

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

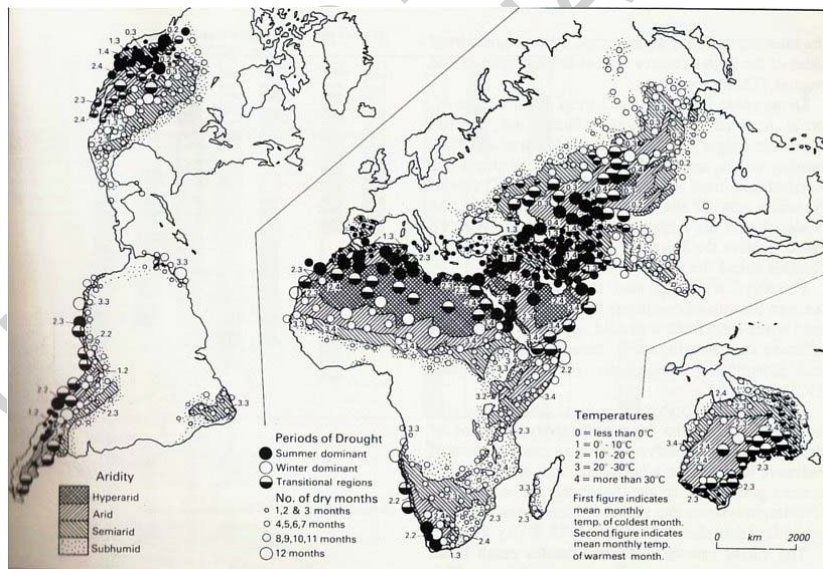


Figure1 - The world's arid lands
Source: UNESCO - 1979

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 Nicholson (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 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 2. 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).

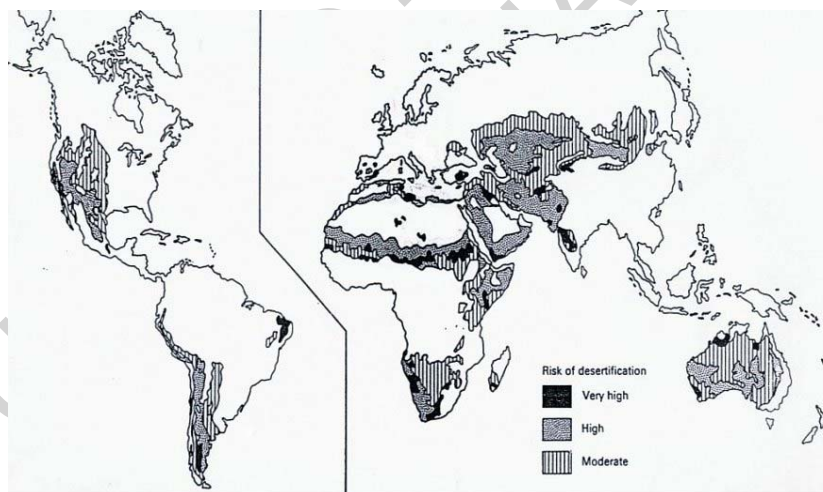


Figure2 - Map of areas at risk of desertification
Source: The United Nations Conference on Desertification – 1977

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 Figure2, 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.”*

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Bibliography

ANTUNES, E. C. (2006) Recuperação de áreas degradadas por meio de recomposição vegetal em solos arenosos no Sudoeste Goiano. Dissertação (Mestrado em Ciências Ambientais) - Universidade Federal de Goiás [Author analyzes the sandization process in the Southwest of the state of Goiás/Brazil and he proposes forms of replacement of the soil with native vegetable covering.]

CONTI, J. B. (1989) A desertificação como problema ambiental. In: III Simpósio de Geografia Física Aplicada. Nova Friburgo. p. 189-194. [Author points out the climatic and ecological desertification in the world and in Brazil.]

CONTI, J. B. (1997) As conseqüências de uma relação conflituosa Homem x meio: desmatamento e desertificação. In: A Geografia Física e as relações sociedade/natureza no mundo tropical. USP. São Paulo. p. 19-22. [Author relates the environmental degradation during the occupancy of the brazilian tropical zone, with the desertification degree.]

DREGNE, H. E. (1986). Desertification of arid lands. In *Physics of desertification*, ed. F. El-Baz and M. H. A. Hassan. Dordrecht, The Netherlands: Martinus, Nijhoff. p. 19. [Author analyzes the problem of the desertification in arid areas indicating the main causes of that phenomenon in those areas.]

GOUDIE, A. S. (1990) Desert degradation. Techniques for desert reclamation. John Wiley & Sons. Chichester. p. 286. [Author relates the deserts dynamics in the world to the climatic and human actions.]

