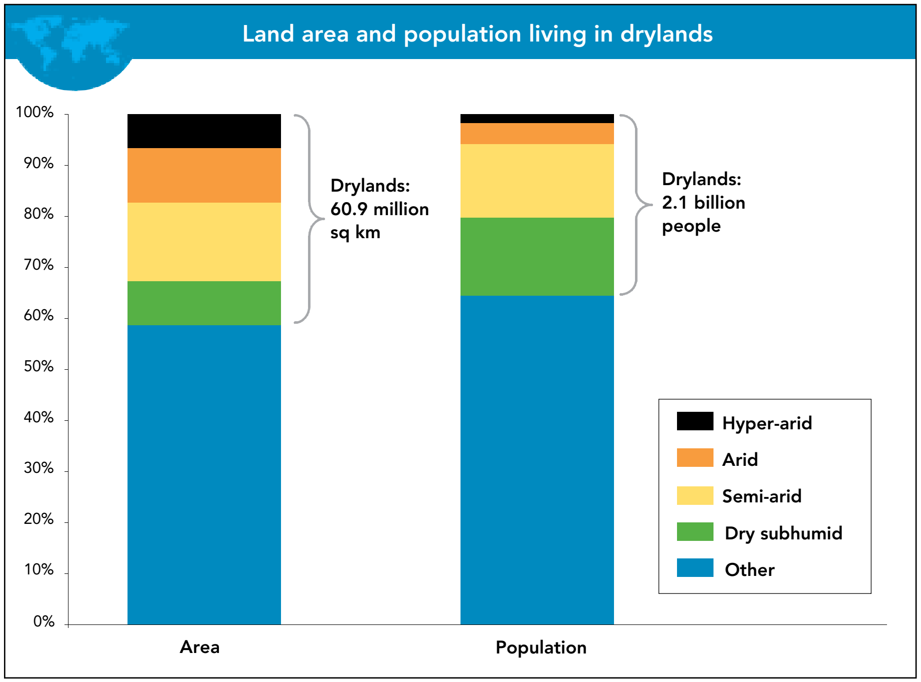
DESERTIFICATION



Source: Millennium Ecosystem Assessment (2005).

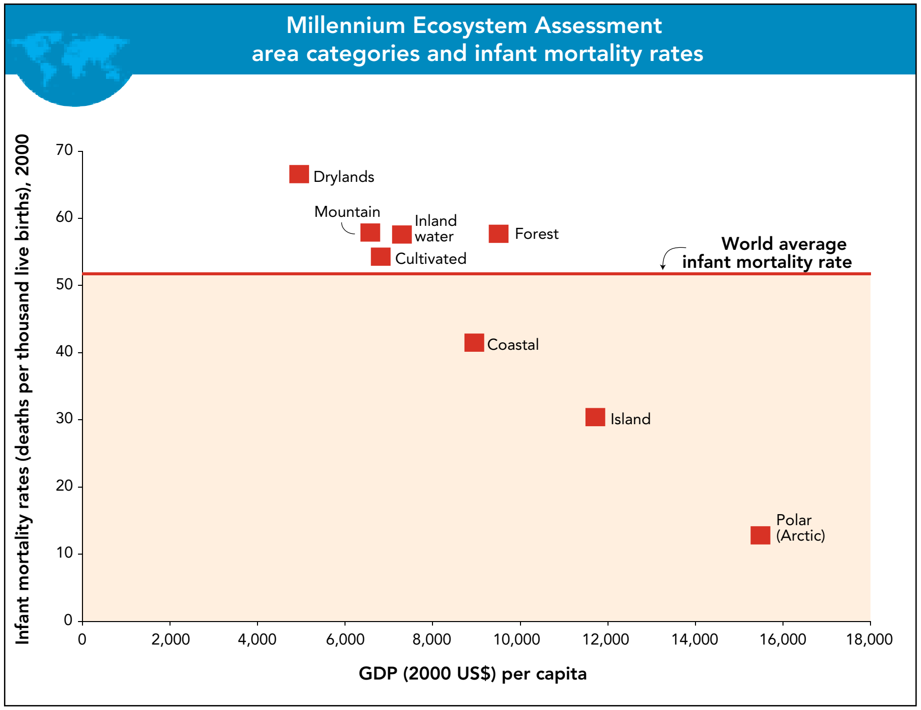
Note: Drylands are defined as areas with an aridity index value of less than 0.65, that is, areas in which annual mean potential evapotranspiration is at least 1.5 times greater than annual mean precipitation.

