertification process. This is the case for regions in Asia, North America, Australia, South America, and even in Europe.

According to Dregne 1986, such areas present the following characteristics:

- *"In the arid regions of Asia is characterized by overgrazing of the rangelands of the Middle East and Central Asia, water erosion of cultivated lands from eastern China to the Mediterranean Sea, and salinization and waterlogging on a large scale in Iraq, Pakistan, China.*
- *There are about 450 million hectares in the arid regions of Canada, the United States, and Mexico. Approximately two-thirds of that total is moderately desertified and less than one-third severely desertified, with a considerable area of slightly desertified land and four small delineations of very severely desertified land.*
- *The coast of Peru is crossed by a large number of short rivers, flowing from the Andes to the Pacific Ocean. Many of the irrigated valleys are affected to some degree by salinization and waterlogging. The valleys constitute only a small part of the coast desert of Peru and even less of the Chilean desert. Most of the desert has experienced little development or desertification.*
- *Farther south, in the semiarid coastal mountains of Chile, land degradation, due to overgrazing and cultivation of sloping lands, has been severe around population centers. Indiscriminate woodcutting has also been an important negative factor in the development of the region.*
- *In Argentina, which has more arid land than any other South American country, overgrazing has led to the degradation of range vegetation, from the high plateaus in the north to the cold Patagonian desert in the south. Wind erosion plagues both range and cultivated lands, especially in the southern half of the nation.*
- *Salinization and waterlogging do not affect a high percentage of the total cultivated land in Spain but important and large areas of affected soils do occur in irrigated valleys. The major salt-affected areas in the northeast are in the Ebro River watershed, in the vicinity of Zaragoza and Herida.*
- *Desertification is most extensive in the saltbush-bluebush (*Atriplex-Maireana*) vegetation type occurring in New South Wales and South Australia, where overgrazing has caused degeneration of the plant cover. Degradation of the vegetation, due to overgrazing, has also been severe on the fine-textured lowland soils (*Vertisols*) of eastern Australia and in the flood plains and surrounding slopes of coastal river valleys, particularly the Gascoyne, Ord, and Victoria catchments in Western Australia and the Northern Territory.*
- *There are about 450 million hectares in the arid regions of Canada, the United States, and Mexico. Approximately two-thirds of that total is moderately desertified and less than one-third severely desertified, with a considerable area of slightly desertified land and four small delineations of very severely desertified land."*

2.1 Desertification: awareness and debate

Considering desertification, two formulations are considered:

- a. The bioclimatic evolution that tends to transform a region into a desert;
- b. The interventions exercised by societies which accelerate the substitution of a vegetation landscape for an abiotic one, with a new dynamic.

However, there are no agreements as to these formulations, be it neither on the influence of natural processes nor on the possible human interventions, which are capable of inducing environmental transformation.

Mainquet, 1994, searching to define conceptual variations associated to the perception process, on considering the different spatial and temporal scales, establishes five phases: 1) consciousness, 2) the exaggerated perception of the process, 3) the doubt on the process, 4) the myth of desert expansion, and 5) the new realism.

The Consciousness Phase, possibly set in the 1940's, indicates soil and flora deterioration caused, at least in part, by human activity, and being considered the principle agent for the process. Aubreville, 1949, is noted for being the originator of this consciousness when using such a definition to identify the beginning of "true deserts" in the former European colonies in northern Africa, where annual precipitation varies between 700 and 1,500 mm. The methods used for agricultural production in this African territory, were the same methods practiced in continental Europe. These methods are considered the main promoters for the origin of land deterioration, called desertification.

The Exaggerated Perception of the Process Phase sprouts from the 1970's, when there is a need to have a common definition, accepted internationally. This is also the moment, when basic tools and products came from remote sensing and climate data, promoting spatialization of the phenomenon, on the world scale. The belief was that drought, desertification and famine are directly linked and that they should be urgently solved. At this moment, staged by the UNCCD, scientific recognition of the process is officially recognized, also considering that 15% of the world's population lives in semi-arid or even arid zones and that 45% of the Earth's surface is set inside these zones.

