The world's drylands: a classification

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Chapter 2

THE WORLD'S DRYLANDS: A CLASSIFICATION

Ton Dietz and Els Veldhuizen

Abstract:
In this chapter a global overview of drylands is presented. The study region and case study areas are selected using a few simple criteria. Starting with the aridity class and degree of degradation areas were classified based on the population density and on the presence of at least one large city in the area.

2.1 THE WORLD'S TROPICAL AND SUBTROPICAL DRYLANDS

The world's drylands can be characterised as semi-arid and sub-humid areas, with average annual P/ETP between 0.20 and 0.75 (UNESCO, 1977). Average rainfall conditions restrict rain-dependent agriculture to mainly sorghum, millet and marginal maize cultivation as food crops and groundnuts and cotton as crops for agro-industry and for export. Animal husbandry based on mainly cattle, goats and sheep can also add to food supply and cash income. In general, rain-fed agriculture gives relatively low crop yields per hectare. Yearly rainfall variation can be considerable. Rainfall unreliability results in relatively high risks of crop failure due to drought (and occasionally excessive rainfall). Yet, the world's drylands support a considerable part of the world's population. According to the World Atlas of Desertification (UNEP, 1997, p. 106), in Africa 40% of the population lives in areas prone to drought and susceptible to desertification. In Asia it is almost as high (39%), while in South America it is 30%.

In West Africa, UNESCO's map of the world distribution of arid regions (UNESCO, 1977) shows a band of semi-arid conditions from Dakar in Senegal, via Ouagadougou in Burkina Faso to Niamey in Niger and further to Kano in Nigeria, the Sahel proper. South of this zone there is a band of sub-humid conditions.

Other tropical and subtropical drylands in the world can be found in the Americas (Mexico and the southern United States, northern Venezuela, north-eastern Brazil, western Ecuador, Peru, parts of Chile, southern Bolivia, western Paraguay and northern Argentina), in northern Africa, and in major parts of eastern and southern Africa, in West Asia (Israel, Jordan, Syria, Lebanon, south-western Arabia and Yemen, major parts of Iran, and Afghanistan) and in the Indian subcontinent (major parts of Pakistan, western and southern India), in minor parts of China, and in major parts of Australia.

UNESCO's aridity assessment was based on rainfall (P) and evapo-transpiration (ETP) conditions for mostly 1930-1960. Semi-arid conditions are defined between P/ETP of 0.20 and 0.50, as for sub-humid conditions the boundaries are set at a P/ETP between 0.50 and 0.75. Combined with assessments of land degradation and population density it formed the basis for the ICCD typology of all drylands in the tropics and subtropics (Dietz & Veldhuizen, 1998). Land degradation assessments were based on the so-called GLASOD map (Oldeman *et al*., 1991). Population density was first assessed by using data for the situation in the 1960s, mainly based on the World Atlas of Agriculture (IGDA, 1971) and differentiating between 'high density areas' (with more than 50 inhabitants per square kilometre) and 'low density areas' (<50 inh. km^{-2}). Later, it was possible to update these population density data for the situation of the mid-1990s (Global Demography Project, CIESIN, ESRA, NCGIA, see UNEP/GRID, 1998). Urbanisation assessments were added for the situation around 1960 and around 1990, based on the United Nations Demographic Yearbooks, and using the existence of urban administrative areas of more than 100,000 inhabitants as a threshold for

differentiating 'urban' from 'rural' areas. All data were mapped by using a grid system of 1°×1°, roughly covering 110×110 km.

In total the world has 1902 1°×1° 'cells' in the tropics or subtropics, which were completely or mainly semi-arid and/or sub-humid, an area of 23 million km², or 17% of the world's land mass. Table 2-1 gives an overview for the world's major regions, showing that the West African drylands, the focus of this study, had the fifth largest expanse, after eastern & southern Africa, south & central America, Australia and the Indian sub-continent. The West-African drylands cover 20% of the total West African land area. Most of the remainder is arid, like in North Africa, West Asia, and Australia, and unlike all the other world regions, where most of the non-drylands are humid.