Drylands cover roughly 40 per cent of the earth's land surface and are inhabited by over 2 billion people, approximately one third of the world's population

About 90 per cent live in developing countries. A large share of the dryland population depends on crop and livestock production for their livelihoods. Whereas most area in drylands consists of rangeland (65 per cent), one fourth of it is able to sustain cultivation, although with productivity constraints from low soil moisture. Dryland rangelands support half of the world's livestock and provide forage for wildlife.[45]

"The impact of desertification is intensifying due to climate change, which is reducing the availability of freshwater, fertile soil, and forest and vegetation. As the degraded land loses value, investments in agriculture and rural development decline even more."

—Ban Ki-moon
United Nations Secretary-General

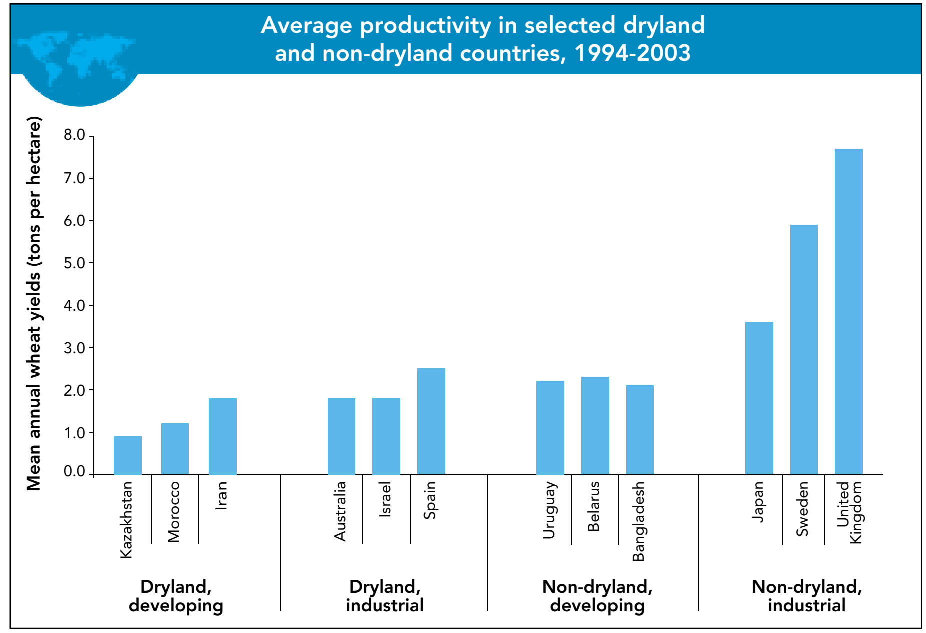


Source: Millennium Ecosystem Assessment (2005).

Note: The Millennium Ecosystem Assessment used 10 categories of systems to report its global findings. Ecosystems in each category share a suite of biological, climatic and social factors that tend to differ across categories. These categories are, however, not ecosystems themselves. Each contains a number of ecosystems and they overlap. Urban systems are excluded.

Drylands have the lowest GDP per capita and the highest infant mortality rates

At a global level, there are only a limited number of measures of human well-being available through which to assess patterns across ecosystem boundaries. Population, infant mortality rates and GDP can be obtained using data from subnational sources. The figure shows that drylands have the lowest GDP per capita and the highest infant mortality rates. This does not imply causality. Still, the high incidence of poverty combined with heavy dependence on fragile ecosystems for livelihoods makes dryland populations especially vulnerable to further land degradation and declines in ecosystem services.[46]



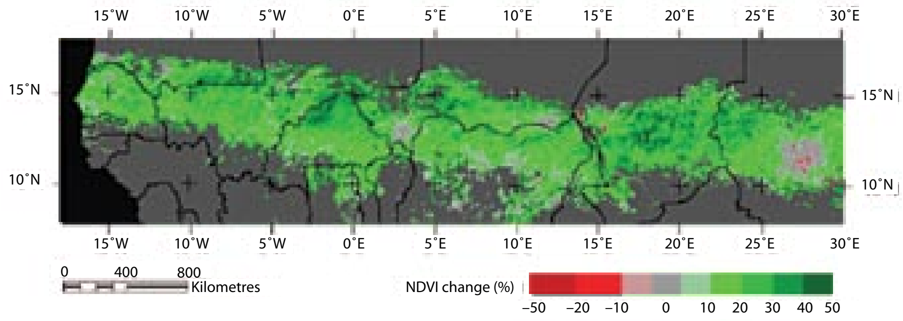
Source: Millennium Ecosystem Assessment (2005).

