

## Introduction

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The ever-increasing demand for food and natural resources by a rapidly growing human population has exerted environmental stress resulting in widespread ecosystem degradation. An extreme form of such degradation, termed ‘desertification’, is estimated to affect the living conditions of about one billion people. As a result, this topic spawned the United Nations Convention to Combat Desertification (UN-CCD) in 1994.

The term ‘desertification’ encompasses a variety of processes driven both by natural and anthropogenic forces. Desertification has occurred in most regions of the world, cutting across a broad spectrum of contrasts in climate, ecosystem types, land uses and socio/economic settings. The complexity of this phenomenon has challenged our ability to categorize, inventory, monitor and repair the condition of the land. Short-comings in communication and understanding are magnified by the improper, incomplete or ‘out of context’ transfer of knowledge from one region or land use category to another. One of the most important distinctions to be made in relation to land degradation is between cultivated land used for annual crop production and ‘rangelands’. Rangelands represent a variety of ecosystems and landforms not suited for intensive agriculture or forestry, because of limitations imposed by climate, soils or topography (Stoddardt et al. 1975, Holecheck et al. 1989). Grazing by free-ranging livestock is the traditional primary use of the world’s rangelands. However, there is growing recognition of the importance of these vast acreages for wildlife habitat, hydrology and ground water recharge, recreation and aesthetics.

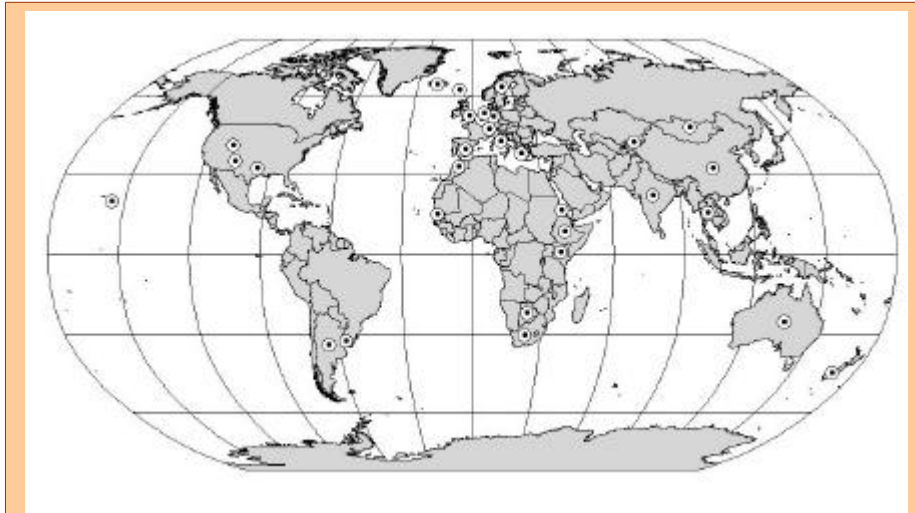
Historic approaches to halting, mitigating or reversing rangeland degradation were agronomically-based rather than ecologically-based. Agronomic approaches were typically intensive, costly and non-sustainable. As such, they were ill-suited to extensively managed rangelands characterized by variable or extreme climatic conditions, poor soils, and/or rugged topography. Agronomic efforts at rangeland improvement often consisted of practices such as broadcast seeding and fertilization with little regard for spatial and temporal heterogeneity or the status of underlying ecosystem processes that promote or retard degradation and restoration.

In recognition of these short-comings, a group of about 80 experts from over 40 countries were assembled in Iceland in September 1997 for a workshop on rangeland desertification. The goal of the workshop was to bring together a broad spectrum of scientific expertise representing bioclimatically and culturally diverse regions to compare and contrast ecological perspectives on rangeland desertification.