Table 2-1 Number of tropical/subtropical semi-arid and sub-humid cells per major world region (one cell = 1°×1°).

Region	Semi-arid	Sub-humid	Total	total as % of region
West Africa	86	53	139	20
Eastern & southern Africa	272	328	600	57
North Africa	40	3	43	9
West Asia	45	13	58	12
Indian subcontinent	85	101	186	55
China	44	46	90	12
South & Central America	197	212	409	25
USA	52	32	84	11
Australia	211	82	293	46
Total	1032	870	1902	17

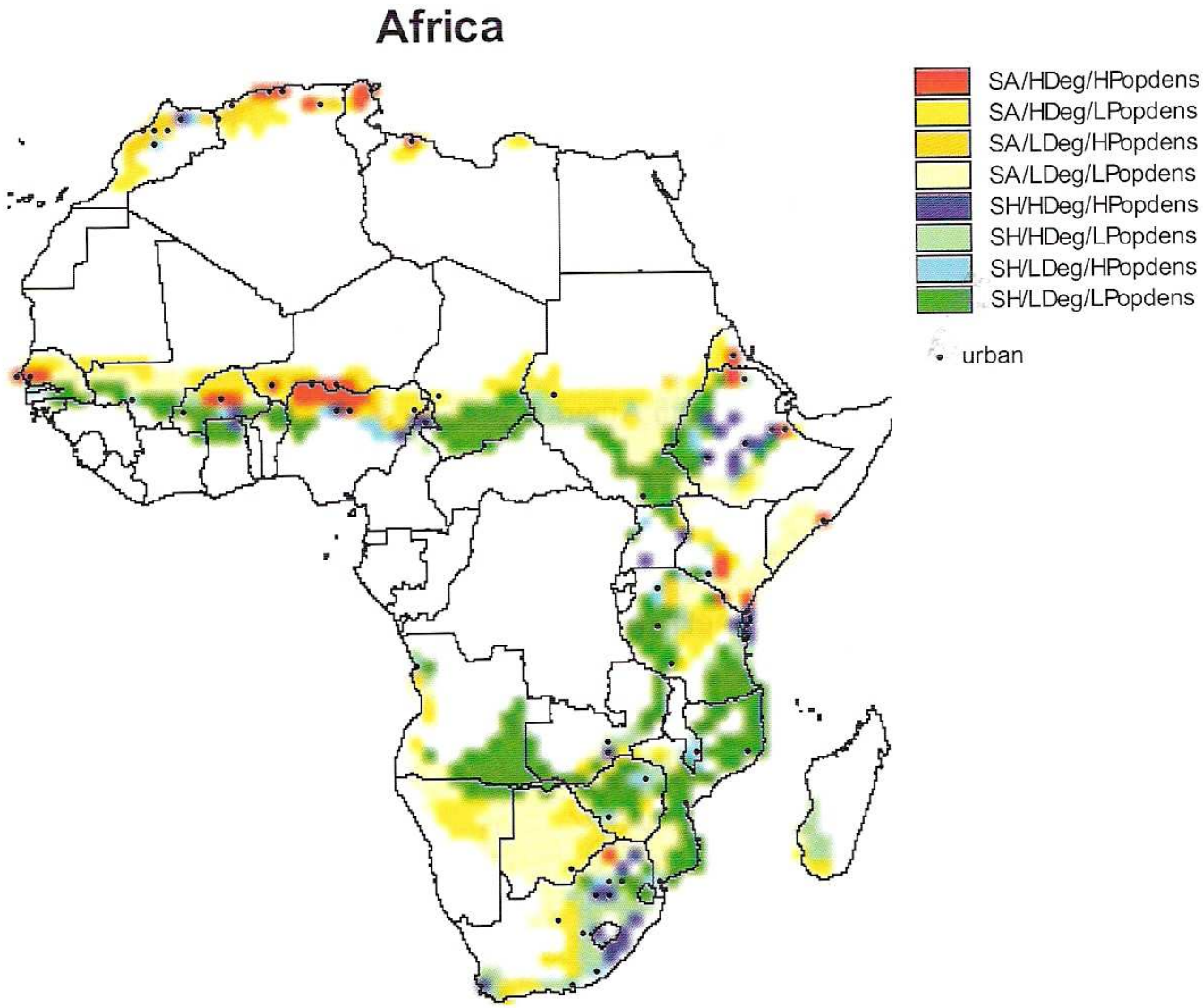
source: for aridity: UNESCO, 1977, for area: World Bank, 1998; the assessments and interpretations were done by a 'leeronderzoek' (student research) group of the Dept. of Geography and Planning, of the University of Amsterdam, supervised by Ton Dietz and Els Veldhuizen, and consisting of Marcel Gerrits, Minette Kits Nieuwenkamp, Karin Nijenhuis, Annemarie Poldermans and Laura de Pundert (see Dietz & Veldhuizen, 1998). Later, a population update was produced, to which also Janneke Vader contributed (see Veldhuizen & Dietz, 1999). Together they form the basis of Map 2-1 to 2.3.