HULME, M & KELLY, M. (1993). Exploring the links between: Desertification and Climate Change. *Environment*. 35 (6): 5-11. Washington. [The work introduces an analysis of the relationship of the climate with the desertification, demonstrating that areas that suffered drought phenomena related with desertification have those oscillations as climatic characteristics along the time.]

IBGE. Instituto Brasileiro de Geografia e Estatística. Indicadores de Desenvolvimento Sustentável.(2004) Estudos e pesquisas informações Geográficas (4). Coordenação de Recursos Naturais e Estudos Ambientais e Coordenação de Geografia. Rio de Janeiro.p.389 [It is a study accomplished by IBGE that expressed the analysis of the indicators of sustainable development. It emphasizes processes of degradation of the soil

as the desertification in the Northeast of Brazil and sandization in the Southwest of Rio Grande do Sul.]

IMPrensa @ UNICAMP.br acessado em 28/1/2007. [Newspaper on line of UNICAMP that reveals the research results on the theme of the sandization in the Center-west of Brazil in one of their reports.]

JORNAL O POPULAR. (digital) 6/6/2006 acessado em 28/1/2007. [Report that shows the result of teacher's research linked to the theme in UFGO (Universidade Federal de Goiás).]

LATORRE ALONSO, J. (1989) Algunas Experiencias de Reforestación de Zonas Áridas y Semiáridas de Chile. Degradación de Zonas Áridas en el Entorno Mediterráneo. Ministerio de Obras Públicas e Urbanismo, Madrid. p. 117-150. [Text that shows recovery experiences of degraded areas in the arid regions of Chile.]

LE HOUÉROU, H.N (1977) The Nature and Cause of Desertification. Arid Zone News Letter. University of Arizona, Tucson. 3:1-7. [The text discusses the desertification and desertization concepts indicating the distinction between both.]

LE HOUÉROU, H.N. (1989) Agrosilvicultura e Silvopastoralismo para Combatir la Degradación del Suelo en la Cuenca Mediterránea. Viejas soluciones para problemas nuevos. Degradación de Zonas Áridas en el Entorno Mediterráneo. Ministerio de Obras Públicas e Urbanismo, Madrid. p. 105-116. [The text analyzes critically experiences to combat problems of soil degradation in the Mediterranean areas.]

MAINGUET, M. (1994) Desertification natural background and Human mismanagement. 2nd edition. Springer-Verlag. Berlin. p. 314. [Important reference about the desertification concept and its different approaches with time; the author presents case studies in the different places in the world.]

MAINGUET, M. (1995) La désertification expression de la décadence? In: L'Homme et la sécheresse. Édition Masson. Paris. p. 285-296. [Author points out different aspects of desertification, as its nature and the role of human interventions in its origin, its physic and human dimensions.]

MAINGUET, M. (1995) Les notions d'aridité et de sécheresse dans les écosystèmes secs. In: L'Homme et la sécheresse. Édition Masson. Paris. p 27-50. [Author shows the differences in the concepts of aridity and dryness in the context of dry ecosystems, pointing out the different degrees of aridity and types of dryness that are related to the desertification.]

NICHELSON, S.E. (1978) Climatic Variations in Sahel and other African Regions During the Past Five Centuries. Journal of Arid Environments. USA. 1:3-24. [It approaches the study of the climatic variations of Sahel during the years seeking to discuss that variation in the relationship with the causes of the desertification.]

NIMER, E. (1980) Subsídio ao plano de ação mundial para combater a desertificação – Programa das Nações Unidas para o Meio Ambiente. In: Revista Brasileira de Geografia. 42(3). jul/set. Rio de Janeiro. p. 612-627. [Important Brazilian work about the understanding of desertification in Brazil and in the world, showing international and national policies against desertification.]

NIMER, E. (1988) Desertificação: realidade ou mito? In: Revista Brasileira de Geografia. 50(1) jan/mar. Rio de Janeiro. p. 7-39. [Author recovers his 1980' work adding new debates about desertification in Brazil and in the world.]

PROGRAMA DE AÇÃO NACIONAL DE COMBATE À DESERTIFICAÇÃO E MITIGAÇÃO DOS EFEITOS DA SECA: PAN – BRASIL (2004). Ministério do Meio Ambiente. Secretaria de Recursos Hídricos. Brasília. p. 242. [The most important official document from Brazilian government about the desertification, its occurrence and the policies and techniques used to combat it.]

