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GLOBAL STATUS OF DESERTIFICATION

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INTRODUCTION

Desertification has been defined by the United Nations Environment Programme in February 1990 as "land degradation in arid, semiarid, and dry subhumid areas resulting from adverse human impact". This definition replaces the 1977 definition adopted at the United Nations Conference on Desertification in Nairobi, Kenya. The old definition said that desertification is the "diminution or destruction of the biological potential of the land and can lead ultimately to desert-like conditions". The 1977 definition did not mention anything about the climatic zones in which desertification would occur or about the cause of the phenomenon. It was generally understood that desertification occurred in the arid regions but the particular climatic zones were not identified. The direct cause of desertification was believd at that time to be a combination of drought and human actions. The 1990 definition omits hyperarid regions because there can be no human-induced land degradation in the absence of humans, and there are no humans in most of the hyperarid zone. There is one exception, of course, in the irrigated cases. Oases in the hyperarid zone suffer the same salinity and waterlogging problems that other irrigated lands do.

The global status of desertification, as reported here, was assessed in a 1991 study conducted by the author for the United Nations Environment Programme. A desertification map was prepared from the results of the global survey, at a scale of 1/25,000,000. The 1991 map is greatly revised version of a map that was prepared for the United Nations Conference on Desertification (Dregne 1977). Desertification status refers to the current condition of land degradation as compared with what the condition would be in the absence of human impacts. Desertification vulnerability (hazard) and rate were not evaluated.

DESERTIFICATION PROCESSES

The principal desertification processes are 1) degradation of the vegetative cover, 2) accelerated water and wind erosion, and 3) salinization and water logging. These processes affect the three major land uses in arid areas: irrigation agriculture, rainfed cropland (dry farming), and pastoralism on rangelands. Rangeland desertification is primarily a matter of degradation of the vegetative cover through overgrazing

productivity estimate. For present purposes, a range condition of excellent or good placed the rangeland in the slight desertification class (less than 25% loss of productivity). Fair condition meant moderate desertification (25-50% loss of productivity), poor condition meant severe desertification (50-75% loss of productivity) and very poor condition was equated with very severe desertification (more than 75% loss of productivity). Very severe desertification (which follows vegetation degratdation) of rangelands was associated with deep and extensive gullying, exposure of unproductive subsoils by water or wind erosion, the formation of mobile sand dunes, or the presence of a repeating sequence of hummocks and blowouts.

Very severe desertification is a small fraction of each land use category. This indicates that most land damage does not cause abandonment of land. Practically all vegetation degradation, salinziation, and waterlogging are reversible. The most serious threat to long-term land porductivity is water erosion.

While the numbers used in this report give an impression of accuracy in the various assessments, it should be understood clearly that the data base upon which the assessments were made is poor. A large amount of personal opinion colors the evaluation.

RESULTS

Table 1 gives the amount of irrigated land, rainfed cropland, and rangeland in the drylands of the world. All of the land lies in the arid, semiarid, and subhumid climatic zones except for a small amount of irrigated land in the hyperarid zone of the Sahara Desert in Africa.

Table 1. Land use in the drylands of the world, by continent.

Continent	Irrigated land	Rainfed cropland	Rangeland	Total
	million hectares			
Africa	10.4	79.8	1,342.3	1,432.5
Asia	92.0	218.2	1,571.2	1,881.4
Australia and New Zealand	1.9	42.1	657.2	701.2
Europe	11.9	22.1	111.6	145.6
North America	20.9	74.2	483.1	578.2
South America	8.4	21.3	390.9	420.6
Total	145.5	457.7	4,556.3	5,159.5

About 3 percent of the drylands is irrigated, 9 percent is rainfed cropland, and 88 per cent in rangeland. The most extensive land use (rangeland) is the least productive.

An indication of the degree of land degradation in each land use is presented in Table 2.

Table 2. Percent degradation, by land use and continent

Continent	Irrigated land	Rainfed cropland	Rangeland
Africa	18	61	74
Asia	35	56	76
Australia and New Zealand	13	34	55
Europe	16	54	72
North America	28	16	85
South America	17	31	76
Total	30	47	73

Very roughly, about one-quarter of the irrigated land, one-half of the rainfed cropland, and three-quarters of the rangeland are desertified. Degradation of irrigated land is reversible because there are well-proven measurrs that can be taken to lower water tables and wash salt from the soil. Vegetation degradation of rangelands is also reversible by natural means (stop overgrazing and woodcutting) but the restoration of vegetative cover can take a long time unless seeding and planting are done under favorable conditions. Erosion of rainfed croplands is the big problem that can cause permanent land damage. There is no economic way to restore the surface layer of a soil that has been eroded down to within several centimeters of the underlying bedrock. It is possible, however, to re-build a productive topsoil on a deep uniform soil that has lost several centimeters by erosion but still has a subsoil 3 or 4 meters thick.

