World Soil Resources Report 90

LAND RESOURCE POTENTIAL AND CONSTRAINTS AT REGIONAL AND COUNTRY LEVELS

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World Soil Resources Reports **90**

LAND RESOURCE POTENTIAL AND CONSTRAINTS AT REGIONAL AND COUNTRY LEVELS

Based on the work of

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Chapter 1
Introduction

BACKGROUND AND OBJECTIVES

For many years, FAO have been building up information about the world's land resources, in part from their own studies but mainly by assembling information produced by national resource survey organizations and cooperating international institutions. This may be said to have begun 30 years ago with the publication of the first sheets of the *Soil Map of the World*, more recently made available in digitized form (FAO-UNESCO 1970-80, 1995). At an early stage it was realized that in order to evaluate land potential, data on soils and landforms must be combined with the analysis of climate. Estimates of land degradation, and of potential arable land, have been added to the range of information. In recent years, great advances have been made through the application of electronic data-processing, through geographical information systems (GIS) and modelling. The survey, analysis and evaluation of land resource information are ongoing tasks.

The purpose of this paper is to provide an overview of the land resource data presently available. Specific objectives are:

- to indicate the relative extent of land resource limitations to agriculture and other forms of land use, with a focus on the national (country) level;.
- to highlight areas which call for the treatment or management of specific land resource constraints, so that regional and national action plans can be better focused on specific problems;
- to indicate the limitations of the data, and hence the priority needs for improved information.

In addition to the analysis of specific kinds of data, some correlations are made between physical resource constraints, land degradation, and population, to explore the extent to which intuitive relationships are confirmed.

In contrast to many previous FAO studies, the coverage is worldwide. This permits comparisons between developing countries, the countries of the Commonwealth of Independent States and the Baltic States, and developed countries. In all, 160 countries are evaluated, omitting very small countries for reasons of data unreliability at a world scale.

The results presented here widen and complement those given in *FAO Production Yearbook* (FAO, annual), in the FAO statistical databases accessible via their Web site (FAO, ongoing), and in *World Resources Reports* (World Resources Institute *et al.*, biannual). They extend the data on soil constraints and land degradation status earlier presented for countries of sub-Saharan Africa (Wood *et al.*, 1998) towards the whole world.

DATA SOURCES AND LIMITATIONS

The major data sources employed in this review are as follows:

- The digitized soil map of the world and derived soil properties (FAO-UNESCO, 1995).
- The global assessment of soil degradation (GLASOD) (Oldeman *et al.*, 1990, 1991).
- A global climatic database (Leemans and Cramer, 1991), to which was applied a method of determining length of growing period (Fischer *et al.*, 1995).
- The soil fertility capability classification (Sanchez *et al.*, 1982), applied to the soil map of the world by means of an FAO computer program, in order to determine the extent and location of major soil constraints.
- *Estimates of available arable land prepared for the ongoing FAO study* World Agriculture: Towards 2015/30.
- A global population database (Tobler *et al.*, 1995).

Some more detailed or precise information on the earth's physical resources has recently become available. These include the *Soil and Terrain Database* (SOTER) (FAO *et al.*, 1998a, 1998c; Nachtergaele, 1996); a revised Asian assessment of soil degradation (ASSOD) (Lynden and Oldeman, 1997); and an improved global climatic database (Climatic Research Unit, 1999). However, it has not been possible to incorporate these new sources in the present study, for reasons of time or incomplete world coverage.

There are a number of inherent limitations to small-scale global studies of this kind, presented at regional and country levels. In the first place, at the global scale the resolution of data is necessarily coarse; in the case of soil maps, simplifications of mapping units and generalizations of boundaries are necessitated at successive stages of generalization to national and global maps. This means that for small countries, results tend to be unreliable, whereas for large countries, the data are likely to represent averages across several agro-ecological zones. Limitations specific to the various types of data used are discussed in Chapters 2-5.

For these reasons, the results reported here must be treated as first approximations, not as definitive indicators of the country status of land resources. It is likely that they will be extended and complemented by the ongoing programme on land quality indicators (Pieri *et al.*, 1995; FAO et al. 1997). There is an urgent need to improve the reliability of the data. This can only be done through more detailed studies by national resource survey organizations.

Chapter 2
Soil constraints

METHODS

In order to translate soil characteristics into agronomic constraints, use was made of one of the best known methods, the fertility capability classification (FCC) (Sanchez *et al.*, 1982). This characterizes soils by means of a set of fertility constraints, that is, inherent features which offer problems to soil management. The FCC criteria were linked with the mapping units of the Soil Map of the World by taxonomic transfer functions, algorithms based on statistical analysis of soil profiles belonging to each mapping unit (Batjes *et al.*, 1997). For example, the indicator *hydromorphy* in the FCC is applied to all soil mapping units belonging to the classes of Fluvisols, Gleysols and Histosols, and to gleyic units in other soil groups. The correspondences between FCC criteria and soil classes are shown in Table 1.

TABLE 1
Correspondence between inherent soil constraints in the soil fertility capability classification (FCC) and soil classes of the Soil Map of the World

FCC soil constraints	Major soil groups	Soil units
Hydromorphy	Fluvisols, Gleysols, Histosols	Gleyic
Low cation exchange capacity	Arenosols, Ferralsols provided sandy and not humic	
Aluminium toxicity	Ferralsols and Acrisols that are not humic.	Dystric Cambisols, Dystric Planosols, Dystric Gleysols
High phosphorus fixation	clayey Ferralsols and clayey Acrisols.	
Vertic properties	Vertisols	Vertic Cambisols, Vertic Luvisols
Salinity	Salt flats, Solonchaks	Saline phases
Sodicity	Solonetz	Sodic phases
Shallowness	Lithosols, Rendzinas, Rankers.	
Erosion risk		Steep slopes: moderate slopes with contrasting top- and subsoil texture.

There are some substantial data limitations to the sources used. First, the reliability of some of the maps and data is known to be relatively low. The soil map of the world is based on information compiled more than 20 years ago, and more than half the survey coverage of developing countries is only at reconnaissance scales (Zinck, 1994). Secondly, the successive stages of reduction in scale, from local soil maps to the national level, and from the latter to the Soil Map of the World, necessitate a considerable degree of amalgamation of mapping units and simplification of boundaries. There may also have been some inconsistencies in converting national soil mapping units to the legend of the Soil Map of the World. At more than one scale of reduction, it may be necessary to use only the dominant soils of an soil association. Finally, each soil fertility constraint has to be assigned to the whole of a particular soil type, although the constraints will not be present over the entire area.

RESULTS: WORLD AND REGIONAL LEVEL

Eight inherent soil constraints are covered:

- *Hydromorphy:* poor soil drainage.
- *Low cation exchange capacity:* low capacity to retain added nutrients.
- *Aluminium toxicity:* strong acidity.
- *High phosphorus fixation:* a high level of ferric oxides in the clay fraction.
- *Vertic properties:* dark, expanding and contracting ('cracking') clays.
- *Salinity and sodicity:* presence of free soluble salts.
- *Shallowness:* rock or a rock-like horizon close to the soil surface.
- *Erosion hazard:* a high risk of soil erosion, caused by steep slopes, or moderate slopes in association with erosion-prone soils.

Further explanations, together with indications of the soil management problems associated with each constraint, are given in the results by countries below.

An important qualification to the interpretation of the results should be noted. All data reported on inherent soil constraints apply to the total areas of regions or countries, not to their arable land, nor agricultural land, only. Thus, for example, the areas shown as having erosion hazard and shallowness include mountainous regions in which little or no attempt at agricultural use is made.

The areas of major soil constraints are summarized by region in Table 2. Results are shown in thousands of square kilometres, and as percentages of the region affected by each constraint. The areas shown are partly overlapping, i.e. it is common for soils to be affected by more than one constraint.

TABLE 2
Area of major soil constraints by region

		Soil Constraint							
	Total area	**Hydromorphy**		**Low cation exchange capacity**		**Aluminium toxicity**		**High phosphorus fixation**	
	('000) km²	**('000) km²**	**%**	**('000) km²**	**%**	**('000) km²**	**%**	**('000) km²**	**%**
Sub-Saharan Africa	23755	1903	8	3716	16	4371	18	1009	4
North Africa and Near East	12379	79	1	292	2	1	0	0	0
Asia and Pacific	28989	3083	11	1105	4	3906	14	1395	5
North Asia, east of Urals	21033	5702	27	11	0	783	4	0	0
South and Central America	20498	2086	10	982	5	8019	39	3016	15
North America	21410	3388	16	0	0	2219	10	1	0
Europe	6843	1142	17	44	1	569	8	0	0
World	134907	17382	13	6151	5	19867	15	5421	4

		Soil Constraint							
	Total Area	**Vertic properties**		**Salinity and sodicity**		**Shallowness**		**Erosion hazard**	
	('000) km²	**('000) km²**	**%**	**('000) km²**	**%**	**('000) km²**	**%**	**('000) km²**	**%**
Sub-Saharan Africa	23755	1072	5	884	4	3007	13	3627	15
North Africa and Near East	12379	69	1	780	6	2854	23	1185	10
Asia and Pacific	28989	1455	5	3043	11	4892	17	4655	16
North Asia, east of Urals	21033	0	0	2137	10	2796	13	3349	16
South and Central America	20498	439	2	1115	5	2313	11	3923	19
North America	21410	106	1	191	1	2491	12	3851	18
Europe	6843	87	1	219	3	780	12	1386	20
World	134907	3228	2	8369	6	19133	14	21975	16

For definitions of regions, see Appendix 1.

For the world's land area as a whole, there are four major constraints, each occupying 13-16% of the global area. In order of extent, these are: erosion hazard, aluminium toxicity,

shallowness, and hydromorphy. Four other constraints each cover 2-6% of the area: salinity and sodicity, low cation exchange capacity, high phosphorus fixation, and vertic properties.

On a regional scale, *erosion hazard* and *shallowness* are extensive in all seven regions. In addition, the dominant regional constraints are as follows:

Sub-Saharan Africa	*Aluminium toxicity, low cation exchange capacity*
North Africa and Near East	*Salinity and sodicity*
Asia and the Pacific	*Aluminium toxicity, hydromorphy, salinity and sodicity*
North Asia, east of Urals	*Hydromorphy, salinity and sodicity*
South and Central America	*Aluminium toxicity, high phosphorus fixation,hydromorphy*
North America	*Hydromorphy, aluminium toxicity*
Europe	*Hydromorphy*

At the broad regional scale, these results are in accordance with field experience.

RESULTS: COUNTRY LEVEL

Country-level results are given in full in Appendix 2, Tables A2a-A2g. The country results can be grouped according to the absolute or relative extent of each soil constraint. Such analysis can be used for preliminary assessment of potential development strategies, or potential for soil management technology transfer (Nachtergaele and Brinkman, 1996). Countries having the greatest relative extent of each constraint, as percentages of their total land areas, are shown in Figures 1-8.

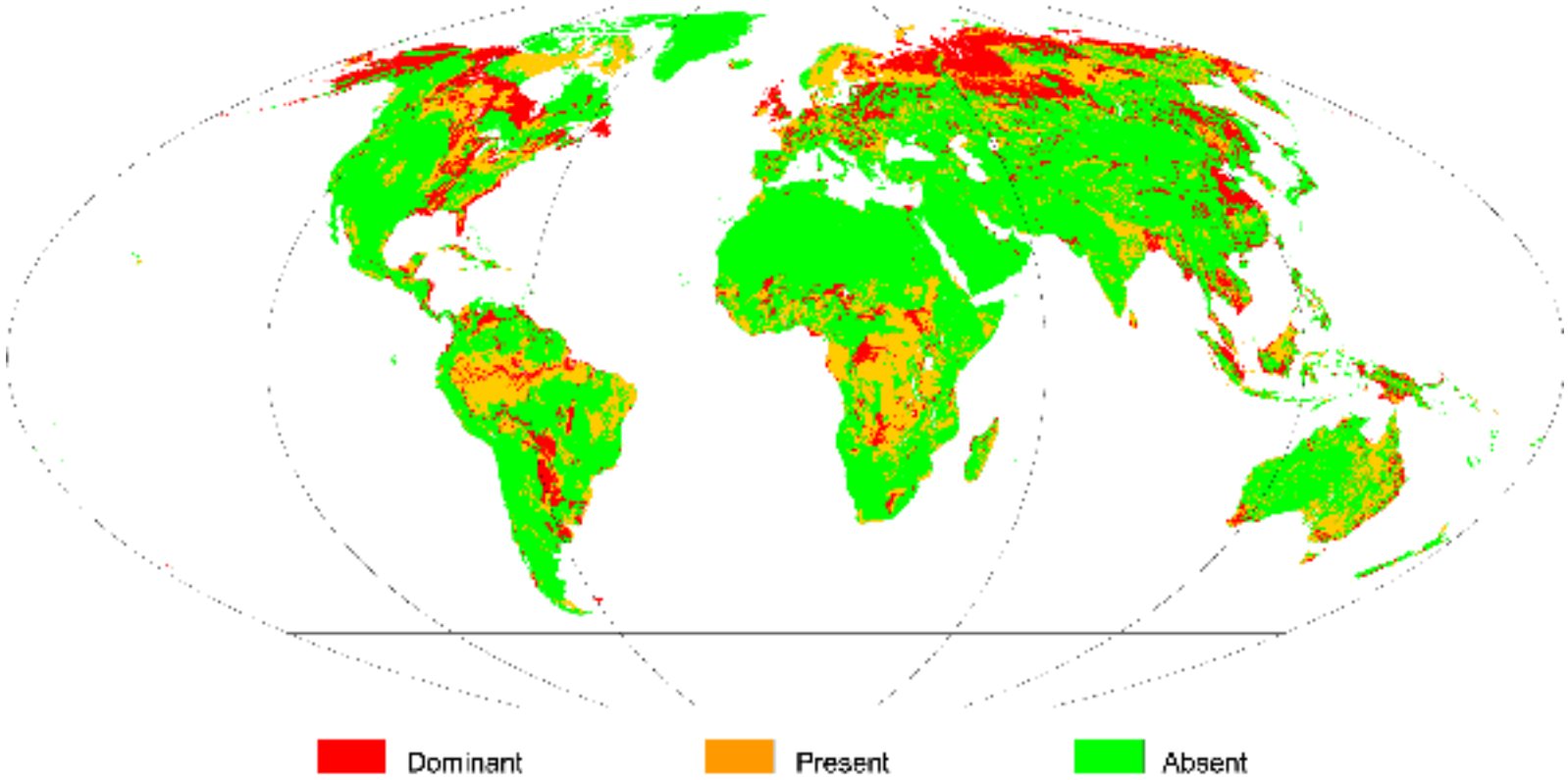
Hydromorphy (poor soil drainage)

Hydromorphy, wetness in the soil profile for all or part of the year, is governed mainly by physiography. Such land is generally flat and low-lying with respect to the surrounding land. Common environmental situations, each presenting distinctive management problems, include alluvial and coastal plains, deltas, and river valleys, the latter including the distinctive valley-floors of the savanna zone, known in Africa by local names such as *dambo, mbuga* or *fadama*. Peat bogs are also extensive, mainly but not exclusively in the temperate and sub-polar zones, including on elevated plateaux under high rainfall.

Some 20 countries have a substantial proportion (>25%) of their land affected by hydromorphic constraints, with the highest proportions (>50%) in the Falklands, the United Kingdom, and Bangladesh. In the case of Bangladesh, lying mainly in the deltaic zone of the Ganges, this would be expected. For the United Kingdom it comes as a surprise; the cause is a combination of peat moors, fenlands and clay vales, coupled with the high degree of generalization necessary in reducing the national soil map to the scale of the Soil Map of the World.

When under agricultural management, hydromorphic soils are often used for rice production in the tropics, and permanent grassland in the temperate zone. The *dambo* valley floors present a complex challenge to management, with alternative uses of seasonal grazing, rice or vegetables; under grazing, there is a serious danger of degradation from erosion and lowering of the water table (Koohafkan *et al.*, 1997; Young, 1998). Wetlands are also highly valued as wildlife reserves, their drainage being restricted by law in some countries. A fundamental challenge is to harmonize agricultural sector policies with environmental considerations, in order to balance the different uses of wetlands, and to establish ecologically sound management practices.

Hydromorphic Soils of the World



Flat_polar_quartic Projection

FAO -GIS, March 2000

FIGURE 1
Countries most affected by soil constraints: hydromorphy

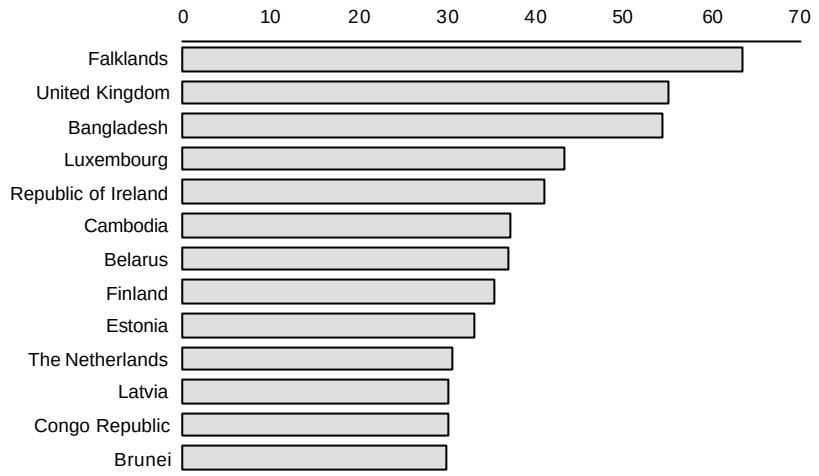
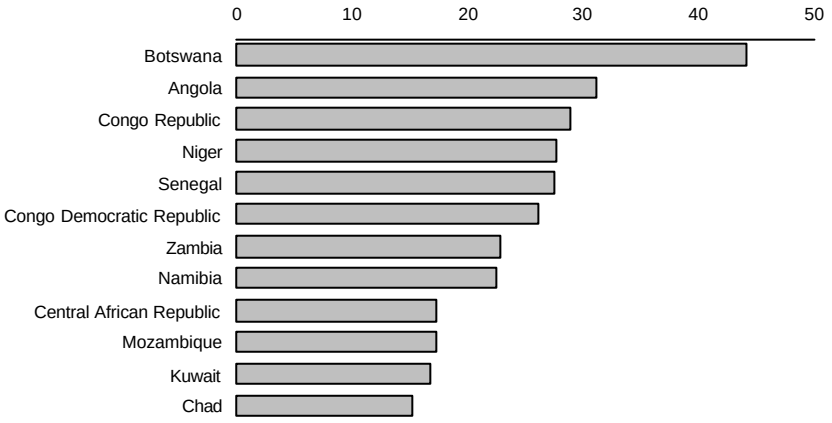


FIGURE 2
Countries most affected by soil constraints: low cation exchange capacity



Low cation exchange capacity (low inherent fertility)

Soils with a low cation exchange capacity (CEC) have topsoils with a low organic matter content, a low clay content, clay minerals with low CEC per gramme of clay, or all these properties. As such, these soils have a low inherent fertility and also a low capacity to retain nutrients added as fertilizer. For the most part, these are highly sandy soils (Arenosols).

Twelve countries, eleven of them in Africa, have more than 15% of their land affected by this constraint. Five of these twelve (Botswana, Niger, Namibia, Kuwait and Chad) lie in the semi-arid or arid zones. The others extend into subhumid or even humid regions, but have extensive areas of sandy or highly-weathered soils.

The low nutrient reserves, often accompanied by a low organic matter content and low soil moisture storage capacity, call for the relatively high inputs if these soils are expected to produce at other than low yield levels. However, owing to the low nutrient retention capacity, the addition

of fertilizers may not be economic. If ways can be found to raise the soil organic matter content (e.g. through agroforestry or green manuring), then fertilizer use efficiency can be improved.

Aluminium toxicity

These are soils in which the exchange complex is dominated by alumina. This is associated with a soil reaction of pH <5.5, often <5.0, and although technically less correct, the problem is commonly described as one of strongly acid soils. The main cause is strong leaching resulting from high rainfall.

This is predominantly a problem of the humid tropics, although found also in the subhumid tropics and in a few temperate-zone countries with areas of high rainfall, e.g. New Zealand. It affects some 8 M km^2 in South America and 4 M km^2 in both Africa and Asia (mainly South-East Asia). The eight countries most affected lie largely or entirely in the rain forest zone, and many of the remainder in Figure 3 possess substantial areas of rain forest. About a third of the 160 countries covered by this study have more than 25% of their territory affected by aluminium toxicity.

Although some crops (e.g. pineapple, tea) are tolerant of high levels of exchangeable aluminium, for most crops it is a serious constraint. This is one reason why the traditional subsistence agriculture of these regions is sometimes based on root crops (e.g. cassava, yams) rather than cereals. For most crops and cultivars, fertilizer response will be poor so long as the soil reaction remains strongly acid. Liming is a technically feasible solution, but at the high levels of lime required, this may not be economic, particularly because of high transport costs in countries which lack local supplies of lime.

FIGURE 3
Countries most affected by soil constraints:aluminium toxicity

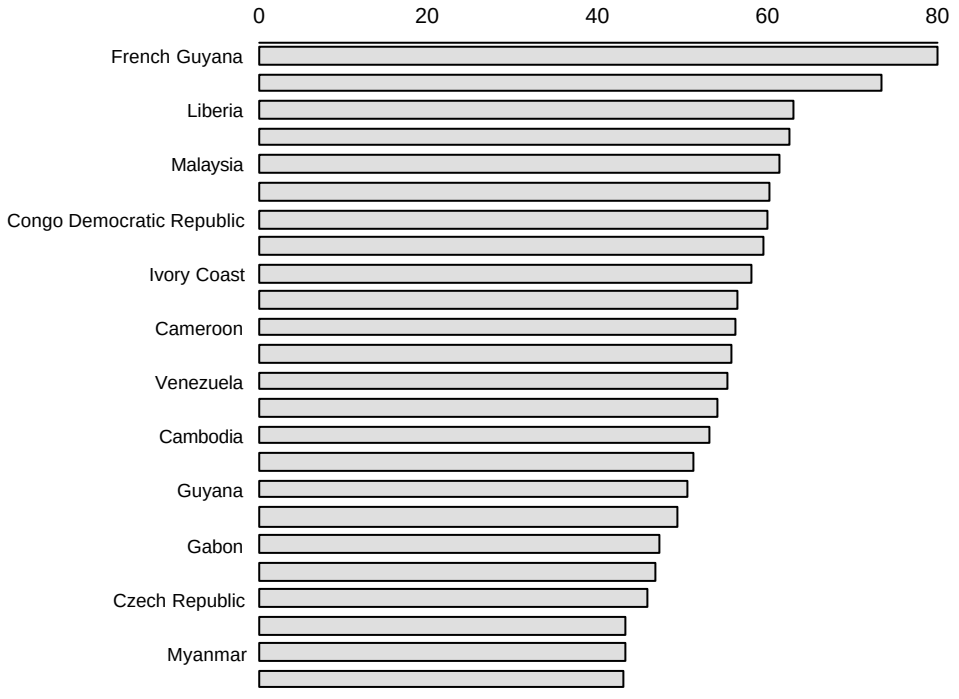
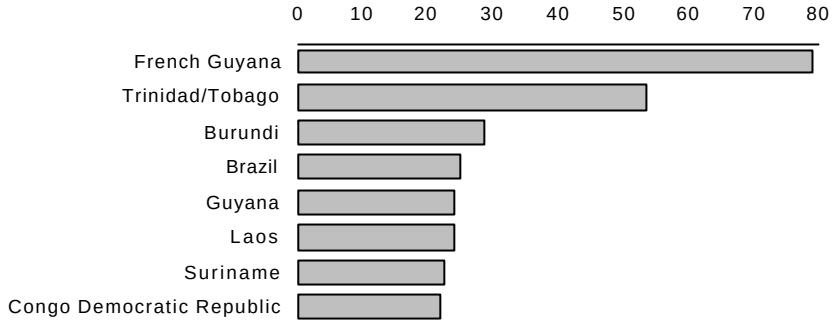


FIGURE 4
Countries most affected by soil constraints: high phosphorus fixation



High phosphorus fixation

This problem is caused primarily by a high content of free ferric oxides (Fe_2O_3) in the clay fraction, which fix phosphate ions in unavailable forms. It is a feature also found in strongly acid soils, and hence commonly associated with the previous constraint, aluminium toxicity.

Of the eight countries with more than 20% of land affected by high phosphorus fixation, all except two (Trinidad and Tobago, Burundi) appear also among the countries most affected by aluminium toxicity (Figure 3). Phosphorus fixation is found particularly in Brazil and a group of three countries along its northern borders.

The phosphorus deficiency caused by this constraint is difficult to overcome, since added phosphate fertilizers rapidly become fixed. Slow-release forms of phosphorus are preferable, and recent research on the addition of rock phosphate represents a significant attempt to ameliorate this problem.

Vertic properties

Vertic properties, the FCC term applicable largely to Vertisols ('black cotton soils'), are the properties possessed by black or dark-coloured clayey soils which swell on wetting and shrink, causing wide cracks, in drying. The cause is a high clay content coupled with >50% 2:1 lattice (montmorillonitic) clay minerals.

The distribution of Vertisols is highly localized, being linked with mafic (basic) rocks, semi-arid climates, or both these conditions. The greatest absolute extents are found in India (the lavas of the Deccan), Australia, and Sudan (especially the Gezira zone). Twelve countries, in all the major continental regions, have over 10% of their land with vertic properties, Uruguay and India having the highest relative extent.

Vertisols are chemically fertile and have moderate organic matter contents, but their management for cultivation is difficult owing to their physical properties: stiff and sticky when wet, hard when dry. Root damage can occur during development of cracks. Some Vertisols are under annual crops including, although by no means only, cotton, whilst others remain as pasture.

Salinity and sodicity

Saline and sodic (natric) soils occur naturally on low-lying sites in semi-arid to arid regions. They are caused by accumulation of free salts in the profile (salinity), or dominance of the exchange

FIGURE 5
Countries most affected by soil constraints: vertic properties

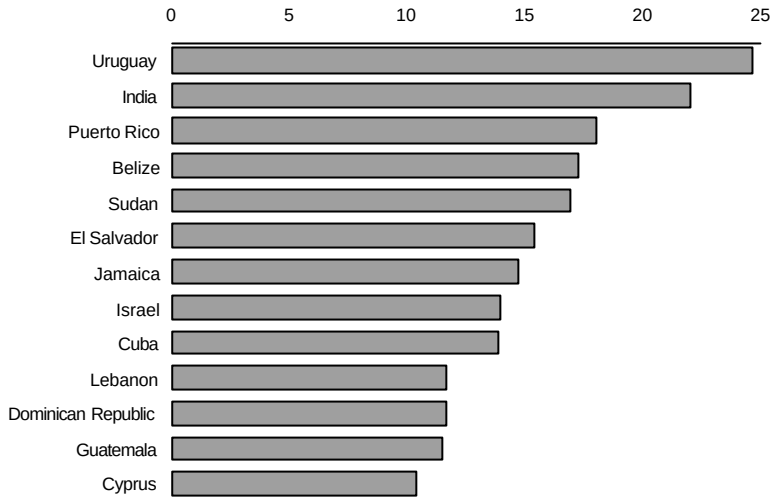
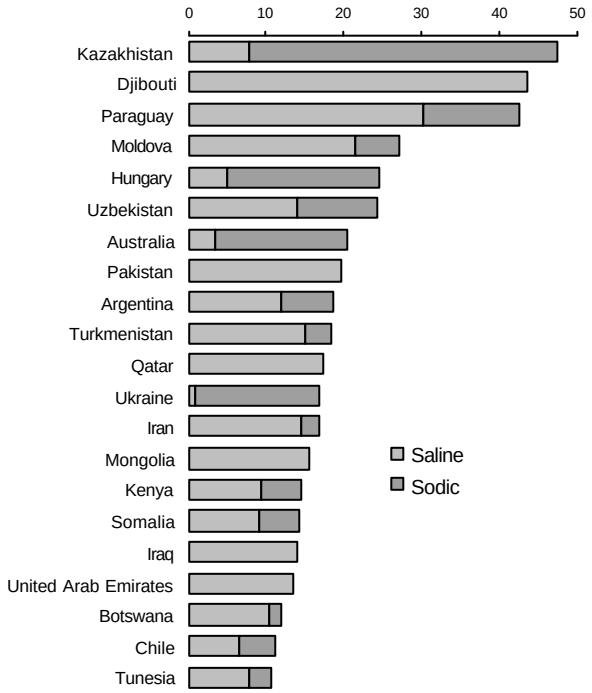


FIGURE 6
Countries most affected by soil constraints: salinity and sodicity



complex by sodium ions (sodicity). The areas shown on the Soil Map of the World, andthusrepresented in Figure 6 and Appendix 1, largely exclude secondary salinization caused by poor management of irrigation schemes.

Salinity is a problem in many parts of the semi-arid and arid zones. Of the 21 countries with over >15% of their land affected, 13 lie in a broad belt extending from the African Sahara and

its bordering sahel zone through the Middle East and into Central Asia. Sodicity appears to be even more strongly localized, with six countries (three of them in Central Asia) affected over more than 10% of their extent. However, some of the contrasts are undoubtedly caused by differences of interpretation, as between countries, over what constitutes a sodic soil.

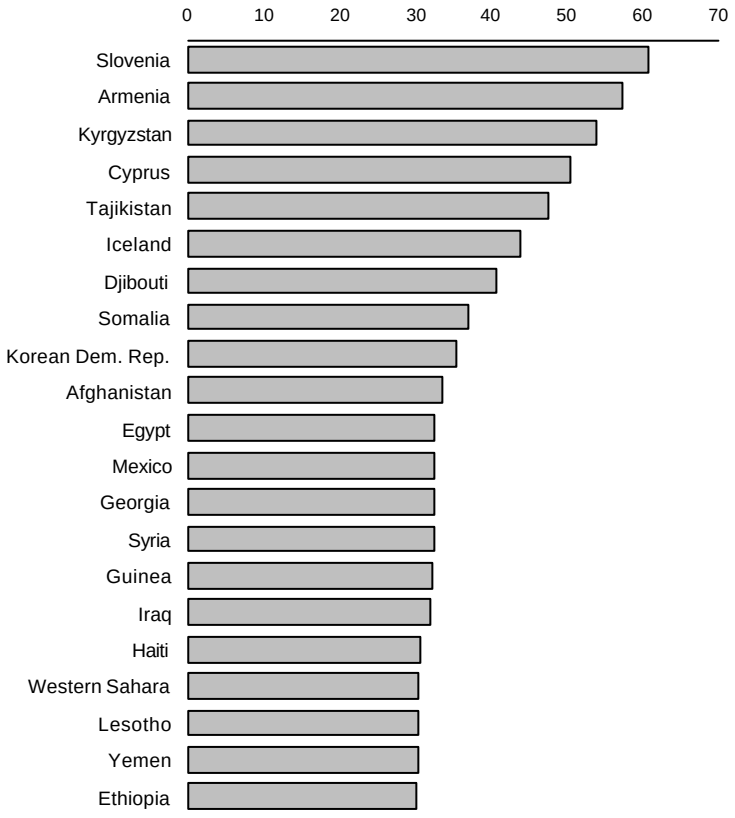
Reclamation of naturally saline soils is generally uneconomic or impractical, owing to the cost or unavailability of non-saline water, whilst schemes to reclaim salinized soils of irrigation schemes are extremely costly. Sodicity is still more difficult to overcome although methods exist, involving drainage, leaching and vegetation. Mildly saline soils can be used for salt-tolerant crops (e.g. date palm, barley, cotton).

Shallowness

The limitation of shallowness applies to soils with rock or a hard, cemented horizon near the surface. In the FCC a maximum depth of 50 cm is specified, but the majority of the mapped area has <30 cm depth. These soils are often stony or gravelly, prone to desiccation, and frequently occur on steeplands (see Chapter 3).

The world distribution of shallow soils (now known as Leptosols, formerly as Lithosols, Rendzinas and Rankers) shows a moderate degree of correspondence with major mountain ranges, together with some polar and arid regions. These three sets of environments account for most of the countries shown as most widely affected.

FIGURE 7
Countries most affected by soil constraints: shallowness



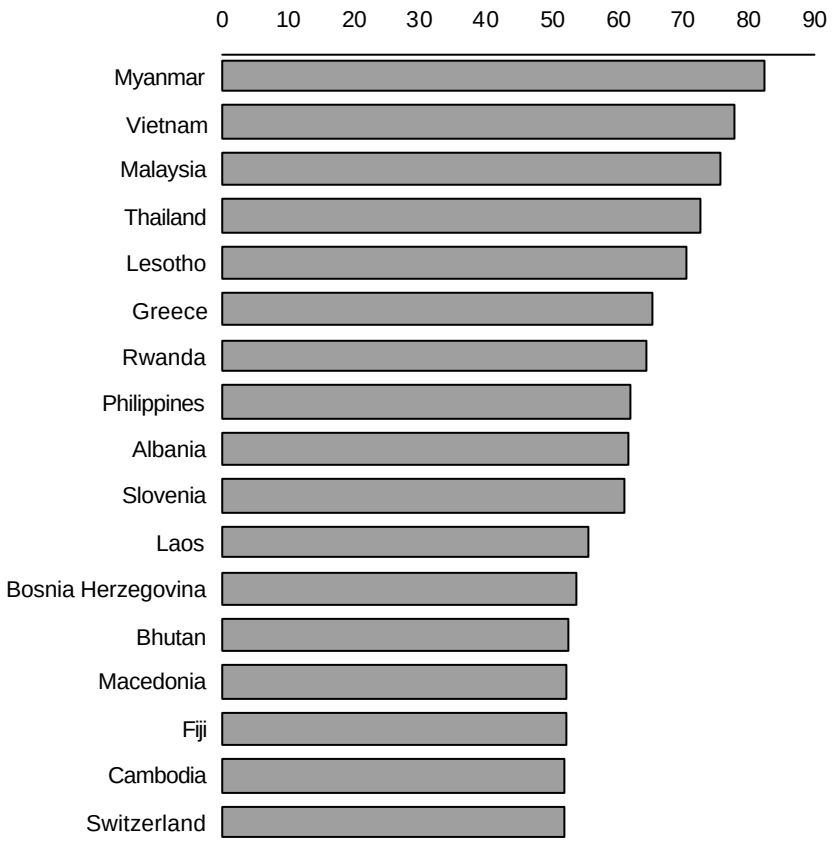
Pressure of population on land has resulted in the cultivation of shallow soils on steep slopes becoming quite widespread in the tropics. Such cultivation is likely to be short-lived unless measures are taken to check erosion; areas of irreversibly degraded, abandoned land are found (e.g. in Haiti). Most such land should be kept under natural vegetation, and used for grazing or recreational purposes. An exception is the case of Rendzinas, shallow soils over limestone, which under careful management can be highly productive for grain production, as in the UK.

Erosion hazard

Many attempts have been made to map degrees of erosion hazard. The basis employed here is to identify areas on the Soil Map of the World having predominantly very steep slopes (>30%), together with areas of steep slopes (8-30%) in conjunction with an abrupt textural contrast in the soil profile, denoting these as having a severe erosion hazard.

The world area having high erosion hazard is somewhat greater than for the other major soil constraints: shallowness, aluminium toxicity, and hydromorphy. This justifies the strong emphasis which has been given to control of erosion as a prerequisite for good soil management. The countries mapped as having the greatest relative area prone to erosion show a somewhat erratic distribution, far from coincident with those in which water erosion has, to date, been the most severe.

FIGURE 8
Countries most affected by soil constraints: erosion hazard



There is a large body of research, published studies and technical manuals on control of soil erosion, including many produced by FAO (e.g. FAO 1977, 1987, 1991). The former focus on earth structures (bunds, terraces, etc.) has given way to the present approach (often known as better land husbandry) which places great emphasis on acceptance and adaptation of conservation practices by local farming communities, as well as on the use of biological methods (e.g. agroforestry) (Shaxson *et al.*, 1989; Douglas, 1994). There is much to be learnt from indigenous soil conservation methods (FAO *et al.*, 1998c). It is clearly recognized that the physical circumstances giving rise to a high potential erosion hazard, as identified here, are not the sole cause of erosion; equally important are the social and economic conditions of land users which may force them to cultivate (or graze upon) unsuitable land, or which fail to provide them with incentives for conservation. Since the circumstances of erosion, and the perceived benefits from adoption of conservation measures, vary so widely with site-specific physical, social and economic conditions, there is much scope for closer dialogue between concerned institutions and land users.

SOILS WITHOUT MAJOR CONSTRAINTS

A range of soils exists which are not affected by any of the eight major constraints covered above. Some fall into the dryland zone, discussed below, and others possess constraints within the soil fertility capability classification which are not included above, because they are either less severe or of relatively low extent.[1] These certainly cannot be called 'soils without problems', as any farmer would testify! Based on the method by which these have been identified, they may be referred to simply as soils without major constraints.

In terms of the classes shown on the Soil Map of the World, the soils without major constraints fall particularly, but not entirely, into the major soil groups of Chernozems, Kastanozems, Nitisols, Luvisols, Phaeozems and Cambisols.

Just under a quarter of the world's land area has soils which lack the eight major constraints of the fertility capability classification (Table 3). North Asia (east of the Urals) has the largest total and relative extent, caused particularly by the broad belt of Chernozems and Kastanozems which stretches across the region. The Asia-Pacific region and North America have the next highest total extents of such soils, and six of the eight regions have between 18 and 31%. The exception is North Africa and the Near East with only 9%, to which must be added the constraint of dryness which affects most of the region.