Maps 2.1-2.3 give the results for Africa, Central/South America and Asia/Australia: semi-arid (SA) versus sub-humid (SH) areas; high land degradation (HDeg) versus low land degradation (LDeg); high population density (HPopdens) versus low population density (LPopdens) in 1994 and rural versus urban in 1990. Table 2-2 and Table 2-3 give the detailed results per world region for semi-arid and sub-humid conditions.

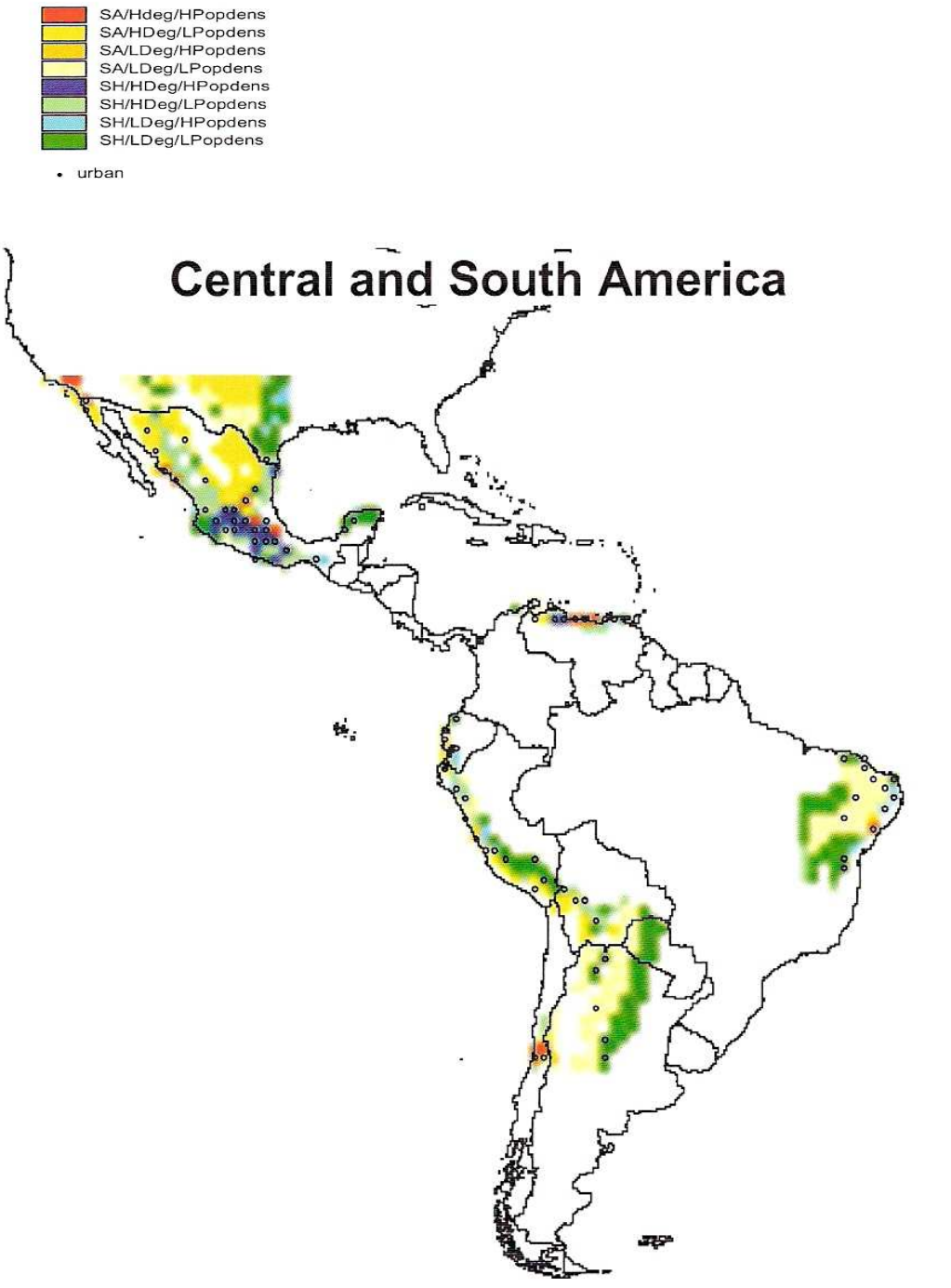
Table 2-2 Detailed profile of the world's tropical and subtropical drylands: semi-arid.