Why convene a desertification workshop in Iceland? As noted in the book “Rangeland Desertification” (Arnalds and Archer 2000) published concurrently with these proceedings, severe land degradation has radically impacted most of Iceland’s rangeland ecosystems. Iceland thus exemplifies the fact that the problem of desertification extends beyond Africa and the dryland regions of the world. Ongoing degradation

continues in much of Iceland, yet there have been significant scientific and social advances in combating desertification. Thus, there is both cause for concern and reason for optimism. In this context, Iceland provided an appropriate, and somewhat extraordinary setting for this workshop.

The experts attending the workshop represented many disciplines and geographical regions and shared a common interest in severe land degradation. During the workshop, principles of land degradation were discussed and illustrated by a diverse array of case studies from all regions of the world (Figure 1).



**Figure 1.** Geographical distribution of degradation research reviewed at the 1997 Rangeland Desertification Workshop in Iceland and summarized in these proceedings and in Arnalds and Archer (2000).

The wealth of information introduced at the workshop could not be presented in a single publication. We, as editors assisted by inputs from an organizational committee, were therefore faced with the task of dividing the papers into two volumes. The volume presented here contains a compilation of case studies of rangeland desertification in the world. The other volume, titled *Rangeland Desertification*, and published by Kluwer (Arnalds and Archer 2000), focuses on concepts and principles. It provides an evaluation of thresholds, and non-linear change with respect to vegetation, hydrology, nutrients and erosion. Socio-economic constraints and approaches for preventing and reversing degradation are also examined.

This volume provides a current and unique documentation of rangeland desertification in many countries and regions of the world. The preface by Ms. Vigdís Finnbogadóttir, former President of Iceland, conveys the urgency and importance of progressive resource management. Thad Box's chapter is a retrospective, yet forward-looking examination of the world's rangelands from a perspective that is uniquely philosophical, pragmatic, scientific and artistic. The outlook on desertification provided by the ensuing case-study chapters is sobering, but many practical and potential solutions are discussed. The world's rangeland ecosystems have clearly changed. In some instances, these transformations occurred long ago, as exemplified by China and the Mediterranean Basin. In other instances, change has been more recent, as in Argentina and New Zealand. A common thread throughout the case studies is the ever-increasing

pressures on the world's rangelands. A 300% increase in livestock numbers is reported in Botswana from 1966–1991, and similar trends have been observed in China, Ethiopia, the Mediterranean, India, and other areas presented herein. The volume concludes with a summary of issues discussed by the workshop participants, an itemization of key science issues, and an assessment of implications for the UN Convention to Combat Desertification.

Ecosystem degradation and desertification can be natural (Haynes 1982), human-induced (Owen 1979, Gornitz and NASA 1985) or a combination of the two (Verstraete 1986). However, the subject of land degradation and desertification is young and often poorly defined. There is even debate as to whether factors such as livestock grazing has caused ecosystem degradation to occur (Mace 1991, Illius and O'Connor 1999). The term desertification is still subjected to debates (see Arnalds 2000).

Recent concerns regarding potential climate change associated with greenhouse-gas accumulations in the atmosphere has focused public attention on climate effects on ecosystem processes. However, to the extent that it exceeds natural variability, this potential climate change is directly or indirectly the result of human population growth, land use change and the attendant alteration of ecosystem processes associated with resource utilization. These issues form the core of ecosystem degradation and desertification. The potential consequences of human population growth, land use change and resource consumption are quite independent of, and, arguably, are collectively more important than changes in climate which may be gradual and which may not be manifested for many decades. Thus, a pre-occupation with 'global warming' should not divert attention from more immediate and tractable problems associated with human impacts on the land.

Anthropogenic environmental impacts have shaped the the earth's surface. They represent a much greater and more immediate threat to the environment at present than climate change in the near future. Furthermore, they can reinforce the negative effects of climate change (Schlesinger et al. 1990, Burke et al. 1991, Turner et al. 1993, Vitousek 1994, Dale 1997).

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**Figure 2.** Two participants of the Rangeland Desertification Workshop observing Icelandic desert. Photo G. Johannesson.