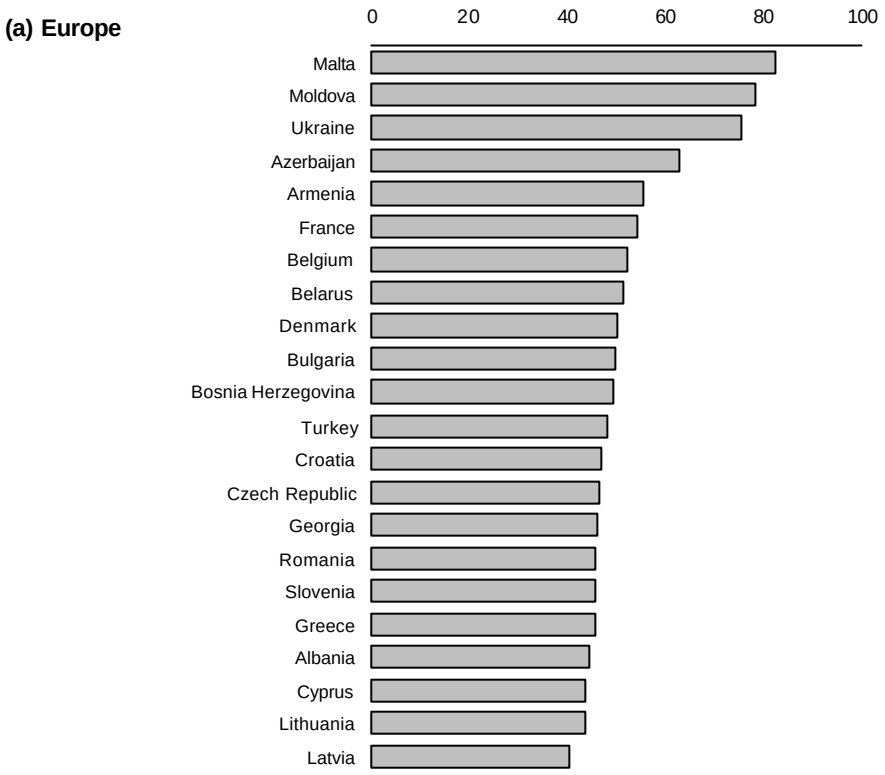
TABLE 3
Area of soils without major constraints by region

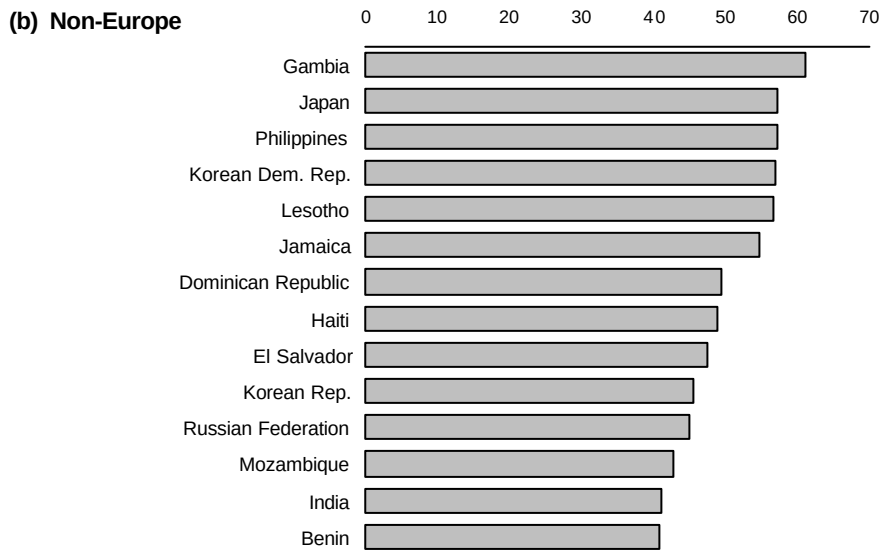
	('000 km^2)	%
Sub-Saharan Africa	4346	18
North Africa and Near East	1081	9
Asia and Pacific	6743	23
North Asia, east of Urals	8460	40
South and Central America	3972	19
North America	5117	27
Europe	2104	31
World	31823	24

A notable feature of the country-level results is that 22 of the 36 countries with over 40% soils without major constraints lie in Europe. This includes the extension of the Chernozem-Kastanozem belt into the Ukraine and adjacent countries. Among non-European countries, the

[1] These additional constraints are: acidity; dominance of allophane in the clay fraction (Andosols); potassium-deficiency; free calcium carbonate; acid sulphate soils (cat clays). Dryness (an ustic or xeric soil moisture regime) is also recognized by the fertility capability classification as a soil limitation.

FIGURE 9
Countries with >40% of soils without major constraints: (a) Europe; (b) non-Europe





greatest total extent by far is found in the Russian Federation (7.7 M km^2). Next in order of absolute area are the United States, Canada, China, Australia, India and Argentina. There is a striking coincidence between countries with high total areas of soils without major constraints and the world's leading grain-producing and exporting countries. Some of the smaller non-European countries listed suggest, to those with personal knowledge of these countries, anomalies in the data.

Chapter 3
Drylands and steeplands

In *Agenda 21,* the programme of action arising out of the 1992 UN Conference on Environment and Development (UNCED, 1992), two sets of environmental conditions are identified as fragile ecosystems, namely drylands and mountain regions[1]. Drylands are described as such primarily because of their desertification hazard. Mountain regions are identified as fragile through a combination of problems, combining erosion hazard with forest clearance and other forms of land degradation. The special problems of these two types of environment, brought about respectively by climate and landforms, are additional to their soil constraints.

DRYLANDS

All the major continents face problems of land degradation in dryland areas, commonly known as desertification[2]. Dryland areas are 'fragile' in that they are extremely vulnerable to land degradation resulting from over-grazing and other forms of inappropriate land use. There have been a number of previous attempts to map desertification hazard (UNEP, 1984) and actual desertification (Middleton and Thomas, 1997). Here, an attempt is made to identify dryland conditions and desertification hazard in a similar manner to the soil constraints, estimating their world and regional extents, together with the countries most affected. Also identified are countries in which significant concentrations of population are found within drylands, extending previous work at the regional scale (Nachtergaele *et al.*, 1996; UNSO-UNDP, 1997).

Methods

In the earlier FAO work, directed primarily at the tropics, agro-ecological zones were defined on the basis of length of growing period for annual crops, taken as the period during which the soil profile remained humid and temperature permitted crop growth (FAO, 1978). Since in temperate latitudes it is primarily temperature that restricts the growing period, it was necessary to redefine the length of growing period, taking the temperature factor into account in more detail (e.g. various temperature limits are used to define periods of dormancy and of killing frosts). This study makes use of the climatic database developed by Leemans and Cramer (1991), and identifies the length of growing period as limited both by temperature and soil moisture, based on the method of Fischer *et al.* (1995).

The results have been grouped into four classes of length of growing period (LGP):

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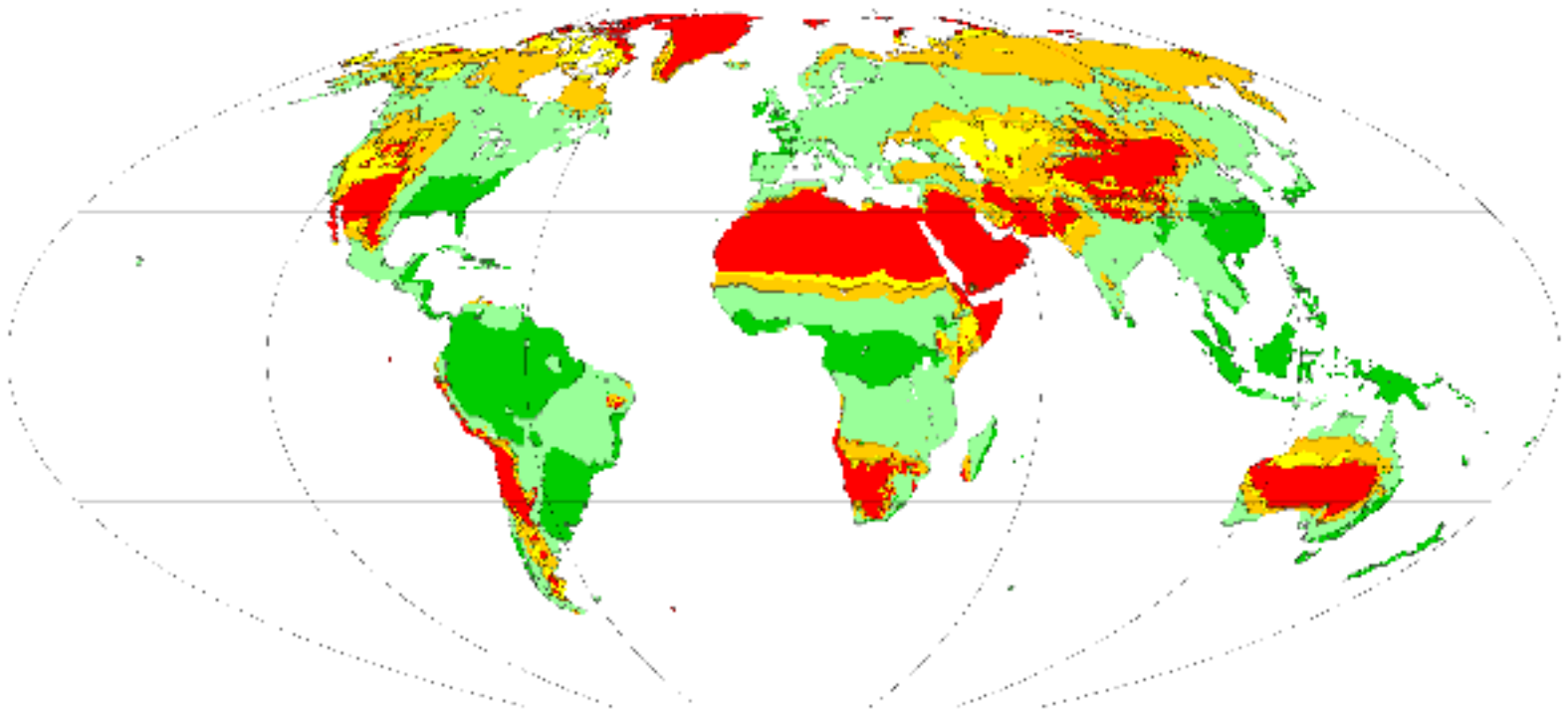
1 *Agenda 21* also describes wetlands, small islands, and coastal areas as fragile ecosystems.

2 Following the first UN Conference on Desertification in 1977, the term 'desertification' came to be loosely applied, sometimes to all forms of land degradation, and was subject to exaggerated claims. It is now defined as land degradation in arid, semi-arid and dry subhumid areas (UNEP, 1997)

Dryland Zones of the World



hyperarid | arid | semi-arid | dry subhumid | non-dryland

Flat_polar_quartic Projection

FAO -GIS, March 2000

- Hyperarid: LGP zero days
- Arid: LGP 1-59 days
- Semi-arid: LGP 60-119 days
- Dry subhumid: LGP 120-179 days

The concept of drylands continues to be debated (Eswaran, 1998). In this study, *drylands* are taken as areas with a potential hazard of desertification. The hyperarid zone is not subject to desertification and is therefore excluded. Hence drylands are defined as the arid, semi-arid and dry subhumid zones, or areas with lengths of growing periods of 1-179 days.

Results

The hyperarid, or extreme desert, environment covers 25.6 M km^2, or 19% of the global land surface.

Drylands vulnerable to desertification cover 45% of the global land surface, with 7, 20 and 18% respectively in the arid, semi-arid and dry subhumid zones. The North Asia (east of Urals) region is dominated by dryland conditions (95%), but all regions have substantial parts of their land resources in the arid to semi-arid zones (Figure 10).

FIGURE 10
Percentage of total land area taken up by desert and dryland areas per region

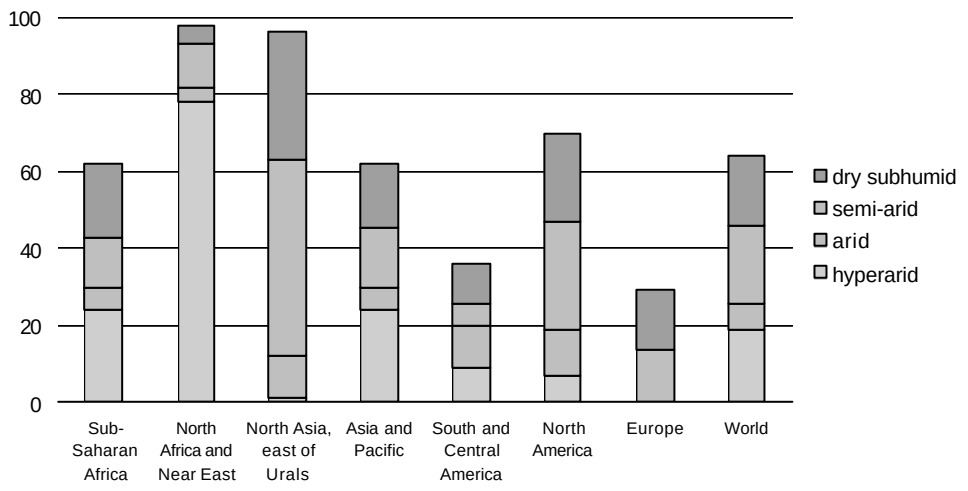


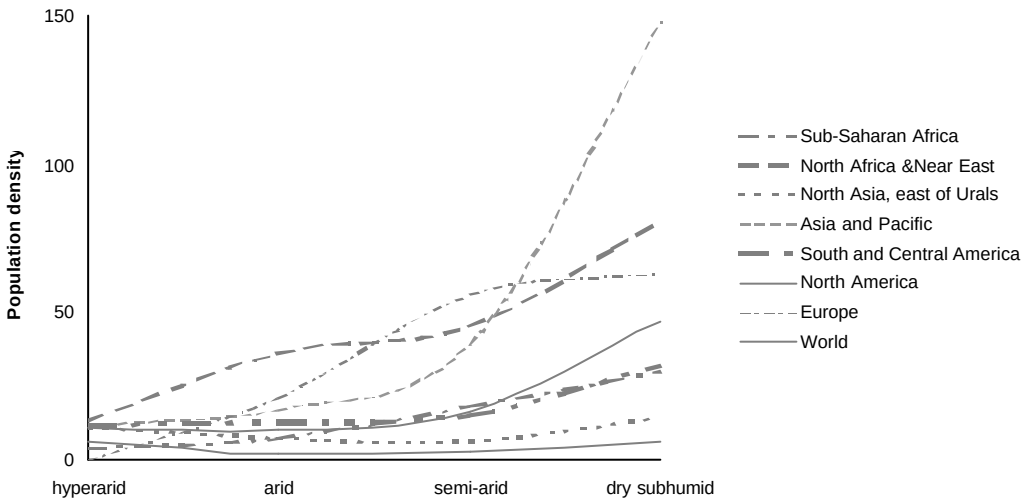
TABLE 4
Area of drylands by length of growing period zone and region

	Hyperarid	Arid	Semi-arid	Dry subhumid	Drylands (total)
	% of total area	% of total area	% of total area	% of total area	% of total area
Sub-Saharan Africa	24	6	13	19	38
North Africa & Near East	78	4	11	5	20
North Asia, east of Urals	1	11	51	33	95
Asia and Pacific	24	6	15	17	38
South & Central America	9	11	6	10	45
North America	7	12	28	23	63
Europe	0	<0.5	13	16	29
World	19	7	20	18	45

TABLE 5
Population density by length of growing period zone and region

	Hyperarid	Arid	Semi-arid	Dry subhumid	Drylands (total)
Sub-Saharan Africa	4	7	19	30	22
North Africa & Near East	13	36	45	81	52
North Asia, east of Urals	12	7	5	14	8
Asia and Pacific	12	17	39	147	84
South & Central America	12	13	15	32	24
North America	6	2	3	6	4
Europe	0	21	56	65	61
World	6	2	10	26	28

FIGURE 11
Population density in desert and dryland areas



It is not always appreciated how substantial a proportion of the world's population lives in drylands. Approximately 1.7 thousand million people, or 38% of the world's population, live in the arid, and the dry and moist semi-arid zones, and a further 270 million (6%) in the hyperarid zone. In the first comprehensive attempt to estimate the population carrying capacity, completed in the early 1980s, a notable feature of the maps and country results was how frequently the semi-arid zone was assessed as 'critical', that is, having current or future populations in excess of their capacity for food production (FAO/UNFP/IIASA, 1983; FAO, 1984).

Two approximate indicators of desertification risk, based on area and population respectively, have been produced by the Office to Combat Desertification and Drought (UNSO/UNDP, 1997). These are:

- area of drylands as a percentage of agriculturally productive land;
- population on drylands as a percentage of population on agriculturally productive land;

where: drylands = arid + dry semi-arid +moist semi-arid zones;
agriculturally productive land = total land area – hyperarid zone.

These indicators are shown for countries in Appendix 3, Tables A3a-g. A summary at regional level is given in Table 6.

TABLE 6
Desertification risk and population level by region

	Desertification risk (UNSO, 1997)		
	Population in drylands (%)	**Based on area of drylands (%)**	**Based on population on drylands (%)**
Sub-Saharan Africa	36	50	37
North Africa & Near East	44	91	79
North Asia, east of Urals	89	96	89
Asia and Pacific	44	50	46
South & Central America	24	19	25
North America	19	68	19
Europe	18	29	19
World	38	57	41

Based on these indicators, 57% of the world's potentially productive area is located in drylands, which carry 41% of world population. On the criterion based on area, over 90% of North Africa and the Near East are vulnerable to desertification, and at least 50% of land in four of the seven regions. On the criterion based on population, North Asia (east of the Urals) has an even higher risk than North Africa and the Near East.

At country level, in order to prevent exaggeration of desertification risk, countries lying largely or entirely in the hyperarid zone were first assigned a risk of zero. These nine countries are listed in Table 7.

Having excluded the hyperarid zone, desertification risk at country level was assessed on the two criteria above (Appendix 3, Table 3a-g). Globally, 25 countries have over 90% of their potentially productive land located in drylands, of which 12 have 100% (Table 8). Based on the criterion of population, 23 countries have >90% of their people living in drylands.

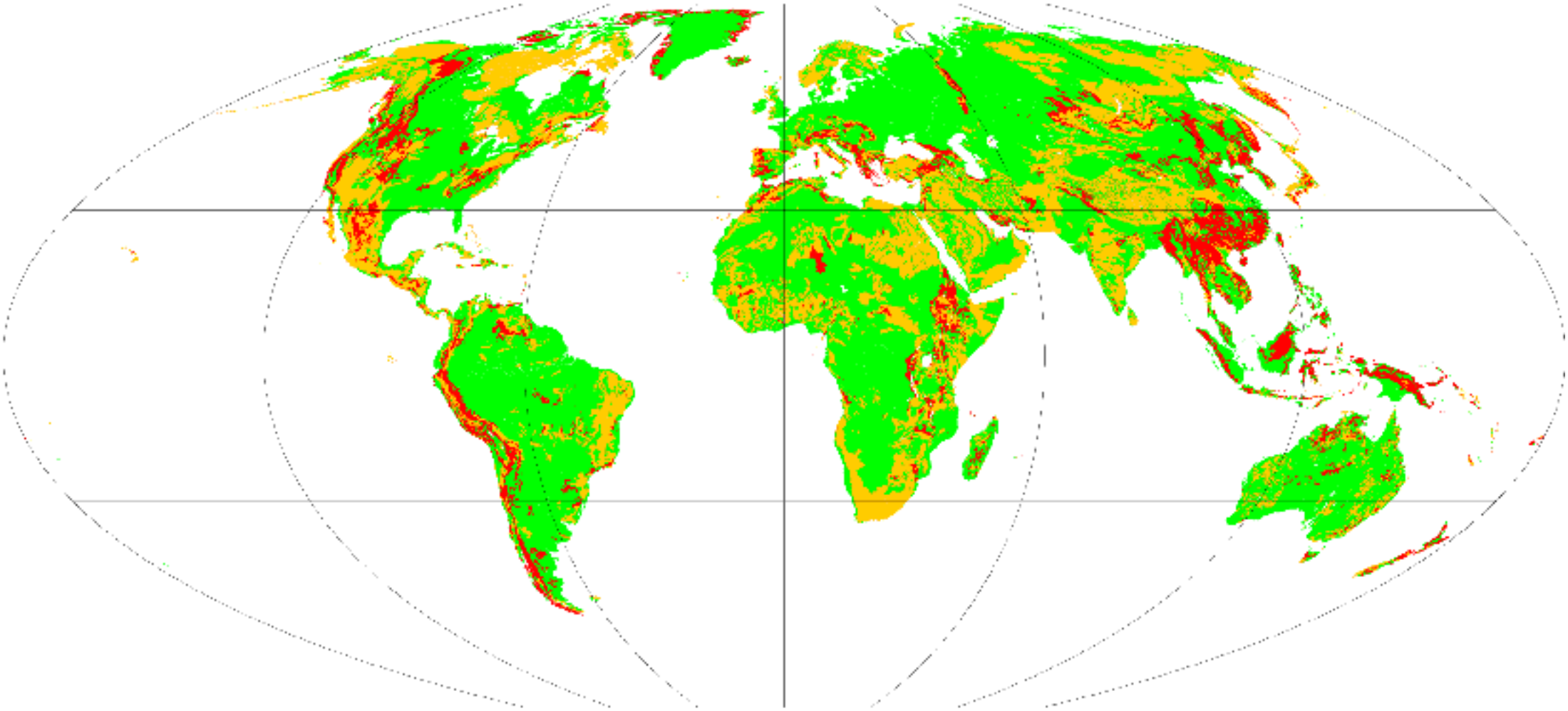
TABLE 7
Countries with >95% of territory in the hyperarid zone

Djibouti	Kuwait
Egypt	Oman
Libya	Qatar
Western Sahara	Saudi Arabia
	United Arab Emirates

TABLE 8
Countries with high vulnerability to desertification

Drylands 100 % of agriculturally productive area				
Afghanistan	Jordan			Pakistan
Armenia	Mauritania			Senegal
Botswana	Mongolia			Somalia
Cyprus				Zimbabwe
Drylands 90-100% of agriculturally productive area				
Botswana	Senegal	Iraq	Mongolia	Cyprus
Chad	Somalia	Jordan	Armenia	Finland
Eritrea	Gambia	Syria	Pakistan	Israel
Mali	Zimbabwe	Yemen	Uzbekistan	Iran
Mauritania	Afghanistan	Kazakhstan	Namibia	Macedonia
Population on drylands >90% total population				
Botswana	Namibia	Afghanistan	Yemen	Cyprus
Burkina Faso	Niger	Iran	Kazakhstan	Israel
Chad	Somalia	Iraq	Mongolia	Macedonia
Eritrea	Zambia	Jordan	Pakistan	
Mauritania	Zimbabwe	Libya	Armenia	

Steeplands of the World



Dominant

Present

Absent

Flat Polar Quartic Projection

FAO-GIS, March 2000

STEEPLANDS

Agenda 21 (UNCED, 1992) identifies 'mountain regions' as a second fragile environment, but does not precisely define these. By implication, they are regarded as having a combination of steep slopes with high altitude, coupled with particular roles in forest production, as water catchments, as reserves of biological diversity, and for recreation.

Although often found at high altitudes, as mountain regions, steeplands need not necessarily be so. Low-altitude hill ranges and dissected scarplands (e.g. on the margins of the African Rift Valley) share many of the same problems. The dominant environmental feature is steep slopes, which in combination with deforestation bring about land degradation through landsliding and soil erosion. There is an established body of research on the problems of steeplands (e.g. Moldenhauer and Hudson, 1988).

Methods

The *Soil Map of the World* recognized three slope classes:

Level to gently undulating	dominant slopes 0-8%
Rolling to hilly	dominant slopes 8-30%
Steeply dissected to mountainous	dominant slopes >30%

Areas in the second and third of these classes are shown at country level in Appendix 4. However, it is clear from inspection of the areas mapped that it is the third class, with dominant slopes >30%, which should be taken as diagnostic of steeplands.

These slope classes were not the primary mapping units of the *Soil Map of the World*, but were added to the areas mapped for soils. It is therefore probable, on *a priori* grounds, that they are less accurate than would have been obtained from mapping specifically directed at landforms.

A means of comparing two independent sources was available from a current FAO digital soil and terrain map of East Africa at 1:1.5 million scale. Variations as between the two estimates are not systematic, and in many cases not large in terms of absolute area[3]. However, in terms of relative area, many of the differences are often substantial (Table 9). Unfortunately, the largest differences occur where slope is most significant, in the >30% slope class, for which the percentage areas shown by one source are often half, or twice or more, those shown by the other. It is likely that data reliability will be improved by the World Soils and Terrain Digital Database (SOTER) (ISRIC, 1993), in which slope forms an integral, rather than supplementary, part of the mapping procedure.

TABLE 9
Percentage areas by slope class for selected countries of East Africa. SMW: Soil Map of the World. DMEA: Digital Soil and Terrain Map of East Africa. Areas are rounded to the nearest whole percent.

	<8%		8-30%		>30%	
	SMW	DMEA	SMW	DMEA	SMW	DMEA
Burundi	32	20	50	53	18	27
Egypt	46	45	40	49	13	6
Kenya	51	51	34	43	15	6
Rwanda	21	8	45	36	34	56
Sudan	63	66	29	31	8	3
Somalia	53	64	35	30	12	6
Uganda	52	43	39	49	12	6

[3] It is not known which is the more correct, although the East Africa map is at a larger scale.

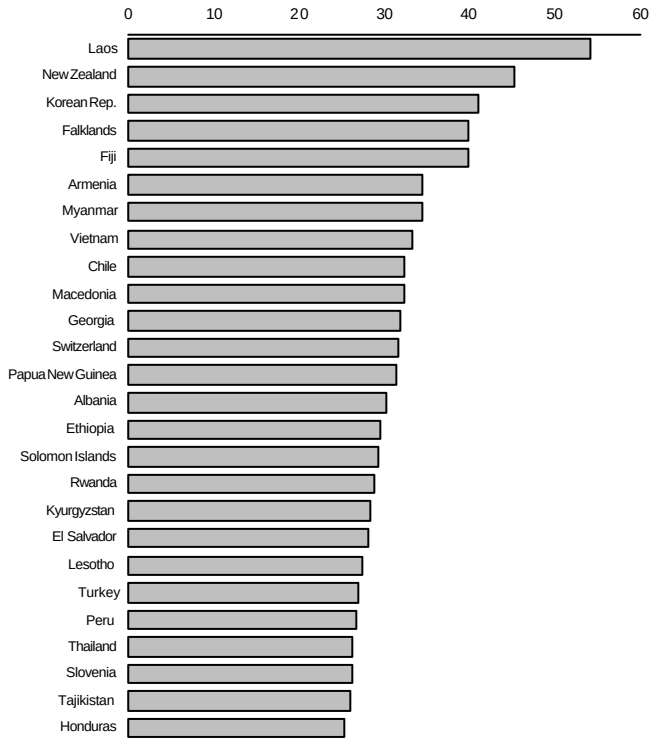
Results

Areas in the slope classes rolling to hilly (steep slopes) and steeply dissected to mountainous (very steep slopes) are shown by country in Appendix 4, Table 4a-g. Worldwide, steeplands occupy nearly 15 M km^2 or 11% of the land area. The greatest absolute areas are found in China, the Russian Federation, the United States, and Canada. China's problems in finding sustainable management for its vast tracts of steeplands are well-recognized. In Africa, the greatest extent is found in Ethiopia, whilst in Central and South America, Mexico and Peru both have over 340 000 km^2 of steeply-sloping terrain.

The countries with the highest relative extent of steeplands are shown in Figure 12. They fall into recognizable groups, mainly associated with the major mountain chains of Eurasia (Switzerland, Albania, Macedonia, Turkey, and 5 countries of Central Asia), the Andes of South America (Chile, El Salvador, Peru, and Honduras), south-east Asia (Laos, Korean Republic, Myanmar, Vietnam, and Thailand), and Oceania (New Zealand, Papua New Guinea, and Fiji). The three African countries represented, Rwanda, Lesotho, and Ethiopia, owe their steeplands not to recent folding but dissection of uplifted plateaux, whilst in two island states, the Falklands and Solomon Islands, the sloping lands are volcanic in origin.

The constraint of steep slopes is by no means confined to the most-affected group in Figure 12. Some 50 countries have >20% of their area under steeplands, those in the 20-25% range including some that are widely recognized as having mountainous or steeply-sloping hill regions, for example Haiti, Afghanistan, Nepal, Jamaica and Malawi. All these countries number the constraints of steeplands among their leading problems of land management, and conversely, benefit from the resource potential (for water, forestry, wildlife, etc.) which such areas offer.

FIGURE 12
Steeplands: countries with >25% of land dominated by very steep (>30%) slopes



Chapter 4
Land degradation

Land degradation refers to the temporary or permanent reduction in the productive capacity of land as a result of human action. It is recognized that land degradation is a problem that is widespread, and in some areas severe. Until recently, however, there was little or no basis for estimating its extent and severity. Exaggerated claims were sometimes made for the extent of soil erosion and (supposed) desertification (Young, 1998).

The first attempt to improve upon this absence of data was made in the late 1980s, when the International Soil Reference and Information Centre (ISRIC), in conjunction with UNEP, undertook a global inventory of the status of human-induced soil degradation (Oldeman *et al.*, 1990, 1991; UNEP, 1992; Oldeman, 1994). The Global Assessment of Soil Degradation (GLASOD) was based on a structured recording of the type, severity and extent of degradation, together with its major causes. The GLASOD survey remains the only uniform global source of land degradation data.

METHODS

The GLASOD survey

The method employed for the GLASOD survey is set out in full in Oldeman et al. (1990). In summary, a set of mapping units, relatively homogeneous in their physical characteristics, was established. For each mapping unit, national experts were asked to estimate:

- Type of degradation: water erosion, wind erosion, chemical deterioration, physical deterioration, and subdivisions of these.
- Degree of degradation: light, moderate, strong, extreme.
- Relative extent of degradation, as percentage of the mapping unit affected.
- Causative factors of degradation: deforestation, overgrazing, agricultural activities (improper agricultural management), overexploitation of vegetation (cutting for fuelwood, etc.), industrial activities (pollution).

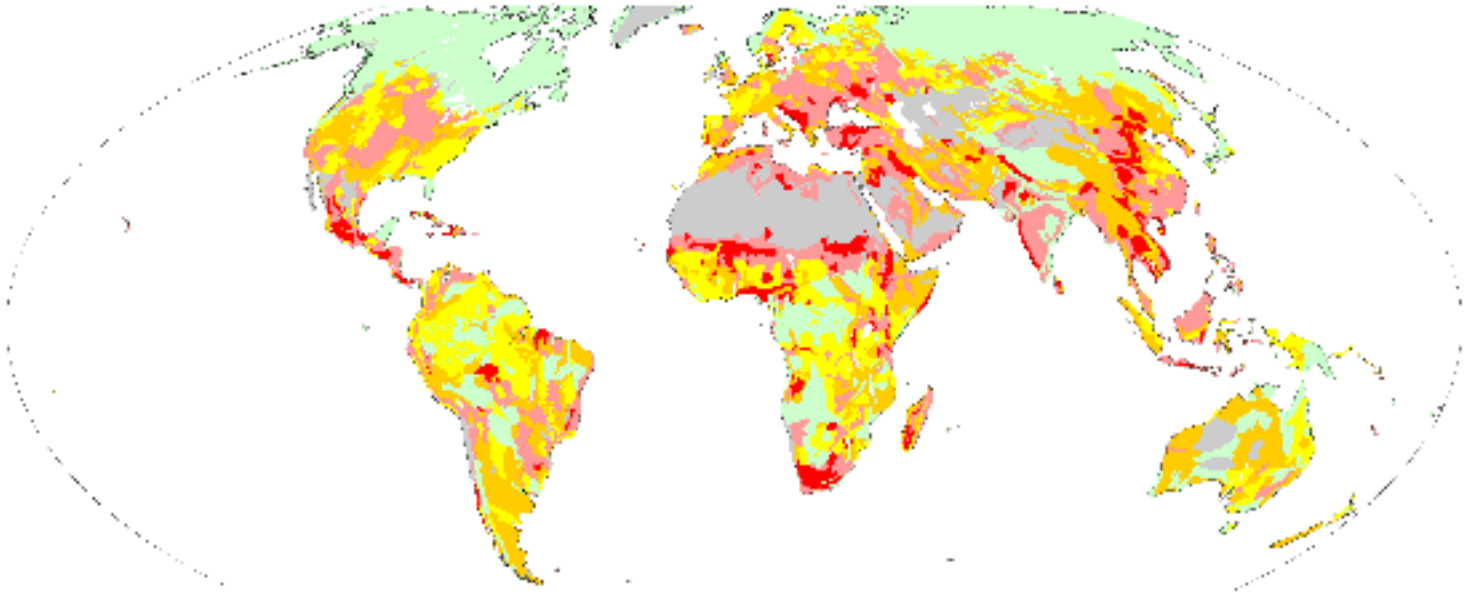
The full set of definitions may be found in Oldeman *et al.* (1990). For present purposes, it is important to note the degrees of degradation, defined in terms of reductions in land productivity. In abbreviated form, these definitions are as follows:

- Light: somewhat reduced agricultural suitability.
- Moderate: greatly reduced agricultural productivity.
- Strong: biotic functions largely destroyed; non-reclaimable at farm level.
- Extreme: biotic functions fully destroyed, non-reclaimable.

Severity of Land Degradation

according to

The GLASOD Study (UNEP - ISRIC)



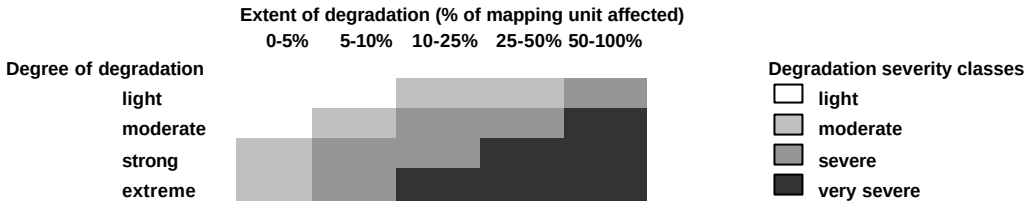
light | medium | high | very high | stable terrain | non-used wasteland

Mollweide Projection

FAO -GIS, March 2000

Soil degradation severity is obtained by combining the degree of degradation with its spatial extent. With four classes for degree, and five for extent, twenty combinations are possible. These were grouped into four *degradation severity classes*: light, moderate, severe, and very severe (Figure 13)[1]. A very severely degraded area can mean, for example, either that extreme degradation affects 10-25% of a mapping unit, or that moderate degradation affects 50-100% of the unit.

FIGURE 13
Land degradation severity classes



The results of the GLASOD survey were initially published as a map at a scale of 1:15 million, showing the dominant (most severe) type of degradation for each mapping unit as a colour, and the degradation severity as intensity of colour. This highlights which type of degradation is dominant in each region, but makes it difficult to isolate the degree of severity of each type. A clearer overview is given by the smaller scale maps in UNEP (1992), showing overall soil degradation severity (Map 4) and the severity of each type of degradation.

The GLASOD data were derived from estimates by over 290 national collaborators, moderated by 23 regional correlators. These estimates were based upon defined mapping units and a carefully structured set of definitions, but ultimately they were dependent on local knowledge rather than surveys. The results are thus to a degree subjective, and open to the criticism that local experts may have allowed perceived correlations with other factors, or even the vested interests of conservation institutions, to influence their judgment. Until methods are established for surveying and monitoring the status of land degradation, however, there is no better source of global data.

Interpretation of the GLASOD data in this study

The present study is based on analysis of the original GLASOD data, digitized, and identified for individual countries. It would have been possible to take either degree or severity of degradation as the basis. Degree of degradation answers the question, "What proportion of the total land area has its productivity reduced by the defined amount?" Table 10 shows degree of soil degradation by percentage of area covered[2]. Combining the world figures for strong and extreme degradation gives the best current estimate of land which has been largely, and for most practical purposes irreversibly, destroyed by land degradation. The total is 3.05 M km^2, or 305 M ha. This may seem small if regarded as 2.3% of the world's land area, but its seriousness is considerably

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1 The original GLASOD survey calls these classes low, medium, high and very high; Here terms more descriptive of degradation severity have been substituted.

2 Because these data are taken directly from the GLASOD published results, the regional units are different from those employed in the present study.

TABLE 10
Degree of soil degradation by subcontinental regions (% of total area)

	None	Light	Moderate	Strong	Extreme
Africa	83	6	6	4	0.2
Asia	82	7	5	3	<0.1
Australasia	88	11	0.5	0.2	<0.1
Europe	77	6	15	1	0.3
North America	93	1	5	1	0
South America	86	6	6	1	0
World:					
Percentage	85	6	7	2	<0.1
Area ('000 km^2)	110 483	7490	9106	2956	92

Source: World Atlas of Desertification (UNEP,1992)

greater, for it is equivalent to 21% of the present arable area of 14.6 M km^2 (this figure is quoted for purposes of comparison; by no means all of the strong degradation has taken place on arable land). The total area with some degree of degradation, and thus with reduced productivity, is 19.6 M km^2.

Only one part of each mapping unit is affected by land degradation, although it is not known which part of the unit is degraded, and which is not. However, if only the actual degraded area is taken into account (as in Table 10), an underestimation of the problem area is likely to result for a number of reasons. First, it does not adequately consider the land surrounding the degraded site, and hence effects upon the farm enterprise. Secondly, off-site effects, such as sedimentation, are not included. Thirdly, land degradation on part of a farm, or other land use enterprise, has adverse effects upon the economy as a whole, whether at village, regional or national levels. Lastly, the percentages in Table 9 are on a base of total land area, and thus include deserts, mountains, and other land which is unused or used for non-agricultural purposes.

For these reasons, this paper takes soil degradation severity, a combination of the degree of degradation with its extent within mapping units, as the basis for analysis. Severity is an indicator of the overall seriousness of degradation, within a mapping unit, country or region.

SEVERITY OF DEGRADATION

Data for land degradation severity, together with the dominant causes and types of degradation, are shown by country in Appendix 5 Tables A5a-g. A regional summary of the severity data is given in Table 11. In South East Asia, virtually all land is regarded as degraded, more than 80% of it to at least a moderate degree. Ninety percent of the long-settled lands of Europe are degraded to some degree. The least degraded regions are North America and the Australia-Pacific region.

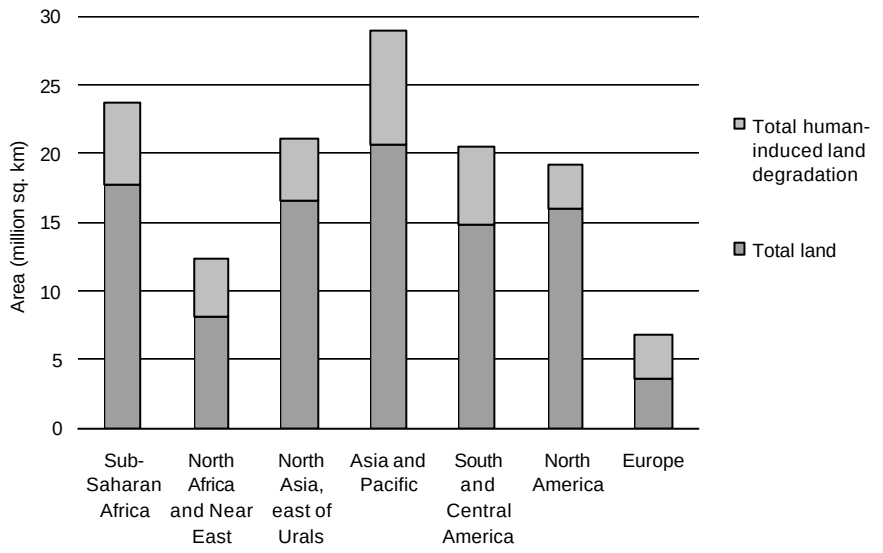
At country level, 58 countries, 21 of them in Europe, are reported as having no land at all in the severity class None, that is, every mapping unit in these countries has at least the Light degree of degradation severity. The countries with the highest proportion of land in the Severe and Very Severe classes are shown in Figure 15[1]. Fifteen countries have 99-100% of their land

[1] It seems likely from inspection of the data that national correspondents differed in their interpretation of what constitutes Severe and Very Severe degradation. These classes have therefore been combined.