Region	N	High degradation				Low degradation			
		High pop. density		*Low pop. density*		*High pop. density*		*Low pop. density*	
		urban	*rural*	*urban*	*rural*	*Urban*	*rural*	*urban*	*rural*
West Africa	86	7	12	1	37	0	7	0	22
East & Southern Africa	272	3	8	4	90	0	4	1	162
North Africa	40	4	4	0	16	7	9	0	0
West Asia	45	3	5	1	14	8	5	1	8
Indian subcontinent	85	14	19	2	5	9	8	1	27
China	44	0	0	0	0	0	0	0	44
South/Centr. America	197	7	7	6	52	4	6	10	105
USA	52	3	1	0	18	3	0	2	25
Australia	211	0	0	0	10	1	0	0	200
Total	1032	41	56	14	242	32	39	15	593
West Africa/total	8%	17%	21%	7%	15%	0%	18%	0%	4%

Map 2-1 Drylands of Africa.



Map 2-2 Drylands of Central and South America.



Map 2-3 Drylands of Asia and Australia.

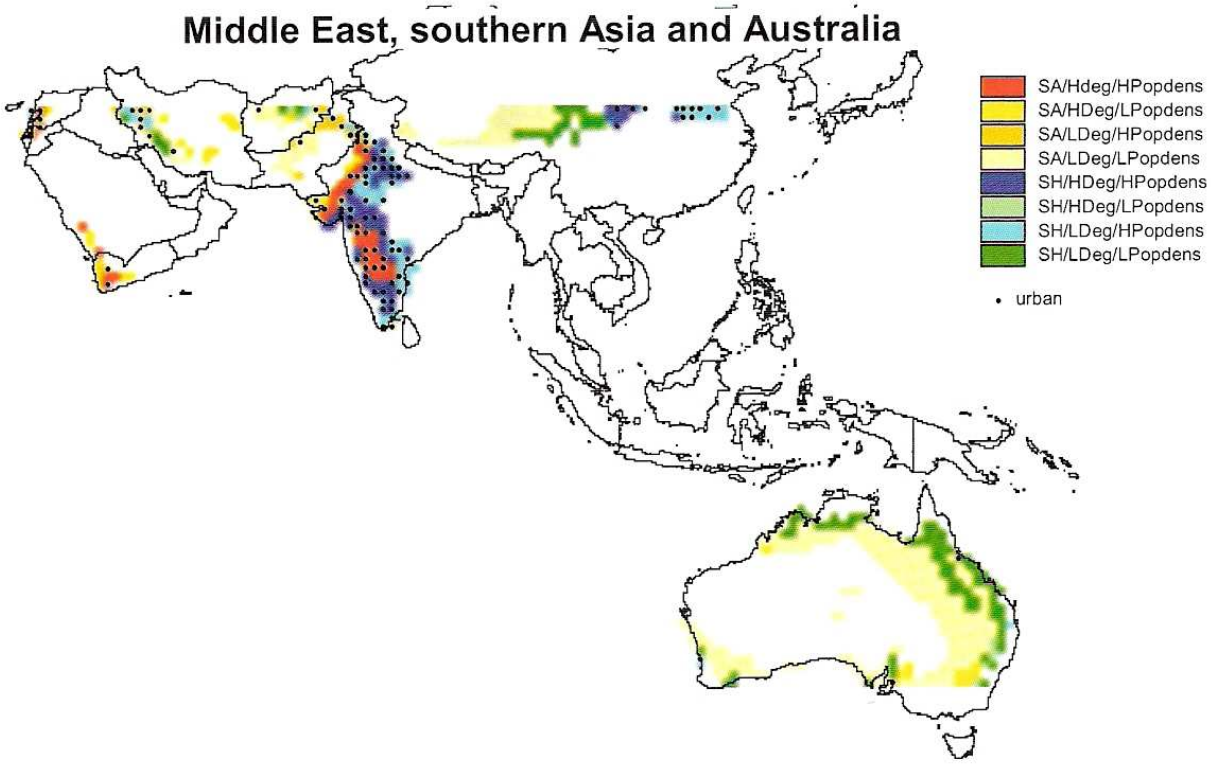


Table 2-3 Detailed profile of the world's tropical and subtropical drylands: sub-humid.

Region	**N**	**High degradation**				**Low degradation**			
		High pop. density		*Low pop. density*		*High pop. density*		*Low pop. density*	
		urban	*rural*	*urban*	*rural*	*Urban*	*rural*	*urban*	*rural*
West Africa	53	1	4	0	4	2	8	1	33
East & Southern Africa	328	9	16	4	67	11	11	5	205
North Africa	3	1	0	0	0	1	1	0	0
West Asia	13	0	0	0	0	4	5	0	4
Indian subcontinent	101	25	26	0	2	24	21	0	3
China	46	3	5	0	2	10	4	0	22
South/Centr. America	212	10	1	11	65	5	1	21	98
USA	32	1	0	0	4	5	1	2	19
Australia	82	0	0	0	5	1	2	1	73