Between 1977 and 1984, the UN includes in its desertification map zones that are classified as sub-humid, spatially widening the desertification process to 35% of the Earth's surface, consequently, implicating an even larger share of the population, in all, characterizing the expansion of this process, at a global scale.

The "Doubt on the Process Phase", set at the end of the 1980's, points to problems of characterizing desertification. There are doubts as to what is the extension of the process, causes and solutions, the irreversibility or not of the process, and the complex dynamics of the sand deposits associated to source areas, where there are population concentrations. This is also the phase, where the results of the employed technology are questioned, principally when coming from international programs, pledging to bare socially cost-effective results, but putting to doubt privately invested cost-effective results.

The "Myth of Desert Growth Phase" reveals the general idea that deserts, as well as the dunes related to these environments, are expanding in range. It is important to note that desertification is characterized more by environmental degradation, at spots in the region of human settlements, than by a linear marginal increase of the great deserts, as generally stated. This calls attention to the significant transgression of cultivated areas over desert environmental limits, even if such limits naturally fluctuate - the case of the northern limit of the African Sahel. Such a conclusion implicates both the expanding agricultural frontier and the related agrarian space reorganization of the Sahel. These changes are not yet well studied and are infrequently associated to the desertification phenomenon.

Finally, the "New Realism Phase", shows how little is actually known about the climate dynamics, which could be capable of broadening the knowledge to face pluviometric and, consequently, hydrologic crisis, particularly in the Sahel, between 1968 and 1985. There will always be doubt on whether these frequent drought periods have actually ended. As for environmental degradation, mainly in dry sub-humid regions, noteworthy is the current and erroneous perception of the geographic space of degradation and regeneration of the environment, when related or not to the activities of society. It is important to disallow the theory of expanding deserts, when employing technological support such as Remote Sensing and monitoring programs to understand the extension and regenerative capacity of desertification related degradation.

Desertification is now understood as a singular process, with a combination of local variables, and not as a generalized process of global degradation. In this sense, it is fundamental to be studied from the perspective of its causes, processes and effects to determine the combination of acting variables.

3. Diversity in the comprehension of the desertification process



Considering the many different definitions of desertification offered by various authors, as well as their proposals to combat such a process, to reflect on this theme is plainly justifiable and opportune because these same definitions are still today object of controversy. The question of scale is set within this context (temporal and spatial), where the principles are fashioned from points of view such as climate, social, botanic, pedologic, among others.

Rapp, 1974 employs the arid and semi-arid regions classification to assert that desertification deals with the propagation of the environmental conditions of these regions, due to human activity or by way of climate change.

The concept elaborated in the 1977 Conference, in Kenya, identifying desert environments as those environments which present reduction or destruction of the biological potential of the land, one understands that the process is almost irreversible, setting it in the present time scale. In relation to the spatial scale desertification is mapped in relation to climatic zones: arid, semi-arid and dry sub-humid, where humans are the degrading agent in the process.

According to Le Houérou, 1977 the desertification process is associated to the degradation of various types of vegetation, in which pluviometric variations

are accountable. This author establishes the same temporal scale of existence as that of the process defined by the Conference in Kenya, 1977, but asserts differently as to the spatial scale, stating that the process may occur at the margins of the deserts or humid florists.

For Nimer, 1980, although many causes give origin to desertification, these can be determined by two factors: climate change, characterized principally by the increase of the deficiency of rain, and human activity. This author also states that whatever the identified cause, natural (regional climate change) or anthropogenic, or even both simultaneously, desertification is understood as increasing environmental degradation, expressed by the drying out and loss in capacity of soils to retain moisture.