TABLE 11
Land degradation severity by region (% of area by severity class)

	None	Light	Moderate	Severe	Very Severe	Total degradation: Light – Very Severe	Degradation: Moderate – Very Severe
Sub-Saharan Africa	33	24	18	15	10	65	42
North Africa & Near East	30	17	19	28	7	70	52
Asia and Pacific	28	12	32	22	7	72	61
North Asia. east of Urals	53	14	12	17	4	47	33
South & Central America	23	27	23	22	5	77	50
Europe	9	21	22	36	12	90	70
North America	51	16	16	16	0	44	29
World	35	18	21	20	6	65	47

FIGURE 14
Human-induced land degradation (severe and very severe) as percentage of total land area



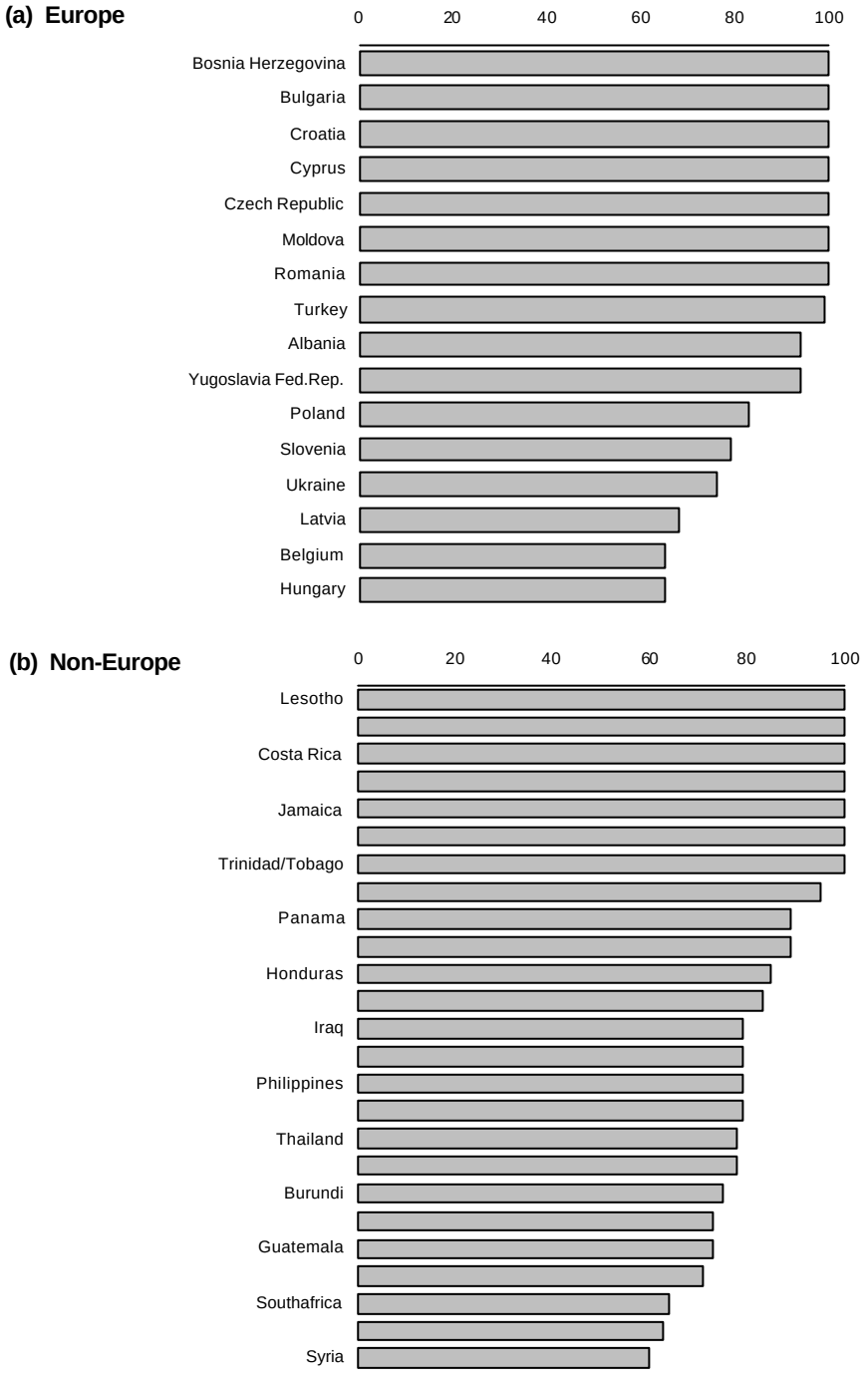
severely degraded. A further 17 have over 75% of land in this degradation severity class, and in total, 41 countries have over 60%. -Some of these countries correspond with expectation from field experience. Lesotho, Haiti and Madagascar, for example, are known to have exceptionally severe soil erosion[1]. Others may seem unexpected, for example Malaysia and Belgium.

SEVERE LAND DEGRADATION DUE TO AGRICULTURAL ACTIVITIES

Annual cropping (including shifting cultivation) is often blamed as a major cause of land degradation, and an attempt was therefore made to isolate such degradation. The GLASOD survey contains no data on land use, so degradation on cultivated land cannot be identified. It

[1] 'The world's most severe soil erosion is possibly found in Ethiopia, Lesotho and Haiti.' (Young, 1998).

FIGURE 15
Countries with >60% of land severely or very severely degraded: (a) Europe; (b) non-Europe



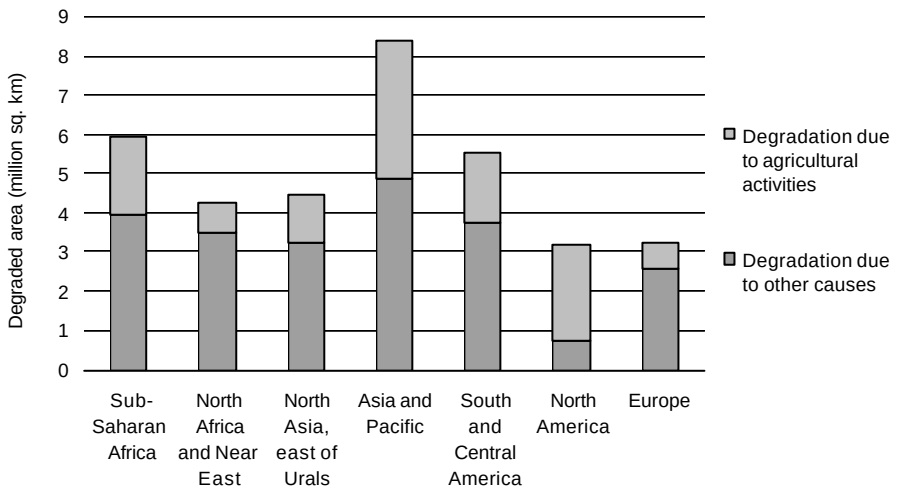
did, however, ask respondents to give, for each mapping unit, the principal causative factors of degradation, one of which was “agricultural activities”. When all such areas are mapped, they show a considerable degree of correspondence with the world’s cultivated land (UNEP, 1992). This causative factor (often recorded as a joint cause together with deforestation and overgrazing) can therefore be taken as an approximate indicator of degradation on agricultural land. Among

Table 12 shows, for areas degraded by agricultural activities only, the regional extent of severely degraded land (the sum of Severe and Very Severe classes). The global extent of such land is 12.4 M km^2, which is 35% of the total area of severely degraded land from all causes. The total area recorded, by land use statistics, as being presently under arable use is only slightly greater than this, 13.5 M km^2. Country information for severely degraded land is given in Appendix 6. Fourteen countries have 100% of land with agriculturally-caused degradation in the Severe and Very Severe classes.

TABLE 12
Human-induced severe and very severe land degradation due to agricultural activities

Region	Area extent ('000 km²)	% of total area	% of severely degraded land
Sub-Saharan Africa	1996	8	34
North Africa and Near East	759	6	18
North Asia, east of Urals	1180	6	27
Asia and Pacific	3506	12	42
South and Central America	1795	9	32
North America	2427	13	77
Europe	727	11	22
World	12391	9	35

FIGURE 16
Degradation due to agricultural activities as a percentage of total human-induced degradation



CAUSES OF DEGRADATION

General

The dominant causes of degradation, as given by GLASOD respondents, are shown at country level in the penultimate column of Tables A5a-g of Appendix 5. These causes are mapped at a world scale in UNEP (1992). At this broad level, the relations are very much as would be expected. As already noted, agricultural activities are given as a cause of degradation throughout most of the agricultural lands of the world, in all continents. Deforestation appears as a joint

cause with agriculture over large parts of these lands (e.g. Togo, Malaysia, Honduras, Costa Rica, Cuba, and island states of the Caribbean), and as a cause in its own right over much of the remainder of the rain forest zone. A recent study (Kirschke, *et al.* 1999) of 73 developing countries has shown that deforestation rates are relevant as a causative factor for both wind and water erosion (including degradation through loss of nutrients and organic matter) under both humid and arid climate conditions, except for the combinatition wind erosion in dry countries, where the corelation is less clear.

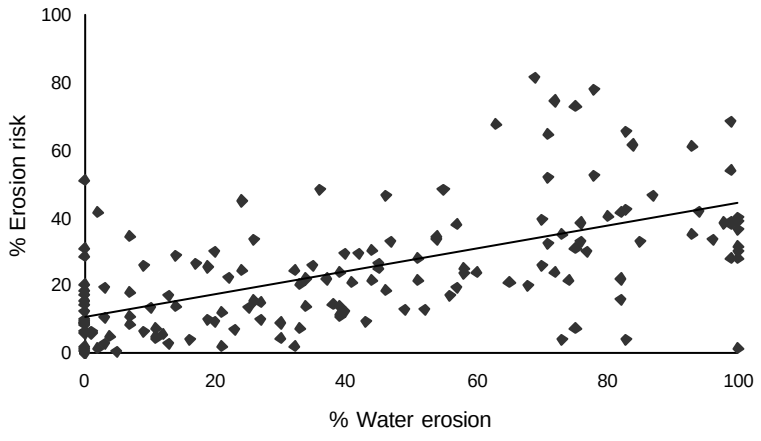
Overgrazing is the dominant cause in most of the dryland countries, not only in developing countries (e.g. Libya, Tunisia, Iran, Iraq, Syria), and across virtually the whole of the sahel belt of Africa. It is also the major cause in many parts of Central Asia, Argentina, and in drylands of developed countries including Australia and Western United States. Overexploitation of vegetation for domestic use (fuelwood, domestic timber) is given as a more localized cause, important in the sahel belt of Africa, western Argentina, Iran and Pakistan. Biological degradation caused by industrial pollution (e.g. toxic wastes, acid rainfall) is a major cause of degradation in some European countries (e.g. Belgium, Lithuania, Luxembourg, The Netherlands, Norway, Sweden).

Soil erosion by water: erosion risk and observed erosion

Standardized, replicable methods of recording and mapping observed erosion have yet to be developed, and with the notable exception of the GLASOD survey, most attempts to map erosion have employed erosion hazard, the causative factors, rather than observed erosion. It is therefore of interest to compare the susceptibility of the soil to erosion with the severity of observed erosion. The present study contains, at a broad scale, both of these elements.

Figure 17 shows the relation between erosion hazard and actual water erosion, plotted at the country level. The vertical scale shows the percentage of each country having soils with high erosion risk (see Chapter 2). The horizontal scale is the percentage of land in the country which is degraded by water erosion (severity classes Moderate-Very Severe), taken from the GLASOD survey. Despite the high degree of generalization inherent in data at the national level, there is evidence of a clear linear relationship. The analysis of Kirschke *et al.* (1999) has shown that, regardless of the prevailing general climatic conditions, the prevalence of steep slopes (slopes >30%) is most relevant in the explanation of water erosion.

FIGURE 17
Erosion hazard and observed erosion, at country level. (R^2=0.34; n=160)



There is scope to investigate the relationship between other types of land degradation and predictive factors for them. In the case of wind erosion, established methods are available; wind erosion is naturally favoured by large areas of levels and plains (or the absence of slopes >8%) (Kirschke *et al.* 1999). For soil chemical deterioration, it will be necessary to explore which inherent factors of the soil lead to a high susceptibility to degradation; relationships would be expected with net topsoil loss (e.g. Stocking, 1986) and nutrient imbalance as determined from farm system studies (Stoorvogel and Smaling, 1993). Degradation due to overgrazing might be expected to show a relation with livestock density (Wint and Rogers, 1998; Kruska *et al.*, 1995).

Land degradation and population density

Given the expected importance of the spatial variation of population density as a factor influencing land degradation, an attempt was made to examine the relationship between population and degradation severity. Appendix 7 Tables 7a-g show, at national level, the population densities associated with each of the GLASOD degradation severity classes (Tobler *et al.*, 1995). Table 13 provides an overview at regional level.

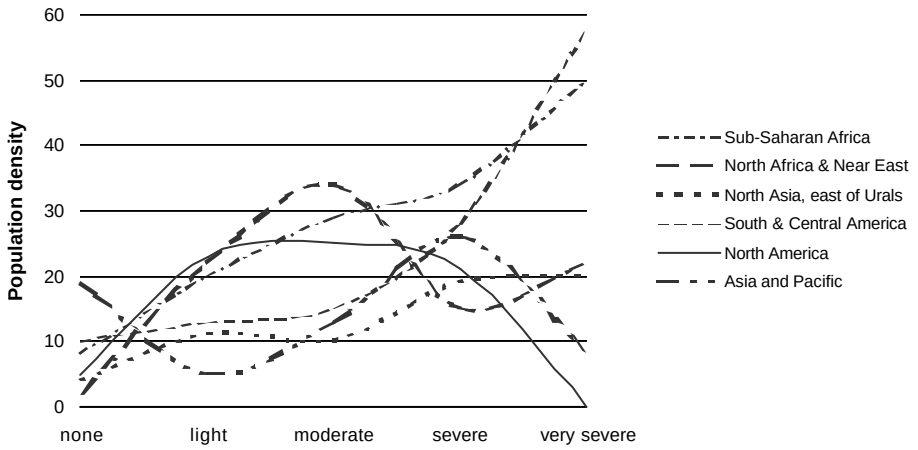
TABLE 13
Land degradation severity and population density by region. (Population density in number of inhabitants per km^2)

	None	Light	Moderate	Severe	Very Severe
Sub-Saharan Africa	8	20	29	34	50
North Africa & Near East	2	22	34	15	22
North Asia, east of Urals	4	11	10	19	20
Asia & Pacific	19	5	13	26	8
South & Central America	10	13	15	28	58
Europe	31	74	108	101	86
North America	5	23	25	21	NA
World	17	25	34	55	67

NA = not applicable

Inspection of the tables suggests a relationship between degradation and population density, which is plotted in Figure 18. In general, higher population densities are associated with land adjudged to be more severely degraded, notably in South and Central America and Sub-Saharan

FIGURE 18
Relationship between land degradation and population density. (Europe is omitted because its high population densities are mainly associated with urbanization.)



Africa. Among exceptions to this trend, the higher density for non-degraded land in Asia and the Pacific is probably linked with rice-growing land. In the case of the lower density on very severely degraded land in the same region, one might suspect out-migration from, or even abandonment of, degraded lands. Thus population density may be treated partly as a cause, but also to some degree as a consequence, of severity of degradation.

At country level, some of the most severe degradation is associated with very high population densities in sloping, highland countries (e.g. Burundi, Rwanda, Thailand, Vietnam, Haiti, Bosnia Herzegovina), or with high population density combined with deforestation (e.g. Togo, Cuba, Costa Rica).

It is commonly argued that population increase in rural communities with growing pressure on land, will lead to an indigenous response in which new techniques are applied, leading to intensification and higher land productivity, an hypothesis first due to Boserup (1965). This response is illustrated by the experience of the Machakos District of Kenya, where population pressure has induced actions that have led to successful land rehabilitation (Tiffen *et al.*, 1994). The study of Kirschke (1999) implies that an intensification of the agricultural system and high levels of land scarcity lead to a higher degree of water erosion. However, the opposite seems true for wind erosion, e.g. low levels of land scarcity and agricultural intensification lead to more wind erosion. A recent study of 64 developing countries (Cuffaro, 1997) has shown that there may also be what are termed adjustment failures. If population densities and land pressures are already high, and population growth is associated with income inequalities and landlessness, then the change in effective demand may be insufficient to promote technical change. These circumstances can lead to a breakdown of communal property rights, a need for non-sustainable cultivation methods in order to produce immediate food needs, and hence to land degradation. A case in point is Malawi, where population increase coupled with land shortage has led to cereal monoculture and lowered soil fertility; but because of the small land holdings, farmers are unable to afford the fertilizer necessary to obtain satisfactory yields (Young, 1999b).

Potential for carbon sequestration on presently degraded land

Land degradation leads to a release of carbon to the atmosphere through oxidation of soil organic matter. In the context of the present concern with increase in atmospheric carbon dioxide, it has been suggested that this process could be reversed: by improved agricultural practices and reclamation of degraded land, soil organic matter could be built up again, a process known as carbon sequestration. Among the land use changes which could be promoted with this objective are improved agricultural practices, the introduction of agroforestry, and reclamation of degraded land. By such means, the carbon stored in soils could be substantially increased, by amounts of the order of 30-50 t ha^{-1}. Thus land use changes which are beneficial to local communities would, in addition, fulfil a global environmental objective.

The link between land degradation and carbon sequestration has been the subject of a recent FAO consultation (FAO, 1999). Papers from this meeting discuss the realistic possibilities for carbon sequestration through reversal of land degradation, and the magnitude of the increases in soil carbon storage by this means.

The economic cost of land degradation

It is clearly important to combat degradation, in order to preserve land resources for future generations. In practice, most decisions on investment for development are taken primarily on

economic grounds. It is therefore desirable to convert the adverse effects of degradation into economic terms. Initial work relating the GLASOD results to economic factors was undertaken by Cuffaro and Heins (1998).

TABLE 14
Annual cost of land degradation in the South Asian region (on-site effects)

Type of degradation	Cost, US$ thousand million per year
Water erosion	5.4
Wind erosion	1.8
Fertility decline	0.6 - 1.2
Waterlogging	0.5
Salinization	1.5
Total annual cost	9.8 – 10.4

Source: Young (1994).

A full discussion of methods for measuring the economic cost of degradation lies beyond the scope of this study, but an example may be given. Taking the GLASOD estimates as a basis, a calculation was made for eight countries of the South Asian region, with a total population of 1200 million (Young, 1994; 1998). Relative production loss for the Light, Moderate and Strong degrees of degradation were taken as 5, 20 and 75% respectively. These reductions were applied to average cereal yields over the affected areas. Fertility decline was estimated on a nutrient replacement basis. The cumulative effect of human-induced land degradation was estimated to cost these countries a sum of the order of US$10 thousand million per year (Table 14).

The agricultural domestic product of these countries at the time of the survey was US$145 billion. The cost of degradation is therefore equivalent to a loss of 7% of the economic value of agricultural production. Inclusion of the off-site effects of water erosion (e.g. siltation of reservoirs), and other off-site and indirect effects (e.g. on-costs of processing) would increase this value substantially, certainly to more than 10%. This loss occurs annually, and will continue to do so unless measures are taken to check and reverse land degradation.

It would be possible to extend an estimate of this kind to global land degradation, using the GLASOD data as a basis, although to do so with adequate thoroughness would require calculations of some complexity. For example, the absolute cost of a given degree of degradation would be very much higher in developed regions – which overall are no less severely degraded. However, there is no reason to suppose that the economic cost of degradation, relative to agricultural production, would be any different for the world as a whole than was found for the case of South Asia. Hence it is likely that land degradation over the world as a whole has an economic cost equivalent to at least 10% of gross agricultural production.

The largest body of economic analysis related to land degradation is found in attempts to conduct cost:benefit analysis of soil conservation projects (e.g. Pimentel *et al.*, 1995; Crosson, 1995). This raises questions of discounting, in assigning a present value to future costs and benefits. Powerful arguments have been advanced that conventional methods of economic analysis under-value land resources, and in particular, that the practice of discounting grossly undervalues future option values, the value of resources to peoples of the future (e.g. Price, 1993; Young, 1998).

Discussion

There are still many problems in the measurement of land degradation, whether it be erosion, nutrient depletion, or other forms of soil degradation. The GLASOD survey is the first attempt at a systematic world coverage, comparable to the FAO-UNESCO Soil Map of the World in the field of soil survey. Soon after the publication of the results, it came to be realized that soil fertility decline, through nutrient imbalance and organic matter degradation, was more widespread than had been recognized at the time of the GLASOD survey. The more recent Asian Assessment

of Soil Degradation (ASSOD) (Lynden and Oldeman, 1997) shows a greater and more extensive impact of soil fertility decline. It will be apparent from some of the anomalies in the results reported here that improvements are needed in the direction of recording and monitoring of land degradation, including by quantitative, objective and replicable methods.

There is still more controversy about estimating the effects on productivity, and interpreting the economic and social impact of degradation. Despite the high political profile attached to actions for mitigating the negative impacts of development on the environment, surprisingly little attention has been paid to the systematic measurement, compilation and interpretation of data of land degradation. Improvements in this area would provide national governments and international institutions with better information on which to base decisions on the appropriate type, location and scale of potential interventions.

Chapter 5
Potential arable land for rainfed agriculture

Introduction and rationale

The most fundamental factor influencing the food production capacity of a country or region is its potential arable land, since it is this land which is responsible for growth of most of the major food crops, cereals and roots. After subtracting land needed for non-food crops, the result of multiplying potential arable land by estimated future crop yields gives estimates of future food production potential. Comparison of this potential with forecasts of future population indicate whether countries or regions have the capacity to feed their populations from their own land resources. This is the basic method that has been employed in many past studies, begun in the late 1970s (FAO/UNFPA/IIASA, 1983; FAO, 1984), and still continuing (Alexandratos, 1995; Fischer and Heilig, 1998).

The existence of a potential for expanding the area of cultivated land is basic to the agricultural planning of individual countries. It is clear that land settlement schemes, based on settlement of formerly uncultivated land, are becoming far less frequent, now that land is in short supply in many regions. Databases at FAO and collaborating institutions provide estimates of potential arable land and country level, whilst estimates of presently cultivated land are found in FAO Production Yearbooks (FAO, annual) and the FAO statistical database FAOSTAT (FAO, ongoing). These sources have been used to provide estimates of potential and actual arable land, and hence land still available for cultivation, at national level.

No account has been taken of the potential for expansion of the irrigated area onto land which is not suited to rainfed cultivation. Whilst some degree of expansion will certainly take place, the potential for this is by now extremely limited. Irrigation of arid lands takes very large quantities of water; whilst a high proportions of regions and countries in the dry zones are now experiencing water shortage.

The overall validity of the method employed, and hence of the results obtained, has been questioned. The sequence followed here will be to outline the method and present the results, followed by a summary of arguments which challenge these. The results presented in the section *Results* should therefore be read in conjunction with the reservations made in the section *The reliability of estimates of available cultivable land*.

Methods

The main sources used to obtain estimates of the land with potential for rainfed agricultural production are the digitized *Soil Map of the World*, a global climatic database (see Chapter 1), and FAO database on climatic and soil requirements for the growth of crops. The basic approach is that of land evaluation, the comparison of the requirements of specified types of land use with the characteristics of mapped areas of land (FAO, 1976).

In this study, the types of land use taken as the basis for evaluation were 21 major world crops, grown under rainfed conditions and at three different technology levels. These were compared with observed climatic and soil characteristics. Estimates were made, at country level, of the suitability of land for rainfed crop production, for each crop and at each level of technology, divided into five classes: very suitable (VS), suitable (S), moderately suitable (MS), marginal (M), and not suitable (NS). Land with rainfed crop production potential was taken as land classified as suitable or marginal (VS, S, MS, or M) for any one of the 21 crops, at the optimum technology level.

Earlier results based on this method have been previously presented, for 91 developing countries (excluding China), in *World Agriculture: Towards 2010* (Alexandratos, 1995, Appendix Table A.8). The following account gives revised estimates for these countries (resulting from ongoing modifications to data and methods), and extends them to the 160 countries, developing and developed, of the present study.

RESULTS

Potential arable land for rainfed agriculture

The results at country level are given in Appendix 8 Tables A8a-g. As well as potential arable land, this shows the actual arable areas in 1994, together with the percentage of potentially arable land actually in under cultivation.

The data for potential arable land should be adjusted by making allowance for two non-agricultural uses of such land, protected land (for nature, etc.) and land for human settlement. Through the work of conservation agencies, data on protected areas is relatively good, and a reasonable working assumption is that such areas will neither be increased nor decreased in the future. Based on a calculation for 63 countries in Alexandratos (1995), it was assumed that half the protected areas occupied land classed as potentially arable. Data on land occupied by settlement is, rather remarkably, available for only a small number of countries, and past studies have made use of estimates on average land per person. A high proportion of such land, here assumed to be 100%, occupies potentially arable land.

Table 15 gives a regional summary of the data on potential arable land. The data show first the gross value, then the adjustments to make allowances for protected land and settlement, to give the net values for potential arable land. The last two columns show the land actually under arable use, and the percentage of potential land actually in use.

Taking these data at face value, and in relative terms, there is greatest potential for agricultural expansion in Sub-Saharan Africa and in South and Central America, which together form over 70% of the global potential increase. In North Asia, Asia and the Pacific, North America and Europe, 54-64% of potential arable land is already in use, hence opportunities for expansion appear to exist although on a more limited scale[1]. The predominantly dryland region of North Africa and the Near East shows actual cultivation in excess of potential, because irrigated cultivation is not included the comparison.

Besides protected land and settlement, a further land requirement is for forest land, particularly rain forest, the clearance of which is considered undesirable in several respects. First, the

[1] In fact, a high proportion of the available land for South and Central America is in South America.

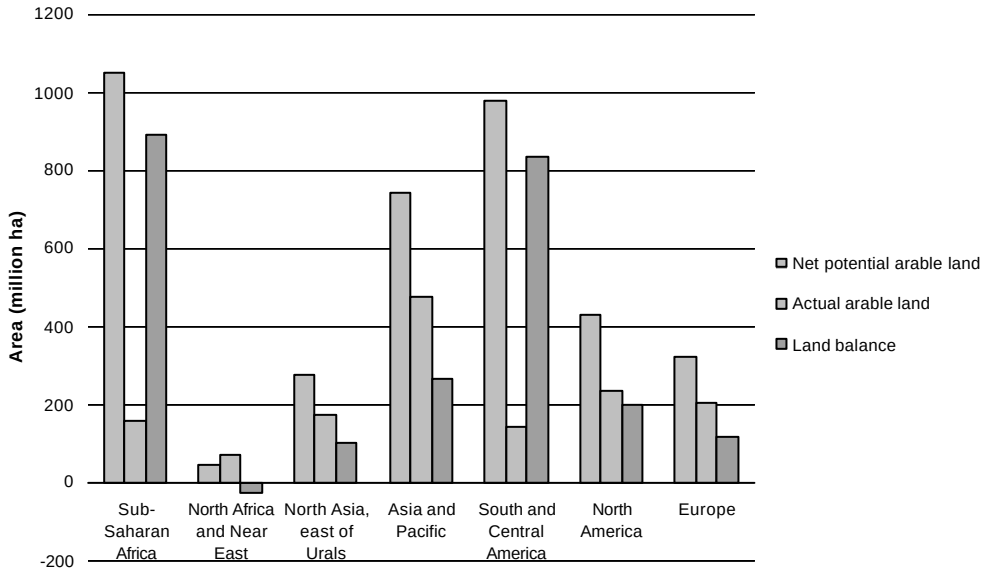
TABLE 15
Comparison of actual and potential available arable land for rainfed agriculture

	Gross potential arable land (rainfed cultivation) (1000 ha)	Protected land		Settlement (% of total area)	Net potential arable land (rainfed cultivation) (1000 ha)	Actual arable land (1994) (1000 ha)	% of potential arable land (rainfed cultivation) actually in use (1994)
		% of total area	% of potential arable				
Sub-Saharan Africa	1 119 492	8.6	4.3	1.9	1 050 083	157 608	15
North Africa and Near East	50 017	8.1	4.0	6.4	44 815	71 580	160
North Asia, east of Urals	286 800	3.0	1.5	(2.3)	275 902	175 540	64
Asia and the Pacific	812 551	9.4	4.7	3.9	742 672	477 706	64
South and Central America	1 048 071	10.6	5.3	1.2	979 946	143 352	15
North America	463 966	9.9	4.9	(2.1)	431 488	233 276	54
Europe	363 120	10.1	5.0	(5.8)	323 903	204 322	63
World	4 144 017	8.9	4.4	2.6	3 848 809	1 463 384	38

Sources and Notes
Protected land Data from Green and Paine (1997); for the proportion on potential arable land, see text.
Settlement Developing regions from Alexandratos (1995), taking forecast populations for 2010. Percentages shown as ( ) are based on 33 ha per 1000 population.

functions of forests are vital to human society, particularly to the welfare of the poor. Secondly, forests provide numerous ecosystem services, of very high economic value (Constanza et al., 1997). In particular, because of the capacity of forests (biomass and forest soils) to store and assimilate carbon dioxide, international opinion is currently strongly opposed to further forest clearance (although the most recent surveys indicate that the rate of forest clearance in the tropics is only slowing slightly (FAO, 1997a)[1]. It has been estimated that in developing countries, over half the 'land balance', of cultivable but non-cultivated land, is occupied by forest. In the two countries with the largest land balances, Brazil and the Congo Democratic Republic, much

FIGURE 19
Land balance in relation to net potential arable land for rainfed agriculture and actual arable land



[1] To put tropical forest clearance in perspective, it must be remembered that a high proportion of the forests of Europe, and substantial parts of North America, have been cleared, albeit at earlier dates. In the UK, 93% of the original forest cover has been cleared.

of this land is occupied by valued rain forest, and this applies also to other countries with large land balances (e.g. Bolivia, Central African Republic, Colombia, Peru, Venezuela). Fischer and Heilig (1998) go so far as to deduct the whole of forest land from the land balance[1].

Finally, it must be borne in mind that substantial parts of the actual non-cultivated land is already under agricultural use, as pasture for livestock production[2]. Converting such land to arable use involves a loss of grazing land; and in some parts of the world such conversion has affected the welfare of communities and peoples dependent on grazing resources.

Land and population

The estimates of actual and potential arable land may be compared with population, past and present, to give a generalized overview of changes in land per caput. The potential arable land was adjusted for its quality by giving a weighting to the suitability classes as follows: Suitable x 0.7, Moderately Suitable x 0.5, Marginal x 0.3. Thus the weighted values give the equivalent areas of Very Suitable land. The comparison may be made in terms of agricultural population (as defined in UN statistics) or total population.

Comparison with agricultural population is relevant to questions concerning the well-being of farmers and the rural community. The right side of Table 16 compares actual arable land with agricultural population for 1965 and 1995. In Europe and North America, and to a lesser degree in South America, the arable land per farmer has increased, as farms have become larger and rural inhabitants migrated to the cities or moved into non-agricultural occupations. A change in

TABLE 16
Actual arable land (1965 and 1995), potential arable land and "equivalent" potential land for agricultural and total population

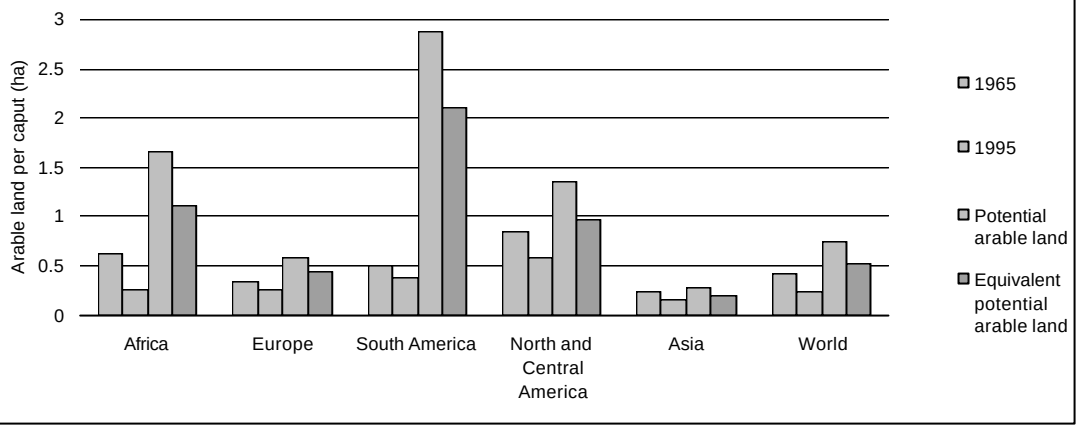
	Agricultural population				Total population			
	1965	1995	Potential arable land per caput agric. population (1994) (ha)	Equivalent potential arable land per caput total population (1994) (ha)	1965	1995	Potential arable land per caput total population (1994) (ha)	Equivalent potential arable land per caput total population (1994) (ha)
Africa	0.86	0.47	2.8	1.9	0.62	0.26	1.64	1.11
Europe	2.25	4.23	4.4	3.3	0.34	0.26	0.59	0.44
South America	1.17	1.88	13.8	10.0	0.49	0.37	2.87	2.09
North & C. America	4.95	5.41	11.7	8.3	0.85	0.59	1.35	0.97
Asia	0.36	0.24	0.5	0.4	0.25	0.15	0.27	0.20
World	0.78	0.59	1.6	1.1	0.42	0.23	0.74	0.53
Brazil	0.72	2.14	17.7	12.7	0.37	0.40	3.5	2.5
Indonesia	0.23	0.31	0.7	0.5	0.16	0.11	0.4	0.3
Nigeria	0.69	0.78	1.6	1.1	0.61	0.29	0.6	0.4
China	0.23	0.11	0.2	0.2	0.16	0.08	0.2	0.1
Pakistan	0.57	0.31	0.1	0.1	0.34	0.15	0.0	0.0
Senegal	0.78	0.37	2.2	1.5	0.65	0.27	1.6	1.1

Source: FAO Production Yearbooks 1976 and 1996

[1] An assumption which implies that only the savannas should be cleared, which is also unacceptable in many respects.

[2] Statistics on arable land include temporary grassland (under 5 years) but not improved permanent pastures.

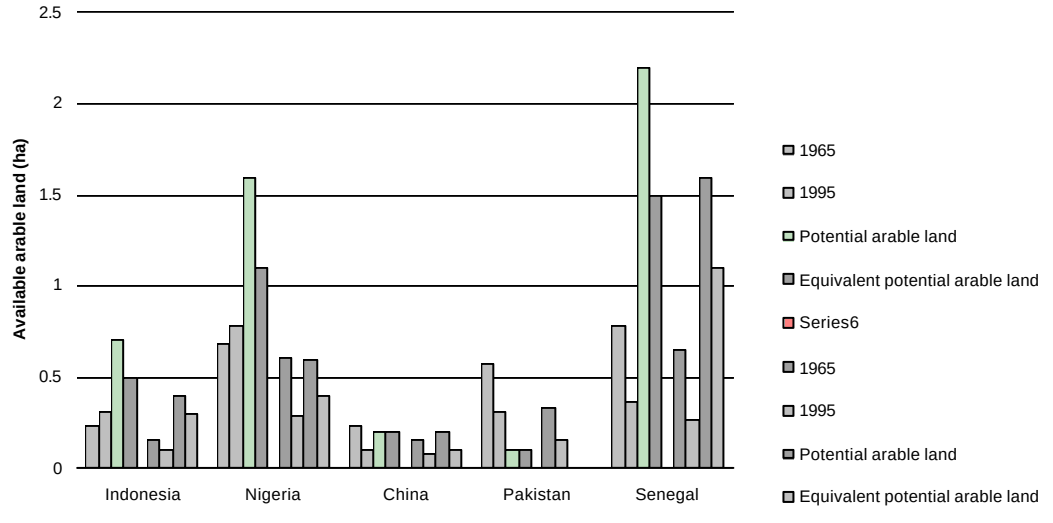
FIGURE 20
Shifts in actual arable land (1965 and 1995), potential arable land and equivalent potential arable land



this direction has also taken place in some countries of the developing world, including oil-producing countries and those which have experienced rapid agricultural expansion (e.g. Brazil, Indonesia, Nigeria) through absorption of labour in the non-agricultural sectors. In other parts of the developing world, however, actual arable land has substantially decreased, in Africa by 45% and in Asia by 33%, changes which have been associated with rural poverty and landlessness. This direction of change, illustrated by China, Pakistan and Senegal, is found among numerous predominantly rural developing countries.

Comparison with total population is relevant to one of the major questions facing the developing world, the extent to which regions and countries can provide adequate nutrition for their populations without food imports. The first two data columns of the left side of Table 16 compare actual arable land with total population for 1965 and 1995. In all continental regions there has been a

FIGURE 21
Available arable land (ha) per per caput in selected countries



decrease in land per caput over every five-year period. In Asia this decrease has been 40%, and in Africa more than 50%. These falls apply also to five of the six sample countries shown, with falls to half or less of the 1965 arable area in four of them. The exception is the relatively land-rich country of Brazil, where much of the increase has been achieved by clearance of rain forest.

THE RELIABILITY OF ESTIMATES OF AVAILABLE CULTIVABLE LAND

The challenge

The successive estimates, made by FAO and collaborating institutions, of land balances, that is, land which is potentially cultivable but not presently cultivated, have recently been challenged (Young, 1998; 1999a). The arguments presented apply particularly to developing countries, where data are less reliable. In this challenge, the method employed is characterized as "the approach of inventory and difference: assessment of the area cultivable, and subtraction of the area presently cultivated". It is argued that the approach of inventory and difference greatly exaggerates the land balance, namely land which is cultivable but not presently cultivated, for three reasons:

- Over-estimation of cultivable land.
- Under-estimated of presently cultivated land.
- Failure to take sufficient account of land required for purposes other than cultivation.