DISCUSSION

Asia has, by far, the largest amount of irrigated land and also is the leading continent in area of rainfed cropland and rangeland. In addition, it has the dubious distinction of having the highest or nearly highest percent of degraded land in the three land use categories. While there is considerable variation among continents in the degradation of their irrigated lands and rainfed croplands, all except Australia have highly degraded rangelands. Australia is unique because it has large areas where the forage is highly unpalatable and the pastoral lands lack good water supplies.

In my opinion, the estimates of irrigated land degradation appear to be reasonably reliable. Salinity certainly is a widespread problem in those lands lying in the hyperarid and arid climatic zones. There are not, however, many field measurements of soil salinity. The presence of salt accumulations on the soil surface

and the typical tip burn on the leaves of affected plants provide most of the evidence of salt damage. Wherever there is a high water table, the likelihood is good that the soil is salt-affected. These indirect indicators of excess salinity in irrigated fields probably make the error in diagnosis fairly small.

My assessment of rangeland degradation may well be too low. Where livestock have grazed an area for one hundred or a thousand years, as is true of nearly all pastoral lands in the arid and semiarid regions, it seems virtually certain that vegetation degradation has occurred in those places where there is an adequate water supply for the livestock. Perhaps the best demonstration of the prevalence of overgrazing is the setting aside by pastoral tribes in the Middle East of grazing reserves for use during droughts. The only reason to do so is if the usual grazing pressure on most of the land is excessive. In nearly all situations, grazing pressure is low only if drinking water is in short supply or the forage is unpalatable or too remote or tsetse flies protect the area from livestock, for the most part. The damage may be less severe in the better-watered subhmid climatic zones but it is still present.

Degradation of rainfed croplands is very difficult to assess over large areas. Water erosion is the principal land damaging process, and it is most prevalent on sloping hills. Complicating the assessment of water erosion is the fact that most erosion is of the sheet or rill type. Gully erosion is obvious even to the untrained eye, wheras professional soil scientists may have difficulty deciding how severe sheet and rill erosion are. Furthermore, excessive sheet erosion on uniform soils that are a hundred meters or more deep, such as loess and sand, may have little effect on soil productivity. Crops may be buried by sediment or have the soil washed away from their roots but the impact causes only short-term damage. Reduction of the effective root zone and gully erosion are the major erosion problems.

Wind erosion can be very destructive if it leads to exposure of subsoils that are unfavorable for root growth, such as compact clayey material or indurated calcium carbonate. Generally, however, wind erosion blows away some of the finc soil particles or causes sandy soils to encroach on highways or accumulate along fences or cover adjoining fields. The on-site impact is largely confined to sand blasting of plants, exposure of roots, or burying of crops. The long-term effect on soil productivity of on-site wind erosion is small. Off-site costs are much greater. In an extensive analysis of on-site and off-site costs of wind erosion in the state of New Mexico, off-site costs were about 45 times greater than on-site costs (Davis and Condra 1985; Huszar 1985). That is why much less emphasis is placed on wind erosion than water erosion as a long-term hazard to soil productivity.

Because there is so little information on how badly water erosion affects permanent soil productivity, it is quite possible that my estimates of degradation of rainfed

croplands are too high. There is no way to confirm or deny the accuracy of the estimates.

CONCLUSIONS

Desertification is a widespread global problem that adversely affects approximately three-quarters of the pastoral land in the drylands, one-half of the rainfed cropland, and one-quarter of the irrigated land. Permanent damage to agricultural lands is primarily limited to water erosion on rainfed croplands and water and wind erosion on rangelands. Vegetation degradation and salinization are reversible although re-vegetating rangelands in the arid climatic zone may require many years. Wind erosion on croplands is a common phenomenon but the long-term soil damage it does is small. There is reason to believe that my estimates of degradation of rainfed croplands are too high and the degradation of rangelands are too low.

REFERENCES

Davis, Bob and Condra. Gary D., 1985. The on-site costs of wind erosion in New Mexico Department of Agricultural Economics, Texas Tech University, Lubbock. 54 p.

Dregne, H.E. 1977. Status of Desertification in the Hot Arid Regions. Map scale: 1/25,000,000. United Nations Conference on Desertification, A/CONF. 74/31. p. 4-6.

Hopkins, Stephen T., and Jones. Douglas E., 1983. Research Guide to the Arid Lands of the World. Oryx Press, Phoenix, Arizona. 391 p.

Huszar, Paul C. 1985. Off-site economic costs of wind erosion in New Mexico. ANRE Report AR:85-3, Department of Agricultural and Natural Resource Economics, Colorado State University, Fort Collins. 35 p.