In relation to climate change, Nimer, 1998, establishes that the onset of a desertification process in a considerably large area could only be possible with the transformation of macro-humid, sub-humid or semi-arid climates into macro-desert or semi-desert climates, meaning ever-increasing precipitation deficits. The author also says that only in regions that are characterized by very fragile ecosystems is it possible for human activity to bring on desertification or semi-desertification. Just is the case for dry climate regions such as the semi-arid, having very rough topography, where the soil is predominantly sandy, although stating that this process can also be verified in humid climate regions, with very fragile ecosystems.

Conti, 1989 establishes two class of desertification: climatic and ecologic. For the climatic desertification, he points out the variability of climatic patterns that lead to a water deficiency in the natural system. These changes may result from natural phenomena as well as from anthropogenic activity or even coming from the combination of both. As for the ecological desertification, the author observes that demographic growth puts pressure on natural resources, generating desiccating conditions, similar to those seen in deserts.

To structure the definition of desertification, Conti, 1997, establishes the following conditions:

- Distribution of the majority of the worlds population in the intertropical zone;
- Population growth more accelerated than in other places, which may be answerable for one of the causes of the strong pressure exerted on the natural resources;
- Great heterogeneity of the natural elements in lower latitudes, being the setting for different peoples, with enormous ethnic and cultural differences;

Based on these conditions, the author understands desertification as the progressive loss of ecosystem productivity, affecting a very expressive share of the sub-humid and semi-arid domains, in all the warm regions of the world.

For Goudie, 1990, the desertification process is an alteration of biomass, with accelerated soil deterioration, making human activity and the climatic factor the principle modifying agents, responsible for the process. In his arguments, the author establishes that the excess of monoculture, excessive pasture herding, salinization and deforestation are causes associated to the occurrence

of the desertification process.

Rochette, 1989, tries to understand the relationships between the desertification process and studies done by other authors on the Sahalien and Sudano-Sahalien zones, investigating the current durability of the drought, vegetation degradation, erosion and social changes. The author also takes into account the difficulties faced by the population to develop their potentials. From these considerations, he asserts that the dynamics of the dry spell can be more easily understood than the desertification itself, which is more complex and evolutionary, resulting from the development of various agents, which implicates all the domains and human behavior, underpinning a continuous link of causes and effects of all the ecosystem comprising elements.

Furthermore, this author defines desertification as a severe degradation of "ecologic capital" demonstrated by the diminishing quantity and productive capacity of resources such as water, soil, vegetation and fauna, all of which human societies exploit to survive. Moreover, it is important to comprehend this complex process from two sequences of factors: the agro-bio-climatic and the human.

Mainquet, 1995, investigates the existing definitions and considerations, to more thoroughly understand the desertification process as an environmental issue. His analyses is not limited to just one concept, but to the interest in evaluating the (ir)reversibility of the process, at a human scale, meaning in the lifespan of a generation (25 years). He also focuses on the physical dimension, the economical implication, the location of the areas and the probable relationships between desertification, levels of development and hunger. In this way, the author centers on desertification from reflections and observations, to evaluate that, besides being a process of spatial amplitude, the decisive human causes are of local breadth.

During the RIO – 92 Conference, it could be said that desertification became visible by association with the potential biological destruction of arid, semi-arid and dry sub-humid lands, making it possible to establish a spatial scale to map the process. In the evaluation of the participants, life is deteriorating due to the interference in the relationships among climate, soil and vegetation, promoting the rupture of the balance connecting these three factors that make up the environment.

4. Policies and experiences of control: practices, success and failure



Regarding the recovery of areas undergoing the process of desertification (desertified), the first example would be the case of the Sahel. According to Toupet, 1992, the development of the Sahel supposes the solution of many problems: restoration of the natural environment, deeply degraded, and still under the shock of recent great droughts; the reordination of a desertified space and the local socio-economical restoration into the world economy. Toupet, additionally states, that the efforts to recover the Sahel are under the responsibility of four groups of agents: the Sahelians themselves, government and public agencies, non-governmental organizations and international public organisms, which practically supply almost all the food and financial aid.