The over-estimation of cultivable land arises through loss of non-cultivable areas (e.g. hills, rock outcrops, minor water bodies) when detailed soil maps are reduced to the smaller scales of national maps and the *Soil Map of the World*. Under-estimation of presently cultivated land occurs because governments often do not report illegal cultivation (e.g. shifting cultivation, incursions into protected areas). It is noted also that more than half the data for actual cultivation as reported in the *FAO Production Yearbook* carry the qualification "F", meaning based on FAO estimates (as opposed to surveys or censuses); and that FAO has, on occasion, made substantial 'adjustments' to data on cultivated areas, sometimes increasing the original data by as much as 30% (Young, 1998; 1999b). With respect to land required for purposes other than cultivation, the estimates for protected land are accepted, but it is asserted that land taken up by human settlements (which includes not only housing but also, for example, industry and transport, recreation, military purposes) is currently under-estimated and is likely to increase, in per capita terms, in the future. Young (1999a) cites 24 countries for which, on the basis of field experience, he believes that the land balances are greatly over-estimated.

An example which illustrates the discrepancy between the assessed and observed land balance is Malawi. In this present study (see Appendix A5a), Malawi is reported as having potential arable land 6835 thousand hectares, actual arable (as at 1994) 1700, and thus only 25% of the potential land is cultivated. This was tested during a field reconnaissance tour, which found virtually no 'spare' land in the more crowded southern and central regions, and very limited areas, almost all on steeply-sloping land, in the northern region (Young, 1999b).

A provisional adjustment is made, taking a hypothetical (developing) country with a land balance of 50%, i.e. cultivable land is reported as twice the area of presently cultivated land. Using approximate adjustments for the three sources of error given above, the land balance is reduced to 23-35%, or if it assumed to be desirable to preserve forest on some 10-20% of cultivable land, then "an original gross land balance of 50% is reduced to a realistic area of between 3% and 25%" (Young, 1999a). A reduction of this order of magnitude produces results

which are more in accord with field observation of the extent of cultivable, non-cultivated, land in developing countries.

It is proposed that this speculation could be tested, by directly attempting to find cultivable but uncultivated land in areas where it is presumed to exist. In seeking to locate such land, particular attention should be given to:

- Whether the land can be cultivated sustainably, without degradation.
- The present functions of the land – social, economic, and with respect to ecosystem services – and the extent to which essential functions would be lost if it were cultivated.

Discussion

The data employed in the present, and previous, studies, rest upon a vast body of field surveys, essentially upon the whole effort of soil survey organizations throughout the world, together with climatic inventories and, for presently cultivated land, the results form periodic national agricultural censuses. The challenge to the validity of the results rests, explicitly, on personal field observation of whether a land balance exists, observation which is extensive but subjective. It cannot therefore be regarded at this stage as more than an alternative hypothesis.

It is relevant to note, however, the differences that are found between the present estimates of potential arable land, obtained as part of the ongoing work for *World Agriculture: Towards 2015/30*, and those published earlier in *World Agriculture: Towards 2010* (Alexandratos, 1995). Both employ the same basic sources and method, although with ongoing updates and modifications. The comparison is available only for the 91 developing countries (excluding China) covered by the earlier study.

Table 17 shows this comparison. For developing countries as a whole, and for the subcontinental regions, the differences are acceptably small, no more than might be expected from new data and minor modifications to methods. For some individual countries, however, there are much larger differences.

To ascertain the true extent of the land balance is a matter of the highest importance for current and future policy and planning in developing countries. The many estimates of whether sufficient land resources exist to feed the population of 10 thousand million forecast for the mid-21st century all assume that substantial increases in area cultivated will be possible. If these land balances were found to be less than currently supposed, then the urgency of research to increase crop yields on the present cultivated area will be very much greater.

TABLE 17
Estimates of potential arable land in this and a previous study

	Potential arable land for rainfed cultivation ('000 ha)		Increase/decrease (%)
	Agriculture: towards 2010 ('000 ha)	This study	
Sub-Saharan Africa	1 008 302	1 069 948	+6.1
North Africa and Near East	77 564	75 406	-2.8
East Asia	184 256	187 351	+1.7
South Asia	212 811	227 156	+6.7
South and Central America	1 053 680	1 040 329	-1.3
91 developing countries	2 536 613	2 600 190	+2.5

Sources: Column 2: Alexandratos (1995, Table A.5). Column 3: this study, Appendix Table A.5. Regional groupings are as in the earlier study: Sub-Saharan Africa excludes South Africa and Namibia, the Near East includes Turkey, East Asia excludes China.

The alternative hypothesis outlined in the section *The challenge* could be tested, not by further refinements in the method of inventory and difference, since it is the validity of this method which is in question, but by the direct approach of attempting to locate the land balance. This could be done in the first instance through sample surveys of representative countries. Whilst it would be possible for these surveys to be undertaken by external research organizations, they are properly a task for national research organizations, supported where necessary by external funding.

Chapter 6

A country ranking according to land resource potential and constraints

The most recent UN projections indicate that, despite an appreciable slowing in rates of population growth, world population will almost certainly increase to some 7 thousand million in the next 15 years, and possibly 8-10 thousand million during the mid-21st century. This increase will take place almost entirely in developing countries. Nearly all these countries already feed their peoples only by supplementing national production by large annual food imports, which place a strain on foreign exchange reserves.

One of the clearest consequences of population increase will be to place pressure for more land to be brought into cultivation. At the same time, existing agricultural land will be used more intensively. These changes, necessary to meet growing needs for food production, require that:

- Further efforts must be made, through research and extension, to overcome soil constraints.
- New land, much of which will be in marginal environments (fragile ecosystems), must be managed sustainably.
- Further land degradation must be avoided, and efforts made to upgrade or, where necessary, reclaim land which is presently degraded.

Methods

With the objective of highlighting priority problem areas, a country-level ranking was applied to many of the criteria considered in this study. For reasons connected with the impracticablility to include a factor based on the major soil constraints, it was found that the potential for agricultural production, including not only soil constraints but also climate constraints, will be better taken into account via suitability ratings for potential arable land.

The following factors were taken as the basis for country-level ranking (percentages refer to total national land areas):

1. **Equivalent potential arable land**
   100–E, where E=equivalent potential arable land as a percentage of total land area, taking equivalent potential arable land as defined in Chapter 5, Sections *Methods* and *Land and population*.

2. **Deserts and drylands**
   The area occupied by deserts and drylands, as a percentage of total land area; where deserts refers to the hyperarid zone, and drylands are as defined in Chapter 3.

3. **Steeplands**
   The area occupied by steeplands (Chapter 3) as a percentage of total land area.

4. **Land degradation severity**
   A weighted index of land degradation severity, constructed by taking the percentage areas in each degradation severity class (Chapter 4), multiplying by weighting factors (1: Light, 2: Moderate, 3: Severe, 4: Very Severe), and summing the four values.

5. **Actual arable land**
   Land presently cultivated, hectares per caput of total population

6. **Land balance**
   Actual arable land as a percentage of potential arable land (Chapter 5). High values indicate a low (or zero) reserve of available land.

7. **Population increase**
   The rate of increase in total population, percent per year. This factor was added to the physical constraints, as an indicator of the future increase in severity of pressures on land.

For all factors except No. 5, high values indicate more severe problems, whilst low values show more favourable conditions. Thus the extremes of the factors are:

Factor	*Problems most severe*	*Problems least severe*
1	Low proportion of land potentially suitable for rainfed cultivation	High proportion of land potentially suitable for rainfed cultivation
2	Large proportion of land with risk of desertification	Small proportion of land with risk of desertification
3	Large proportion of land with problems of steeplands	Small proportion of land with problems of steeplands
4	Very severe land degradation	Less severe land degradation
5	Small area of arable land per capita	Large area of arable land per capita
6	All or most cultivable land in use	Large reserve of cultivable, uncultivated, land
7	High rate of population increase	Low or negative rate of population increase

For factors 1-3, the land percentages were taken as the basis for country ranking. For factors 4-7, the 160 countries included in the study were assigned a ranking, with Rank 1 representing the most favourable conditions, and Rank 160 the least favourable. These three percentages and four rankings were summed, to give an overall ranking according to land resource potential and constraints, now and in the future. In theory, this overall figure could range from 4 to 940, although in practice the extremes are 150 to 760.

The above system was arrived at by seeking factors for which are representative, scientifically valid, for which data are available, and after some degree of trial and error to see which factors gave intuitively satisfactory results. It should not be regarded as definitive; other systems could be applied which would give differing results.

RESULTS

The overall rankings indicate countries with most favourable conditions (low rank numbers) or with most severe problems (high rank numbers), with respect to physical resource potential and constraints, now and in the future. The full list of countries is given in Appendix 9, which shows both the overall ranking and the seven factors from which it is derived.

No great significance should be attached to the precise rankings. However, the approximate ranking is broadly indicative of the severity of a country's land resource problems. To illustrate this, Table 18 lists the 30 highest and lowest ranked countries.

TABLE 18
Highest and lowest ranked countries, according to physical resource potential and constraints

	Highest ranked		Lowest ranked
1-10	Uruguay	131-140	Libya
	Guyana		El Salvador
	Republic of Ireland		Macedonia
	Lithuania		Turkey
	Belarus		Jamaica
	Central African Republic		Burundi
	Latvia		Armenia
	Denmark		Nepal
	Gabon		Iceland
	Equatorial Guinea		Syria
11-20	Estonia	141-150	Somalia
	Suriname		Egypt
	Puerto Rico		South Africa
	Brazil		Haiti
	France		Bhutan
	Japan		Lesotho
	Paraguay		Rwanda
	Belize		Peru
	Malta		Qatar
	Cote d'Ivoire		Afghanistan
21-30	Hungary	151-160	United Arab Emirates
	Sweden		Pakistan
	Finland		Iran
	Bolivia		Saudi Arabia
	Canada		Iraq
	Poland		Eritrea
	Cuba		Kuwait
	Congo Republic		Jordan
	Russian federation		Yemen
	Norway		Oman

Inspection of the ranking table (Appendix 9) shows that major contributory elements to a high ranking are at least 50% of the country's area as equivalent potential arable land; low proportions of drylands, steeplands, or both; a relatively low rank with respect to land degradation; and a low rate of population increase, this last factor being indicative of likely changes in land pressures in the immediate future. Out of the 30 highest-ranked countries, 28 fall into a four regional groups:

- 9 relatively land-rich countries of South and Central America, including the highest-ranked, Uruguay and Guyana;
- 9 European countries, extending from Ireland in the west to Poland and Hungary in the east;
- 5 countries of the CIS and Baltic States, including the Russian Federation;
- 5 countries in the humid zone of Central Africa;
- Outside these groups, Japan and Canada.

Included in the above are two major grain-exporting countries, Canada and France, together with others known for livestock production, e.g. Ireland, Denmark and Uruguay. If the list were to be extended to rank 40, four additional major agricultural producing and exporting countries would be included: New Zealand, Argentina, Australia and Ukraine. In other cases, notably the Central African countries, there would appear to be productive potential that is not yet fulfilled.

The set of lowest-ranked countries includes are two highly contrasted groups:

- 18 countries (including the 12 lowest-ranked) which have over 95% deserts and drylands. This results in low proportions of potential land for rainfed cultivation, and small (often zero or negative) land balances. The fact that 16 of these countries are ranked at below 100 for land degradation suggests the existence of widespread problems of desertification.
- 8 relatively humid countries with problems of steeplands, land degradation, and actual or potential land shortage.

Land pressures are likely to increase in many of these countries, since 13 of them are ranked below 100 with respect to rate of population increase, of which 8 are ranked below 130.

One disturbing feature of the lower-ranking countries may be noted. Depending on the criteria chosen, at least 12 of these 30 countries have, in recent years, experienced serious civil conflict, political instability, or war. By contrast, if the problems arising from the breakup of the CIS and Baltic States are excluded, then there are few examples of serious conflict among the 50 highest-ranked countries. It would be naïve to draw a simple causal relationship from this, although the relationship is strongly suggestive. It seems likely that increased stress, caused by pressure of population upon land resources, can be an explosive mixture, tending to lead towards the breakdown of traditional property rights to land, and ultimately of law and order. Among the many consequences of such changes is serious land degradation (e.g. Bennett, 1991). It has been suggested that in the future, environmental pressures and conflicts may become a leading cause of war and civil strife (e.g. Myers, 1993; Young, 1998); and that land degradation and food shortage may lead to pressures for out-migration, likely to lead to conflict (Döös, 1994).

Chapter 7
Conclusions and recommendations

Summary of conclusions

The results reported here give a first estimate of constraints to agricultural production, land degradation, and agricultural resource potential. The constraints include problems of soils, together with those of drylands and steeplands. The coverage is worldwide, allowing direct comparison between developing countries, the countries of the CIS and Baltic States, and the developed world. In the case of land degradation, some links with causative factors, economics, and population are also given. A tentative country ranking, based on physical resource potential and constraints, is presented.

The principal results are as follows:

1. Eight major soil constraints, individually or in combination, affect three-quarters of the world's land area. The most widespread, each covering 13-16% of global land, are erosion hazard, aluminium toxicity, shallow soils, and hydromorphy (poor drainage).
2. Of the 24% of global land without major soil constraints, the largest areas are found in North Asia, the Asia-Pacific region, and North America. Countries with the highest proportion of constraint-free soils include the world's leading grain-exporting countries and many European nations.
3. Drylands, regions with high drought and desertification hazards, occupy 45% of the global land area, and contain 38% of world population. Over 90% of North Africa and the Near East and North Asia (east of Urals) possess the hazards associated with drylands, and over 50% of North America, Sub-Saharan Africa, and Asia and the Pacific. In 36 countries, drylands occupy 90-100% of agriculturally productive land.
4. Steeplands, regions with problems of erosion and inaccessibility, but also possessing distinctive resource potential, occupy 11% of the global land area, mainly in the major mountain chains but also associated with rift valley faulting and volcanic origins. In some 50 countries, steeplands occupy >20% of the land area.
5. Results from the first global assessment of land degradation show that over 300 M ha, an area equivalent to 21% of present cultivated land, has been directly affected by degradation so severe as to destroy its productive functions. In terms of degradation severity classes, which take into account both degree and extent of degradation, 35% of global land is judged to be free from degradation, 38% has light to moderate degradation, and 26% is severely affected. At national level, 58 countries, 21 of them in Europe, report no land at all that is free from degradation, and 15 countries have 99-100% of land in the severe degradation class.
6. At national level, there is a clear correlation between erosion risk and observed erosion. Links between degradation and population density are more complex, but some of the most

severe degradation is associated with high population densities, particularly in steeplands and where combined with deforestation.

7. For the South Asia region, the on-site costs of land degradation have been estimated at 7% of the value of annual agricultural production. Since degradation there is no worse than in other regions, and taking off-site costs into account, it is provisionally estimated that the annual economic cost of land degradation is at least 10% of gross agricultural production.
8. The potential land for arable, rainfed, agriculture, after taking into account protected areas and settlement, is currently estimated at 3 848 M ha, of which 38% is reported as presently cultivated. However, much of the cultivable but uncultivated land (the 'land balance') is under rain forest, or needed for purposes such as grazing land and ecosystem services. In relative terms, Sub-Saharan Africa and South and Central America have the highest potential for expansion of the cultivated area, whilst in some individual countries the land balance is negative.
9. A first attempt at a country-level ranking based on land resource constraints and potential (including in relation to population increase) is presented. The highest ranked, with most favourable land resource conditions, include many leading grain-growing and exporting countries. The lowest ranked, with most severe problems, include many countries within the semi-arid zone, also those which have recently experienced famines. It is also noted that many countries ranked lowest in terms of land resources have recently been affected by war or civil conflict.
10. There are problems of data unreliability, covering all aspects of the study. World data on soils is in urgent need of updating. Information on land degradation is based on controlled but basically subjective estimation. The validity of estimating land still available for cultivation by subtracting the reported areas of arable land from estimates of cultivable area has been challenged, and the suggestion made that an attempt should be made directly to identify such cultivable but presently uncultivated areas.

Discussion

In order to develop sustainable systems of agriculture that satisfy the present and future needs of a region or country, there must be reliable information on the constraints and potential of the land resources. The results reported here are a first attempt to compare soil constraints, the extent of drylands and steeplands, the status of land degradation, and potential arable land, using standardized data and methods. In addition, some links are indicated between land degradation and the social and economic factors that are essential for understanding its causes.

The principles of soil and water management are well known, but because climatic, soil and landform conditions vary so widely, the design of land use systems, and particularly of conservation measures, must be site-specific. Knowledge of land resources is therefore needed for appropriate and effective programmes to combat land degradation, and to lead towards optimised and sustainable agricultural production.

In current discussions of development planning in the rural sector, emphasis is given to social factors, in particular to the participatory approach. (e.g. FAO, 1997b). However, this should not be at the expense of neglecting equally important physical factors. Just and social and economic conditions vary widely between and within countries, so also do physical conditions, and both demand consideration in the design of land use systems. The lessons which were first learnt in

the 1950s and 1960s, that large economic losses can result from inadequate land resource surveys, should not be forgotten.

There are two substantial limitations to the results presented in this study. The first is the high degree of generalization necessitated by treatment at the national level. A consequence is that many of the results given are well known to those with good geographical knowledge of the countries and regions to which they refer. Nevertheless, its is valuable to have results presented in a form which allows comparison between countries. In particular, it is instructive to be able to compare land resource conditions, in standardized form, between countries of highly contrasted social and economic conditions.

The second limitation has been noted as Conclusion 10 above: the considerable problems of data unreliability. In cases where the results given appear anomalous when compared with field experience, it is necessary to examine whether the original data satisfactorily represent true conditions. As in all branches of development planning, sound management conditions can only be taken on the basis of reliable and sufficiently detailed information.

Recommendations

- Along with the current, and rightful, attention to social and economic factors, development planning in the rural sector should invariably be based on a sound knowledge of land resource constraints and potential.
- Further studies are needed of the relationships between physical and socio-economic factors, particularly the links between population density, population increase, land availability, and land degradation.
- There is an urgent need to implement a vast programme which surveys and evaluates soils, water resources, land degradation, and land use, systematically and at sub-national level. It is only on the basis of detailed and reliable national data that valid international comparisons can be made. For this to be achieved, national resource survey institutions in many developing countries need to be strengthened.
- Specifically, current estimates of the land balance, land that is cultivable but not presently cultivated, should be tested by attempting directly to identify such land, taking into account its potential for sustainable use, and whether it has necessary alternative uses.
- At regional and international level, ongoing programmes that aim to improve knowledge of soil and terrain, climate, water resources, land use and cover, and land degradation, by such means as standardization of methods and collation of data, deserve further support.

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Appendix 1
Country classification per region[1]

Sub-Saharan Africa
Angola
Benin
Botswana
Burkina Faso
Burundi
Cameroon
Central African Republic
Chad
Congo Dem. Rep.
Congo Rep.
Cote d'Ivoire
Djibouti
Eq. Guinea
Eritrea
Ethiopia
Gabon
Ghana
Guinea
Guinea Bissau
Kenya
Lesotho
Liberia
Madagascar
Malawi
Mali
Mauritania
Mozambique
Namibia
Niger
Nigeria
Rwanda
Senegal
Sierra Leone
Somalia
South Africa
Sudan
Swaziland
Tanzania
The Gambia
Togo
Uganda
Zambia
Zimbabwe

North Africa and Near East
Afghanistan
Algeria
Egypt
Iran
Iraq
Jordan
Kuwait
Lebanon
Lybia
Morocco
Oman
Qatar
Saudi Arabia
Syria
Tunisia
United Arab Emirates
Western Sahara
Yemen

North Asia, E of Urals
Kazakhstan
Kyrgyzstan
Russian Federation
Tajikistan
Turkmenistan
Uzbekistan

Asia and Pacific
Australia
Bangladesh
Bhutan
Brunei
Cambodia
China
Fiji
HongKong
India
Indonesia
Japan
Korean DPR
Korean Rep.
Laos
Malaysia
Mongolia
Myanmar
Nepal
New Zealand
Pakistan
Papua New Guinea
Philippines
Solomon Islands
Sri Lanka
Thailand
Viet Nam

South and Central America
Argentina
Belize
Bolivia
Brazil
Chile
Colombia
Costa Rica
Cuba
Dominican Republic
Ecuador
El Salvador
Falklands
French Guyana
Guatemala
Guyana
Haiti
Honduras
Jamaica
Mexico
Neth. Antilles
Nicaragua
Panama
Paraguay
Peru
Puerto Rico
Suriname
Trinidad/Tobago
Uruguay
Venezuela

North America
Canada
United States of America

Europe
Albania
Armenia
Austria
Azerbaijan
Belarus
Belgium
Bosnia Herzegovina
Bulgaria
Croatia
Cyprus
Czech Republic
Denmark
Estonia
Finland
France
Georgia
Germany
Greece
Hungary
Iceland
Ireland (Rep.)
Israel
Italy
Latvia
Lithuania
Luxembourg
Macedonia
Malta
Moldova
Netherlands
Norway
Poland
Portugal
Romania
Slovenia
Spain
Sweden
Switzerland
Turkey
Ukraine
United Kingdom
Yugoslavia

[1] The classification attempts a purely geographical approach to facilitate easier comparison of data.

Appendix 2

Major soil constraints based on FCC criteria

TABLE A2A
Area of major soil constraints in sub-Saharan Africa

		Soil Constraint									
	Total Area	Hydromorphy		Low CEC		Aluminum Toxicity		High P-fixation		Vertic Properties	
	1 000 km^2	1 000 km^2	%	1 000 km^2	%	1 000 km^2	%	1 000 km^2	%	1 000 km^2	%
Angola	1 247	153	12	388	31	339	27	69	6	11	1
Benin	111	12	11	1	1	0	0	0	0	3	2
Botswana	599	30	5	251	44	3	1	0	0	46	8
Burkina Faso	274	42	15	20	7	3	1	0	0	27	10
Burundi	26	2	9	0	0	10	37	7	29	1	4
Cameroon	465	44	9	12	3	262	56	21	4	13	3
CAR	623	51	8	108	17	320	51	24	4	2	0
Chad	1 259	79	6	193	15	0	0	0	0	83	7
Congo D. R.	2 267	381	17	592	26	1363	60	494	22	7	0
Congo Republic	342	103	30	99	29	148	43	17	5	0	0
Cote d'Ivoire	318	19	6	11	3	185	58	9	3	1	0
Djibouti	23	0	1	0	0	0	0	0	0	0	0
Equatorial Guinea	28	6	21	3	10	15	52	0	0	0	0
Eritrea	94	1	1	1	1	7	8	1	2	8	8
Ethiopia	1 101	3	0	22	2	53	5	88	8	101	9
Gabon	258	35	14	31	12	122	47	21	8	0	0
Gambia	10	3	28	0	0	0	0	0	0	0	0
Ghana	228	23	10	9	4	58	26	2	1	4	2
Guinea	246	21	9	6	2	97	40	7	3	1	0
Guinea Buissau	36	5	16	1	4	2	9	0	0	0	0
Kenya	569	22	4	18	3	32	6	2	0	26	5
Lesotho	30	2	8	0	0	0	1	0	0	0	0
Liberia	96	15	16	9	9	61	63	12	12	0	0
Madagascar	582	39	7	45	8	186	32	9	2	8	1
Malawi	94	5	5	3	3	21	23	7	7	3	3
Mali	1 220	63	5	159	13	7	1	0	0	15	1
Mauritania	1 025	4	0	92	9	0	0	0	0	3	0
Mozambique	784	31	4	136	17	151	19	53	7	21	3
Namibia	823	14	2	185	23	0	0	0	0	59	7
Niger	1 267	34	3	351	28	0	0	0	0	9	1
Nigeria	911	124	14	119	13	76	8	0	0	17	2
Rwanda	25	2	8	0	0	5	19	4	16	0	0
Senegal	193	29	15	53	28	0	0	0	0	4	2
Sierra Leone	72	7	10	3	4	43	59	1	2	0	0
Somalia	627	11	2	33	5	8	1	4	1	18	3
South Africa	1 221	53	4	256	21	35	3	20	2	61	5
Sudan	2 376	181	8	212	9	114	5	12	1	402	17
Swaziland	17	2	13	1	8	5	27	3	19	0	0
Tanzania	884	74	8	64	7	262	30	33	4	53	6
Togo	54	5	9	1	1	0	1	0	0	2	3
Uganda	200	21	11	6	3	94	47	5	3	7	4
Zambia	743	137	18	170	23	275	37	83	11	26	4
Zimbabwe	387	17	4	54	14	11	3	2	1	33	8
TOTAL	23 754	1 904	8	3 714	16	4 366	19	982	4	1 064	5

TABLE A2a Cont'd
Area of major soil constraints in sub-Saharan Africa

	Soil Constraint										Soils without maior constraints	
	Total Area 1 000 km^2	Salinity 1 000 km^2	%	Sodicity 1 000 km^2	%	Shallowness 1 000 km^2	%	Erosion 1 000 km^2	%	1 000 km^2	%
Angola	1 247	5	0	1	0	57	5	147	12	226	18
Benin	111	0	0	1	1	9	8	24	22	45	41
Botswana	599	63	11	9	2	14	3	27	5	25	4
Burkina Faso	274	13	5	13	5	66	24	55	20	103	37
Burundi	26	0	2	0	0	1	4	10	39	6	21
Cameroon	465	2	0	6	1	26	6	100	22	88	19
CAR	623	1	0	0	0	46	7	122	20	112	18
Chad	1 259	35	3	75	6	200	16	105	8	195	16
Congo D. R.	2 267	2	0	0	0	9	0	109	5	326	14
Congo Republic	342	0	0	0	0	2	1	23	7	43	13
Cote d'Ivoire	318	0	0	0	0	19	6	85	27	84	26
Djibouti	23	10	44	0	0	9	41	0	2	0	0
Equatorial Guinea	28	0	0	0	0	3	10	3	9	3	12
Eritrea	94	7	7	1	1	2	2	15	16		
Ethiopia	1 101	51	5	25	2	331	30	342	31	370	34
Gabon	258	2	1	0	0	25	10	27	10	85	33
Gambia	10	1	9	0	0	0	4	1	7	6	61
Ghana	228	0	0	6	3	23	10	48	21	55	24
Guinea	246	3	1	0	0	80	32	71	29	67	27
Guinea Buissau	36	2	9	0	0	6	21	6	21	13	36
Kenya	569	54	9	29	5	122	22	122	22	153	27
Lesotho	30	0	0	2	5	9	30	21	71	17	57
Liberia	96	3	3	0	0	8	8	17	18	13	13
Madagascar	582	5	1	5	1	31	5	204	35	224	38
Malawi	94	1	1	0	0	14	14	23	25	29	31
Mali	1 220	20	2	0	0	203	17	137	11	153	13
Mauritania	1 025	9	1	0	0	226	22	92	9	7	1
Mozambique	784	11	1	1	0	54	7	233	30	335	43
Namibia	823	34	4	16	2	136	17	76	9	54	7
Niger	1 267	11	1	10	1	150	12	84	7	45	4
Nigeria	911	20	2	36	4	129	14	241	26	261	29
Rwanda	25	0	0	0	0	2	8	16	65	6	25
Senegal	193	7	3	1	1	36	19	19	10	56	29
Sierra Leone	72	3	4	0	0	13	18	9	12	9	13
Somalia	627	57	9	33	5	233	37	47	8	46	7
South Africa	1 221	12	1	55	5	233	19	296	24	226	19
Sudan	2 376	24	1	32	1	304	13	235	10	331	14
Swaziland	17	0	0	0	2	3	15	7	39	6	33
Tanzania	884	17	2	3	0	70	8	259	29	224	25
Togo	54	1	1	1	1	9	16	13	24	20	36
Uganda	200	0	0	1	1	15	7	32	16	26	13
Zambia	743	0	0	28	4	44	6	71	10	125	17
Zimbabwe	387	3	1	12	3	38	10	55	14	130	34
Total	23 754	484	2	400	2	3 005	13	3 612	15	4 345	18

TABLE A2b
Area of major soil constraints in North Africa and Middle East

	Soil constraint										
	Total area 1000 km^2	Hydromorphy 1 000 km^2	%	Low CEC 1 000 km^2	%	Aluminum Toxicitv 1 000 km^2	%	High P-fixation 1 000 km^2	%	Vertic Properties 1 000 km^2	%
Afghanistan	650	3	0	41	6	0	0	0	0	0	0
Algeria	2 382	5	0	0	0	0	0	0	0	5	0
Egypt	1 001	14	1	0	0	0	0	0	0	1	0
Iran	1 643	24	1	0	0	1	0	0	0	1	0
Iraq	438	3	1	15	3	0	0	0	0	30	7
Jordan	96	0	0	2	2	0	0	0	0	0	0
Kuwait	24	0	1	4	17	0	0	0	0	0	0
Lebanon	104	0	0	0	0	0	0	0	0	1	12
Libya	1 760	3	0	0	0	0	0	0	0	3	0
Morocco	447	9	2	0	0	0	0	0	0	12	3
Oman	271	3	1	13	5	0	0	0	0	0	0
Qatar	11	1	7	0	1	0	0	0	0	0	0
Saudi Arabia	2 396	6	0	191	8	0	0	0	0	0	0
Syria	185	1	1	0	0	0	0	0	0	11	6
Tunisia	164	3	2	0	0	0	0	0	0	5	3
United Arab Emirates	75	4	6	6	9	0	0	0	0	0	0
Western Sahara	252	0	0	0	0	0	0	0	0	0	0
Yemen	480	0	0	19	4	0	0	0	0	0	0
TOTAL	12 379	79	1	292	2	1	0	0	0	69	1

TABLE A2b Cont'd
Area of major soil constraints in North Africa and Middle East

		Soil Constraint								Soils without major constraints	
	Total Area	Salinity		Sodicity		Shallowness		Erosion Risk			
	1,000 km2	1,000 km2	%	1,000 km2	%	1,000 km2	%	1,000 km2	%	1,000 km2	%
Afghanistan	650	37	6	5	1	215	33	138	22	177	27
Algeria	2 382	72	3	6	0	622	26	143	6	160	7
Egypt	1 001	87	9	4	0	325	32	78	8	1	0
Iran	1 643	238	15	37	2	357	22	321	20	371	23
Iraq	438	61	14	0	0	139	32	33	8	45	10
Jordan	96	3	3	0	0	24	26	13	15	8	8
Kuwait	24	2	10	0	0	2	14	1	8	0	0
Lebanon	104	0	0	0	0	2	22	5	46	29	28
Libya	1 760	40	2	0	0	204	12	78	4	33	2
Morocco	447	23	5	0	0	121	27	109	24	153	34
Oman	271	20	6	0	0	92	29	29	9	0	0
Qatar	11	2	17	0	0	2	19	1	10	0	0
Saudi Arabia	2 396	93	5	0	0	430	22	140	7	0	0
Syria	185	5	2	0	0	61	32	21	11	69	37
Tunisia	164	13	8	5	3	46	28	24	14	22	14
United Arab Emirates	75	10	13	0	0	10	12	4	5	0	0
Western Sahara	252	0	0	0	0	77	31	10	4	0	0
Yemen	480	17	4	0	0	127	30	36	9	11	2
TOTAL	12 379	723	6	57	0	2 854	23	1 185	10	1 081	9

TABLE A2c
Area of major soil constraints in North Asia, east of Urals

		Soil Constraint									
	Total Area	Hydromorphy		Low CEC		Aluminum Toxicitv		High P-fixation		Vertic Properties	
	1,000 km2	1,000 km2	%	1,000 km2	%	1,000 km2	%	1,000 km2	%	1,000 km2	%
Kazakhistan	2 715	235	9	0	0	1	0	0	0	0	0
Kyrgyzstan	198	2	1	0	0	0	0	0	0	0	0
Russian Federation	17 044	5 407	32	0	0	783	5	0	0	0	0
Tajikistan	143	5	3	0	0	0	0	0	0	0	0
Turkmenistan	487	15	3	11	2	0	0	0	0	0	0
Uzbekistan	446	39	9	0	0	0	0	0	0	0	0
TOTAL	21 033	5 702	27	11	0	783	4	0	0	0	0

TABLE A2c Cont'd
Area of major soil constraints in North Asia, east of Urals

		Soil Constraint								Soils without major constraints	
	Total Area	Salinity		Sodicity		Shallowness		Erosion Risk			
	1,000 km2	1,000 km2	%	1,000 km2	%	1,000 km2	%	1,000 km2	%	1,000 km2	%
Kazakhistan	2 715	215	8	1 071	40	386	14	78	3	606	22
Kyrgyzstan	198	1	1	0	0	107	54	56	28	45	23
Russian Federation	17 044	63	0	583	3	2 162	13	3 157	19	7 668	45
Tajikistan	143	7	5	0	0	68	48	37	26	37	26
Turkmenistan	487	73	15	17	4	35	7	7	1	33	7
Uzbekistan	446	63	14	46	10	39	9	13	3	71	16
TOTAL	21 033	421	2	1 716	8	2 796	13	3 349	16	8 460	40

TABLE A2d
Area of major soil constraints in Asia and the Pacific

		Soil constraint									
	Total area	Hydromorphy		Low CEC		Al toxicity		High P-fixation		Vertic Properties	
	1000 km^2	1.000 km^2	%	1,000 km^2	%	1,000 km^2	%	1,000 km^2	%	1,000 km^2	%
Australia	7 667	610	8	920	12	287	4	27	0	640	8
Bangladesh	144	78	54	0	0	22	16	2	1	0	0
Bhutan	47	0	0	0	0	12	30	0	0	0	0
Brunei	6	2	30	0	0	3	54	1	17	0	0
Cambodia	181	67	37	3	1	97	53	16	9	6	3
China	9 550	1 195	13	11	0	1 033	11	806	9	74	1
Fiji	18	1	6	0	0	5	26	1	6	0	0
Hong Kong	1	1	62	0	0	0	0	0	0	0	0
India	3 157	151	5	44	2	159	5	10	0	657	22
Indonesia	1 916	377	20	75	4	566	30	174	9	35	2
Japan	369	17	5	0	0	102	27	32	9	0	0
Korean Dem. Rep.	122	9	7	0	0	2	2	1	0	0	0
Korean Rep.	98	6	6	0	0	35	37	6	6	0	0
Laos	237	12	5	0	0	169	73	55	24	2	1
Malaysia	333	72	22	1	0	202	62	0	0	4	1
Mongolia	1 560	9	1	0	0	0	0	0	0	0	0
Myanmar	677	103	15	0	0	288	43	107	16	17	3
Nepal	141	11	8	0	0	44	30	0	0	0	0
New Zealand	265	21	8	0	0	132	50	9	3	0	0
Pakistan	802	11	1	37	5	0	0	0	0	1	0
Papua New Guinea	462	79	17	0	0	156	33	28	6	0	0
Philippines	299	34	12	2	1	77	26	15	5	7	3
Solomon Islands	30	2	6	0	0	7	24	3	10	0	0
Sri Lanka	65	15	23	1	2	11	17	0	0	0	1
Thailand	513	132	26	8	2	310	60	55	11	7	1
Viet Nam	329	69	21	4	1	186	56	50	15	5	2
TOTAL	28 989	3 083	11	1 105	4	3 906	13	1 395	5	1 454	5

TABLE A2d Cont'd
Area of major soil constraints in Asia and the Pacific

				Soil Constraint							
	Total Area	Salinity		Sodicity		Shallowness		Erosion Risk		Soils without maior constraints	
	1.000 km^2	1.000 km^2	%	1,000 km^2	%	1.000 km^2	%	1,000 km^2	%	1.000 km^2	%
Australia	7 667	254	3	1 3266	17	810	11	959	13	1 429	19
Bangladesh	144	9	7	0	0	2	1	21	15	41	29
Bhutan	47	0	0	0	0	5	13	21	53	10	22
Brunei	6	0	0	0	0	0	0	3	50	1	21
Cambodia	181	2	1	4	2	10	6	95	52	21	12
China	9 550	735	8	15	0	2 709	29	2 405	16	1 887	20
Fiji	18	0	2	0	0	0	0	9	52	5	30
Hong Kong	1	0	0	0	0	0	0	0	0	0	29
India	3 157	210	7	15	1	271	9	879	29	1 292	41
Indonesia	1 916	21	1	0	0	169	9	889	47	509	27
Japan	369	0	0	0	0	46	12	127	34	211	57
Korean Dem. Rep.	122	0	0	0	0	43	35	51	42	70	57
Korean Rep.	98	0	0	0	0	28	29	39	40	45	45
Laos	237	0	0	1	1	22	9	282	122	36	15
Malaysia	333	10	3	0	0	7	2	248	76	67	20
Mongolia	1 560	241	16	0	0	318	20	207	13	341	22
Myanmar	677	11	2	0	0	93	14	551	83	133	20
Nepal	141	0	0	0	0	31	21	46	31	37	26
New Zealand	265	1	0	0	0	27	10	179	67	51	19
Pakistan	802	158	20	1	0	190	24	105	13	72	9
Papua New Guinea	462	4	1	0	0	30	6	192	41	141	30
Philippines	299	0	0	0	0	19	6	182	62	171	57
Solomon Islands	30	0	0	0	0	1	3	11	39	0	0
Sri Lanka	65	1	2	5	7	6	10	28	42	24	37
Thailand	513	10	2	4	1	29	6	374	73	96	19
Viet Nam	329	7	2	0	0	28	9	256	78	52	16
TOTAL	28 989	1 673	6	1 370	5	4 892	17	4 655	16	6 743	23

TABLE A2e
Area of major soil constraints in South and Central America, Mexico and the Caribbean