Total	870	50	52	15	149	63	54	30	457
West Africa/total	6%	2%	8%	0%	3%	3%	15%	3%	7%

West Africa's dryland profile, compared to the world's tropical and subtropical dryland profile as a whole, is given in Table 2-4. West Africa's drylands are only 7% of the world's total. However, the most problematic areas, semi-arid areas with relatively high degradation and a relatively high population density, are considerably over represented in West Africa: they consist of 20% of the world's total in that type of drylands.

Table 2-4 West Africa's dryland profile, compared to the World's dryland profile (tropics and subtropics): number of 1°x1° cells and percentage

Type of dryland	West Africa, number of cells	World, number of cells	West Africa as % of World
Total Drylands	139	1902	7
Semi-arid	86	1032	8
High degradation	57	353	16
High density	19	97	20
Urban	7	41	17
Rural	12	56	21
Low density	38	256	15
Urban	1	14	14
Rural	37	242	15
Low degradation	29	679	4
High density	7	71	10
Urban	0	32	0
Rural	7	39	18
Low density	22	608	4
Urban	0	15	0
Rural	22	593	4
Sub-humid	53	870	6
High degradation	9	266	3
High density	5	102	5
Urban	1	50	2
Rural	4	52	8
Low density	4	164	2
Urban	0	15	0
Rural	4	149	3
Low degradation	44	604	7
High density	10	117	9
Urban	2	63	3
Rural	8	54	15
Low density	34	487	7
Urban	1	30	3
Rural	33	457	7

Source: Based on Table 2-3 and 2-4.