The processes that focus on reestablishing the desertified areas were divided up by Mainguet, 1995, into categories: traditional irrigation, including crops in humid (muddy) areas that are associated to the water table; irrigation served by river and dike drainage systems, runoff drainage dam systems; water holes and deep well irrigation systems; the employment of an array of modern irrigation techniques and the stabilization of dune and moving sand banks, through physical methods to reduce sand deflation.

Le Houérou, 1989, proposes agro-silviculture and silvipastoralism to combat soil degradation. This author, focusing on the Mediterranean basin, considers the northern Mediterranean Region (European countries) and the southern Mediterranean Region (African Countries). In the later, humid and semi-arid areas, he considers soil degradation being caused by excessive exploration of farmland through inadequate agricultural practices and suggests the conversion of grain fields into freely growing wild or semi-wild grasses, fodder trees and shrubs species rangeland. The objective would be to halt soil erosion and, at the same time, would permit livestock raising and native fauna survival.

For the northern African countries, where the soil degradation problems originate from the opposite phenomenon, in other words, high density populations occupying marginal land, agrosilviculture and silvipastoralism can help manage the land to secure long term productivity.

In the case of Chile, the efforts were centered on forestation and reforestation of arid and semi-arid regions. According to Latorre Alonso, 1989, these tree plantings correspond to 24 million hectares that are distributed in seven regions, from the northern border with Peru to the South. The objective in this case was to incorporate these areas to agrosilvipastoral activities, marginal to national economy. These efforts permitted researcher to acquire data on the growing conditions of the selected species, as well as permitting to evaluate the most promising species, in relation to Chile's edaphoclimatological units and ecological regionalization. More recently, new species were introduced to the arid and semi-arid zones.

Chile's experience succeeds in using and studying as many species as possible, many are native and unstudied. Also, the traditional concept of park management is being revised to accommodate a multiple use concept that matches ecologically and economically to livestock grazing and shrub and tree coverage, in this way promoting better living conditions for the local populations.

In Brazil, two areas of the Northeastern Region are officially considered by the Ministério do Meio Ambiente, dos Recursos Hídricos e da Amazônia Legal (MMA) - the federal executive office for environmental affairs - as subject to desertification. One having 1,000,000 km², where 4.5 million people live under extreme vulnerability to the process and the second area, of approximately 80.000 km², is home to 2.6 million inhabitants, also dramatically vulnerable to the desertification process.

According to the MMA, the desertification of the Northeast of Brazil is characterized by many distinct cells. These areas compose a large group of

municipalities that loosely spread out in 21,733 km² and, in 2000, accounted for 380.000 habitants. The alert becomes even more severe considering the people that are potentially affected by the associated social and environmental risks, represented by this process. Some of these cells are considered in the climatic risk classes. This signifies that the climate is just one of the controlling factors for the process. The soil type, geology, relief, vegetation and, principally, the manner in which society exploits its natural resources are all important events to the desertification process (IBGE 2004).

The main desertification cells in the Northeast of Brazil are Seridó (RN/PB), Irauçuba (CE), Gilbués (PI), Cabrobó (PE) and Cariri Velho (PB). The main causes for desertification are deforestation, to produce fuel wood and explore clay deposits; intensive land use employing poor agricultural methods, such as slash and burn harvesting and land clearing, salinization, extensive herding and overgrazing.

According to the Brazilian national action program to combat desertification, locally called *Programa de Ação Nacional de Combate à Desertificação e Mitigação dos Efeitos da Seca* (PAN), 2004, in the scope of the ECO-92, there was a recommendation to promote a specific convention to combat desertification, in attention to chapter 12, of the Agenda 21. This chapter establishes that the struggle against desertification should promote preventive measures to be implemented on degraded lands. The participation of various segments of society such as local communities, rural organizations, national governments, non-governmental organizations, national and regional organizations, is also Noteworthy.