		Soil constraint									
	Total area	Hydromorphy		Low CEC		Al toxicity		High P-fixation		Vertic Properties	
	1000 km^2	1,000 km^2	%	1,000 km^2	%	1,000 km^2	%	1,000 km^2	%	1,000 km^2	%
Argentina	2 772	232	8	0	0	12	0	9	0	40	1
Belize	23	5	22	0	1	6	29	0	0	4	17
Bolivia	1 096	151	14	20	2	338	31	88	8	7	1
Brazil	8 479	900	11	889	10	5 354	63	2 149	25	90	1
Chile	749	41	5	0	0	26	3	0	0	8	1
Colombia	1 136	123	11	12	1	636	56	217	19	13	1
Costa Rica	51	9	17	0	0	12	22	4	8	1	3
Cuba	114	17	15	2	2	16	15	1	1	15	14
Dominican Republic	47	3	7	0	0	4	9	0	0	6	12
Ecuador	283	17	6	0	0	59	23	34	13	7	3
El Salvador	21	1	3	0	0	1	6	0	0	3	15
Falklands	12	8	63	0	0	0	0	0	0	0	0
French Guyana	91	3	3	1	1	65	80	64	79	0	0
Guatemala	108	14	13	0	0	12	11	0	0	13	12
Guyana	215	20	9	10	5	106	51	50	24	0	0
Haiti	27	1	3	0	0	1	5	0	0	1	5
Honduras	112	10	9	0	0	34	30	2	2	2	2
Jamaica	11	1	6	0	0	0	1	0	0	2	15
Mexico	1 966	69	4	0	0	44	2	4	0	121	6
Neth. Antilles	1	0	0	0	0	0	0	0	0	0	0
Nicaragua	144	21	15	0	0	37	29	4	3	10	8
Panama	78	12	16	0	0	21	27	3	4	1	2
Paraguay	407	123	30	5	1	71	18	9	2	12	3
Puerto Rico	9	0	5	0	0	2	25	0	1	2	18
Peru	1 281	125	10	21	2	557	43	179	14	11	1
Suriname	164	16	10	6	4	86	60	33	23	0	0
Trinidad/Tobago	5	0	0	0	0	4	71	3	54	0	0
Uruguay	186	25	14	0	0	0	0	0	0	44	25
Venezuela	910	139	15	16	2	514	55	162	18	27	3
TOTAL	20 498	2 086	10	982	5	8 019	39	3 016	15	439	2

TABLE A2e Cont'd
Area of major soil constraints in South and Central America, Mexico and the Caribbean

		Soil Constraint								Soils without maior constraints	
	Total Area	Salinity		Sodicity		Shallowness		Erosion Risk			
	1,000 km^2	1,000 km^2	%	1,000 km^2	%	1,000 km^2	%	1,000 km^2	%	1,000 km^2	%
Argentina	2 772	331	12	185	7	387	14	283	10	922	33
Belize	23	0	0	0	1	3	14	5	22	5	21
Bolivia	1 096	35	3	36	3	147	14	246	23	298	27
Brazil	8 479	27	0	177	2	340	4	1 328	16	741	9
Chile	749	50	7	33	4	179	24	249	33	135	18
Colombia	1 136	5	1	3	0	81	7	232	20	304	27
Costa Rica	51	0	0	0	0	4	7	19	37	20	38
Cuba	114	2	2	3	2	11	10	21	19	44	39
Dominican Republic	47	0	0	0	0	13	26	16	31	23	49
Ecuador	283	1	1	1	0	35	14	73	29	105	37
El Salvador	21	0	0	0	0	3	15	9	42	10	48
Falklands	12	0	0	0	0	2	13	1	6		0
French Guyana	91	0	0	0	0	0	0	1	1	14	15
Guatemala	108	0	0	1	1	20	18	36	33	38	35
Guyana	215	1	0	0	0	32	15	39	18	36	17
Haiti	27	0	0	0	0	8	31	10	38	13	49
Honduras	112	0	0	1	0	26	23	55	48	40	36
Jamaica	11	0	0	0	0	2	15	3	29	6	55
Mexico	1 966	13	1	16	1	637	33	512	26	544	28
Neth. Antilles	1	0	0	0	0	1	56	0	0	NA	NA
Nicaragua	144	0	0	1	0	13	10	47	36	46	32
Panama	78	0	0	1	1	7	9	36	48	27	34
Paraguay	407	123	31	50	13	0	0	16	4	115	28
Puerto Rico	9	0	0	0	0	2	18	3	27	3	35
Peru	1 281	7	1	0	0	255	20	389	30	186	15
Suriname	164	1	1	0	0	1	1	11	7	32	20
Trinidad/Tobago	5	0	0	0	0	0	7	1	22	NA	NA
Uruguay	186	2	0	2	1	31	17	10	6	73	39
Venezuela	910	7	1	1	0	74	8	275	30	192	21
TOTAL	20 498	605	3	509	2	2 313	11	3 923	19	3 972	19

TABLE A2f
Area of major soil constraints in North America

		Soil Constraint									
	Total Area	Hydromorphy		Low CEC		Al Toxicity		High P-fixation		Vertic Properties	
	1000 km^2	1 000 km^2	%	km^2	%	1 000 km^2	%	1 000 km^2	%	1 000 km^2	%
Canada	9 893	1 795	18	0	0	428	4	0	0	0	0
United States of America	9 344	1 592	17	0	0	1790	19	1	0	105	1
TOTAL	19 237	3 388	18	0	0	2 219	12	1	0	105	1

TABLE A2f Cont'd
Area of major soil constraints in North America

		Soil Constraint								Soils without maior constraints	
	Total Area	Salinity		Sodicity		Shallowness		Erosion Risk			
	1 000 km^2	1 000 km^2	%	1 000 km^2	%	1 000 km^2	%	1 000 km^2	%	1 000 km^2	%
Canada	9 893	3	0	65	1	1 693	17	1 525	15	2 074	21
United States of America	9 344	43	0	80	1	798	9	2 271	24	3 043	33
TOTAL	19 237	46	0	145	1	2 491	13	3 795	20	5 117	27

TABLE A2g
Area of major soil constraints in Europe

		Soil Constraint									
	Total Area	Hydromorphy		Low CEC		Al Toxicity		High P-fixation		Vertic Properties	
	1000 km^2	1 000 km^2	%	km^2	%	1 000 km^2	%	1 000 km^2	%	1 000 km^2	%
Albania	29	1	2	0	0	0	1	0	0	0	0
Armenia	30	0	1	0	0	0	0	0	0	0	0
Austria	84	13	16	0	0	21	26	0	0	0	0
Azerbaijan	86	9	10	0	0	0	0	0	0	0	0
Belarus	207	76	37	1	0	8	4	0	0	0	0
Belgium	30	7	23	1	5	6	19	0	0	0	1
Bosnia Herzegovina	51	4	7	0	0	12	23	0	0	0	0
Bulgaria	111	9	8	0	0	7	6	0	0	6	6
Croatia	56	15	26	0	0	3	6	0	0	1	1
Cyprus	9	0	3	0	0	0	0	0	0	1	10
Czech Republic	79	23	29	1	1	36	46	0	0	2	2
Denmark	43	6	15	0	1	3	7	0	0	0	0
Estonia	45	15	33	0	0	0	0	0	0	0	0
Finland	336	119	35	0	0	28	8	0	0	7	2
France	543	93	17	1	0	62	11	0	0	0	0
Georgia	70	4	6	0	0	8	11	0	0	0	0
Germany	358	88	24	4	1	77	21	0	0	8	2
Greece	132	1	1	0	0	1	1	0	0	3	2
Hungary	93	15	16	5	5	0	0	0	0	4	4
Iceland	103	7	7	1	1	0	0	0	0	0	0
Ireland Rep.	69	28	41	0	0	20	29	0	0	0	0
Israel	21	0	0	0	0	0	0	0	0	3	14
Italy	301	10	3	0	0	26	8	0	0	8	3
Latvia	64	19	30	0	0	0	0	0	0	0	0
Lithuania	65	18	28	0	0	0	0	0	0	0	0
Luxembourg	3	1	43	0	12	1	31	0	0	0	0
Macedonia	25	0	0	0	0	10	39	0	0	0	0
Malta	0	0	0	0	0	0	0	0	0	0	0
Moldova	34	5	15	0	0	0	0	0	0	0	0
Netherlands	41	13	31	1	3	0	1	0	0	0	0
Norway	323	38	12	0	0	24	7	0	0	0	0
Poland	312	72	23	19	6	9	3	0	0	0	0
Portugal	89	4	5	0	0	6	6	0	0	1	1
Romania	237	54	23	0	0	25	11	0	0	3	1
Slovenia	20	2	8	0	0	6	30	0	0	0	0
Spain	503	38	8	4	1	28	6	0	0	11	2
Sweden	449	90	20	0	0	20	4	0	0	11	2
Switzerland	41	5	13	0	0	4	10	0	0	0	0
Turkey	778	14	2	0	0	41	5	0	0	15	2
Ukraine	602	77	13	0	0	15	3	0	0	0	0
United Kingdom	244	135	55	5	2	34	14	0	0	0	0
Yugoslavia Fed.Rep.	128	13	10	0	0	27	21	0	0	4	3
TOTAL	6 843	1142	17	44	1	569	8	0	0	87	1

TABLE A2g Cont'd
Area of major soil constraints in Europe (cont.)

	Total Area	Soil Constraint: Salinity		Sodicity		Shallowness		Erosion Risk		Soils without major constraints	
	1,000 km²	1,000 km²	%	1,000 km²	%	1,000 km²	%	1,000 km²	%	1,000 km²	%
Albania	29	0	0	0	0	5	18	18	62	13	45
Armenia	30	0	0	0	0	17	58	10	35	17	55
Austria	84	0	0	0	0	12	14	24	28	23	28
Azerbaijan	86	4	4	2	2	15	18	12	14	54	63
Belarus	207	0	0	0	0	0	0	9	4	106	51
Belgium	30	0	0	0	0	5	15	7	24	16	52
Bosnia Herzegovina	51	0	0	0	0	6	11	27	54	25	50
Bulgaria	111	0	0	3	3	9	8	36	32	55	50
Croatia	56	0	0	1	2	10	18	20	35	26	47
Cyprus	9	0	3	0	3	5	50	3	31	4	44
Czech Republic	79	1	1	0	1	10	13	31	39	37	46
Denmark	43	0	0	0	0	0	0	4	10	22	50
Estonia	45	0	0	0	0	0	0	1	2	5	11
Finland	336	0	0	0	0	16	5	5	2	28	8
France	543	2	0	0	0	30	6	129	24	294	54
Georgia	70	0	0	0	0	23	33	24	35	32	46
Germany	358	0	0	0	0	27	8	50	14	31	9
Greece	132	3	2	2	1	36	27	86	66	60	45
Hungary	93	5	5	18	20	1	1	13	14	10	11
Iceland	103	0	0	0	0	45	44	22	22	0	0
Ireland Rep.	69	0	0	0	0	1	2	10	15	0	0
Israel	21	1	3	0	0	5	23	4	18	5	25
Italy	301	3	1	0	0	72	24	122	41	6	2
Latvia	64	0	0	0	0	0	0	3	4	26	40
Lithuania	65	0	0	0	0	0	0	1	2	28	44
Luxembourg	3	0	0	0	0	1	29	1	31	0	0
Macedonia	25	0	0	2	8	4	16	13	52		
Malta	0	0	0	0	0	0	10	0	23	0	82
Moldova	34	7	21	2	6	0	0	0	1	26	78
Netherlands	41	0	0	0	0	0	0	0	1	0	1
Norway	323	0	0	0	0	56	17	28	9	24	7
Poland	312	0	0	0	0	4	1	53	17	76	24
Portugal	89	0	0	0	0	21	23	34	38	6	6
Romania	237	5	2	11	5	6	2	57	24	108	46
Slovenia	20	0	0	1	3	12	61	12	61	9	46
Spain	503	24	5	0	0	70	14	131	26	16	3
Sweden	449	0	0	0	0	43	10	9	2	17	4
Switzerland	41	0	0	0	0	7	18	21	52	7	17
Turkey	778	8	1	0	0	188	24	261	34	376	48
Ukraine	602	5	1	97	16	2	0	23	4	455	76
United Kingdom	244	0	0	0	0	7	3	32	13	12	5
Yugoslavia Fed.Rep.	128	5	4	7	7	10	8	38	30	48	38
TOTAL	6,843	73	1	146	2	780	11	1,386	20	2,104	31

	Total Area	Soil Constraint: Hydromorphy		Low CEC		Aluminum Toxicity		High P-fixation		Vertic Properties	
	1000 km²	1,000 km²	%	km²	%	1,000 km²	%	1,000 km²	%	1,000 km²	%
WORLD TOTAL	134,907	17,383	12.9	6,149	4.6	19,863	14.7	5,394	4.0	3,219	2.4

	Total Area	Soil Constraint: Salinity		Sodicity		Shallowness		Erosion Risk		Soils without maior constraints	
	1,000 km²	1,000 km²	%	1,000 km²	%	1,000 km²	%	1,000 km²	%	1,000 km²	%
WORLD TOTAL	134,907	4,025	3	4,344	3	1,9131	14	21,960	16	17,383	24

Appendix 3
Deserts, dryland areas and population distribution

TABLE A3a
Deserts, dryland areas and population distribution per country, sub-Saharan Africa

	Total area ('000 km^2)	Desert		Drylands						Total area of drylands ('000 km^2)	Desertification risk** (%)
		Hyperarid (lgp 0 days)		Arid (lgp 1-59 days)		Semi-arid (lgp 60-119 days)		Dry sub-humid (lgp 120-179 days)			
		%	Area ('000 km^2)	%	Area ('000 km^2)	%	Area ('000 km^2)	%	Area ('000 km^2)		
Angola	1 247	3	36	1	14	7	85	29	367	465	38
Benin	111	0	0	0	0	0	0	27	31	31	27
Botswana	599	57	342	11	62	31	186	2	10	258	100
Burkina Faso	274	0	0	0	0	20	56	66	182	238	87
Burundi	26	0	0	0	0	0	0	0	0	0	0
Cameroon	465	0	0	0	0	2	9	8	39	47	10
Central African Republic	623	0	0	0	0	0	0	6	35	35	6
Chad	1 259	38	479	19	234	23	284	19	244	761	98
Congo Dem. Rep.	2 267	0	0	0	0	0	0	2	45	45	2
Congo Rep.	342	0	0	0	0	0	0	0	0	0	0
Cote d'Ivoire	318	0	0	0	0	0	0	0	0	0	0
Djibouti	23	99	23	1	0	0	0	0	0	0	0
Eq. Guinea	28	0	0	0	0	0	0	0	0	0	0
Eritrea	94	42	40	8	8	50	46	0	0	54	100
Ethiopia	1 104	10	106	19	210	15	170	23	250	630	63
Gabon	258	0	0	0	0	0	0	0	0	0	0
Ghana	228	0	0	0	0	1	2	6	14	16	7
Guinea	246	0	0	0	0	0	0	11	26	26	11
Guinea Bissau	36	0	0	0	0	0	0	77	28	28	77
Kenya	569	11	64	19	111	31	178	18	100	389	77
Lesotho	31	2	1	0	0	0	0	7	2	2	8
Liberia	96	0	0	0	0	0	0	0	0	0	0
Madagascar	582	4	26	0	0	15	85	47	272	357	64
Malawi	94	0	0	0	0	0	0	71	67	67	71
Mali	1 220	51	625	11	130	19	234	18	221	585	98
Mauritania	1 031	78	808	7	74	14	147	0	1	223	100
Mozambique	784	5	41	1	9	10	77	15	117	204	27
Namibia	823	58	474	7	58	33	274	2	12	345	99
Niger	1 267	53	667	15	186	25	317	1	17	520	87
Nigeria	911	0	0	0	1	14	125	30	275	401	44
Rwanda	25	0	0	0	0	0	0	0	0	0	0
Senegal	197	0	0	0	0	46	91	54	106	197	100
Sierra Leone	72	0	0	0	0	0	0	0	0	0	0
Somalia	629	66	415	20	123	14	89	1	3	215	100
South Africa	1 221	41	504	4	55	15	182	18	214	451	63
Sudan	2 376	39	935	11	256	17	408	19	459	1123	78
Swaziland	17	6	1	0	0	0	0	45	8	8	48
Tanzania	884	0	0	0	0	2	14	45	395	409	46
The Gambia	11	0	0	0	0	0	0	97	11	11	97
Togo	54	0	0	0	0	0	0	10	5	5	10
Uganda	200	0	0	0	0	0	0	0	0	0	0
Zambia	743	0	0	0	0	0	2	87	643	645	87
Zimbabwe	387	8	30	1	2	25	98	66	255	356	100
Total	23 777	24	5 614	6	1 532	13	3 159	19	4 453	9144	50

AGLS Database derived from Global AEZ data (FAO/IIASA) and global population database (Tobler et al.,1995)
Reference Fisher et al. (1995) and Nachtergaele, Janssen and Zanetti (1996)
NA: not applicable
** Desertification risk as defined by UNSO, 1997

TABLE A3a Cont'd
Deserts, dryland areas and population distribution per country, sub-Saharan Africa

	Desert		Drylands						Total Country Population ('000)	Total population in drylands ('000)	% of total population in dryland areas	% of population under desertification risk
	Hyperarid (lgp 0 days)		Arid (lgp 1-59 days)		Semi-arid (lgp 60-119 days)		Drysub-humid (lgp 120-179 days)					
	Population ('000)	Population Density	Population ('000)	Population Density	Population ('000)	Population Density	Population ('000)	Population Density				
Angola	76	2	75	5	2 051	24	901	2	10466	3027	29	29
Benin	0	NA	0	NA	0	NA	465	15	5259	465	9	9
Botswana	481	1	114	2	783	4	11	1	1416	908	64	97
Burkina Faso	0	NA	0	NA	1 423	26	7 843	43	10186	9266	91	91
Burundi	0	NA	0	NA	0	NA	0	NA	5930	0	0	0
Cameroon	0	NA	0	NA	450	53	2 311	60	12833	2761	22	22
Central African Republic	0	NA	0	NA	0	NA	36	1	3203	36	1	1
Chad	84	0	346	1	2 012	7	3 225	13	6161	5583	91	92
Congo Dem. Rep.	0	NA	0	NA	0	NA	1 061	24	43930	1061	2	2
Congo Rep.	0	NA	0	NA	0	NA	0	NA	2518	0	0	0
Cote d'Ivoire	0	NA	0	NA	0	NA	0	NA	13329	0	0	0
Djibouti	417	18	0	0	0	NA	0	NA	585	0	0	0
Eq. Guinea	0	NA	0	NA	0	NA	0	NA	389	0	0	0
Eritrea	644	16	139	18	2 843	61	5	50	3084	2987	97	122
Ethiopia	1 112	10	1 672	8	4 869	29	9 738	39	57719	16279	28	29
Gabon	0	NA	0	NA	0	NA	0	NA	1046	0	0	0
Ghana	0	NA	0	NA	122	73	1 533	109	16856	1655	10	10
Guinea	0	NA	0	NA	0	NA	545	21	7092	545	8	8
Guinea Bissau	0	NA	0	NA	0	NA	917	33	1047	917	88	88
Kenya	236	4	320	3	1 729	10	5 109	51	26459	7158	27	27
Lesotho	30	45	0	NA	0	NA	216	94	1977	216	11	11
Liberia	0	NA	0	NA	0	NA	0	NA	2119	0	0	0
Madagascar	361	14	0	NA	908	11	3 392	12	14406	4300	30	31
Malawi	0	NA	0	NA	0	NA	8 324	125	9587	8324	87	87
Mali	222	0	401	3	3 031	13	5 337	24	10462	8769	84	86
Mauritania	961	1	277	4	943	6	9	9	2217	1229	55	98
Mozambique	1 310	32	145	15	1 419	18	8 219	70	16636	9783	59	64
Namibia	435	1	103	2	918	3	77	6	1499	1098	73	103
Niger	192	0	147	1	7 968	25	480	29	8846	8595	97	99
Nigeria	0	NA	0	0	6 674	54	25 790	94	108467	32464	30	30
Rwanda	0	NA	0	NA	0	NA	0	NA	5296	0	0	0
Senegal	0	NA	0	NA	4 482	49	2 743	26	8102	7225	89	89
Sierra Leone	0	NA	0	NA	0	NA	0	NA	4127	0	0	0
Somalia	6 655	16	1 855	15	1 110	12	68	22	9822	3033	31	96
South Africa	4 799	10	409	8	3 248	18	14 547	68	40552	18204	45	51
Sudan	3 872	4	4 593	18	8 851	22	5 693	12	26148	19137	73	86
Swaziland	42	40	0	NA	0	NA	309	40	833	309	37	39
Tanzania	0	NA	0	NA	1 211	86	9 346	24	29172	10557	36	36
The Gambia	0	NA	0	NA	0	NA	825	77	1077	825	77	77
Togo	0	NA	0	NA	0	NA	397	73	3970	397	10	10
Uganda	0	NA	0	NA	0	NA	2	8	19080	2	0	0
Zambia	0	NA	0	NA	4	3	7 900	12	7897	7904	100	100
Zimbabwe	246	8	18	8	2 697	27	8 012	31	10936	10727	98	100
Total	22 175	4	10 614	7	59 746	19	135 386	30	572736	205746	36	37

AGLS Database derived from Global AEZ data (FAO/IIASA) and global population database (Tobler et al.,1995)
Reference Fisher et al. (1995) and Nachtergaele, Janssen and Zanetti (1996)
NA: not applicable
** Desertification risk as defined by UNSO, 1997

TABLE A3b
Deserts, dryland areas and population distribution per country, North Africa and Near East

	Total area ('000 km^2)	Desert		Drylands						Total area of drylands ('000 km^2)	Deserti-fication risk** (%)
		Hyperarid (lgp 0 days)		Arid (lgp 1-59 days)		Semi-arid (lgp 60-119 days)		Dry sub-humid (lgp 120-179 days)			
		%	Area ('000 km^2)	%	Area ('000 km^2)	%	Area ('000 km^2)	%	Area ('000 km^2)		
Afghanistan	650	20	133	25	164	54	348	1	5	517	100
Algeria	2 382	88	2 089	1	12	4	88	5	124	224	76
Egypt	1 001	100	1 000	0	0	0	1	0	0	1	0
Iran	1 643	39	638	14	222	41	681	5	81	984	98
Iraq	438	67	295	2	8	13	58	17	72	138	97
Jordan	96	68	65	6	6	14	13	12	12	31	100
Kuwait	24	100	24	0	0	0	0	0	0	0	0
Lebanon	104	0	0	0	0	2	2	52	54	56	54
Lybia	1 760	95	1 677	1	21	2	42	1	19	83	0
Morocco	447	34	150	3	13	20	90	30	133	235	79
Oman	271	100	272	0	0	0	0	0	0	0	0
Qatar	11	100	11	0	0	0	0	0	0	0	0
Saudi Arabia	2 396	100	2 401	0	0	0	0	0	0	0	0
Syria	185	25	46	7	13	30	56	32	59	129	93
Tunisia	164	69	112	1	1	7	11	14	23	35	68
United Arab Emirates	75	100	75	0	0	0	0	0	0	0	0
Western Sahara	252	100	252	0	0	0	0	0	0	0	0
Yemen	480	93	447	3	13	1	7	2	10	30	90
Total	12 379	78	9 687	4	474	11	1 396	5	592	2 462	91

AGLS Database derived from Global AEZ data (FAO/IIASA) and global population database (Tobler et al.,1995)
Reference Fisher et al. (1995) and Nachtergaele, Janssen and Zanetti (1996)
NA: not applicable
** Desertification risk as defined by UNSO, 1997

TABLE A3b Cont'd
Deserts, dryland areas and population distribution per country, North Africa and Near East

	Desert		Drylands						Total Country Population ('000)	Total population in drylands ('000)	% of total population in dryland areas	% of population under desertifica-tion risk
	Hyperarid (lgp 0 days)		Arid (lgp 1-59 days)		Semi-arid (lgp 60-119 days)		Drysub-humid (lgp 120-179 days)					
	Population ('000)	Population Density	Population ('000)	Population Density	Population ('000)	Population Density	Population ('000)	Population Density				
Afghanistan	1 013	8	3 562	22	11 638	33	423	93	16 994	15 623	92	98
Algeria	2 669	1	283	24	1 436	16	11 513	93	27 450	13 232	48	53
Egypt	55 599	56	0	NA	2	2	0	NA	60 946	2	0	0
Iran	10 070	16	10 293	46	36 398	53	4 572	57	63 903	51 263	80	95
Iraq	14 271	48	85	11	2 049	35	3 997	55	20 758	6 131	30	95
Jordan	873	13	248	41	970	74	1 876	158	3 967	3 094	78	100
Kuwait	1 589	65	0	NA	0	NA	0	NA	1 608	0	0	0
Lebanon	0	NA	0	NA	42	19	1 347	25	2 819	1 389	49	49
Lybia	2 382	1	173	8	2 393	57	197	10	5 225	2 763	53	97
Morocco	1 719	11	577	46	3 344	37	15 414	116	26 025	19 335	74	80
Oman	2 072	8	0	NA	0	NA	0	NA	2 082	0	0	0
Qatar	451	39	0	NA	0	NA	0	NA	457	0	0	0
Saudi Arabia	18 052	8	0	NA	0	NA	0	NA	18 056	0	0	0
Syria	2 021	44	354	26	2 927	52	6 359	107	14 262	9 640	68	79
Tunisia	2 575	23	42	37	1 036	97	1 266	55	8 820	2 344	27	38
United Arab Emirates	1 806	24	0	NA	0	NA	0	NA	1 812	0	0	0
Western Sahara	201	1	0	NA	0	NA	0	NA	201	0	0	0
Yemen	12 401	28	1 335	99	684	102	1 046	104	15 475	3 065	20	100
Total	129 764	13	16 952	36	62 919	45	48 010	81	290 860	127 881	44	79

AGLS Database derived from Global AEZ data (FAO/IIASA) and global population database (Tobler et al.,1995)
Reference Fisher et al. (1995) and Nachtergaele, Janssen and Zanetti (1996)
NA: not applicable
** Desertification risk as defined by UNSO, 1997

TABLE A3c
Deserts, dryland areas and population distribution per country, North Asia, east of Urals

	Total area ('000 km²)	Desert		Drylands						Total area of drylands ('000 km²)	Desertification risk** (%)
		Hyperarid (lgp 0 days)		Arid (lgp 1-59 days)		Semi-arid (lgp 60-119 days)		Dry sub-humid (lgp 120-179 days)			
		%	Area ('000 km²)	%	Area ('000 km²)	%	Area ('000 km²)	%	Area ('000 km²)		
Kazakhstan	2 715	0	0	56	1 516	33	908	8	209	2 633	97
Kyrgyzstan	198	9	17	5	10	66	131	13	27	168	93
Russian Federation	17 044	0	51	2	359	55	9 342	40	6 746	16 446	97
Tajikistan	143	8	11	28	40	55	79	2	2	121	92
Turkmenistan	487	3	15	49	238	34	166	0	2	406	86
Uzbekistan	446	7	32	56	248	28	124	1	2	375	90
Total	21 033	1	127	11	2 410	51	10 750	33	6 988	20 149	96

AGLS Database derived from Global AEZ data (FAO/IIASA) and global population database (Tobler et al.,1995)
Reference Fisher et al. (1995) and Nachtergaele, Janssen and Zanetti (1996)
NA: not applicable
** Desertification risk as defined by UNSO, 1997

TABLE A3c Cont'd
Deserts, dryland areas and population distribution per country, North Asia, east of Urals

	Desert		Drylands						Total Country Population ('000)	Total population in drylands ('000)	% of total population in dryland areas	% of population under desertification risk
	Hyperarid (lgp 0 days)		Arid (lgp 1-59 days)		Semi-arid (lgp 60-119 days)		Drysub-humid (lgp 120-179 days)					
	Population ('000)	Population Density	Population ('000)	Population Density	Population ('000)	Population Density	Population ('000)	Population Density				
Kazakhstan	18	NA	6 432	4	7 558	8	2 184	10	16 952	16 174	95	96
Kyrgyzstan	124	7	124	13	4 097	31	657	25	5 010	4 878	97	100
Russian Federation	17	0	2 600	7	30 859	3	97 395	14	147 760	130 854	89	89
Tajikistan	153	14	366	9	4 529	57	175	72	5 767	5 070	88	90
Turkmenistan	106	7	1 673	7	1 259	8	14	7	3 921	2 946	75	77
Uzbekistan	1 013	31	6 480	26	11 710	94	121	54	21 860	18 311	84	88
Total	1 431	11	17 675	7	60 012	6	100 546	14	201 270	178 233	89	89

AGLS Database derived from Global AEZ data (FAO/IIASA) and global population database (Tobler et al.,1995)
Reference Fisher et al. (1995) and Nachtergaele, Janssen and Zanetti (1996)
NA: not applicable
** Desertification risk as defined by UNSO, 1997

TABLE A3d
Deserts, dryland areas and population distribution per country, Asia and Pacific

	Total area ('000 km^2)	Desert		Drylands						Total area of drylands ('000 km^2)	Deserti-fication risk** (%)
		Hyperarid (lgp 0 days)		Arid (lgp 1-59 days)		Semi-arid (lgp 60-119 days)		Dry sub-humid (lgp 120-179 days)			
		%	Area ('000 km^2)	%	Area ('000 km^2)	%	Area ('000 km^2)	%	Area ('000 km^2)		
Australia	7 667	38	2 912	9	661	22	1 713	17	1 275	3 649	77
Bangladesh	144	0	0	0	0	0	0	0	0	0	0
Bhutan	47	10	5	0	0	2	1	7	3	4	9
Brunei	6	0	0	0	0	0	0	0	0	0	0
Cambodia	181	0	0	0	0	0	0	0	0	0	0
China	9 550	30	2 835	7	642	15	1 389	19	1 782	3 812	57
Fiji	18	0	0	0	0	0	0	0	0	0	0
HongKong	1	0	0	0	0	0	0	0	0	0	0
India	3 157	2	70	2	63	18	576	50	1 574	2 214	72
Indonesia	1 916	0	0	0	0	0	0	1	13	13	1
Japan	369	0	0	0	0	0	0	4	13	13	4
Korean DPR	122	0	0	0	0	0	0	31	37	37	31
Korean Rep.	98	0	0	0	0	0	0	0	0	0	0
Laos	237	0	0	0	0	0	0	1	1	1	1
Malaysia	333	0	0	0	0	0	0	0	0	0	0
Mongolia	1 560	47	726	9	142	38	599	6	95	837	100
Myanmar	677	0	0	0	0	0	1	1	3	4	1
Nepal	141	16	23	0	0	3	5	31	44	49	42
New Zealand	265	0	0	0	0	0	0	2	5	5	2
Pakistan	802	65	523	16	125	16	128	3	27	281	100
Papua New Guinea	462	0	0	0	0	0	0	0	0	0	0
Philippines	299	0	0	0	0	0	0	0	0	0	0
Solomon Islands	30	0	0	0	0	0	0	0	0	0	0
Sri Lanka	65	0	0	0	0	0	0	6	4	4	6
Thailand	513	0	0	0	0	0	0	0	2	2	0
Viet Nam	329	0	0	0	0	0	0	2	7	7	2
Total	28 989	24	7 094	6	1 634	15	4 411	17	4 887	10 933	50

AGLS Database derived from Global AEZ data (FAO/IIASA) and global population database (Tobler et al.,1995)
Reference Fisher et al. (1995) and Nachtergaele, Janssen and Zanetti (1996)
NA: not applicable
** Desertification risk as defined by UNSO, 1997

TABLE A3d Cont'd
Deserts, dryland areas and population distribution per country, Asia and Pacific

	Desert		Drylands						Total Country Population ('000)	Total population in drylands ('000)	% of total population in dryland areas	% of population under desertification risk
	Hyperarid (lgp 0 days)		Arid (lgp 1-59 days)		Semi-arid (lgp 60-119 days)		Drysub-humid (lgp 120-179 days)					
	Population ('000)	Population Density	Population ('000)	Population Density	Population ('000)	Population Density	Population ('000)	Population Density				
Australia	195	0	41	0	323	0	1255	1	4 048	1619	40	42
Bangladesh	0	NA	0	NA	0	NA	0	NA	114 980	0	0	0
Bhutan	51	11	0	NA	5	7	73	23	1 447	78	5	6
Brunei	0	NA	0	NA	0	NA	0	NA	250	0	0	0
Cambodia	0	NA	0	NA	0	NA	0	NA	8 306	0	0	0
China	21 314	8	3 785	6	35	0	240 243	135	313 662	244 063	78	83
Fiji	0	NA	0	NA	0	NA	0	NA	424	0	0	0
HongKong	0	NA	0	NA	0	NA	0	NA	1 152	0	0	0
India	5 025	72	3 710	59	141 125	245	451 911	287	869 663	596 746	69	69
Indonesia	0	NA	0	NA	0	NA	528	39	166 929	528	0	0
Japan	0	NA	0	NA	0	NA	767	59	111 083	767	1	1
Korean DPR	0	NA	0	NA	0	NA	3 336	89	20 929	3 336	16	16
Korean Rep.	0	NA	0	NA	0	NA	0	NA	29 011	0	0	0
Laos	0	NA	0	NA	0	NA	59	42	4 594	59	1	1
Malaysia	0	NA	0	NA	0	NA	0	NA	17 807	0	0	0
Mongolia	585	1	201	1	1 291	2	109	1	2 186	1 601	73	100
Myanmar	0	NA	0	NA	0	0	3	1	59 941	3	0	0
Nepal	135	6	11	26	94	21	7 209	163	17 449	7 314	42	42
New Zealand	0	NA	0	NA	0	NA	4	1	3 063	4	0	0
Pakistan	61 361	117	20 657	165	30 766	241	9 542	349	122 647	60 965	50	99
Papua New Guinea	0	NA	0	NA	0	NA	0	NA	3 875	0	0	0
Philippines	0	NA	0	NA	0	NA	0	NA	58 826	0	0	0
Solomon Islands	0	NA	0	NA	0	NA	0	NA	232	0	0	0
Sri Lanka	0	NA	0	NA	0	NA	916	237	17 299	916	5	5
Thailand	0	NA	0	NA	0	NA	85	55	56 430	85	0	0
Viet Nam	0	NA	0	NA	0	NA	1 764	243	67 572	1 764	3	3
Total	88 666	12	28 405	17	173 639	39	717 804	147	2 073 805	919 848	44	46

AGLS Database derived from Global AEZ data (FAO/IIASA) and global population database (Tobler et al.,1995)
Reference Fisher et al. (1995) and Nachtergaele, Janssen and Zanetti (1996)
NA: not applicable
** Desertification risk as defined by UNSO, 1997

TABLE A3e
Deserts, dryland areas and population distribution per country, South and Central America

	Total area ('000 km^2)	Desert		Drylands						Total area of drylands ('000 km^2)	Desertification risk** (%)
		Hyperarid (lgp 0 days)		Arid (lgp 1-59 days)		Semi-arid (lgp 60-119 days)		Dry sub-humid (lgp 120-179 days)			
		%	Area ('000 km^2)	%	Area ('000 km^2)	%	Area ('000 km^2)	%	Area ('000 km^2)		
Argentina	2 772	20	550	32	328	19	519	12	328	1175	53
Belize	23	0	0	0	0	0	0	0	0	0	0
Bolivia	1 096	10	108	12	24	8	89	12	136	249	25
Brazil	8 479	1	43	1	17	1	77	7	562	655	8
Chile	749	31	231	34	24	7	50	14	104	178	34
Colombia	1 136	0	0	0	1	1	15	1	8	24	2
Costa Rica	51	0	0	0	0	0	0	0	0	0	0
Cuba	114	0	0	0	0	0	0	0	0	0	0
Dominican Republic	47	0	0	0	0	0	0	0	0	0	0
Ecuador	283	2	6	4	6	5	15	14	40	60	22
El Salvador	21	0	0	0	0	0	0	0	0	0	0
Falklands	12	0	0	0	0	0	0	0	0	0	0
French Guyana	91	0	0	0	0	0	0	0	0	0	0
Guatemala	108	0	0	0	0	0	0	0	0	0	0
Guyana	215	0	1	0	0	0	0	0	0	0	0
Haiti	27	0	0	0	0	0	0	0	0	0	0
Honduras	112	0	0	0	0	0	0	0	0	0	0
Jamaica	11	0	0	0	0	0	0	0	0	0	0
Mexico	1 966	33	657	40	120	14	272	28	548	941	72
Neth. Antilles	1	0	0	0	0	0	0	0	0	0	0
Nicaragua	144	0	0	0	0	0	0	0	0	0	0
Panama	78	0	0	0	0	0	0	0	0	0	0
Paraguay	407	0	0	0	0	0	0	15	61	61	15
Peru	9	15	188	17	28	7	91	10	132	252	23
Puerto Rico	1 281	0	0	0	0	0	0	0	0	0	0
Suriname	164	0	0	0	0	0	0	0	0	0	0
Trinidad/Tobago	5	0	0	0	0	0	0	0	0	0	0
Uruguay	186	0	0	0	0	0	0	0	0	0	0
Venezuela	910	1	5	1	5	1	12	3	30	47	5
Total	20 498	9	1 788	11	554	6	1 140	10	1 949	3 644	19

AGLS Database derived from Global AEZ data (FAO/IIASA) and global population database (Tobler et al.,1995)
Reference Fisher et al. (1995) and Nachtergaele, Janssen and Zanetti (1996)
NA: not applicable
** Desertification risk as defined by UNSO, 1997

TABLE A3e Cont'd
Deserts, dryland areas and population distribution per country, South and Central America

	Desert		Drylands						Total Country Population ('000)	Total population in drylands ('000)	% of total population in dryland areas	% of pop. under desertification risk
	Hyperarid (lgp 0 days)		Arid (lgp 1-59 days)		Semi-arid (lgp 60-119 days)		Drysub-humid (lgp 120-179 days)					
	Population ('000)	Population Density	Population ('000)	Population Density	Population ('000)	Population Density	Population ('000)	Population Density				
Argentina	2 641	5	1 099	4	2 056	4	1 494	5	33404	4 649	14	15
Belize	0	NA	0	NA	0	NA	0	NA	205	0	0	0
Bolivia	765	7	181	7	1 133	13	1 595	12	40 768	2 909	7	7
Brazil	452	11	292	NA	2 198	29	14 938	27	36 336	17428	48	49
Chile	1 233	5	2 912	16	692	14	2 210	21	13 652	5 814	43	47
Colombia	0	NA	20	18	262	18	208	26	33 962	490	1	1
Costa Rica	0	NA	0	NA	0	NA	0	NA	3 289	0	0	0
Cuba	0	NA	0	NA	0	NA	0	NA	10 616	0	0	0
Dominican Republic	0	NA	0	NA	0	NA	0	NA	7 691	0	0	0
Ecuador	18	3	497	43	1 050	71	2 666	67	10 196	4 213	41	41
El Salvador	0	NA	0	NA	0	NA	0	NA	5 718	0	0	0
Falklands	0	NA	0	NA	0	NA	0	NA	2	0	0	0
French Guyana	0	NA	0	NA	0	NA	0	NA	126	0	0	0
Guatemala	0	NA	0	NA	0	NA	0	NA	10 243	0	0	0
Guyana	0	0	0	0	0	NA	0	NA	742	0	0	0
Haiti	0	NA	0	NA	0	NA	0	NA	6 365	0	0	0
Honduras	0	NA	0	NA	0	NA	0	NA	5 257	0	0	0
Jamaica	0	NA	0	NA	0	NA	0	NA	2 131	0	0	0
Mexico	6 351	10	1941	11	5 974	22	34 540	63	89 593	42 455	47	51
Neth. Antilles	0	NA	0	NA	0	NA	0	NA	22	0	0	0
Nicaragua	0	NA	0	NA	0	NA	0	NA	4 216	0	0	0
Panama	0	NA	0	NA	0	NA	0	NA	2 469	0	0	0
Paraguay	0	NA	0	NA	0	NA	7	0	4 788	7	0	0
Peru	9 841	52	924	50	3 636	40	3771	28	24 019	8 331	35	59
Puerto Rico	0	NA	0	NA	0	NA	0	NA	3 278	0	0	0
Suriname	0	NA	0	NA	0	NA	0	NA	425	0	0	0
Trinidad/Tobago	0	NA	0	NA	0	NA	0	NA	1 199	0	0	0
Uruguay	0	NA	0	NA	0	NA	0	NA	2 953	0	0	0
Venezuela	101	18	171	25	351	30	1 134	38	19 232	1 656	9	9
Total	21 402	12	8 037	13	17 352	15	62 563	32	372 897	87 952	24	25