For West Africa's drylands, the distribution of the types per country is given in Table 2-5. Four categories of drylands are most prominent in West Africa:

- The semi-arid areas with high degradation but relatively low population density have 38 cells, many of them in Niger. One of these cells is urban: Maiduguri in Nigeria's north-eastern corner;
- The least problematic type in terms of probable resource stress (sub-humid, with low degradation and low population density), is represented by 34 cells, many of those in Mali. One of those cells is urban: Bobo-Dioulasso, second city of Burkina Faso;
- The category of least problematic semi-arid areas (those with low degradation and low population densities) consists of 22 cells, many of those in Mali and non of them urban;
- The category of most problematic semi-arid areas comes fourth, with 19 cases: three cells, two of them urban, in Senegal (urban: Dakar and Thiès/Kaolack), three in Burkina Faso, at the Mossi plateau, including Burkina Faso's capital city Ouagadougou, four in Niger (including the urban cells of Niamey and Maradi in Niger), and nine in northern Nigeria, including the urban areas Kano and Sokoto.

Four other types of dryland areas are less prominent in West Africa:

- The category of sub-humid areas with low degradation but high densities is represented by 10 cells, including two urban ones: Bamako, capital city of Mali, and Maroua, administrative headquarters of Cameroon's Extreme North Province;
- The category of semi-arid areas with low degradation, but high densities has seven cases, almost all of those in Nigeria and non of them urban;
- The category of most problematic sub-humid areas, with high degradation and high population densities, has five cases, including one urban cell: Katsina in Nigeria;
- Finally the category of sub-humid areas with high degradation and low densities has four cells, none of those urban.

Table 2-5 Types of drylands in West Africa, country details, number of 1°x1° cells.

Country	Total drylands	SAHD HP	SAHD LP	SALD HP	SALD LP	SHHD HP	SHHD LP	SHLD HP	SHLD LP
Mauritania	4		4						
Senegal	13	3 (2urb)	3		5				2
Gambia	3							2	1
Guinea Bissao	1								1
Guinea	1								1
Mali	27		4		12		1	1 (1urb)	9
Burkina Faso	20	3 (1urb)	7		2	1	1	1	5 (1urb)
Cote d'Ivoire	1								1
Ghana	6					1			5
Togo	1						1		
Benin	5								5
Niger	18	4 (2urb)	13		1				
Nigeria	32	9 (2urb)	5 (1urb)	6	2	2 (1urb)		5	3
Cameroon	5		2	1		1	1	1 (1urb)	1
Total	139	19 (7urb)	38 (1urb)	7	22	5 (1urb)	4	10 (2urb)	34 (1urb)

SA = Semi Arid SH = Sub-humid (according to UNESCO map);

HD = High degradation LD = Low degradation (according to GLASOD map);

HP = High population density LP = Low population density (around 1994);

urb = with at least one city of more than 100,000 inhabitants in 1990.

For in-depth analysis five rural and two urban areas were selected as examples of their dryland types (see Table 2-6). For some other areas (*e.g.* north-western Ghana, Niamey in Niger and Dakar in Senegal) additional information was gathered.

Table 2-6 Selected case study areas in West Africa.

Type	number in West Africa	rural area selected	urban area selected
SAHDHP	19	Kaya (Burkina Faso)	Ouagadougou (Burkina Faso)
SAHDLP	38	Douentza/Bandiagara (Mali), Gorom-Gorom (Burkina Faso)	
SHHDHP	5	Bolgatanga (Ghana)	
SHLDHP	10		Bamako (Mali)
SHLDLP	34	Koutiala/Sikasso (Mali)	