Among the foremost action and technical points stated in the PAN, 2004, special attention can be given to: the participation of civil society in the processes of land ownership or tenure reorganization, for those localities having greater concentrations of family agriculture, where conflicts and social inequalities are most evident; the necessity to consider agroenvironmental analysis principles, that consider the logic of family agriculture and the edaphoclimatic conditions of desertification susceptible lands; reformulation the technical assistance and agricultural extension, to capacitate technicians to act on family focused agricultural systems, within agroecological principles; soil management and conservation, to recover those soils that present salinization and bad conservation; and to prepare and implement Agroextractivist Territorial Development Plans, catered for the sustainable economic exploration of the Caatinga and the Cerrado, thus offering an alternative economy for local populations.

Beside the Northeastern Brazilian Region, at defining desertification risk areas for the whole of Brazil, the MMA included lands of the southwestern sector Rio Grande do Sul (RS), the southernmost State of Brazil, as areas of special attention, meaning that this sector presents a strong environmental degradation process. The map showing the desertification events and the areas of special attention in Brazil, Figure 2, also shows the intensity of the process.



Figure 3. Climatic vulnerability to desertification
Source: IBGE, 2004

5. Sandization as a process of special attention



From the 1970's on, the southwestern sector of RS, especially, the sub-region known as *Campanha Gaúcha*, starts to be seen as an area prone to the desertification process. The reason for this is the first studies done in the area, but mainly due to the press that makes known to the public, at end of that decade, a series of articles on soil degradation in the region, calling it a desert. In a post-study (Souto, 1985) as well as other printed articles, handle the phenomenon as a desert and the process as desertification. They go on to associate this process to anthropogenic causes, due to over-herding or agricultural expansion of soybean fields and mechanization, in the municipalities of Alegrete, São Francisco de Assis, Manuel Viana, Itaqui and others.

Suertegaray, 1987, parting from the analysis of the definition of desertification and studying the region, considered the use of the definition of desert inadequate to explain the processes that were occurring. The case study did not compose an arid nor semi-arid region, registering average yearly precipitations of around 1,400mm and also lacking reliable evidence that the process in expansion was changing regional humid climate to a semi-arid or arid climate, as would be the case for the concept of desertification, defined at the Conference in Nairobi, in 1977.

To synthesize the explanation of this process, Suertegaray (1987, 1992, 1994) adopts the term *arenização (sandization)*, where the sand deposits of southwestern RS, result from the reworking of non-consolidated surface sands. These sediments are constantly mobilized, which in turn, hinder the vegetation from fixing itself. The reworking of such deposits, in the case of surface formations, probably quaternary, resulted from morphogenetic dynamics, where surface runoff, particularly the concentrated flows in gullies, expose, transport and deposit the sand. In this way, originating in the sand formations these, when in contact with the wind, tend to be constantly removed. Nutrient loss and mobilization make it difficult for pedogenesis and vegetation growth to progress. The results are sand deposits, locally known as *areais* (sand deposits with no vegetation cover). Suertegaray, 1987 describes this process as being of a natural origin, which can be intensified by herding or agricultural activities.

The hydroclimatic analysis shows the variability of meteorological phenomena and its relation with sandization. Verdum, 1997 e Suertegaray,

Guasselli e Verдум, 2001 studied the interannual precipitation averages for the area, revealing an irregular pluviometric regime. From daily and monthly data, it became evident that there was a monthly shift from dry spell to rainy episodes. In this way, climate variability in the southwestern sector of RS may be described by its long dry spells and large rainy periods. From understanding the performance of the hydro system, it is possible to observe that the outflowing water table and the concentrated runoff are the structural responses of the system to atmospheric dynamics (dry spells and rainy episodes).

This study makes clear that, not only is the water table important to charge the drainage system, but that there is a strong relationship between extreme atmospheric events and the concentrated runoff – gully-flash flooding events. These Phases, in turn, are efficient enough to provoke the morphogenetic litho-pedologic processes on the fragile surface, eroding and leaving the *areais* behind.

The region of RS with the occurrences of sandization can be seen on map, Figure 4, showing the extension of the *areais*, by municipality, based on a 1989 survey, with the use of a satellite image. Data on Table 1 presents a comparison between 1989 and 2005, relative to the area occupied by the *areais*, related to Total number, in each municipality.