AGLS Database derived from Global AEZ data (FAO/IIASA) and global population database (Tobler et al.,1995)
Reference Fisher et al. (1995) and Nachtergaele, Janssen and Zanetti (1996)
NA: not applicable
** Desertification risk as defined by UNSO, 1997

TABLE A3f
Deserts, dryland areas and population distribution per country, North America

	Total area ('000 km^2)	Desert		Drylands						Total area of drvlands ('000 km^2)	Deserti-fication risk** (%)
		Hyperarid (lgp 0 days)		Arid (lgp 1-59 days)		Semi-arid (lgp 60-119 days)		Dry sub-humid (lgp 120-179 days)			
		%	Area ('000 km^2)	%	Area ('000 km^2)	%	Area ('000 km^2)	%	Area ('000 km^2)		
Canada	9 893	0	20	10	953	41	4 048	40	3 989	8 990	90
United States of America	9 344	12	1 217	14	1 348	16	1 545	7	702	3 595	42
Total	19 237	6	1 237	12	2 301	28	5 593	24	4 691	12 585	68

AGLS Database derived from Global AEZ data (FAO/IIASA) and global population database (Tobler et al.,1995)
Reference Fisher et al. (1995) and Nachtergaele, Janssen and Zanetti (1996)
NA: not applicable
** Desertification risk as defined by UNSO, 1997

TABLE A3f Cont'd
Deserts, dryland areas and population distribution per country, North America

	Desert		Drylands						Total Country Population ('000)	Total population in drylands ('000)	% of total population in dryland areas	% of population under desertification risk
	Hyperarid (lgp 0 days)		Arid (lgp 1-59 days)		Semi-arid (lgp 60-119 days)		Drysub-humid (lgp 120-179 days)					
	Population ('000)	Population Density	Population ('000)	Population Density	Population ('000)	Population Density	Population ('000)	Population Density				
Canada	0	0	37	0	1 773	0	3 837	1	27 839	5 647	20	20
United States of America	7 699	6	5 753	4	17 009	11	24 462	35	257 503	47 224	18	19
Total	7 699	6	5 790	3	18 782	3	28 299	6	285 342	52 871	19	19

AGLS Database derived from Global AEZ data (FAO/IIASA) and global population database (Tobler et al.,1995)
Reference Fisher et al. (1995) and Nachtergaele, Janssen and Zanetti (1996)
NA: not applicable
** Desertification risk as defined by UNSO, 1997

TABLE A3g
Deserts, dryland areas and population distribution per country, Europe

	Total area ('000 km^2)	Desert		Drylands						Total area of drylands ('000 km^2)	Deserti-fication risk** (%)
		Hyperarid (lgp 0 days)		Arid (lgp 1-59 days)		Semi-arid (lgp 60-119 days)		Dry sub-humid (lgp 120-179 days)			
		%	Area ('000 km^2)	%	Area ('000 km^2)	%	Area ('000 km^2)	%	Area ('000 km^2)		
Albania	29	0	0	0	0	0	0	37	11	11	37
Armenia	30	0	0	0	0	88	26	12	4	30	100
Austria *	84	0	0	0	0	2	1	23	19	21	25
Azerbaijan	87	0	0	0	0	31	27	50	43	70	81
Belarus	207	0	0	0	0	0	0	0	0	0	0
Belgium	31	0	0	0	0	0	0	0	0	0	0
Bosnia Herzegovina	51	0	0	0	0	0	0	0	0	0	0
Bulgaria	111	0	0	0	0	6	7	81	90	97	87
Croatia	57	0	0	0	0	0	0	0	0	0	0
Cyprus	9	0	0	0	0	0	0	100	9	9	100
Czech Republic	79	0	0	0	0	0	0	0	0	0	0
Denmark	43	0	0	0	0	0	0	4	2	2	4
Estonia	45	0	0	0	0	0	0	50	23	23	50
Finland	338	0	0	0	0	8	28	91	307	335	99
France	552	0	0	0	0	0	0	2	11	11	2
Georgia *	70	0	0	0	0	3	2	33	23	25	35
Germany	357	0	0	0	0	0	0	0	0	0	0
Greece	314	0	0	0	0	0	0	11	33	33	11
Hungary	93	0	0	0	0	0	0	12	12	12	12
Iceland *	103	0	0	0	0	0	0	1	1	1	1
Ireland (Rep.)	70	0	0	0	0	0	0	0	0	0	0
Israel	21	26	5	9	2	28	6	35	7	15	98
Italy	301	0	0	0	0	0	1	3	8	10	3
Latvia	65	0	0	0	0	0	0	0	0	0	0
Lithuania	65	0	0	0	0	0	0	0	0	0	0
Luxembourg	3	0	0	0	0	0	0	0	0	0	0
Macedonia	25	0	0	0	0	0	0	100	25	25	100
Malta	0	0	0	0	0	0	0	0	0	0	0
Moldova	34	0	0	0	0	1	1	80	27	28	82
Netherlands	37	0	0	0	0	0	0	0	0	0	0
Norway *	324	0	0	0	0	15	48	5	18	66	20
Poland	313	0	0	0	0	0	0	0	0	0	0
Portugal	92	0	0	0	0	0	0	2	2	2	2
Romania	238	0	0	0	0	8	19	37	89	107	45
Slovenia	20	0	0	0	0	0	0	10	2	2	10
Spain	505	0	0	0	0	0	1	2	12	13	3
Sweden *	450	0	0	0	2	14	63	12	52	117	26
Switzerland	41	0	0	0	0	0	0	0	0	0	0
Turkey	779	0	0	0	2	64	502	21	162	666	86
Ukraine	604	0	0	0	0	20	124	23	139	263	44
United Kingdom	245	0	0	0	0	0	0	0	0	0	0
Yugoslavia	102	0	0	0	0	0	0	20	21	21	20
Total	7 022	0	5	0	6	12	855	16	1 153	2 014	29

AGLS Database derived from Global AEZ data (FAO/IIASA) and global population database (Tobler et al.,1995)
Reference Fisher et al. (1995) and Nachtergaele, Janssen and Zanetti (1996)
NA: not applicable
** Desertification risk as defined by UNSO, 1997

TABLE A3g Cont'd
Deserts, dryland areas and population distribution per country, Europe

	Desert		Drylands						Total Country Population ('000)	Total population in drylands ('000)	% of total population in dryland areas	% of population under desertification risk
	Hyperarid (lgp 0 days)		Arid (lgp 1-59 days)		Semi-arid (lgp 60-119 days)		Drysub-humid (lgp 120-179 days)					
	Population ('000)	Population Density	Population ('000)	Population Density	Population ('000)	Population Density	Population ('000)	Population Density				
Albania	0	NA	0	NA	0	NA	984	91	3 389	984	29	29
Armenia	0	NA	0	NA	2 893	110	372	106	3 495	3 265	93	93
Austria *	0	NA	0	NA	70	49	1 330	69	7 986	1 400	18	18
Azerbaijan	0	NA	0	NA	1 706	64	2 645	61	7 384	4 351	59	59
Belarus	0	NA	0	NA	0	NA	0	NA	10 443	0	0	0
Belgium	0	NA	0	NA	0	NA	0	NA	10 112	0	0	0
Bosnia Herzegovina	0	NA	0	NA	0	NA	0	NA	3 707	0	0	0
Bulgaria	0	NA	0	NA	538	82	6 153	68	8 922	6 691	75	75
Croatia	0	NA	0	NA	0	NA	0	NA	4 511	0	0	0
Cyprus	0	NA	0	NA	0	NA	674	73	726	674	93	93
Czech Republic	0	NA	0	NA	0	NA	0	NA	10 296	0	0	0
Denmark	0	NA	0	NA	0	NA	175	110	5 189	175	3	3
Estonia	0	NA	0	NA	0	NA	782	35	1 552	782	50	50
Finland	0	NA	0	NA	9	0	4 240	14	5 068	4 249	84	84
France	0	NA	0	NA	0	NA	768	71	57 508	768	1	1
Georgia *	0	NA	0	NA	150	77	1 801	80	5 446	1 951	36	36
Germany	0	NA	0	NA	0	NA	51	142	80 857	51	0	0
Greece	0	NA	0	NA	0	NA	1 661	50	10 377	1 661	16	16
Hungary	0	NA	0	NA	0	NA	1 131	98	10 292	1 131	11	11
Iceland *	0	NA	0	NA	0	NA	2	1	264	2	1	1
Ireland (Rep.)	0	NA	0	NA	0	NA	0	NA	3 560	0	0	0
Israel	2	0	15	8	725	121	4 978	673	5 718	5 718	100	100
Italy	0	NA	0	NA	53	44	627	74	57127	680	1	1
Latvia	0	NA	0	NA	0	NA	8	31	2 611	8	0	0
Lithuania	0	NA	0	NA	0	NA	0	NA	3 712	0	0	0
Luxembourg	0	NA	0	NA	0	NA	0	NA	351	0	0	0
Macedonia	0	NA	0	NA	0	NA	2 091	83	2 137	2 091	98	98
Malta	0	NA	0	NA	0	NA	0	NA	364	0	0	0
Moldova	0	NA	0	NA	52	104	3 655	135	4 515	3 707	82	82
Netherlands	0	NA	0	NA	0	NA	0	NA	15 295	0	0	0
Norway *	0	NA	0	NA	109	2	81	5	4 312	190	4	4
Poland	0	NA	0	NA	0	NA	0	NA	38 460	0	0	0
Portugal	0	NA	0	NA	0	NA	36	22	9 838	36	0	0
Romania	0	NA	0	NA	1 259	67	10 680	121	22 763	11 939	52	52
Slovenia	0	NA	0	NA	0	NA	161	81	1 925	161	8	8
Spain	0	NA	0	NA	183	362	780	64	39 513	963	2	2
Sweden *	0	NA	0	0	35	1	224	4	8 706	259	3	3
Switzerland	0	NA	0	NA	0	NA	11	268	7 056	11	0	0
Turkey	0	NA	111	47	28 031	56	13 493	83	59 597	41 635	70	70
Ukraine	0	NA	0	NA	12 229	99	13 632	98	51 551	25 861	50	50
United Kingdom	0	NA	0	NA	0	NA	0	NA	58 142	0	0	0
Yugoslavia	0	NA	0	NA	0	NA	1 893	91	10 623	1 893	18	18
Total	2	0	126	21	48 042	56	75 119	65	654 955	123 287	19	19

AGLS Database derived from Global AEZ data (FAO/IIASA) and global population database (Tobler et al.,1995)
Reference Fisher et al. (1995) and Nachtergaele, Janssen and Zanetti (1996)
NA: not applicable
** Desertification risk as defined by UNSO, 1997

	Total area ('000 km^2)	Desert		Drylands						Total area of drylands ('000 km^2)	Desertification risk** (%)
		Hyperarid (lgp 0 days)		Arid (lgp 1-59 days)		Semi-arid (lgp 60-119 days)		Dry sub-humid (lgp 120-179 days)			
		%	Area ('000 km^2)	%	Area ('000 km^2)	%	Area ('000 km^2)	%	Area ('000 km^2)		
WORLD TOTAL	134 907	19	25 637	7	8 951	20	27 392	18	24 714	61 057	56

	Desert		Drylands						Total Country Population ('000)	Total population in drylands ('000)	% of total population in dryland areas	% of population under desertification risk
	Hyperarid (lgp 0 days)		Arid (lgp 1-59 days)		Semi-arid (lgp 60-119 days)		Drysub-humid (lgp 120-179 days)					
	Population ('000)	Population Density	Population ('000)	Population Density	Population ('000)	Population Density	Population ('000)	Population Density				
WORLD TOTAL	271 138	11	87 599	10	440511	16	1 167 727	47	4 451 922	1 695 837	38	41

Appendix 4
Steeplands

TABLE A4a
Steeplands per country, sub-Saharan Africa

	Total area ('000 km^2)	Steep slopes 8-30% ('000 km^2)	%	Very steep slopes >30% ('000 km^2)	%	Total steeplands ('000 km^2)	%
Angola	1 247	401	32	43	3	444	36
Benin	111	31	28	5	4	35	32
Botswana	599	121	20	7	1	129	21
Burkina Faso	274	112	41	12	4	124	45
Burundi	26	15	58	3	13	19	72
Cameroon	465	216	46	18	4	233	50
Central African Republic	623	302	49	20	3	323	52
Chad	1 259	350	28	41	3	391	31
Congo Dem. Rep.	2 267	649	29	47	2	696	31
Congo Rep.	342	119	35	2	0	121	35
Cote d'Ivoire	318	133	42	11	3	143	45
Djibouti	23	9	39	0	2	9	41
Eq. Guinea	28	12	43	1	3	13	46
Eritrea	94						
Ethiopia	1 104	406	37	326	30	732	66
Gabon	258	154	60	9	4	164	63
Gambia	11	1	11	0	1	1	12
Ghana	228	72	31	10	4	82	36
Guinea	246	133	54	25	10	158	64
Guinea Bissau	36	10	27	4	10	13	37
Kenya	569	197	35	77	13	274	48
Lesotho	31	16	52	9	27	25	80
Liberia	96	50	52	5	6	55	57
Madagascar	582	317	54	47	8	364	63
Malawi	94	42	44	19	20	60	64
Mali	1 220	432	35	63	5	495	41
Mauritania	1 031	197	19	39	4	236	23
Mozambique	784	389	50	51	7	441	56
Namibia	823	259	31	54	7	313	38
Niger	1 267	191	15	57	5	249	20
Nigeria	911	306	34	52	6	358	39
Rwanda	25	12	46	7	29	19	75
Senegal	197	51	26	6	3	58	29
Sierra Leone	72	35	48	7	10	42	58
Somalia	629	263	42	33	5	296	47
South Africa	1 221	478	39	141	12	618	51
Sudan	2 376	690	29	127	5	817	34
Swaziland	17	8	47	4	22	12	69
Tanzania	884	309	35	127	14	435	49
Togo	54	19	36	4	7	23	43
Uganda	200	75	38	20	10	95	47
Zambia	743	173	23	28	4	201	27
Zimbabwe	387	97	25	24	6	121	31
Total	23 772	7 851	33	1 583	7	9 434	40

TABLE A4b
Steeplands per country, North Africa and Near East

	Total area	Steep slopes 8-30%		Very steep slopes >30%		Total steeplands	
	('000 km^2)	('000 km^2)	%	('000 km^2)	%	('000 km^2)	%
Afghanistan	650	224	35	138	21	363	56
Algeria	2 382	604	25	131	6	735	31
Egypt	1 001	341	34	78	8	419	42
Iran	1 643	516	31	311	19	827	50
Iraq	438	107	25	33	7	140	32
Jordan	96	46	47	12	13	58	60
Kuwait	24	4	14	1	5	5	20
Lebanon	104	5	4	4	4	8	8
Libya	1 760	386	22	73	4	459	26
Morocco	447	150	34	92	21	243	54
Oman	271	96	35	29	11	126	46
Qatar	11	3	22	1	10	4	32
Saudi Arabia	2 396	698	29	138	6	836	35
Syria	185	66	36	19	10	85	46
Tunisia	164	52	32	23	14	75	46
United Arab Emirates	75	16	21	3	4	19	25
Western Sahara	252	103	41	10	4	112	44
Yemen	480	164	34	36	7	200	42
Total	12 379	3 579	29	1 132	9	4 711	38

TABLE A4c
Steeplands per country, North Asia, east of Urals

	Total area	Steep slopes 8-30%		Very steep slopes >30%		Total steeplands	
	('000 km^2)	('000 km^2)	%	('000 km^2)	%	('000 km^2)	%
Kazakhstan	2 715	538	20	77	3	615	23
Kyrgyzstan	198	61	31	56	28	117	59
Russian Federation	17 044	5 119	30	1 739	10	6 858	40
Tajikistan	143	40	28	37	26	77	54
Turkmenistan	487	87	18	7	1	94	19
Uzbekistan	446	97	22	14	3	111	25
Total	21 033	5 943	28	1 930	9	7 872	37

TABLE A4d
Steeplands per country, Asia and Pacific

	Total area ('000 km^2)	Steep slopes 8-30% ('000 km^2)	%	Very steep slopes >30% ('000 km^2)	%	Total steeplands ('000 km^2)	%
Australia	7 667	3 923	51	328	4	4 252	55
Bangladesh	144	18	13	11	8	29	20
Bhutan	47	22	48	10	21	32	69
Brunei	6	3	53	1	9	4	62
Cambodia	181	54	30	33	18	87	48
China	9 550	2 899	30	2 043	21	4 942	52
Fiji	18	7	36	7	40	14	76
HongKong	1	0	0	0	0	0	0
India	3 157	1 343	43	237	8	1 581	50
Indonesia	1 916	762	40	453	24	1 215	63
Japan	369	241	65	88	24	329	89
Korean DPR	122	59	48	30	24	89	73
Korean Rep.	98	60	61	40	41	101	102
Laos	237	82	35	128	54	210	89
Malaysia	333	155	46	80	24	235	71
Mongolia	1 560	817	52	198	13	1 015	65
Myanmar	677	242	36	234	35	475	70
Nepal	141	77	55	29	20	106	75
New Zealand	265	93	35	120	45	213	80
Pakistan	802	204	25	104	13	309	38
Papua New Guinea	462	165	36	145	31	310	67
Philippines	299	197	66	50	17	247	82
Solomon Islands	30	11	38	9	29	20	67
Sri Lanka	65	30	46	6	9	36	55
Thailand	513	226	44	135	26	360	70
Viet Nam	329	115	35	109	33	225	68
Total	28 989	11 805	41	4 628	16	16 433	57

TABLE A4e
Steeplands per country, South and Central America

	Total area	Steep slopes 8-30%		Very steep slopes >30%		Total steeplands	
	('000 km^2)	('000 km^2)	%	('000 km^2)	%	('000 km^2)	%
Argentina	2 772	481	17	283	10	763	28
Belize	23	9	39	2	9	11	47
Bolivia	1 096	253	23	175	16	428	39
Brazil	8 479	2 938	35	293	3	3 230	38
Chile	749	212	28	243	32	455	61
Colombia	1 136	412	36	119	10	531	47
Costa Rica	51	24	48	9	17	33	65
Cuba	114	52	46	7	6	59	52
Dominican Republic	47	25	53	9	19	34	71
Ecuador	283	89	31	60	21	149	53
El Salvador	21	11	53	6	28	17	81
Falklands	12	10	490	1	40	11	530
French Guyana	91	65	71	0	0	65	71
Guatemala	108	52	48	23	22	76	70
Guyana	215	90	42	22	10	113	52
Haiti	27	15	56	6	24	22	80
Honduras	112	59	53	28	25	88	78
Jamaica	11	5	48	2	20	8	68
Mexico	1 966	1 001	51	373	19	1 373	70
Neth. Antilles	1	0	30	0	0	0	30
Nicaragua	144	59	41	19	13	78	54
Panama	78	40	51	11	14	51	66
Paraguay	407	63	16	0	0	63	16
Peru	9	321	25	340	27	661	52
Puerto Rico	1 281	5	52	2	18	6	70
Suriname	164	41	25	0	0	41	25
Trinidad/Tobago	5	2	44	1	22	3	66
Uruguay	186	20	11	7	4	27	14
Venezuela	910	382	42	146	16	528	58
Total	20 498	6 735	33	2 186	11	8 921	44

TABLE A4f
Steeplands per country, North America

	Total area	Steep slopes 8-30%		Very steep slopes >30%		Total steeplands	
	('000 km^2)	('000 km^2)	%	('000 km^2)	%	('000 km^2)	%
Canada	9 893	4 048	41	1 108	11	5 156	52
United States of America	9 344	3 728	38	1 326	14	5 054	52
Total	19 237	7 776	39	2 434	12	10 210	51

TABLE A4g
Steeplands per country, Europe

	Total area	Steep slopes 8-30%		Very steep slopes >30%		Total steeplands	
	('000 km^2)	('000 km^2)	%	('000 km^2)	%	('000 km^2)	%
Albania	29	15	53	9	30	24	83
Armenia	30	12	39	10	35	22	73
Austria	84	52	61	17	20	68	81
Azerbaijan	87	34	39	12	14	46	53
Belarus	207	33	16	0	0	33	16
Belgium	31	17	54	1	2	17	56
Bosnia Herzegovina	51	30	59	13	24	43	83
Bulgaria	111	58	52	17	16	75	68
Croatia	57	35	62	4	8	39	70
Cyprus	9	5	55	2	24	7	79
Czech Republic	79	79	100	16	20	95	120
Denmark	43	23	53	0	0	23	53
Estonia	45	2	4	0	0	2	4
Finland	338	106	31	5	2	111	33
France	552	280	51	37	7	317	58
Georgia	70	27	39	22	32	49	71
Germany	357	184	52	7	2	191	54
Greece	314	57	18	48	15	105	33
Hungary	93	36	38	3	3	39	41
Iceland	103	52	51	22	22	75	72
Ireland (Rep.)	70	37	52	1	1	37	53
Israel	21	11	52	2	11	13	63
Italy	301	171	57	74	24	245	81
Latvia	65	7	11	0	0	7	11
Lithuania	65	8	12	0	0	8	12
Luxembourg	3	2	78	0	0	2	78
Macedonia	25	16	62	8	32	24	94
Malta	0	0	67	0	0	0	67
Moldova	34	11	32	0	0	11	32
Netherlands	37	5	14	0	0	5	14
Norway	324	212	66	28	9	240	74
Poland	313	140	45	4	1	144	46
Portugal	92	55	59	19	20	73	79
Romania	238	113	48	24	10	137	58
Slovenia	20	12	59	5	26	17	85
Spain	505	299	59	100	20	398	79
Sweden	450	208	46	9	2	217	48
Switzerland	41	18	43	13	31	31	75
Turkey	779	405	52	210	27	614	79
Ukraine	604	114	19	9	1	123	20
United Kingdom	245	94	38	11	5	106	43
Yugoslavia	102	44	43	21	21	65	64
Total	7 022	3 116	44	780	11	3 896	55

	Total area	Steep slopes 8-30%		Very steep slopes >30%		Total steeplands	
	('000 km^2)	('000 km^2)	%	('000 km^2)	%	('000 km^2)	%
World total	134 907	46 804	35	14 672	11	61 476	46

Appendix 5
Land degradation severity

TABLE A5a
Land degradation: severity of humun-induced degradation for Sub-Saharan Africa

	Total area 1000 km^2	None		Light		Moderate		Severe		Very severe		Cause	Type
		1000km^2	%	1000km^2	%	1000km^2	%	1000km^2	%	1000km^2	%		
Angola	1 247	759	61	193	16	121	10	65	5	105	8	D	W
Benin	111	0	NA	61	54	28	25	11	10	12	11	D	W
Botswana	599	183	31	267	44	80	13	25	4	44	7	O	N
Burkina Faso	274	0	0	59	21	59	21	36	3	120	44	O,D,A	W
Burundi	26	2	7	0	0	5	17	0	0	21	76	A	W
Cameroon	465	188	40	25	5	85	18	68	14	109	23	A,O,D	W
Central af	623	273	44	321	51	17	3	2	4	9	2	D	W
Chad	1 259	510	40	381	30	85	7	289	23	17	1	O	N,W,P
Congo D.R.	2 267	767	33	1210	52	185	8	152	7	23	1	D	W,C
Congo Republic	342	268	78	42	12	24	7	2	1	6	2	D	C
Cote d'Ivoire	318	9	3	255	79	46	14	0	0	12	4	D	W,C
Djibouti	23	0	0	0	0	23	100	0	0	0	0	O	N
Equatorial Guinea	28	22	79	6	21	0	0	0	0	0	0	D	C
Eritrea	94	13	14	0	0	21	22.7	52	55	8	8	O	W,N
Ethiopia	1 104	53	4	125	10	700	57	97	8	244	20	O	W
Gabon	258	217	81	8	3	24	9	18	7	0	0	D	C
Ghana	11	14	6	60	25	142	60	7	3	15	6	D	W
Guinea	228	0	0	200	78	45	18	10	4	0	0	D	W
Guinea Bissau	246	0	0	9	24	27	76	0	0	0	0	D,A	W,C
Kenya	36	38	7	237	41	128	22	111	19	66	11	O	W
Lesotho	569	0	0	0	0	0	0	23	75	8	25	O	W
Liberia	31	44	40	55	49	0	0	12	11	0	0	D	C
Madagascar	96	0	0	27	5	147	25	286	48	133	22	A	W
Malawi	582	37	39	3	3	55	58	0	0	0	0	A	W
Mali	94	567	46	218	18	84	7	165	13	201	16	O	W,N
Mauritania	1 220	764	74	0	0	0	0	182	18	84	8	O	N
Mozambique	1 031	244	31	228	29	312	39	0	0	0	0	A,D	W
Namibia	784	467	57	97	12	70	9	174	21	15	2	O	W
Niger	823	642	54	9	1	0	0	330	28	203	17	O	N
Nigeria	1 267	27	3	349	38	39	4	248	27	258	28	D,O	W
Rwanda	911	0	0	0	0	7	28	0	0	19	71	A,D	W
Senegal	25	0	0	77	39	50	25	27	14	42	22	D,O,A	W,C
Sierra	197	0	0	35	48	10	14	28	39	0	0	D	W,C
Somalia	72	146	23	61	9.6	329	52	0	0	93	15	O,A	W
South Africa	629	263	22	98	8	60	5	219	19	541	46	O	W,N
Sudan	1 221	1 163	46	326	13	263	11	366	15	0	15	O	W,N
Swaziland	2 376	0	0	0	0	17	100	0	0	0	0	A	W
Tanzania	17	114	12	289	31	295	31	228	24	11	1	A,O	W
The Gambia	884	0	0	6	53	5	47	0	0	0	0	D	W
Togo	54	0	0	14	24	12	22	17	30	14	24	D,A	W
Uganda	200	9	4	2	1	101	43	96	41	27	12	O,D,A	W
Zambia	743	135	18	157	21	334	44	126	17	0	0	D	W
Zimbabwe	387	34	9	205	53	151	39	0	0	0	0	A,O	W
Total	23 772	6809	34	5715	24	4186	18	3472	15	2460	10		

NA: not applicable

A: agriculture
O: overgrazing
D: deforestation
V: overexploitation of vegetation

W: water erosion
N: wind erosion
C: chemical deterioration
P: physical deterioration

TABLE A5b
Land degradation: severity of human-induced degradation for North Africa and Middle East

	Total area 1000 km²	None		Light		Moderate		Severe		Very severe		Cause	Type
		1000km²	%	1000km²	%	1000km²	%	1000km²	%	1000km²	%		
Afghanistan	650	32	5	75	12	362	56	127	20	54	8	O	W
Algeria	2 382	1 048	44	579	24	250	11	445	19	52	2	A	N, C
Egypt	1 001	614	62	272	27	26	3	66	7	19	2	A	C
Iran	1 643	129	8	94	6	465	28	674	41	282	17	V,O,D	W,C,N
Iraq	438	3	1	0	0	91	21	196	45	149	34	O,A	N,C,W,P
Jordan	96	3	4	0	0	62	65	14	14	16	17	O,D	N,W
Kuwait	24	0	0	0	0	24	98	0	0	1	2	O	N
Lebanon	104	0	0	72	69	6	6	26	25	0	0	O,D	W
Libya	1 760	941	54	88	5	37	2	593	34	95	5	O, (A)	N, (C)
Morocco	447	20	4	42	9	297	67	63	14	24	5	A, D, (O)	W, (C,N)
Oman	271	42	16	76	28	46	17	107	39	0	0	O,D	W,N
Qatar	11	0	0	7	65	4	35	0	0	0	0	O	N
Saudi Arabia	2 396	514	21	732	31	348	15	660	28	142	6	O	N
Syria	185	0	0	9	5	64	35	78	42	33	18	A,O	W,N,C
Tunisia	164	35	21	0	0	0	0	129	79	0	0	O, A, (D)	N, (C)
United Arab Emirates	75	14	19	0	0	58	77	3	4	0	0	O,A	N,C
Western Sahara	252	251	100	0	0	1	0	0	0	0	0	NA	NA
Yemen	480	18	4	85	18	161	33	217	45	0	0	D,O	W,N
TOTAL	12 379	3 664	30	2 132	17	2 302	19	3 398	27	865	7		

NA: not applicable

A: agriculture
O: overgrazing
D: deforestation
V: overexploitation of vegetation

W: water erosion
N: wind erosion
C: chemical deterioration
P: physical deterioration

TABLE A5c
Land degradation: severity of human-induced degradation for North Asia, east of Urals

	Total area 1000 km²	None		Light		Moderate		Severe		Very severe		Cause	Type
		1000km²	%	1000km²	%	1000km²	%	1000km²	%	1000km²	%		
Kazakhistan	2 715	1 424	52	315	12	503	19	410	15	62	2	D, O	N, W
Kyrgyzstan	198	72	36	122	62	0	0	4	2	0	0	O, (A)	W, (C)
Russian Federation	17 044	8 795	52	2 579	15	1 862	11	3 108	18	700	4	D, A	W
Tajikistan	143	119	83	0	0	14	10	10	7	0	0	A	C, W, (N)
Turkmenistan	487	363	75	1	0	56	12	44	9	21	4	A	C, P
Uzbekistan	446	336	75	9	2	42	9	60	13	0	0	A	C, P
Total	21 033	11 109	53	3 026	14	2 476	12	3 639	17	784	4		

NA: not applicable

A: agriculture
O: overgrazing
D: deforestation
V: overexploitation of vegetation

W: water erosion
N: wind erosion
C: chemical deterioration
P: physical deterioration

TABLE A5d
Land degradation: severity of human-induced degradation for Far East, South East Asia, Australia, Pacific Islands

	Total area 1000 km^2	None		Light		Moderate		Severe		Very severe		Cause	Type
		1000km^2	%	1000km^2	%	1000km^2	%	1000km^2	%	1000km^2	%		
Australia	7 667	3 027	39	1 183	15	3 211	42	246	3	0	0	O	W,N
Bangladesh	144	7	5	0	0	98	68	39	27	0	0	A,D	C,W
Bhutan	47	1	2	31	67	11	24	0	0	3	7	D,O	W
Brunei	6	0	0	0	0	0	0	6	100	0	0	A,D	P,C,W
Cambodia	181	23	13	4	2	65	36	48	27	40	22	D	W
China	9 550	2 644	28	776	8	2 835	30	2 347	25	948	10	D,A	W,N
Fiji	18	18	100	0	0	0	0	0	0	0	0	NA	NA
HongKong	1	0	0	1	100	0	0	0	0	0	0	A	W
India	3 157	1 184	37	16	1	111	4	1 352	43	494	16	D,A	W,C
Indonesia	1 916	10	1	695	36	497	26	607	32	108	6	D,A	W,C
Japan	369	305	82	65	18	0	0	0	0	0	0	A	W
Korean Dem. Rep.	122	0	0	0	0	101	83	21	17	0	0	D,O,A	W,C
Korean Rep.	98	0	0	0	0	57	58	41	42	0	0	A,D	W,C
Laos	237	0	0	37	16	197	83	0	0	3	1	D	W
Malaysia	333	0	0	0	0	55	17	277	83	0	0	D,A	W,C
Mongolia	1 560	235	15	321	21	606	39	399	26	0	0	A,O	N,W
Myanmar	677	9	1	0	0	424	63	237	35	6	1	D,A	W,C
Nepal	141	32	23	41	29	29	20	39	27	0	0	D,O	W
New Zealand	265	23	9	67	25	157	59	18	7	0	0	D,O	W
Pakistan	802	200	25	16	2	391	49	178	22	18	2	D,O,A	W,N,C
Papua New Guinea	462	363	79	84	18	15	3	0	0	0	0	D	W
Philippines	299	9	3	0	0	53	18	227	3	10	3	D	W
Solomon Islands	30	0	0	0	0	30	100	0	0	0	0	D	W
Sri Lanka	65	0	0	11	17	19	29	14	22	21	32	D,A	W,C
Thailand	513	0	0	10	2	102	20	144	28	258	50	D,A	W,C
Viet Nam	329	0	0	0	0	71	21	97	29	162	49	D,A	W,C
TOTAL	28 989	8 089	28	3 357	12	9 136	32	6 336	22	2071	7		

NA: not applicable

A: agriculture
O: overgrazing
D: deforestation
V: overexploitation of vegetation

W: water erosion
N: wind erosion
C: chemical deterioration
P: physical deterioration

TABLE A5e
Land degradation: severity of human-induced degradation for South and Central America

	Total area 1000 km²	None		Light		Moderate		Severe		Very severe		Cause	Type
		1000km²	%	1000km²	%	1000km²	%	1000km²	%	1000km²	%		
Argentina	2 772	233	8	808	29	1 428	51	292	11	11	0	A,O,D	W,N,C
Belize	23	16	71	0	0	0	0	7	29	0	0	D	C
Bolivia	1 096	566	52	124	11	98	9	248	23	60	6	O,D	W,N,C
Brazil	8 479	1 643	19	2 494	29	1 975	23	2 009	24	358	4	D,A	W,C
Chile	749	338	45	55	7	212	28	107	14	37	5	D	W,N
Colombia	1 136	117	10	604	53	213	19	202	18	0	0	D,O	W,C
Costa Rica	51	0	0	0	0	0	0	16	32	35	68	D,O	W,P,C
Cuba	114	22	19	23	20	8	7	40	35	21	19	A,D	W,C
Dominican Republic	47	0	0	0	0	28	59	19	40	0	1	D	W
Ecuador	283	14	5	188	66	64	23	7	2	11	4	D	W,C
El Salvador	21	0	0	1	6	0	0	20	94	0	0	A	W
Falklands	12	0	0	0	0	2	100	0	0	0	0	O	W
French Guyana	91	80	88	0	0	11	12	0	0	0	0	A	P
Guatemala	108	19	18	10	10	0	0	79	73	0	0	D,A	W,C
Guyana	215	89	42	94	44	4	2	28	13	0	0	A,O	W
Haiti	27	0	0	0	0	0	1	0	1	27	98	D	W
Honduras	112	15	13	0	0	2	2	95	84	0	0	A,D	W,C
Jamaica	11	0	0	0	0	0	0	11	100	0	0	D	W
Mexico	1 966	710	36	201	10	181	9	525	27	349	18	A,O	W
Neth. Antilles	1	0	0	0	0	1	100	0	0	0	0	O	N
Nicaragua	144	26	18	0	0	6	4	112	76	0	0	A,D	W,C
Panama	78	3	4	6	8	0	0	49	63	20	25	D,O	W
Paraguay	407	284	70	0	0	13	3	79	19	31	8	A,D	W,C
Puerto Rico	9	0	0	0	0	0	0	9	100	0	0	D	W
Peru	1 281	254	20	335	26	270	21	409	32	13	1	D,O	W,C
Suriname	164	120	73	15	9	29	18	0	0	0	0	A	P
Trinidad/Tobago	5	0	0	0	0	0	0	5	100	0	0	A,D	P,W
Uruguay	186	85	46	77	41	2	1	22	12	0	0	A,O	W
Venezuela	910	152	17	494	54	74	8	190	21	0	0	D,O	W,C
TOTAL	20 498	4 786	23	5 529	27	4 621	23	4 580	22	973	5		

NA: not applicable

A: agriculture
O: overgrazing
D: deforestation
V: overexploitation of vegetation

W: water erosion
N: wind erosion
C: chemical deterioration
P: physical deterioration

TABLE A5f
Land degradation: severity of human-induced degradation for North America

	Total area 1000 km²	None		Light		Moderate		Severe		Very severe		Cause	Type
		1000km²	%	1000km²	%	1000km²	%	1000km²	%	1000km²	%		
Canada	9 893	8 920	90	288	3	476	5	208	2	0	0	A	N
United States of America	9 344	899	10	2 837	30	2 659	28	2 949	32	0	0	A, O	W, N
Total	19 237	9 819	51	3 125	16	3 135	16	3 158	16	0	0		

NA: not applicable

A: agriculture
O: overgrazing
D: deforestation
V: overexploitation of vegetation

W: water erosion
N: wind erosion
C: chemical deterioration
P: physical deterioration