There is a relative advantage of cultivation in non-dryland countries, but agroecological differences are only one part of the story

Yield differentials between developing dryland countries and developed dryland countries are modest, suggesting that nature may be the binding constraint. In the case of non-dryland wheat, by contrast, the yield differentials between developing countries and industrial countries are very wide. Moreover, industrialized dryland countries exhibit wheat yields nearly as high as those produced by non-dryland developing countries. Thus, socio-economic, institutional and technological conditions also matter.[47]

> "Combating desertification yields multiple local and global benefits and helps mitigate biodiversity loss and human-induced global climate change."

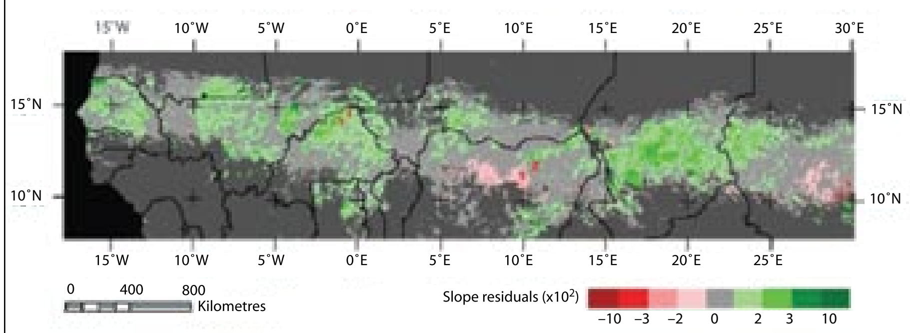
A. Percentage change in vegetation greenness in the Sahel, 1982-2003



Source: Herrmann, Anyamba and Tucker (2005).

Note: Overall trends in vegetation greenness throughout the period 1982-2003 based on monthly Advanced Very High Resolution Radiometer, Normalized Difference Vegetation Index (AVHRR NDVI) time series. Percentages express changes in average NDVI between 1982 and 2003.

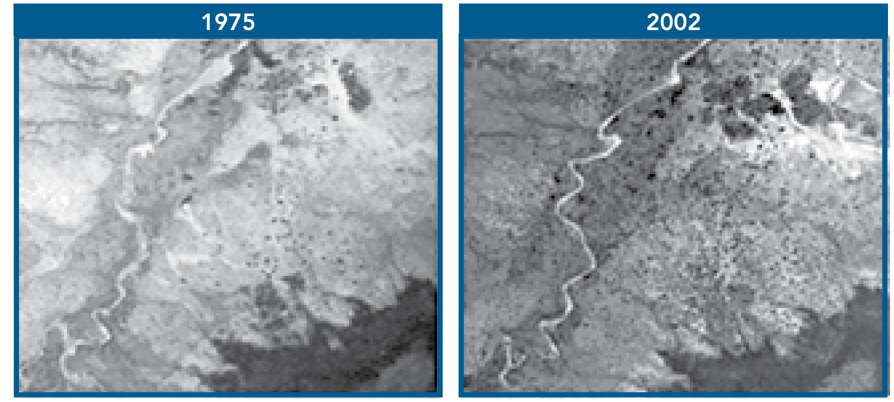
B. Effect of rainfall on vegetation greenness



Source: Herrmann, Anyamba and Tucker (2005).

Note: Overall trends in the residual NDVI throughout the period 1982-2003 based on regression of vegetation greenness (AVHRR NDVI) on 3-monthly cumulative rainfall. Slopes of residual NDVI trend lines between 1982 and 2003 are expressed in units of NDVI x 10^4.

Land-cover recovery in south-western Niger (Galma village)



Source: G. Tappan, USGS Data Center for EROS, South Dakota.