Table 1 - Distribution and extension of the *areais* in the southwest sector of Rio Grande do Sul, Brazil, between 1989 - 2005.

Source: ANDRADES F^o., Clodis de O.; SUERTEGARAY, Dirce M.A.; GUASSELLI, Laurindo A. Atualizacao do mapeamento e quantificacao dos areias do sudoeste do RS através de imagens LANDSAT TM. 17^o Salão de Iniciação Científica da UFRGS. Out/2005.

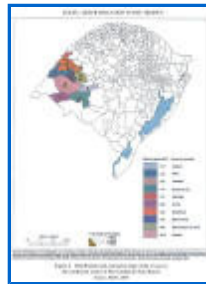


Figure 4. Distribution and extension map of the *areais* in the southwest sector of Rio Grande do Sul, Brazil. Source: IBGE, 2004

More recently, in other Brazilian states, land degradation phenomenon has been identified as sandization. The Midwestern Region is most noteworthy.

- The inadequate use of soil already affects 70% of the land in the Alto Araguaia watershed, Midwestern Region of Brazil. Due to the indiscriminate use of the land, mainly herding, great-eroded areas are becoming common and putting at risk the Cerrado. A study, produced for the Instituto de Estudos Sócio-Ambientais da UFG (Universidade Federal de Goiás), and coordinated by Selma Simões de Castro, identified 102 cases of erosion. Some of these were very complex, and

one in particular, measured 1,300 m², extending among a group 4 municipalities (1,516.73 km²): Mineiros and Santa Rita do Araguaia, in the State of Goiás (GO), Taquari e Baús, in the state of Mato Grosso (MT). An investigation done in agreement with UNICAMP revealed, for example, that the present state of conservation and preservation of the Rio Araguaia (2,627 km) - one of the most important rivers in the Rio Tocantins watershed - is suffering the consequences of a process that points to the threat of sandization. *Imprensa Unicamp* According to Simões, the "the natural process of erosion has been accelerated and amplified by the intervention of Man. Because these areas are slopes, rain and runoff promote erosion on the plains, especially at the Araguaia headwaters. Agriculture, herding and destruction of riparian forests intensify the process". *Jornal o Popular*, 6/6/2006.

- Antunes (2006), indicates the municipality of Serranópolis, in the southwestern sector of GO, as a sandization site. The author points out that this process was spurred by intensive deforestation, overherding, extenuation of farmland, inadequate irrigation and conservation practices mismanagement.

Besides the above, other regions of the states of Mato Grosso (MT) and Mato Grosso do Sul (MS) that have sandy soils are cases for concern.

The sandization process, since the 1970's, has been associated to desertification. However, sandization is single phenomenon; one associated to hydrological and wind processes, and associated to climates regimes that are different from those that characterize the desertification processes. Desertification laden-lands have distinct sand dynamics and soil degradation, related agricultural practices. Desertification has produced different proposals to study and challenges to overcome. Such proposals point to physical control of the processes, to renovate undergrowth and to plant forests for the sustainability challenge.

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Related Chapters

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Glossary

Arid index : The ratio between precipitation and potential evapotranspiration, being it an indicator to identify aridity around the world. Based on this index, the more arid the region is the smaller the arid index value, and greater is the

risk of desertification. The regions that are subject to desertification are those that present an arid index of up to 0.65.

Desertification : The potential biological destruction of arid, semi-arid and dry sub-humid lands; the deterioration due to the human interference in the relationships among climate, soil and vegetation, promoting the rupture of the balance connecting these three factors that make up the environment.

Sandization : The process of the reworking of non-consolidated surface sands that are constantly mobilized, which in turn, hinder the vegetation from fixing itself; resulted from morphogenetic dynamics, where surface runoff, particularly the concentrated flows in gullies, expose, transport and deposit the sand that, when in contact with the wind, tend to be constantly removed. Nutrient loss and mobilization make it difficult for pedogenesis and vegetation growth to progress.

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