TABLE A5g
Land degradation: severity of human-induced degradation for Europe

	Total area 1000 km²	None		Light		Moderate		Severe		Very severe		Cause	Type
		1000km²	%	1000km²	%	1000km²	%	1000km²	%	1000km²	%		
Albania	29	0	0	0	0	2	6	4	14	23	80	D, (A)	W, (C)
Armenia	30	0	0	10	34	16	55	3	11	0	0	A	W
Austria	84	0	0	0	0	52	62	32	38	0	0	A, O	W, P
Azerbaijan	87	3	3	27	31	8	9	49	56	0	0	A	C
Belarus	207	0	0	79	38	115	56	13	6	0	0	A,D	P,W
Belgium	31	0	0	3	10	8	26	20	65	0	0	I, A	C, P
Bosnia Herzegovina	51	0	0	0	0	0	0	2	4	49	96	D	W
Bulgaria	111	0	0	0	0	0	0	111	100	0	0	D, (A)	W, (P)
Croatia	57	0	0	0	0	0	0	28	50	28	50	D	W
Cyprus	9	0	0	0	0	0	0	9	100	0	0	A, (I)	W, (C)
Czech Republic	79	0	0	0	0	0	0	79	100	0	0	A	W, P
Denmark	43	16	37	27	63	0	0	0	0	0	0	D, A	W, P
Estonia	45	27	59	0	0	16	36	2	5	0	0	D	W
Finland	338	24	7	233	69	44	13	35	11	0	0	A, (D,I)	P, (C)
France	552	0	0	320	59	173	32	50	9	0	0	A	W
Georgia	70	12	17	45	65	5	8	7	10	0	0	A	C, W
Germany	357	10	3	111	31	123	35	112	31	0	0	A, I	C. W. P
Greece	314	0	0	0	0	69	52	62	47	1	1	D, A	W, C
Hungary	93	0	0	13	14	19	21	60	65	0	0	D, A	W, C, P
Iceland	103	17	17	0	0	32	31	33	32	20	20	D, O	W, N
Ireland Rep.	70	47	68	22	32	0	0	0	0	0	0	O	W
Israel	21	12	57	8	37	1	6	0	0	0	0	D, A, I	W, P, C
Italy	301	0	0	0	0	216	72	84	28	0	0	D, A	W, P
Latvia	65	11	17	6	9	4	6	44	68	0	0	D, A	W, P
Lithuania	65	14	22	30	46	9	13	12	19	0	0	I, A	C, W
Luxembourg	3	0	0	1	49	0	0	1	51	0	0	I, A	C, P, (N)
Macedonia	25	0	0	0	0	3	11	11	44	11	45	D,A	W,C
Malta	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Moldova	34	0	0	0	0	0	0	34	100	0	1	D	W
Netherlands	37	0	0	25	61	14	34	2	5	0	0	I, A	C, P
Norway	324	248	77	58	18	7	2	10	3	0	0	I, (A, D)	C, W
Poland	313	50	16	0	0	3	1	153	49	107	34	A	W, P
Portugal	92	1	1	36	40	33	37	0	0	19	21	D, A	W, (P)
Romania	238	0	0	0	0	0	0	212	89	25	11	D, A	W
Slovenia	20	0	0	0	0	4	21	4	18	12	61	D,A,O	W,P
Spain	505	11	2	103	20	198	39	175	35	16	3	I, A	C, (P)
Sweden	450	53	12	191	42	93	21	85	19	28	6	O	W
Switzerland	41	0	0	12	28	30	72	0	0	0	0	D	W
Turkey	779	5	1	0	0	2	0	535	69	235	30	O,D,A	W. N. P
Ukraine	604	8	1	8	1	126	21	297	49	162	27	A, (I)	W, C
United Kingdom	245	59	24	40	17	98	40	47	19	0	0	D	W
Yugoslavia Fed.Rep.	102	0	0	0	0	8	6	39	31	80	63	D	W
Total	7 022	628	9	1 409	21	1 533	22	2 456	36	818	12		

NA: not applicable

A: agriculture
O: overgrazing
D: deforestation
V: overexploitation of vegetation

W: water erosion
N: wind erosion
C: chemical deterioration
P: physical deterioration

	Total area 1000 km^2	None		Light		Moderate		Severe		Very severe	
		1000km^2	%	1000km^2	%	1000km^2	%	1000km^2	%	1000km^2	%
WORLD	134 907	46 066	34	24 292	18	27 389	20	27 036	20	7 971	6

Appendix 6

Human-induced land degradation due to agricultural activities

TABLE A6a
Human-induced land degradation due to agricultural activities per country, Africa

		Land degradation (total)				Land degradation due to agricultural activities				
	Total area ('000 km^2)	severe ('000 km^2)	very severe ('000 km^2)	total degradation ('000 km^2)	% of total area degraded	severe degradation ('000 km^2)	very severe degradation ('000 km^2)	total degradation ('000 km^2)	% of degraded area due to agric. activities	% of total area degraded due to agric. activities
Angola	1 247	65	105	170	14	1	0	1	1	0
Benin	111	11	12	23	21	0	16	16	71	15
Botswana	599	25	44	69	12	71	0	71	104	12
Burkina Faso	274	36	120	156	57	24	94	119	76	43
Burundi	26	0	21	21	81	1	16	17	80	65
Cameroon	465	68	109	177	38	38	108	146	82	31
Central African Rep.	623	2	9	11	2	3	3	6	57	1
Chad	1 259	289	17	306	24	0	4	4	1	0
Congo Dem. Rep.	2 267	152	23	175	8	75	2	77	44	3
Congo Rep.	342	2	6	8	2	0	0	0	0	0
Cote d'Ivoire	318	0	12	12	4	0	12	12	99	4
Djibouti	23	0	0	0	0	0	0	0	NA	0
Eq. Guinea	28	0	0	0	0	0	0	0	NA	0
Eritrea	94	52	8	59	63	0	8	8	13	8
Ethiopia	1 104	97	244	341	31	0	64	64	19	6
Gabon	258	18	0	18	7	0	0	0	0	0
Ghana	11	7	15	22	10	0	15	15	68	7
Guinea	228	10	0	10	4	0	0	0	0	0
Guinea Bissau	246	0	0	0	0	0	0	0	NA	0
Kenya	36	111	66	177	31	0	31	31	17	5
Lesotho	569	23	8	31	100	0	0	0	0	0
Liberia	31	12	0	12	13	0	0	0	0	0
Madagascar	96	286	133	419	72	61	65	126	30	22
Malawi	582	0	0	0	0	0	0	0	NA	0
Mali	94	165	201	366	30	11	22	33	9	3
Mauritania	1 220	182	84	266	26	11	0	11	4	1
Mozambique	1 031	0	0	0	0	0	0	0	NA	0
Namibia	784	174	15	189	23	2	0	2	1	0
Niger	823	330	203	533	42	52	0	52	10	4
Nigeria	1 267	248	258	506	56	75	164	238	47	26
Rwanda	911	0	19	19	76	0	19	19	99	75
Senegal	25	27	42	69	36	7	39	46	66	24
Sierra Leone	197	28	0	28	39	0	0	0	0	0
Somalia	72	0	93	93	15	0	21	21	23	3
South Africa	629	219	541	760	62	159	102	261	34	21
Sudan	1 221	366	0	366	15	288	95	383	105	16
Swaziland	2 376	0	0	0	0	0	0	0	NA	0
Tanzania	17	228	11	239	27	46	0	46	19	5
Gambia	884	0	0	0	0	0	0	0	NA	0
Togo	54	17	14	31	57	0	14	14	44	25
Uganda	200	96	27	123	62	25	5	31	25	15
Zambia	743	126	0	126	17	126	0	126	100	17
Zimbabwe	387	0	0	0	0	0	0	0	NA	0
Total	23 772	3 472	2 460	5 931	25	1 077	919	1 996	34	8

AGLS database on degradation status derived from the GLASOD (UNEP/ISRIC, 1991) study

TABLE A6b
Human-induced land degradation due to agricultural activities per country, Near and Middle East

		Land degradation (total)				Land degradation due to agricultural activities				
	Total area ('000 km^2)	severe ('000 km^2)	very severe ('000 km^2)	total degradation ('000 km^2)	% of total area degraded	severe degradation ('000 km^2)	very severe degradation ('000 km^2)	total degradation ('000 km^2)	% of degraded area due to agric. activities	% of total area degraded due to agric. activities
Afghanistan	650	127	54	181	28	4	0	4	2	1
Algeria	2 382	445	52	498	21	255	52	307	62	13
Egypt	1 001	66	19	85	8	39	12	51	60	5
Iran	1 643	674	282	956	58	35	38	73	8	4
Iraq	438	196	149	344	79	4	141	145	42	33
Jordan	96	14	16	30	31	0	0	0	0	0
Kuwait	24	0	1	1	2	0	1	1	100	2
Lebanon	104	26	0	26	25	0	0	0	0	0
Libya	1 760	593	95	688	39	0	0	0	0	0
Morocco	447	63	23	87	19	87	0	87	100	19
Oman	271	107	0	107	39	0	0	0	0	0
Qatar	11	0	0	0	0	0	0	0	NA	0
Saudi Arabia	2 396	660	142	802	33	0	0	0	0	0
Syria	185	78	33	112	60	8	33	41	37	22
Tunisia	164	126	0	126	77	51	0	51	41	31
United Arab Emirates	75	3	0	3	4	0	0	0	0	0
Western Sahara	252	0	0	0	0	0	0	0	NA	0
Yemen	480	217	0	217	45	0	0	0	0	0
Total	12 379	3 395	865	4 260	34	482	277	759	18	6

TABLE A6c
Human-induced land degradation due to agricultural activities per country, North Asia, east of Urals

		Land degradation (total)				Land degradation due to agricultural activities				
	Total area ('000 km^2)	severe ('000 km^2)	very severe ('000 km^2)	total degradation ('000 km^2)	% of total area degraded	severe degradation ('000 km^2)	very severe degradation ('000 km^2)	total degradation ('000 km^2)	% of degraded area due to agric. activities	% of total area degraded due to agric. activities
Kazakhstan	2 715	410	62	473	17	30	5	35	7	1
Kyrgyzstan	198	4	0	4	2	4	0	4	95	2
Russian Federation	17 044	3 108	700	3 808	22	1 008	0	1 008	26	6
Tajikistan	143	10	0	10	7	9	0	9	90	6
Turkmenistan	487	44	21	66	13	43	21	64	98	13
Uzbekistan	446	60	0	60	13	60	0	60	100	13
Total	21 033	3 637	784	4 421	21	1 153	27	1 180	27	6

AGLS database on degradation status derived from the GLASOD (UNEP/ISRIC, 1991) study

TABLE A6d
Human-induced land degradation due to agricultural activities per country, Asia and Pacific

		Land degradation (total)				Land degradation due to agricultural activities				
	Total area ('000 km^2)	severe ('000 km^2)	very severe ('000 km^2)	total degradation ('000 km^2)	% of total area degraded	severe degradation ('000 km^2)	very severe degradation ('000 km^2)	total degradation ('000 km^2)	% of degraded area due to agric. activities	% of total area degraded due to agric. activities
Australia	7 667	246	0	246	3	146	0	146	59	2
Bangladesh	144	39	0	39	27	20	0	20	53	14
Bhutan	47	0	3	3	7	0	0	0	0	0
Brunei	6	6	0	6	100	4	0	4	63	63
Cambodia	181	48	40	89	49	0	8	8	9	4
China	9 550	2 347	948	3 295	35	1 887	182	2 069	63	22
Fiji	18	0	0	0	0	0	0	0	NA	0
HongKong	1	0	0	0	0	0	0	0	NA	0
India	3 157	1 352	494	1 846	58	266	0	266	14	8
Indonesia	1 916	607	108	714	37	152	65	217	30	11
Japan	369	0	0	0	0	0	0	0	NA	0
Korean DPR	122	21	0	21	17	21	0	21	100	17
Korean Rep.	98	41	0	41	42	41	0	41	100	42
Laos	237	0	3	3	1	0	0	0	0	0
Malaysia	333	277	0	277	83	38	0	38	14	11
Mongolia	1 560	399	0	399	26	335	0	335	84	21
Myanmar	677	237	6	243	36	126	0	126	52	19
Nepal	141	39	0	39	27	0	0	0	0	0
New Zealand	265	18	0	18	7	5	0	5	30	2
Pakistan	802	178	18	195	24	44	0	44	23	6
Papua New Guinea	462	0	0	0	0	0	0	0	NA	0
Philippines	299	227	10	237	79	0	0	0	0	0
Solomon Islands	30	0	0	0	0	0	0	0	NA	0
Sri Lanka	65	14	21	35	54	0	0	0	0	0
Thailand	513	144	258	401	78	64	12	76	19	15
Viet Nam	329	97	162	259	79	71	19	90	35	27
Total	28 989	6 336	2 071	8 407	29	3 220	285	3 506	42	12

AGLS database on degradation status derived from the GLASOD (UNEP/ISRIC, 1991) study

TABLE A6e
Human-induced land degradation due to agricultural activities per country, South and Central America

		Land degradation (total)				Land degradation due to agricultural activities				
	Total area ('000 km^2)	severe ('000 km^2)	very severe ('000 km^2)	total degradation ('000 km^2)	% of total area degraded	severe degradation ('000 km^2)	very severe degradation ('000 km^2)	total degradation ('000 km^2)	% of degraded area due to agric. activities	% of total area degraded due to agric. activities
Argentina	2 772	292	11	303	11	3	0	3	1	0
Belize	23	7	0	7	30	0	0	0	0	0
Bolivia	1 096	248	60	308	28	24	7	31	10	3
Brazil	8 479	2 009	358	2 367	28	868	34	902	38	11
Chile	749	107	37	144	19	0	0	0	0	0
Colombia	1 136	202	0	202	18	25	0	25	12	2
Costa Rica	51	16	35	51	100	0	10	10	19	19
Cuba	114	40	21	61	54	15	14	29	47	25
Dominican Republic	47	19	0	19	40	0	0	0	0	0
Ecuador	283	7	11	17	6	0	11	11	62	4
El Salvador	21	20	0	20	95	20	0	20	101	96
Falklands	12	0	0	0	0	0	0	0	NA	0
French Guyana	91	0	0	0	0	0	0	0	NA	0
Guatemala	108	79	0	79	73	19	0	19	24	18
Guyana	215	28	0	28	13	16	0	16	57	7
Haiti	27	0	27	27	100	0	0	0	0	0
Honduras	112	95	0	95	85	54	0	54	57	48
Jamaica	11	11	0	11	100	0	0	0	0	0
Mexico	1 966	525	349	874	44	215	227	442	51	22
Neth. Antilles	1	0	0	0	0	0	0	0	NA	0
Nicaragua	144	112	0	112	78	91	3	94	84	65
Panama	78	49	20	69	88	0	0	0	0	0
Paraguay	407	79	31	110	27	74	0	74	67	18
Peru	9	409	13	422	33	0	0	0	0	0
Puerto Rico	1 281	9	0	9	100	0	0	0	0	0
Suriname	164	0	0	0	0	0	0	0	NA	0
Trinidad/Tobago	5	5	0	5	100	3	0	3	65	65
Uruguay	186	22	0	22	12	22	0	22	99	12
Venezuela	910	190	0	190	21	42	0	42	22	5
Total	20 498	4 580	973	5 552	27	1 490	305	1 795	32	9

TABLE A6f
Human-induced land degradation due to agricultural activities per country, North America

		Land degradation (total)				Land degradation due to agricultural activities				
	Total area ('000 km^2)	severe ('000 km^2)	very severe ('000 km^2)	total degradation ('000 km^2)	% of total area degraded	severe degradation ('000 km^2)	very severe degradation ('000 km^2)	total degradation ('000 km^2)	% of degraded area due to agric. activities	% of total area degraded due to agric. activities
Canada	9 893	208	0	208	2	208	0	208	100	2
United States of America	9 344	2 949	0	2 949	30	2 219	0	2 219	75	23
Total	19 237	3 158	0	3 158	16	2 427	0	2 427	77	12

AGLS database on degradation status derived from the GLASOD (UNEP/ISRIC, 1991) study

TABLE A6g
Human-induced land degradation due to agricultural activities per country, Europe

		Land degradation (total)				Land degradation due to agricultural activities				
	Total area ('000 km^2)	severe ('000 km^2)	very severe ('000 km^2)	total degradation ('000 km^2)	% of total area degraded	severe degradation ('000 km^2)	very severe degradation ('000 km^2)	total degradation ('000 km^2)	% of degraded area due to agric. activities	% of total area degraded due to agric. activities
Albania	29	4	23	27	94	4	0	4	15	14
Armenia	30	3	0	3	11	3	0	3	95	10
Austria	84	32	0	32	38	26	0	26	83	31
Azerbaijan	86	49	0	49	56	47	0	47	96	54
Belarus	207	13	0	13	6	0	0	0	2	0
Belgium	30	20	0	20	65	7	0	7	37	24
Bosnia Herzegovina	51	2	49	51	100	0	0	0	0	0
Bulgaria	111	111	0	111	100	34	0	34	30	30
Croatia	56	28	28	56	100	3	0	3	5	5
Cyprus	9	9	0	9	100	0	0	0	0	0
Czech Republic	79	79	0	79	100	73	0	73	93	93
Denmark	43	0	0	0	0	0	0	0	NA	0
Estonia	45	2	0	2	5	0	0	0	0	0
Finland	336	35	0	35	11	35	0	35	100	11
France	543	50	0	50	9	0	0	0	0	0
Georgia	70	7	0	7	10	7	0	7	100	10
Germany	358	112	0	112	31	75	0	75	67	21
Greece	132	62	1	63	48	3	0	3	5	3
Hungary	93	60	0	60	65	27	0	27	45	29
Iceland	103	33	20	53	52	0	0	0	0	0
Ireland (Rep.)	69	0	0	0	0	0	0	0	NA	0
Israel	21	0	0	0	0	0	0	0	NA	0
Italy	301	84	0	85	28	10	0	10	12	3
Latvia	64	44	0	44	68	0	0	0	0	0
Lithuania	65	12	0	12	19	0	0	0	0	0
Luxembourg	3	1	0	1	51	0	0	0	0	0
Macedonia	25	11	11	22	89	0	0	0	0	0
Malta	0	NA	NA	NA	NA	NA	NA	NA	NA	NA
Moldova	34	34	0	34	100	0	0	0	1	1
Netherlands	41	2	0	2	5	2	0	2	96	5
Norway	323	10	0	10	3	0	0	0	0	0
Poland	312	153	107	260	83	46	0	46	18	15
Portugal	89	0	19	19	21	0	19	19	100	21
Romania	237	212	25	237	100	110	0	110	46	46
Slovenia	20	4	12	16	79	1	0	1	8	6
Spain	503	175	16	191	38	31	0	31	16	6
Sweden	449	85	28	113	25	33	0	33	29	7
Switzerland	41	0	0	0	0	0	0	0	NA	0
Turkey	778	535	235	770	99	24	6	30	4	4
Ukraine	602	297	162	459	76	31	0	31	7	5
United Kingdom	244	47	0	47	19	47	0	47	100	19
Yugoslavia	128	39	80	120	94	20	0	20	17	16
Total	6 843	2 456	818	3274	48	702	25	727	22	11

AGLS database on degradation status derived from the GLASOD (UNEP/ISRIC, 1991) study

	Total area ('000 km^2)	severe ('000 km^2)	very severe ('000 km^2)	total degradation ('000 km^2)	% of total area degraded	severe degradation ('000 km^2)	very severe degradation ('000 km^2)	total degradation ('000 km^2)	% of degraded area due to agric. activities	% of total area degraded due to agric. activities
WORLD	134 907	27 033	7 971	35 005	26	10 552	1 838	12 391	35	9

Appendix 7

Land degradation severity and population distribution

TABLE A7a
Land degradation severity and population distribution for Sub-Saharan Africa

	None		Light		Moderate		Severe		Very severe	
	area (%)	density	area (%)	density	area (%)	density	area (%)	density	area (%)	density
Angola	61	7	16	7	10	9	5	11	8	29
Benin	NA	NA	54	17	25	26	10	37	11	221
Botswana	31	1	44	2	13	5	4	11	7	2
Burkina Faso	0	NA	21	34	21	39	3	49	44	49
Burundi	7	262	0	NA	17	121	0	NA	76	236
Cameroon	40	11	5	85	18	35	14	55	23	19
Central af	44	1	51	6	3	9	4	3	2	61
Chad	40	1	30	8	7	10	23	6	1	13
Congo D.R.	33	10	52	14	8	38	7	31	1	222
Congo Republic	78	2	12	18	7	1	1	27	2	76
Cote d'Ivoire	3	7	79	47	14	22	0	NA	4	24
Djibouti	0	NA	0	NA	100	18	0	NA	0	NA
Equatorial Guinea	79	9	21	16	0	NA	0	NA	0	NA
Eritrea	14	13	0	NA	23	17	55	43	8	122
Ethiopia	4	20	10	33	57	22	8	107	20	91
Gabon	81	4	3	10	9	3	7	14	0	NA
Ghana	6	34	25	109	60	47	3	64	6	116
Guinea	0	NA	78	20	18	32	4	62	0	NA
Guinea Bissau	0	NA	24	16	76	33	0	NA	0	NA
Kenya	7	19	41	3	22	34	19	106	11	123
Lesotho	0	NA	0	NA	0	NA	75	53	25	93
Liberia	40	14	49	23	0	NA	11	78	0	NA
Madagascar	0	NA	5	90	25	28	48	18	22	9
Malawi	39	75	3	123	58	140	0	NA	0	NA
Mali	46	0	18	17	7	34	13	8	16	8
Mauritania	74	1	0	NA	0	NA	18	7	8	2
Mozambique	31	18	29	20	39	24	0	NA	0	NA
Namibia	57	3	12	1	9	1	21	2	2	1
Niger	54	0	1	22	0	NA	28	16	17	15
Nigeria	3	152	38	58	4	106	27	92	28	171
Rwanda	0	NA	0	NA	28	149	0	NA	71	354
Senegal	0	NA	39	14	25	35	14	16	22	100
Sierra	0	NA	48	45	14	80	39	74	0	NA
Somalia	23	12	10	15	52	10	0	NA	15	39
Southfrica	22	50	8	38	5	32	19	62	46	14
Sudan	46	8	13	7	11	16	15	16	15	14
Swaziland	0	NA	0	NA	100	50	0	NA	0	NA
Tanzania	12	22	31	18	31	38	24	33	1	97
The Gambia	0	NA	53	42	47	117	0	NA	0	NA
Togo	0	NA	24	34	22	50	30	51	24	139
Uganda	4	66	1	9	43	45	41	105	12	104
Zambia	18	7	21	7	44	14	17	16	0	NA
Zimbabwe	9	7	53	32	39	29	0	NA	0	NA
Total	33	8	24	20	16	29	15	34	12	50

TABLE A7b
Land degradation severity and population distribution for North Africa and Middle East

	None		Light		Moderate		Severe		Very severe	
	area (%)	density	area (%)	density	area (%)	density	area (%)	density	area (%)	density
Afghanistan	5	10	12	47	56	28	20	14	8	23
Algeria	44	1	24	1	11	39	19	34	2	22
Egypt	62	15	27	38	3	43	7	430	2	370
Iran	8	16	6	58	28	44	41	44	17	21
Iraq	1	109	0	3	21	37	45	14	34	97
Jordan	4	13	0	224	65	22	14	171	17	11
Kuwait	0	NA	0	NA	98	66	0	NA	2	70
Lebanon	0	NA	69	27	6	26	25	27	0	NA
Libya	54	1	5	1	2	18	34	6	5	1
Morocco	4	5	9	232	67	41	14	38	5	114
Oman	16	7	28	7	17	9	39	8	0	NA
Qatar	0	NA	65	42	35	36	0	NA	0	NA
Saudi Arabia	21	2	31	13	15	7	28	7	6	2
Syria	0	NA	5	151	35	69	42	66	18	100
Tunisia	21	5	0	NA	0	NA	79	63	0	NA
United Arab Emirates	19	8	0	NA	77	27	4	46	0	NA
Western Sahara	100	1	0	NA	0	3	0	NA	0	NA
Yemen	4	4	18	18	33	75	45	8	0	NA
TOTAL	30	1	18	22	17	34	30	15	5	22

TABLE A7c
Land degradation severity and population distribution for North Asia, east of Urals

	None		Light		Moderate		Severe		Very severe	
	area (%)	density	area (%)	density	area (%)	density	area (%)	density	area (%)	density
Kazakhistan	52	5	12	8	19	8	15	7	2	5
Kyrgyzstan	36	24	62	27	0	NA	2	40	0	NA
Russian Federation	52	2	15	9	11	9	18	19	4	22
Tajikistan	83	29	0	NA	10	76	7	81	0	NA
Turkmenistan	75	8	0	13	12	7	9	10	4	8
Uzbekistan	75	31	2	252	9	50	13	89	0	NA
Total	53	4	14	11	12	10	17	19	4	20

TABLE A7d
Land degradation severity and population distribution for Asia and Pacific

	None		Light		Moderate		Severe		Very severe	
	area (%)	density	area (%)	density	area (%)	density	area (%)	density	area (%)	density
Australia	39	1	15	1	42	0	3	0	0	NA
Bangladesh	5	407	0	NA	68	901	27	610	0	NA
Bhutan	2	170	67	34	24	10	0	NA	7	38
Brunei	0	NA	0	NA	0	NA	100	43	0	NA
Cambodia	13	136	2	67	36	26	27	13	22	82
China	28	3	8	89	30	31	25	43	10	49
Fiji	100	23	0	NA	0	NA	0	NA	0	NA
HongKong	0	NA	100	1084	0	NA	0	NA	0	NA
India	37	343	1	377	4	291	43	252	16	169
Indonesia	1	20	36	30	26	47	32	147	6	309
Japan	82	254	18	523	0	NA	0	NA	0	NA
Korean Dem. Rep.	0	NA	0	NA	83	131	17	368	0	NA
Korean Rep.	0	NA	0	NA	58	143	42	705	0	NA
Laos	0	NA	16	28	83	17	0	NA	1	56
Malaysia	0	NA	0	NA	17	156	83	33	0	NA
Mongolia	15	1	21	1	39	1	26	3	0	NA
Myanmar	1	184	0	NA	63	71	35	119	1	6
Nepal	23	164	29	42	20	127	27	174	0	NA
New Zealand	9	8	25	28	59	5	7	9	0	NA
Pakistan	25	144	2	835	49	145	22	124	2	90
Papua New Guinea	79	9	18	8	3	7	0	NA	0	NA
Philippines	3	131	0	NA	18	128	3	208	3	356
Solomon Islands	0	NA	0	NA	100	8	0	NA	0	NA
Sri Lanka	0	NA	17	135	29	385	22	428	32	110
Thailand	0	NA	2	116	20	55	28	101	50	137
Viet Nam	0	NA	0	NA	21	227	29	324	49	125
TOTAL	28	19	12	5	32	13	22	26	7	8

TABLE A7e
Land degradation severity and population distribution for South and Central America

	None		Light		Moderate		Severe		Very severe	
	area (%)	density	area (%)	density	area (%)	density	area (%)	density	area (%)	density
Argentina	8	11	29	10	51	11	11	25	0	11
Belize	71	11	0	NA	0	NA	29	5	0	NA
Bolivia	52	22	11	63	9	175	23	10	6	13
Brazil	19	3	29	2	23	6	24	7	4	3
Chile	45	16	7	66	28	3	14	13	5	68
Colombia	10	6	53	21	19	26	18	75	NA	NA
Costa Rica	0	NA	0	NA	0	NA	32	27	68	82
Cuba	19	179	20	55	7	61	35	82	19	77
Dominican Republic	0	NA	0	NA	59	172	40	142	1	80
Ecuador	5	1	66	32	23	46	2	41	4	87
El Salvador	0	NA	6	260	0	NA	94	268	0	NA
Falklands	0	NA	0	NA	100	1	0	NA	0	NA
French Guyana	88	1	0	NA	12	1	0	NA	0	NA
Guatemala	18	11	10	113	0	91	73	112	0	NA
Guyana	42	1	44	5	2	0	13	6	0	NA
Haiti	0	NA	0	NA	1	77	1	125	98	232
Honduras	13	23	0	NA	2	74	84	50	0	NA
Jamaica	0	NA	0	NA	0	NA	100	187	0	NA
Mexico	36	16	10	66	9	32	27	39	18	112
Neth. Antilles	0	NA	0	NA	100	28	0	NA	0	NA
Nicaragua	18	6	0	NA	4	116	76	30	0	NA
Panama	4	NA	8	2	0	NA	63	43	25	17
Paraguay	70	8	0	NA	3	10	19	24	8	18
Puerto Rico	0	NA	0	NA	0	NA	100	368	0	NA
Peru	20	6	26	23	21	17	32	24	1	12
Suriname	73	1	9	1	18	12	0	NA	0	NA
Trinidad/Tobago	0	NA	0	NA	0	NA	100	234	0	NA
Uruguay	46	7	41	9	1	8	12	76	0	NA
Venezuela	17	13	54	6	8	13	21	70	0	NA
TOTAL	23	10	27	13	23	15	22	28	5	58

TABLE A7f
Land degradation severity and population distribution for North America

	None		Light		Moderate		Severe		Very severe	
	area (%)	density	area (%)	density	area (%)	density	area (%)	density	area (%)	density
Canada	90	1	3	12	5	14	2	19	0	NA
United States of America	10	55	30	24	28	27	32	22	0	NA
Total	56	5	15	23	15	25	15	21	0	NA

TABLE A7g
Land degradation severity and population distribution for Europe

	None		Light		Moderate		Severe		Very severe	
	area (%)	density	area (%)	density	area (%)	density	area (%)	density	area (%)	density
Albania	0	NA	0	NA	6	106	14	215	80	99
Armenia	0	NA	34	106	55	111	11	115	0	NA
Austria	0	NA	0	NA	62	0	38	132	0	NA
Azerbaijan	3	49	31	61	9	65	56	63	0	NA
Belarus	0	95	38	43	56	57	6	39	0	NA
Belgium	0	NA	10	239	26	439	65	305	0	NA
Bosnia Herzegovina	0	NA	0	NA	0	NA	4	87	96	87
Bulgaria	0	NA	0	NA	0	NA	100	80	0	91
Croatia	0	NA	0	NA	0	107	50	83	50	81
Cyprus	0	NA	0	NA	0	NA	100	73	0	NA
Czech Republic	0	NA	0	NA	0	NA	100	116	0	NA
Denmark	37	74	63	113	0	NA	0	NA	0	NA
Estonia	59	34	0	NA	36	34	5	40	0	NA
Finland	7	13	69	7	13	12	11	55	0	NA
France	0	NA	59	74	32	153	9	131	0	NA
Georgia	17	97	65	73	8	93	10	74	0	NA
Germany	3	126	31	202	35	239	31	246	0	NA
Greece	0	NA	0	NA	52	94	47	45	1	79
Hungary	0	NA	14	81	21	149	65	104	0	NA
Iceland	17	0	0	NA	31	1	32	2	20	1
Ireland Rep.	68	50	32	24	0	NA	0	NA	0	NA
Israel	57	5	37	651	6	536	0	NA	0	NA
Italy	0	NA	0	NA	72	195	28	164	0	1186
Latvia	17	42	9	40	6	40	68	41	0	NA
Lithuania	22	58	46	58	13	59	19	58	0	NA
Luxembourg	0	NA	49	189	0	NA	51	112	0	NA
Macedonia	0	NA	0	NA	11	84	44	77	45	89
Malta	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Moldova	0	NA	0	NA	0	NA	100	134	1	130
Netherlands	0	NA	61	393	34	245	5	463	0	NA
Norway	77	8	18	30	2	22	3	2	0	NA
Poland	16	94	0	NA	1	60	49	124	34	128
Portugal	1	18	40	128	37	120	0	NA	21	20
Romania	0	NA	0	NA	0	NA	89	99	11	89
Slovenia	0	NA	0	NA	21	78	18	75	61	104
Spain	2	26	20	80	39	84	35	61	3	58
Sweden	12	5	42	4	21	49	19	11	6	61
Switzerland	0	NA	28	293	72	116	0	NA	0	NA
Turkey	1	36	0	NA	0	41	69	83	30	65
Ukraine	1	85	1	126	21	65	49	85	27	111
United Kingdom	24	47	17	108	40	0	19	409	0	NA
Yugoslavia Fed Rep.	0	NA	0	NA	6	74	31	78	63	84
Total	9	31	21	74	22	108	36	101	12	86

	None		Light		Moderate		Severe		Very severe	
	area (%)	density	area (%)	density	area (%)	density	area (%)	density	area (%)	density
WORLD	36	17	18	25	20	34	20	55	6	67

Appendix 8
Actual and potential available arable land

TABLE A8a
Actual and potential available arable land, Sub-Saharan Africa

	Total area (1000 ha)	Potential arable land ('000 ha)	Equivalent Potential Arable Land ('000 ha)	Eq. Pot. Arable land/ total area	Actual arable land 1994 (1000 ha)	% of potentially arable land actually in use (1994)	Total population 1994 ('000)	Agricultural population 1994 ('000)
Angola	123 775	88 105	53 914	44	3 500	4.0	10 674	7 894
Benin	11 790	9 753	7 862	67	1 880	19.3	5 259	3 173
Botswana	57 485	9 173	5 045	9	420	4.6	1 416	586
Burkina Faso	27514	20 341	15 245	55	3 565	17.5	10 186	9 285
Burundi	2 815	1 414	851	30	1 180	83.5	5 930	5 652
Cameroon	46 274	35 910	25 706	56	7 040	19.6	12 833	8 788
Central African Republic	61 857	47 887	35 250	57	2 020	4.2	3 203	2 544
Chad	128 075	33 051	24 118	19	3 256	9.9	6 161	5 026
Congo Dem. Rep.	34 366	22 995	15 626	45	170	0.7	2 518	1 142
Congo Rep.	233 470	167 831	109 645	47	7 900	4.7	43 930	28 263
Cote d'Ivoire	32 465	26 226	18 700	58	3 710	14.1	13329	7 944
Djibouti	2 299	0	0	0	0	0.0	585	585
Eq. Guinea	2 681	1 646	1 161	43	230	14.0	389	286
Eritrea	12 116	590	262	2	519	88.0	3 437	2 729
Ethiopia	112 895	42 945	29 220	26	11 012	25.6	53 435	45 746
Gabon	26 486	17 873	13 212	50	460	2.6	1 046	598
Gambia	1 092	785	600	55	172	21.9	1 077	866
Ghana	24 181	18 321	13 233	55	4 320	23.6	16 856	9 661
Guinea	24 602	13 217	8 912	36	730	5.5	7 092	5 564
Guinea Bissau	3 613	2 306	1 500	42	340	14.7	1 047	887
Kenya	59 440	15 845	9 806	16	4 520	28.5	26 459	21 404
Lesotho	3 010	362	196	6	320	88.4	1 977	790
Liberia	9 870	6 294	4 307	44	375	6.0	2 119	2 074
Madagascar	59 159	35 602	22 793	39	3 105	8.7	14 406	10 971
Malawi	11 959	6 771	5 099	43	1 700	25.1	9 587	9 367
Mali	124 852	26 513	17 383	14	2 503	9.4	10 462	8 834
Mauritania	104 383	1 381	715	1	208	15.1	2 217	1 105
Mozambique	79 894	63 544	44 002	55	3 180	5.0	16 636	12 664
Namibia	81 933	11 889	6 539	8	662	5.6	1 499	688
Niger	118 254	10 278	5 450	5	3 605	35.1	8 846	7 914
Nigeria	91 207	66 230	47 813	52	32 700	49.4	108 467	41 992
Rwanda	2 450	746	474	19	1 170	156.8	5 296	7 083
Senegal	19 510	13 270	9 037	46	2 350	17.7	8 102	6 059
Sierra Leone	7 203	3 955	2 788	39	540	13.7	4 127	2 947
Somalia	64448	2 381	1 016.4	2	1 020	42.8	9 822	6 747
South Africa	122 230	28 097	17 898	15	13 179	46.9	40 552	5 380
Sudan	248 838	86 728	62 945	25	12 975	15.0	26 148	18 706
Swaziland	1 770	805	471	27	191	23.7	833	289
Tanzania	93 819	67 285	45 911	49	3 500	5.2	29 172	23 685
Togo	5 720	4 291	3 044	53	2 430	56.6	3 970	2 513
Uganda	2 4219	14 169	9 784	40	6 800	48.0	19 080	17 233
Zambia	74 837	58 471	40 559	54	5 273	9.0	7 897	6 788
Zimbabwe	38 940	24 575	1 4251	37	2 878	11.7	10 936	7 352
Total	2 417 796	1 109 851	752 344	31	157 608	14.2	569 013	369 804

TABLEA8a Cont'd
Actual and potential available arable land, Sub-Saharan Africa

	Actual arable land/caput (agricultural population) (HA)	Potential arable land/caput (agricultural population) (HA)	Equivalent Potential Arable Land/caput (agricultural population) (HA)	Actual arable land/caput (total population) (HA)	Potential arable land/caput	Equivalent Potential Arable Land/caput
Angola	0.4	11.2	6.8	0.3	8.3	5.1
Benin	0.6	3.1	2.5	0.4	1.9	1.5
Botswana	0.7	15.7	8.6	0.3	6.5	3.6
Burkina Faso	0.4	2.2	1.6	0.3	2.0	1.5
Burundi	0.2	0.3	0.2	0.2	0.2	0.1
Cameroon	0.8	4.1	2.9	0.5	2.8	2.0
Central African Republic	0.8	18.8	13.9	0.6	15.0	11.0
Chad	0.6	6.6	4.8	0.5	5.4	3.9
Congo Dem. Rep.	0.1	20.1	13.7	0.1	9.1	6.2
Congo Rep.	0.3	5.9	3.9	0.2	3.8	2.5
Cote d'Ivoire	0.5	3.3	2.4	0.3	2.0	1.4
Djibouti	0.0	0.0	0.0	0.0	0.0	0.0
Eq. Guinea	0.8	5.8	4.1	0.6	4.2	3.0
Eritrea	0.2	0.2	0.1	0.2	0.2	0.1
Ethiopia	0.2	0.9	0.6	0.2	0.8	0.5
Gabon	0.8	29.9	22.1	0.4	17.1	12.6
Gambia	0.2	0.9	0.7	0.2	0.7	0.6
Ghana	0.4	1.9	1.4	0.3	1.1	0.8
Guinea	0.1	2.4	1.6	0.1	1.9	1.3
Guinea Bissau	0.4	2.6	1.7	0.3	2.2	1.4
Kenya	0.2	0.7	0.5	0.2	0.6	0.4
Lesotho	0.4	0.5	0.2	0.2	0.2	0.1
Liberia	0.2	3.0	2.1	0.2	3.0	2.0
Madagascar	0.3	3.2	2.1	0.2	2.5	1.6
Malawi	0.2	0.7	0.5	0.2	0.7	0.5
Mali	0.3	3.0	2.0	0.2	2.5	1.7
Mauritania	0.2	1.2	0.6	0.1	0.6	0.3
Mozambique	0.3	5.0	3.5	0.2	3.8	2.6
Namibia	1.0	17.3	9.5	0.4	7.9	4.4
Niger	0.5	1.3	0.7	0.4	1.2	0.6
Nigeria	0.8	1.6	1.1	0.3	0.6	0.4
Rwanda	0.2	0.1	0.1	0.2	0.1	0.1
Senegal	0.4	2.2	1.5	0.3	1.6	1.1
Sierra Leone	0.2	1.3	0.9	0.1	1.0	0.7
Somalia	0.2	0.4	0.2	0.1	0.2	0.1
South Africa	2.4	5.2	3.3	0.3	0.7	0.4
Sudan	0.7	4.6	3.4	0.5	3.3	2.4
Swaziland	0.7	2.8	1.6	0.2	1.0	0.6
Tanzania	0.1	2.8	1.9	0.1	2.3	1.6
Togo	1.0	1.7	1.2	0.6	1.1	0.8
Uganda	0.4	0.8	0.6	0.4	0.7	0.5
Zambia	0.8	8.6	6.0	0.7	7.4	5.1
Zimbabwe	0.4	3.3	1.9	0.3	2.2	1.3
Total	0.4	3.0	2.0	0.3	2.0	1.3