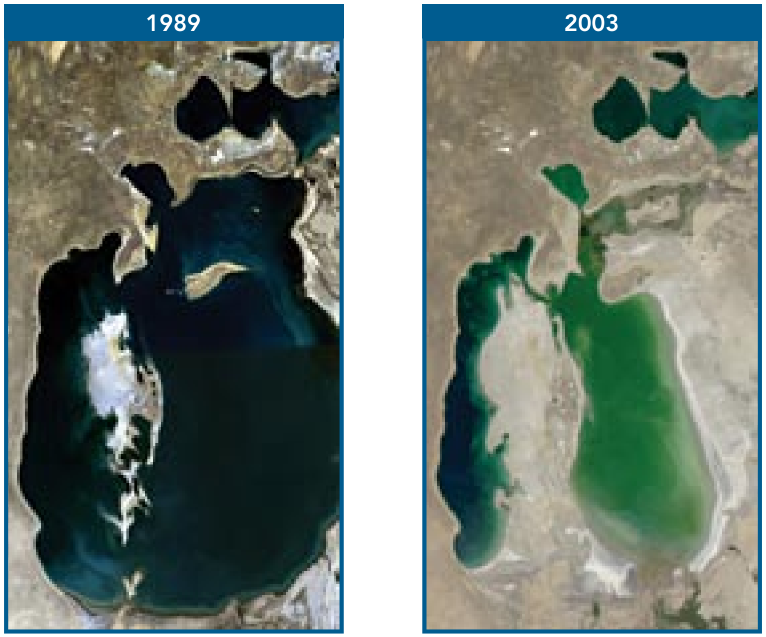
Note: The black spots are mature trees. The aerial photo on the left shows that there were very few trees in the village of Galma in 1975. The satellite image on the right shows not only that the village has increased in size, but that there are also many more trees.

Innovations building on indigenous knowledge have helped reverse desertification processes in some parts of the world

In the Sahel, the most recent analyses indicate that there has been a greening of most of the region since the early 1990s. Figure A shows that, for the period 1982-2003, the overall trend in vegetation greenness is positive over a large portion of the Sahel region, reaching up to 50 per cent increase in parts of Mali, Mauritania and Chad, and confirming previous findings at a regional scale. The spatial pattern of the effect of rainfall on vegetation greenness in figure B further reveals that, although there are large areas in which changes in vegetation greenness correspond closely to what is expected from variations in rainfall (grey areas), there are also regions where the vegetation has been greening more than can be explained by rainfall alone (red areas). These "positive hot spots" are concentrated in parts of Senegal, Mauritania, Mali, the Niger, the Central Plateau of Burkina Faso and large portions of Chad. In some cases (e.g., Niger Delta of Mali; south-western Mauritania), this can be explained by an expansion of irrigation. In other areas, however, a recovery of vegetation greenness beyond what would be expected from the recovery of rainfall can be attributed to increased investment and improvements in soil and water conservation techniques building on traditional knowledge (e.g., Central Plateau of Burkina Faso, Tahoua and Maradi regions in the Niger).[48]

In northern Nigeria and the Sudan, vegetation greening has fallen short of what would be expected from the increase in rainfall. This has been particularly sharp in northern Nigeria. One explanation is the neglect of good land-use practices.[49]

Irrigation and land degradation in drylands: the Aral Sea



Source: NASA Earth Observatory.

Paramount examples of desertification resulting from irrigation schemes are found in the Aral and Caspian Sea regions, the Hei and Tarim River basins in western China, and the Senegal River basin in Africa[50]

Once the world's fourth largest lake, the Aral Sea has shrunk dramatically over the past few decades as the primary rivers that fed it have been diverted and tapped nearly dry for irrigation of farmland. By 1989, the northern and southern half of the sea had become virtually separated. The drying out of the sea's southern part exposed the salty seabed. Dust storms increased, spreading the salty soil on the agricultural lands. The water making its way back to the sea is increasingly saline and polluted by pesticides and fertilizer. In 2003, the sea's southern half had been separated into a western and eastern half.[51]