RAPP, A. (1974) A review of desertification in Africa: water, vegetation and man. Secretariat for International Ecology (SIES), Report n° 1, Stockolm. p . 77. [Author analysis the arid and semi-arid regions classification to assert that desertification deals with the propagation of the environmental conditions of these regions.]

ROCHETTE, R.M. (1989) Le Sahel en lutte contre la désertification: leçons d'expériences. Comité Inter-États de lutte contre la sécheresse au Sahel, CILSS. Margraf. Weikersheim. p. 696. [Author characterizes the desertification in the Sahel, África, and presents experiences made with local communities to its control.]

SOUTO, J.J.P. (1985) Deserto, uma Ameaça? Estudos dos Núcleos de Desertificação na Fronteira Sudoeste do Rio Grande do Sul. Secretaria da Agricultura, Porto Alegre, Rio Grande do Sul, p. 169. [This book

presents an analysis of the causes of the desertification in the Southwest of Rio Grande do Sul, attributing to that process human cause.]

SUERTEGARAY, D.M.A. (1996) Desertificação: recuperação e desenvolvimento sustentável. In: Geomorfologia e Meio Ambiente. Guerra A.J.T. & Cunha S.B. da (org.). Rio de Janeiro. p. 249-266. [The text rescues the desertification and sandization concepts, presents examples of recovery processes and analyzes critically the proposals of use of those areas for forestation.]

SUERTEGARAY, D. M. A. (1998) Deserto Grande do Sul. Editora da UFRGS. Porto Alegre. p. 109. [The book is the synthesis of the theory that demonstrates that the deserts or sand deposits of the Southwest of Rio Grande do Sul have natural origin and recently, due to the fragility of that landscape they suffer enlargement process.]

SUERTEGARAY, D. M. A., GUASSELLI, L. A., VERDUM, R., BASSO, L. A., MEDEIROS, R. M., BELLANCA, E., BERTÊ, A. M. A. (2001) Projeto Arenização no Rio Grande do Sul, Brasil: gênese, dinâmica e espacialização. Biblio3w Revista Bibliográfica de Geografía y Ciencias Sociales, Número 287, Volumen VI. Universidad de Barcelona. Barcelona. [This text speaks about the Atlas, about the occurrence area and about the dynamics of the sandization, indicating the distribution, the genesis and the recovery forms.]

SUERTEGARAY, D. M. A., VERDUM, R., BELLANCA, E. T., UAGODA, R. S. (2005) Sobre a gênese da arenização no sudoeste do Rio Grande do Sul. Revista Terra Livre, v.1, p. 135 - 150. [The article presents the last interpretations on the genesis of the sand deposits and the sandization process.]

SUERTEGARAY, D. M. A., GUASSELLI, L. A., VERDUM, R. (2001) Atlas da Arenização - Sudoeste do Rio Grande do Sul. Porto Alegre: Centro Estadual de Pesquisas em Sensoriamento Remoto e Meteorologia e Governo do Rio Grande do Sul, v.1. p.84. [Atlas that shows the distribution of the sand deposits, the explanation about their genesis and indication of recovery processes.]

UNESCO (1977) Conferência das Nações Unidas sobre a Desertificação. Nairobi.Quênia. [The most important international reference about desertification.]

UNESCO (1992) Conferência do Rio. Agenda 21. Rio de Janeiro.Brasil. [The most important international reference about the world-wide environmental concerns; it dedicates a specific chapter to desertification.]

VERDUM, R. (1997) Approche Géographique des “déserts” dans les communes de São Francisco de Assis et Manuel Viana, État du Rio Grande do Sul, Brésil. Tese de Doutorado. Université de Toulouse Le Mirail. Toulouse. p. 211. [Study about the climate, geology, soil, geomorphology, hydrology and of human occupancy dynamics of sandisation in south of Brazil.]

VERDUM, R., QUEVEDO, D., ZANINI, L., CÂNDIDO, L.(2002) Desertificação: questionando as bases conceituais, escalas de análise e conseqüências. Revista Geographia, v.3. Niterói, p.119 - 132. [Authors show the diverse use of the desertification concept in scientific articles, books and from geography post-graduation students.]

VERDUM, R. (2004) Tratados internacionais e implicações locais: a desertificação. Revista Geographia, v.11. Niterói. p.79 - 88. [Author points out the international agreements about the desertification and their relations with Brazilian legislation and the propositions to its control in Brazil.]

VERDUM, R. (2003) Un cas spectaculaire du grand ravin Oliveira In: Mélanges des Études Hydrologiques. Geode & Office Internation de l'Eau. Toulouse. p. 94-106. [Case-study of a gully, that points out the environment fragility and the water dynamics for the formation of great erosions.]

Biographical Sketches

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