TABLE A8b
Actual and potential available arable land, North Africa and Near East

	Total area (1000 ha)	Potential arable land ('000 ha)	Equivalent Potential Arable Land ('000 ha)	Eq. Pot. Arable land/ total area	Actual arable land 1994 (1000 ha)	% of potentially arable land actually in use (1994)	Total population 1994 ('000)	Agricultural population 1994 ('000)
Afghanistan	63 088	3 039	1 325	2	8 054	265.0	16 994	13 105
Algeria	230 452	12 834	7 656	3	8 043	62.7	27 450	6 492
Egypt	98 786	121	59	0	3 500	2 892.6	60 946	21 213
Iran	161 601	4 709	1 986	1	18 122	384.8	63 903	23 521
Iraq	43 041	4 406	2 890	7	5 750	130.5	20 758	2 441
Jordan	9 006	563	260	3	405	71.9	3 967	595
Kuwait	1 657	1	0	0	5	500.0	1 608	20
Lebanon	1 030	269	178	17	306	113.8	2 819	138
Libya	160 950	2 464	1 355	1	2 170	88.1	5 225	362
Morocco	39 658	12 270	7 669	19	9 291	75.7	26 025	10 910
Oman	31 009	1	0	0	63	6 300	2 082	884
Qatar	1 107	1	0	0	8	800.0	457	14
Saudi Arabia	195 304	1	0	0	3 800	380 000	18 056	2 577
Syria	18 603	5 636	3 555	19	5 527	98.1	14 262	4 607
Tunesia	15 342	3 310	2 071	14	4 952	149.6	8 820	2 128
United Arab Emirates	7 613	1	0	0	39	3 900	1 812	168
Western Sahara	26 984	1	0	0	NA	NA	201	NA
Yemen	42 328	5	2	0	1 545	30 900	15 475	7 991
Total	1 147 559	49 632	29 009	3	71 580	144.2	290 860	97 166

TABLE A8b Cont'd
Actual and potential available arable land, North Africa and Near East

	Actual arable land/caput (agricultural population) (HA)	Potential arable land/caput (agricultural population) (HA)	Equivalent Potential Arable Land/caput (agricultural population) (HA)	Actual arable land/caput (total population) (HA)	Potential arable land/caput	Equivalent Potential Arable Land/caput
Afghanistan	0.6	0.2	0.1	0.5	0.2	0.1
Algeria	1.2	2.0	1.2	0.3	0.5	0.3
Egypt	0.2	0.0	0.0	0.1	0.0	0.0
Iran	0.8	0.2	0.1	0.3	0.1	0.0
Iraq	2.4	1.8	1.2	0.3	0.2	0.1
Jordan	0.7	0.9	0.4	0.1	0.1	0.1
Kuwait	0.3	0.1	0.0	0.0	0.0	0.0
Lebanon	2.2	1.9	1.3	0.1	0.1	0.1
Libya	6.0	6.8	3.7	0.4	0.5	0.3
Morocco	0.9	1.1	0.7	0.4	0.5	0.3
Oman	0.1	0.0	0.0	0.0	0.0	0.0
Qatar	0.6	0.1	0.0	0.0	0.0	0.0
Saudi Arabia	1.5	0.0	0.0	0.2	0.0	0.0
Syria	1.2	1.2	0.8	0.4	0.4	0.2
Tunesia	2.3	1.6	1.0	0.6	0.4	0.2
United Arab Emirates	0.2	0.0	0.0	0.0	0.0	0.0
Western Sahara	NA	NA	NA	NA	0.0	0.0
Yemen	0.2	0.0	0.0	0.1	0.0	0.0
Total	0.7	0.5	0.3	0.2	0.2	0.1

TABLE A8c
Actual and potential available arable land, North Asia, east of Urals

	Total area (1000 ha)	Potential arable land ('000 ha)	Equivalent Potential Arable Land ('000 ha)	Eq. Pot. Arable land/ total area	Actual arable land 1994 (1000 ha)	% of potentially arable land actually in use (1994)	Total population 1994 ('000)	Agricultural population 1994 ('000)
Kazakhstan	270 282	7 313	3 107	1	34 978	478.3	16 952	3 571
Kyrgyzstan	19 840	864	414	2	1 420	164.4	5 010	1 391
Russian Federation	1 674 146	282 569	219 696	13	132 302	46.8	147 760	18 667
Tajikistan	14 277	1 896	1 219	9	860	45.4	5 767	2 184
Turkmenistan	46 904	759	312	1	1 480	195.0	3 921	1 594
Uzbekistan	44 519	4 345	2 027	5	4 500	103.6	21 860	7 526
Total	2 069 968	297 746	226 774	11	175 540	59.0	201 270	34 933

TABLE A8c Cont'd
Actual and potential available arable land, North Asia, east of Urals

	Actual arable land/caput (agricultural population) (HA)	Potential arable land/caput (agricultural population) (HA)	Equivalent Potential Arable Land/caput (agricultural population) (HA)	Actual arable land/caput (total population) (HA)	Potential arable land/caput	Equivalent Potential Arable Land/caput
Kazakhstan	9.8	2.0	0.9	2.1	0.4	0.2
Kyrgyzstan	1.0	0.6	0.3	0.3	0.2	0.1
Russian Federation	7.1	15.1	11.8	0.9	1.9	1.5
Tajikistan	0.4	0.9	0.6	0.1	0.3	0.2
Turkmenistan	0.9	0.5	0.2	0.4	0.2	0.1
Uzbekistan	0.6	0.6	0.3	0.2	0.2	0.1
Total	5.0	8.5	6.5	0.9	1.5	1.1

TABLE A8d
Actual and potential available arable land, Asia and Pacific

	Total area (1000 ha)	Potential arable land ('000 ha)	Equivalent Potential Arable Land ('000 ha)	Eq. Pot. Arable land/ total area	Actual arable land 1994 (1000 ha)	% of potentially arable land actually in use (1994)	Total population 1994 ('000)	Agricultural population 1994 ('000)
Australia	766 923	124 913	83 504	11	47 196	37.8	17 650	831
Bangladesh	14 003	9 401	7 388	53	9 694	103.1	114 980	73 310
Bhutan	4 036	18	12	0	134	744.4	1 614	1 517
Brunei	538	259	194	36	7	2.7	280	280
Cambodia	18 197	12 212	9 226	51	3 838	31.4	8 306	7 281
China	934 949	201 647	137 626	15	95 782	47.5	1 208 842	863 988
Fiji	1 815	337	176	10	260	77.2	771	341
HongKong	119	24	17	15	7	29.2	6 061	50
India	306 140	206 327	168 961	55	169 650	82.2	918 570	534 549
Indonesia	189 220	71 233	49 481	26	30 171	42.4	194 615	96 331
Japan	36 930	12 861	8 277	22	37 178	289.1	124 960	6 961
Korean DPR	12 443	3 627	2 481	20	2 000	55.1	23 483	8 195
Korean Rep.	9 685	3 931	2 385	25	2 055	52.3	44 563	5 702
Laos	23 001	5 900	3 681	16	900	15.3	4 594	3 673
Malaysia	32 669	12 828	9 394	29	604	4.7	19 695	4 376
Mongolia	155 100	177	94	0	1 320	745.8	2 363	691
Myanmar	66 490	24 487	16 919	25	10 076	41.1	45 555	32 949
Nepal	14 725	2 269	1 582	11	2 354	103.7	21 360	19 945
New Zealand	26 617	8 637	5 342	20	3 800	44.0	3 063	358
Pakistan	79 847	5 442	4 054	5	21 350	392.3	136 645	70 885
Papua New Guinea	46 648	14 108	9 753	21	415	2.9	4 205	3 276
Philippines	29 331	9 342	6 716	23	9 190	98.4	66 188	28 221
Solomon Islands	2 802	446	288	10	57	12.8	366	277
Sri Lanka	6 574	3 717	3 089	47	1 883	50.7	18 125	8 517
Thailand	51 603	32 198	23 435	45	20 800	64.6	58 183	32 901
Viet Nam	33 391	11 594	7 817	23	6 985	60.2	72 931	50 828
Total	2 863 796	777 935	561 890	20	477 706	61.4	3 117 968	1 856 233

TABLE A8d Cont'd
Actual and potential available arable land, Asia and Pacific

	Actual arable land/caput (agricultural population) (HA)	Potential arable land/caput (agricultural population) (HA)	Equivalent Potential Arable Land/caput (agricultural population) (HA)	Actual arable land/caput (total population) (HA)	Potential arable land/caput	Equivalent Potential Arable Land/caput
Australia	56.8	150.3	100.5	2.7	7.1	4.7
Bangladesh	0.1	0.1	0.1	0.1	0.1	0.1
Bhutan	0.1	0.0	0.0	0.1	0.0	0.0
Brunei	0.0	0.9	0.7	0.0	0.9	0.7
Cambodia	0.5	1.7	1.3	0.5	1.5	1.1
China	0.1	0.2	0.2	0.1	0.2	0.1
Fiji	0.8	1.0	0.5	0.3	0.4	0.2
HongKong	0.1	0.5	0.3	0.0	0.0	0.0
India	0.3	0.4	0.3	0.2	0.2	0.2
Indonesia	0.3	0.7	0.5	0.2	0.4	0.3
Japan	5.3	1.8	1.2	0.3	0.1	0.1
Korean DPR	0.2	0.4	0.3	0.1	0.2	0.1
Korean Rep.	0.4	0.7	0.4	0.0	0.1	0.1
Laos	0.2	1.6	1.0	0.2	1.3	0.8
Malaysia	0.1	2.9	2.1	0.0	0.7	0.5
Mongolia	1.9	0.3	0.1	0.6	0.1	0.0
Myanmar	0.3	0.7	0.5	0.2	0.5	0.4
Nepal	0.1	0.1	0.1	0.1	0.1	0.1
New Zealand	10.6	24.1	14.9	1.2	2.8	1.7
Pakistan	0.3	0.1	0.1	0.2	0.0	0.0
Papua New Guinea	0.1	4.3	3.0	0.1	3.4	2.3
Philippines	0.3	0.3	0.2	0.1	0.1	0.1
Solomon Islands	0.2	1.6	1.0	0.2	1.2	0.8
Sri Lanka	0.2	0.4	0.4	0.1	0.2	0.2
Thailand	0.6	1.0	0.7	0.4	0.6	0.4
Viet Nam	0.1	0.2	0.2	0.1	0.2	0.1
Total	0.3	0.4	0.3	0.2	0.2	0.2

TABLE A8e
Actual and potential available arable land, South and Central America

	Total area (1000 ha)	Potential arable land ('000 ha)	Equivalent Potential Arable Land ('000 ha)	Eq. Pot. Arable land/ total area	Actual arable land 1994 (1000 ha)	% of potentially arable land actually in use (1994)	Total population 1994 ('000)	Agricultural population 1994 ('000)
Argentina	277 685	90 571	71 161	26	27 200	30.0	34 182	3 847
Belize	2 063	984	709	34	57	5.8	205	65
Bolivia	108 903	61 917	46 067	42	2 380	3.8	7 237	3 258
Brazil	853 637	549 389	393 802	46	50 713	9.2	159 143	30 978
Chile	75 202	3 327	2 003	3	4 250	127.7	14 044	2 518
Colombia	113 184	65 536	47 690	42	5 460	8.3	34 545	8 429
Costa Rica	5 200	1 205	858	16	530	44.0	3 347	783
Cuba	11 068	7 494	5 788	52	3 370	45.0	10 960	1 768
Dominican Republic	4 879	2 169	1 418	29	1 480	68.2	7 691	1 634
Ecuador	25 263	12 864	9 194	36	3 036	23.6	11 220	3 347
El Salvador	2 015	864	573	28	730	84.5	5 641	1 904
Falklands	1 203	0	0	0	0	NA	2	2
French Guyana	8 038	6 627	5 127	64	12	0.2	141	141
Guatemala	11 045	3 710	2 821	26	1 910	51.5	10 322	5 266
Guyana	20 907	13 305	9 739	47	496	3.7	825	167
Haiti	2 723	846	511	19	910	107.6	7 035	4 390
Honduras	11 490	3 424	2 162	19	2 030	59.3	5 493	2 008
Jamaica	1 132	156	108	10	219	140.4	2 429	636
Mexico	196 062	52 162	36 471	19	24 730	47.4	91 858	22 906
Neth. Antilles	92	17	11	12	8	47.1	197	NA
Nicaragua	12 909	5 546	3 663	28	1 270	22.9	4 275	1 013
Panama	7 569	2 363	1 584	21	665	28.1	2 585	585
Paraguay	39 905	21 589	13 257	33	2 270	10.5	4 830	1 798
Peru	928	114	68	7	77	67.5	23 331	8 281
Puerto Rico	128 922	43 363	30 567	24	4 140	9.5	3 646	122
Suriname	14 429	9 273	6 736	47	68	0.7	418	85
Trinidad/Tobago	514	321	226	44	122	38.0	1 292	119
Uruguay	17 907	14 245	12 522	70	1 304	9.2	3 167	437
Venezuela	92 388	55 092	38 411	42	3 915	7.1	21 378	2 285
Total	2 047 262	1 028 473	743 243	36	143 352	13.9	471 439	108 772

TABLE A8e Cont'd
Actual and potential available arable land, South and Central America

	Actual arable land/caput (agricultural population) (HA)	Potential arable land/caput (agricultural population) (HA)	Equivalent Potential Arable Land/caput (agricultural population) (HA)	Actual arable land/caput (total population) (HA)	Potential arable land/caput	Equivalent Potential Arable Land/caput
Argentina	7.1	23.5	18.5	0.8	2.6	2.1
Belize	0.9	15.1	10.9	0.3	4.8	3.5
Bolivia	0.7	19.0	14.1	0.3	8.6	6.4
Brazil	1.6	17.7	12.7	0.3	3.5	2.5
Chile	1.7	1.3	0.8	0.3	0.2	0.1
Colombia	0.6	7.8	5.7	0.2	1.9	1.4
Costa Rica	0.7	1.5	1.1	0.2	0.4	0.3
Cuba	1.9	4.2	3.3	0.3	0.7	0.5
Dominican Republic	0.9	1.3	0.9	0.2	0.3	0.2
Ecuador	0.9	3.8	2.7	0.3	1.1	0.8
El Salvador	0.4	0.5	0.3	0.1	0.2	0.1
Falklands	0.0	0.0	0.0	0.0	0.0	0.0
French Guyana	0.1	47.0	36.4	0.1	47.0	36.4
Guatemala	0.4	0.7	0.5	0.2	0.4	0.3
Guyana	3.0	79.7	58.3	0.6	16.1	11.8
Haiti	0.2	0.2	0.1	0.1	0.1	0.1
Honduras	1.0	1.7	1.1	0.4	0.6	0.4
Jamaica	0.3	0.2	0.2	0.1	0.1	0.0
Mexico	1.1	2.3	1.6	0.3	0.6	0.4
Neth. Antilles	NA	NA	na	0.0	0.1	0.1
Nicaragua	1.3	5.5	3.6	0.3	1.3	0.9
Panama	1.1	4.0	2.7	0.3	0.9	0.6
Paraguay	1.3	12.0	7.4	0.5	4.5	2.7
Peru	0.0	0.0	0.0	0.0	0.0	0.0
Puerto Rico	33.9	355.4	250.5	1.1	11.9	8.4
Suriname	0.8	109.1	79.2	0.2	22.2	16.1
Trinidad/Tobago	1.0	2.7	1.9	0.1	0.2	0.2
Uruguay	3.0	32.6	28.7	0.4	4.5	4.0
Venezuela	1.7	24.1	16.8	0.2	2.6	1.8
Total	1.3	9.5	6.8	0.3	2.2	1.6

TABLE A8f
Actual and potential available arable land, North America

	Total area (1000 ha)	Potential arable land ('000 ha)	Equivalent Potential Arable Land ('000 ha)	Eq. Pot. Arable land/ total area	Actual arable land 1994 (1000 ha)	% of potentially arable land actually in use (1994)	Total population 1994 ('000)	Agricultural population 1994 ('000)
Canada	978 404	125 317	75 989	8	45 500	36.3	29 251	763
United States of America	946 837	354 315	269 180	28	187 776	53.0	260 665	7 868
Total	1 925 241	479 632	345 169	18	233 276	48.6	289 916	8 631

TABLE A8f Cont'd
Actual and potential available arable land, North America

	Actual arable land/caput (agricultural population) (HA)	Potential arable land/caput (agricultural population) (HA)	Equivalent Potential Arable Land/caput (agricultural population) (HA)	Actual arable land/caput (total population) (HA)	Potential arable land/caput	Equivalent Potential Arable Land/caput
Canada	59.6	164.2	99.6	1.6	4.3	2.6
United States of America	23.9	45.0	34.2	0.7	1.4	1.0
Total	27.0	55.6	40.0	0.8	1.7	1.2

TABLE A8g
Actual and potential available arable land, Europe

	Total area (1000 ha)	Potential arable land ('000 ha)	Equivalent Potential Arable Land ('000 ha)	Eq. Pot. Arable land/ total area	Actual arable land 1994 (1000 ha)	% of potentially arable land actually in use (1994)	Total population 1994 ('000)	Agricultural population 1994 ('000)
Albania	2 829	834	544	19	702	84.2	3 078	1 655
Armenia	2 970	422	241	8	573	135.8	3 544	558
Austria	8 354	3 348	2 362	28	1 513	45.2	8 024	465
Azerbaijan	8 558	3 929	2 434	28	2 000	50.9	7 447	2 265
Belarus	20 615	17 185	15 274	74	6 329	36.8	10 308	1 870
Belgium	3 005	2 401	1 856	62	NA	NA	10 112	230
Bosnia Herzegovina	5 125	2 708	1 922	38	800	29.5	3 527	322
Bulgaria	11 057	7 763	5 975	54	4 219	54.3	8 444	935
Croatia	5 678	3 716	2 934	52	1 221	32.9	4 511	598
Cyprus	932	433	252	27	143	33.0	734	78
Czech Republic	7 833	6 500	4 779	61	3 386	52.1	10 296	1 119
Denmark	4 408	3 594	3 081	70	2 374	66.1	5 205	241
Estonia	4 493	2 181	1 997	44	1 144	52.5	1 541	211
Finland	33 078	13 839	9 252	28	2 593	18.7	5 089	383
France	54 550	38 806	29 666	54	19 488	50.2	57 747	2 377
Georgia	7 013	2 378	1 800	26	1 127	47.4	5 367	1 348
Germany	35 436	28 125	21 569	61	12 015	42.7	81 410	2 189
Greece	13 243	6 479	3 963	30	3 502	54.1	10 416	1 865
Hungary	9 213	8 040	6 929	75	4 974	61.9	10 264	1 471
Iceland	10 109	0	0	0	6	NA	266	23
Ireland (Rep.)	6 933	4 861	3 467	50	1 317	27.1	3 568	437
Israel	2 179	720	475	22	435	60.4	5 408	190
Italy	30 314	16 764	11 928	39	11 143	66.5	57 171	3 556
Latvia	6 334	5 395	5 258	83	1 740	32.3	2 583	371
Lithuania	6 449	5 481	5 287	82	3 046	55.6	3 724	669
Luxembourg	254	143	86	34	NA	NA	351	12
Macedonia	2 509	1 007	634	25	661	65.6	2 142	344
Malta	42	39	26	63	13	33.3	364	7
Moldova	3 331	2 852	2 219	67	2 180	76.4	4 348	1 349
Netherlands	3 825	1 856	1 406	37	948	51.1	15 389	661
Norway	31 808	2 238	994	3	901	40.3	4 337	233
Poland	30 983	27 980	22 296	72	14 642	52.3	38 544	8 942
Portugal	8 780	5 027	3 444	39	2 900	57.7	9 831	1 553
Romania	23 593	17 383	12 238	52	9 925	57.1	22 731	4 026
Slovenia	2 004	1 010	665	33	286	28.3	1 890	79
Spain	50 909	24 481	15 056	30	20 129	82.2	39 143	3 485
Sweden	44 358	13 891	9 191	21	2 780	20.0	8 779	395
Switzerland	4 111	1 093	765	19	434	39.7	7 131	314
Turkey	77 823	25 318	14 577	19	27 771	109.7	60 771	28 572
Ukraine	59 512	51 897	42 886	72	34 357	66.2	51 652	9 574
United Kingdom	24 418	15 659	12 555	51	5 989	38.2	58 615	1 226
Yugoslavia	10 159	6 444	4 605	45	4 085	63.4	10 763	2 646
Total	679 127	384 220	286887	42	213 791	55.6	656 565	88 844

TABLE A8g Cont'd
Actual and potential available arable land, Europe

	Actual arable land/caput (agricultural population) (HA)	Potential arable land/caput (agricultural population) (HA)	Equivalent Potential Arable Land/caput (agricultural population) (HA)	Actual arable land/caput (total population) (HA)	Potential arable land/caput	Equivalent Potential Arable Land/caput
Albania	0.4	0.5	0.3	0.2	0.3	0.2
Armenia	1.0	0.8	0.4	0.2	0.1	0.1
Austria	3.3	7.2	5.1	0.2	0.4	0.3
Azerbaijan	0.9	1.7	1.1	0.3	0.5	0.3
Belarus	3.4	9.2	8.2	0.6	1.7	1.5
Belgium	NA	10.4	8.1	NA	0.2	0.2
Bosnia Herzegovina	2.5	8.4	6.0	0.2	0.8	0.5
Bulgaria	4.5	8.3	6.4	0.5	0.9	0.7
Croatia	2.0	6.2	4.9	0.3	0.8	0.7
Cyprus	1.8	5.6	3.2	0.2	0.6	0.3
Czech Republic	3.0	5.8	4.3	0.3	0.6	0.5
Denmark	9.9	14.9	12.8	0.5	0.7	0.6
Estonia	5.4	10.3	9.5	0.7	1.4	1.3
Finland	6.8	36.1	24.2	0.5	2.7	1.8
France	8.2	16.3	12.5	0.3	0.7	0.5
Georgia	0.8	1.8	1.3	0.2	0.4	0.3
Germany	5.5	12.8	9.9	0.1	0.3	0.3
Greece	1.9	3.5	2.1	0.3	0.6	0.4
Hungary	3.4	5.5	4.7	0.5	0.8	0.7
Iceland	0.3	0.0	0.0	0.0	0.0	0.0
Ireland (Rep.)	3.0	11.1	7.9	0.4	1.4	1.0
Israel	2.3	3.8	2.5	0.1	0.1	0.1
Italy	3.1	4.7	3.4	0.2	0.3	0.2
Latvia	4.7	14.5	14.2	0.7	2.1	2.0
Lithuania	4.6	8.2	7.9	0.8	1.5	1.4
Luxembourg	NA	11.9	7.1	NA	0.4	0.2
Macedonia	1.9	2.9	1.8	0.3	0.5	0.3
Malta	1.9	5.6	3.8	0.0	0.1	0.1
Moldova	1.6	2.1	1.6	0.5	0.7	0.5
Netherlands	1.4	2.8	2.1	0.1	0.1	0.1
Norway	3.9	9.6	4.3	0.2	0.5	0.2
Poland	1.6	3.1	2.5	0.4	0.7	0.6
Portugal	1.9	3.2	2.2	0.3	0.5	0.4
Romania	2.5	4.3	3.0	0.4	0.8	0.5
Slovenia	3.6	12.8	8.4	0.2	0.5	0.4
Spain	5.8	7.0	4.3	0.5	0.6	0.4
Sweden	7.0	35.2	23.3	0.3	1.6	1.0
Switzerland	1.4	3.5	2.4	0.1	0.2	0.1
Turkey	1.0	0.9	0.5	0.5	0.4	0.2
Ukraine	3.6	5.4	4.5	0.7	1.0	0.8
United Kingdom	4.9	12.8	10.2	0.1	0.3	0.2
Yugoslavia	1.5	2.4	1.7	0.4	0.6	0.4
Total	2.4	4.3	3.2	0.3	0.6	0.4

Appendix 9
Country ranking

Rank	Country	% Eq. Pot. Arable land of total area	Deserts and drylands	Steep-lands	Land degradation severity		Actual arable land per caput		Land balance		Population increase		Sum of ranks
						Rank		Rank		Rank		Rank	
	Sub-Saharan Africa												
35	Angola	56	40	3	83	24	0.33	54	4	8	3.1	148	334
56	Benin	33	27	4	178	80	0.36	46	19	41	2.9	143	375
63	Botswana	91	100	1	110	36	0.30	63	5	12	2.1	98	402
97	Burkina Faso	45	87	4	248	120	0.35	50	18	39	2.8	140	485
136	Burundi	70	0	13	338	152	0.20	95	83	124	2.6	128	582
35	Cameroon	44	10	4	175	77	0.55	21	20	43	2.7	135	334
6	Central African Republic	43	6	3	77	21	0.63	14	4	8	2.1	98	193
62	Chad	81	99	3	117	39	0.53	22	10	28	2.5	122	394
60	Congo Dem. Rep.	55	2	2	93	29	0.07	146	1	3	2.9	143	380
28	Congo Rep.	53	0	0	37	10	0.18	103	5	12	2.8	140	319
20	Cote d'Ivoire	42	0	3	123	42	0.28	71	14	32	2.2	107	298
128	Djibouti	100	100	2	200	92	0.00	158	0	1	2.3	108	561
10	Eq. Guinea	57	0	3	21	5	0.59	18	14	32	2.4	110	225
156	Eritrea	98	100	0	243	118	0.15	117	88	127	2.7	135	695
130	Ethiopia	74	67	30	228	106	0.21	90	26	51	3.1	148	565
9	Gabon	50	0	4	42	12	0.44	34	3	5	2.4	110	215
90	Gambia	45	97	1	147	57	0.12	125	22	45	2.1	98	468
76	Ghana	45	7	4	178	80	0.16	109	24	47	2.7	135	428
42	Guinea	64	11	10	126	44	0.26	80	6	17	2.5	122	348
95	Guinea Bissau	58	77	10	176	78	0.10	128	15	35	2	95	481
97	Kenya	84	80	13	186	86	0.32	57	29	55	2.4	110	485
146	Lesotho	94	10	27	325	147	0.17	108	88	127	2.4	110	623
52	Liberia	56	0	6	82	23	0.16	109	6	17	4.6	159	370
125	Madagascar	61	66	8	287	133	0.18	103	9	23	3	147	541
87	Malawi	57	71	20	119	40	0.22	87	25	50	2.6	128	453
112	Mali	86	99	5	135	51	0.18	103	9	23	2.9	143	510
89	Mauritania	99	100	4	86	25	0.24	83	15	35	2.4	110	456
61	Mozambique	45	31	7	107	33	0.09	136	5	12	2.5	122	386
87	Namibia	92	99	7	101	31	0.19	97	6	17	2.4	110	453
107	Niger	95	94	5	153	60	0.44	34	35	64	3.2	151	503
101	Nigeria	48	44	6	239	114	0.41	38	49	87	3.3	153	489
147	Rwanda	81	0	29	390	158	0.30	63	157	143	3.5	154	627
113	Senegal	54	100	3	219	102	0.22	87	18	39	2.6	128	513
51	Sierra Leone	61	0	10	193	88	0.29	68	14	32	2.4	110	369
141	Somalia	98	100	5	173	74	0.13	122	43	74	2.6	128	602
143	South Africa	85	78	12	259	128	0.10	128	47	81	2	95	607
65	Sudan	75	87	5	140	53	0.32	57	15	35	2.1	98	410
79	Swaziland	73	51	22	200	92	0.50	25	24	47	2.5	122	433
64	Tanzania	51	46	14	169	71	0.23	84	5	12	2.6	128	407
83	Togo	47	10	7	254	125	0.61	15	57	102	2.7	135	441
100	Uganda	60	0	10	258	127	0.36	46	48	86	3.7	157	486
45	Zambia	46	87	4	160	63	0.67	11	9	23	2.5	122	355
73	Zimbabwe	63	100	6	131	47	0.26	80	12	31	2.1	98	425

Rank	Country	% Eq. Pot. Arable land of total area	Deserts and drylands	Steep-lands	Land degradation severity		Actual arable land per caput		Land balance		Population increase		Sum of ranks
						Rank		Rank		Rank		Rank	
North Africa and Near East													
150	Afghanistan	98	100	21	214	97	0.47	29	265	146	4.8	160	651
110	Algeria	97	97	6	111	37	0.29	68	63	109	2	95	508
142	Egypt	100	100	8	60	16	0.06	147	2 893	155	1.6	79	605
153	Iran	99	99	19	253	124	0.28	71	385	148	2.4	110	669
155	Iraq	93	99	7	311	145	0.28	71	131	139	2.7	135	690
158	Jordan	97	100	13	240	115	0.10	128	72	118	2.9	143	714
157	Kuwait	100	100	5	204	94	0.00	158	500	151	2.1	98	707
122	Lebanon	83	54	4	156	62	0.11	126	114	137	1.4	66	531
131	Libya	99	100	4	132	48	0.42	37	88	127	3.2	151	566
119	Morocco	81	86	21	207	96	0.36	46	76	119	1.5	73	522
160	Oman	100	100	11	180	82	0.03	152	6 300	157	3.9	158	760
149	Qatar	100	100	10	135	51	0.02	155	800	154	1.5	73	643
154	Saudi Arabia	100	100	6	166	68	0.21	90	380 000	159	3.1	148	671
140	Syria	81	95	10	272	130	0.39	40	98	130	2.4	110	596
123	Tunesia	86	90	14	236	110	0.56	19	150	142	1.5	73	534
151	United Arab Emirates	100	100	4	166	68	0.02	155	3 900	156	1.6	79	662
159	Yemen	100	99	7	219	102	0.10	128	30 900	158	3.5	154	749
	North Asia, east of Urals												
69	Kazakhstan	99	97	3	103	32	2.06	2	478	150	0.5	33	416
106	Kyrgyzstan	98	93	28	68	19	0.28	71	164	144	0.9	48	501
28	Russian Federation	87	97	10	108	34	0.90	6	47	81	-0.4	4	319
109	Tajikistan	91	93	26	41	11	0.15	117	45	78	1.9	91	507
94	Turkmenistan	99	86	1	68	19	0.38	41	195	145	1.7	83	475
115	Uzbekistan	95	91	3	61	17	0.21	90	104	133	1.8	87	516
	Asia and Pacific												
35	Australia	89	86	4	109	35	2.67	1	38	67	1	52	334
110	Bangladesh	47	0	8	218	101	0.08	141	103	132	1.6	79	508
145	Bhutan	100	19	21	144	54	0.08	141	744	152	2.6	128	615
85	Brunei	64	0	9	300	137	0.03	152	3	5	1.6	79	446
49	Cambodia	49	0	18	243	118	0.46	31	31	58	1.9	91	366
118	China	85	70	21	180	82	0.08	141	47	81	0.7	41	521
57	Fiji	90	0	40	0	1	0.34	51	77	121	1.5	73	376
108	India	45	72	8	198	90	0.18	103	82	122	1.3	64	504
81	Indonesia	74	1	24	205	95	0.16	109	42	73	1.2	61	436
16	Japan	22	4	24	18	3	0.30	63	289	147	0	14	276
120	Korean DPR	80	31	24	217	100	0.09	136	55	100	1.1	55	526
115	Korean Rep.	75	0	41	242	116	0.05	150	52	93	0.7	41	516
105	Laos	84	1	54	187	87	0.20	95	15	35	2.8	140	496
93	Malaysia	71	0	24	283	131	0.03	152	5	12	1.7	83	473
126	Mongolia	100	100	13	174	75	0.56	19	746	153	1.9	91	551
86	Myanmar	75	1	35	234	109	0.22	87	41	72	1.5	73	451
138	Nepal	89	51	20	152	59	0.11	126	104	133	2.4	110	589
33	New Zealand	80	2	45	164	65	1.24	4	44	76	1.1	55	327
152	Pakistan	95	100	13	174	75	0.16	109	392	149	2.5	122	663
42	Papua New Guinea	79	0	31	25	7	0.10	128	3	5	2.1	98	348
84	Philippines	77	0	17	59	15	0.14	121	98	130	1.7	83	443
91	Sri Lanka	53	6	9	269	129	0.10	128	51	89	1.1	55	469
74	Thailand	55	0	26	326	148	0.36	46	65	111	0.7	41	427
128	Viet Nam	77	2	33	328	149	0.10	128	60	106	1.4	66	561

Rank	Country	% Eq. Pot. Arable land of total area	Deserts and drylands	Steep-lands	Land degradation severity	Rank	Actual arable land per caput	Rank	Land balance	Rank	Population increase	Rank	Sum of ranks
	South and Central America												
34	Argentina	74	62	10	164	65	0.80	8	30	56	1.1	55	331
18	Belize	66	0	9	87	26	0.28	71	6	17	2.1	98	286
24	Bolivia	58	33	16	122	41	0.33	54	4	8	2.1	98	307
14	Brazil	54	8	3	163	64	0.32	57	9	23	1.1	55	265
101	Chile	97	55	32	125	43	0.30	63	128	138	1.2	61	489
31	Colombia	58	2	10	145	56	0.16	109	8	22	1.4	66	323
121	Costa Rica	84	0	17	368	156	0.16	109	44	76	1.8	87	528
27	Cuba	48	0	6	215	98	0.31	61	45	78	0.3	27	318
97	Dominican Republic	71	0	19	242	116	0.19	97	68	116	1.4	66	485
48	Ecuador	64	23	21	134	50	0.27	76	24	47	1.7	83	364
132	El Salvador	72	0	28	288	134	0.13	122	84	125	1.8	87	568
38	French Guyana	36	0	0	24	6	0.09	136	0	1	3.6	156	335
117	Guatemala	74	0	22	229	108	0.19	97	51	89	2.6	128	518
2	Guyana	53	0	10	87	26	0.60	17	4	8	1	52	167
144	Haiti	81	0	24	397	160	0.13	122	108	135	1.9	91	613
104	Honduras	81	0	25	256	126	0.37	44	59	105	2.4	110	492
135	Jamaica	90	0	20	300	137	0.09	136	140	141	1.1	55	579
101	Mexico	81	81	19	181	84	0.27	76	47	81	1.4	66	489
66	Nicaragua	72	0	13	236	110	0.30	63	23	46	2.3	108	411
74	Panama	79	0	14	297	135	0.26	80	28	53	1.4	66	427
17	Paraguay	67	15	0	95	30	0.47	29	11	30	2.4	110	281
148	Peru	93	34	27	300	137	0.00	158	68	116	1.5	73	638
13	Puerto Rico	76	0	18	168	70	1.14	5	10	28	0.9	48	245
12	Suriname	53	0	0	45	13	0.16	109	1	3	1.2	61	240
92	Trinidad/Tobago	56	0	22	300	137	0.09	136	38	67	1	52	470
1	Uruguay	30	0	4	79	22	0.41	38	9	23	0.5	33	150
41	Venezuela	58	6	16	133	49	0.18	103	7	21	1.8	87	340
	North America												
25	Canada	92	90	11	19	4	1.56	3	36	65	0.8	44	310
52	United States of America	72	49	14	182	85	0.72	10	53	97	0.8	44	370
	Europe												
127	Albania	81	37	30	374	157	0.23	84	84	125	0.8	44	559
137	Armenia	92	100	35	177	79	0.16	109	136	140	0.5	33	587
72	Austria	72	25	20	238	112	0.19	97	45	78	0.2	21	424
95	Azerbaijan	72	81	14	219	102	0.27	76	51	89	0.9	48	481
5	Belarus	26	0	0	169	71	0.61	15	37	66	-0.2	8	186
58	Belgium/Luxembourg	38	0	2	251	122	0.08	141	31	58	0.1	17	379
71	Bosnia Herzegovina	62	0	24	396	159	0.23	84	30	56	0.6	37	423
68	Bulgaria	46	87	16	300	137	0.50	25	54	98	-0.4	4	413
45	Croatia	48	0	8	350	154	0.27	76	33	61	-0.2	8	355
124	Cyprus	73	100	24	300	137	0.19	97	33	61	0.9	48	540
52	Czech Republic	39	0	20	300	137	0.33	54	52	93	0.3	27	370
8	Denmark	30	4	0	63	18	0.46	31	66	112	0.1	17	212
11	Estonia	56	50	0	87	26	0.74	9	52	93	-0.6	2	236
23	Finland	72	99	2	127	45	0.51	23	19	41	0.2	21	303
15	France	46	2	7	150	58	0.34	51	50	88	0.2	21	272
49	Georgia	74	35	32	111	37	0.21	90	47	81	0.1	17	366
38	Germany	39	0	2	194	89	0.15	117	43	74	0	14	335
58	Greece	70	11	15	248	120	0.34	51	54	98	0	14	379
21	Hungary	25	12	3	251	122	0.48	28	62	108	-0.5	3	301

Rank	Country	% Eq. Pot. Arable land of total area	Deserts and drylands	Steep-lands	Land degradation severity		Actual arable land per caput		Land balance		Population increase		Sum of ranks
						Rank		Rank		Rank		Rank	
139	Iceland	100	1	22	238	112	0.02	155	NA	160	0.8	44	594
3	Ireland (Rep.)	50	0	1	32	8	0.37	44	27	52	0.2	21	176
114	Israel	78	99	11	49	14	0.08	141	60	106	1.4	66	515
66	Italy	61	3	24	228	106	0.19	97	66	112	-0.2	8	411
7	Latvia	17	0	0	226	105	0.67	11	32	60	-0.7	1	194
4	Lithuania	18	0	0	128	46	0.82	7	56	101	-0.2	8	180
132	Macedonia	75	100	32	332	151	0.31	61	66	112	0.6	37	568
19	Malta	37	0	0	0	1	0.04	151	33	61	0.6	37	287
77	Moldova	33	82	0	301	144	0.50	25	76	119	0.3	27	430
55	Netherlands	63	0	0	144	54	0.06	147	51	89	0.2	21	374
30	Norway	97	20	9	32	8	0.21	90	40	70	0.3	27	321
26	Poland	28	0	1	286	132	0.38	41	52	93	0.2	21	316
47	Portugal	61	2	20	199	91	0.29	68	58	104	-0.1	12	358
70	Romania	48	45	10	311	145	0.44	34	57	102	0.5	33	417
79	Slovenia	67	10	26	340	153	0.15	117	28	53	-0.3	7	433
44	Spain	70	3	20	216	99	0.51	23	82	122	-0.1	12	349
21	Sweden	79	26	2	165	67	0.32	57	20	43	0.3	27	301
77	Switzerland	81	0	31	172	73	0.06	147	40	70	0.3	27	430
134	Turkey	81	86	27	328	149	0.46	31	110	136	1.3	64	574
40	Ukraine	28	44	1	299	136	0.67	11	66	112	-0.4	4	336
32	United Kingdom	49	0	5	154	61	0.10	128	38	67	0.1	17	326
82	Yugoslavia	55	20	21	357	155	0.38	41	63	109	0.6	37	438