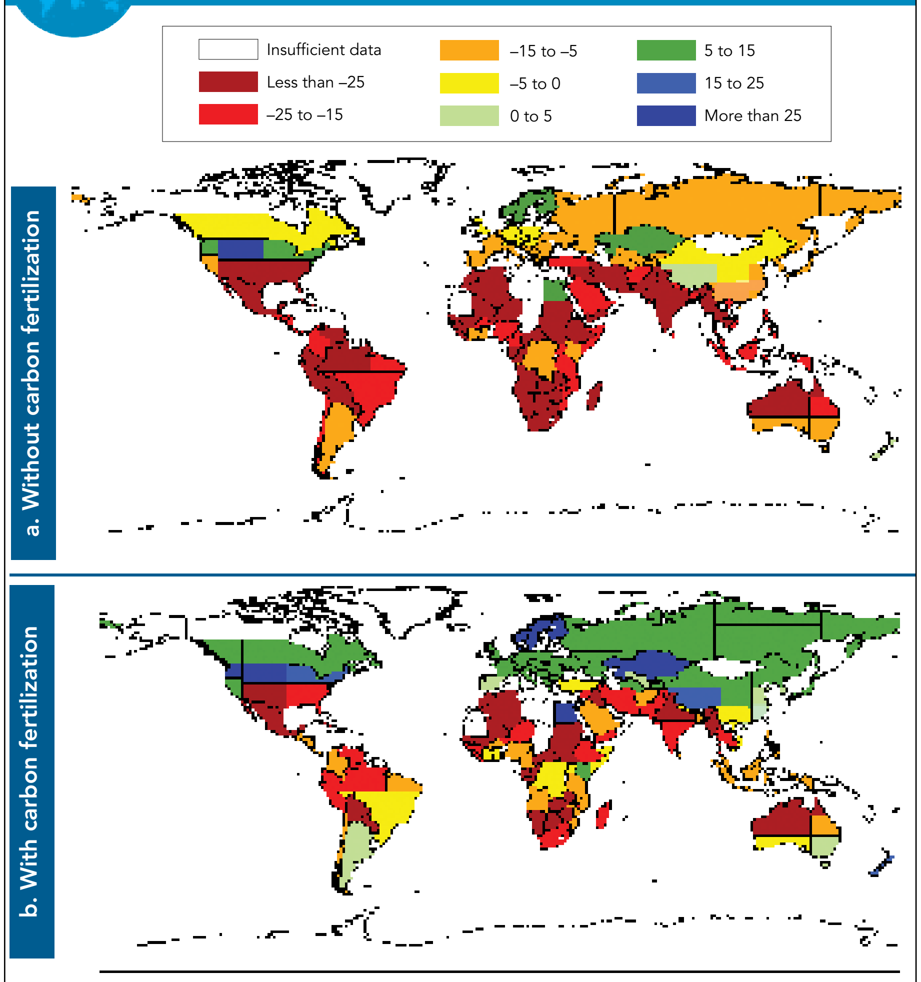
> **"Irrigation has led to increased cultivation and food production in drylands, but in many cases this has been unsustainable without extensive public capital investment."**

Sub-Saharan African and Central Asian drylands are among the most vulnerable to climate change

An estimated 10-20 per cent of drylands are being degraded through a reduction or loss of biological or economic productivity. Such desertification is caused by various factors, including climate variations and human activities. About 1-6 per cent of the dryland inhabitants live in dersertified areas. A much larger number is under threat from desertification, which is likely to be aggravated by climate change.[52]

Several studies have been conducted on long-term environmental and agricultural change, but only of late have climatic factors been seriously taken into account. In north China, for instance, wind erosion appears to have compounded the effects of anthropogenic pressure to accelerate desertification.[53]

Projected impact of climate change on agricultural productivity by the end of the century (percentage change)



Source: Cline (2007).

Note: Because the focus is on the impacts on agricultural potential, trade effects are not considered. Adaptation through shifts in planting timing and shifts to other available crops and increased irrigation using existing systems are considered to some extent.

Agricultural activity in many developing countries is likely to be adversely affected by climate change

There is still some debate regarding the extent to which climate change will affect agricultural productivity at the global level (e.g., because of uncertainty regarding the effects of higher carbon concentration on plant growth, or carbon fertilization). By one estimate, under business as usual, climate change by the 2080s would reduce world agricultural production capacity by about 16 per cent if carbon fertilization is omitted and by about 3 per cent if it is included. Other studies are more optimistic. There is, however, wide consensus that, even if a moderate increase were the outcome at the global level, there would be serious losses for many countries and regions, particularly in the developing world. For instance, it is estimated that India and a large number of countries in Africa would face major losses in crop yields even with carbon fertilization.[54]

Furthermore, the likely increase in the frequency of extreme events, such as droughts, floods and pest outbreaks (which are not considered in these projections), suggests that it would be a risky strategy to focus the response to climate change exclusively on adaptation.[55]

Endnotes

45 Millennium Ecosystem Assessment (2005), *Ecosystems and Human Well-being: Current State and Trends: Findings of the Condition and Trends Working Group*, http://www.millenniumassessment.org/en/Condition.aspx.

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55 W. R. Cline (2007), *Global Warming and Agriculture: Impact Estimates by Country*, Center for Global Development, Peterson Institute for International Economics, Washington, D.C., 186 p.; and IPCC (2007), "Food, fibre and forest products", chapter 5 in *Climate Change 2007: Impacts, Adaptation and Vulnerability*, Fourth Assessment Report.

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