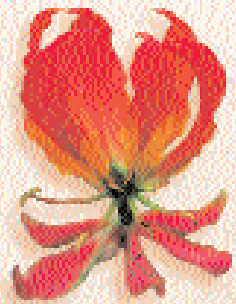


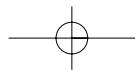
SAND AND WATER
CHAPTER
FOUR

CLIMATE

The rain makers



An advancing storm of swirling dust and rain.



People came from far and wide to consult the famous rain-making Mbukushu chiefs in the 1800s. Today, our more technical approach to aspects of climate tells us that Kavango's climate is dominated by two weather systems. The first is the Inter Tropical Convergence Zone, a large band of moist air that shifts north in winter and south in summer. The southward movement in summer of the Zone from the tropics brings warm moist air, clouds and – with some luck – rain to northern Namibia. The other weather system is the belt of temperate high-pressure cells that lie to the south. These cells also move north and south, one cell usually lying over Botswana during winter while another lies in the Atlantic Ocean off the south-western coast of Namibia. Both cells bring cool and dry air to the region. In a sense, there is a power play between the two climate systems, the southerly high-pressure cells feeding dry air, which pushes away the warm moist air coming from the northern tropical zone. Winters and dry spells during summer are periods when the high-pressure cells dominate the area, while wet summers are those when the Inter Tropical Convergence Zone lies well to the south.¹

RAINFALL

The presence and north-south movement of moist air to the north and dry from the south has two fundamental effects on Kavango's rainfall. First, a gradient in rainfall is created from the wettest areas in

the north to the driest places in the south (FIGURE 12). Second, rainfall is extremely variable because the moist and dry air masses move in and out of the region so rapidly and unpredictably. Rains thus vary a great deal: from year to year, from month to month and even day to day.

The gradient of rainfall within Kavango is part of a much larger gradation covering the whole catchment area of the Okavango River (see FIGURE 20 on page 49). There are no major hills or mountains in this whole area and so the gradient is particularly even across the flat landscape. The whole area is also characterized by a clear distinction between the wetter summer months and dry winter period (FIGURE 13). No rain of any significance is received in Kavango between May and September. Chances of rain then increase progressively until January, the month in which the highest totals are recorded on average. February has slightly less rain, followed by less and less in March and April. About 80% of all rain falls between December and March, with another 15% being recorded in November and April.

Records over the past 60 years are available for most years at Rundu and Andara (FIGURE 14). The annual totals are extremely variable, ranging from less than 300 millimetres in the driest years to over 1,000 millimetres in very wet years. Almost every year differs from the one before and after it, but some cyclical changes are evident. This is especially true for the dry cycle during the 1960s, the wetter period

FIGURE 12- Average rainfall per year is highest in the north of the region.

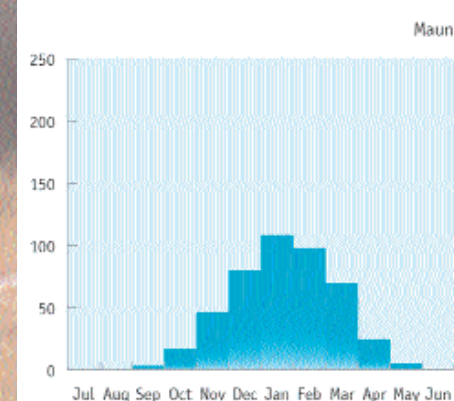
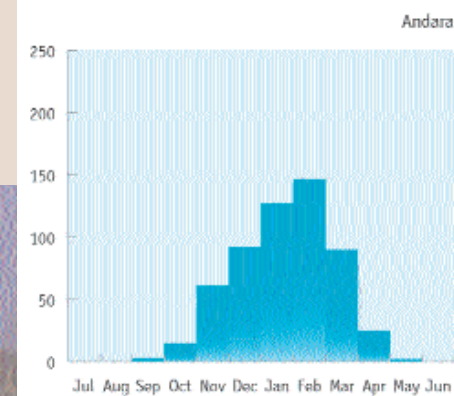
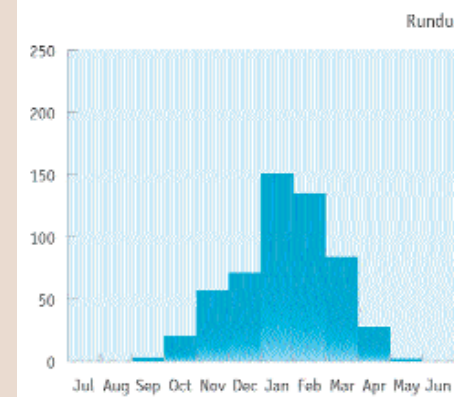
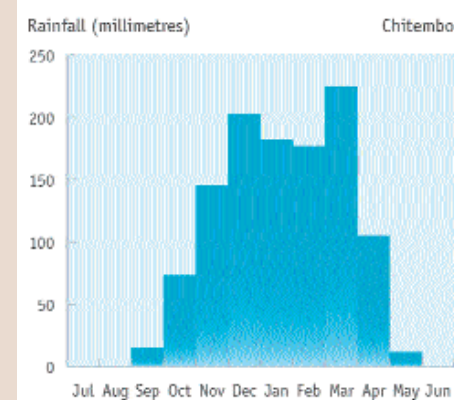
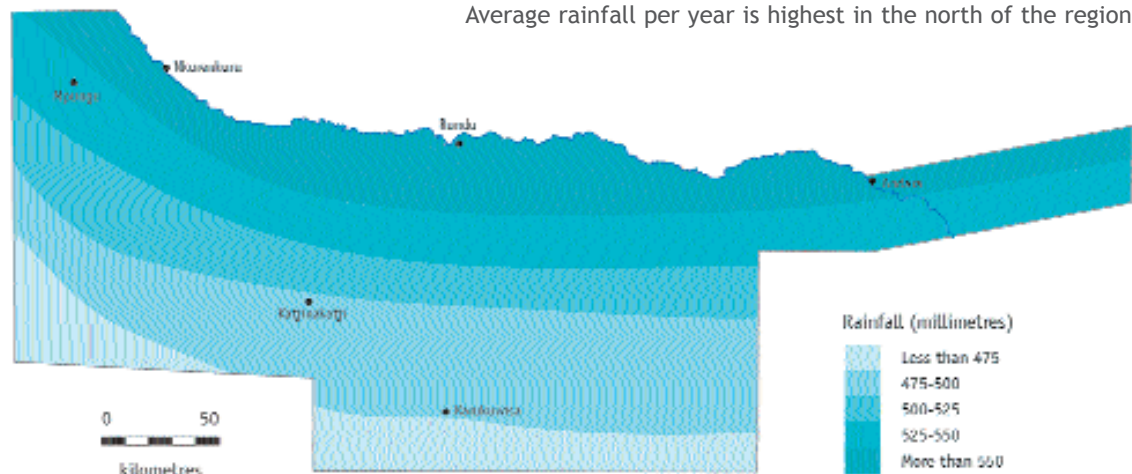


FIGURE 13- Most rains fall during the summer months, both within the Kavango (Rundu and Andara) and to the north in Angola (at Chitembo) and to the south in the Okavango Delta (Maun).

Average, minimum and maximum annual rainfalls (in millimetres) at Andara, Rundu and Nkurenkuru.

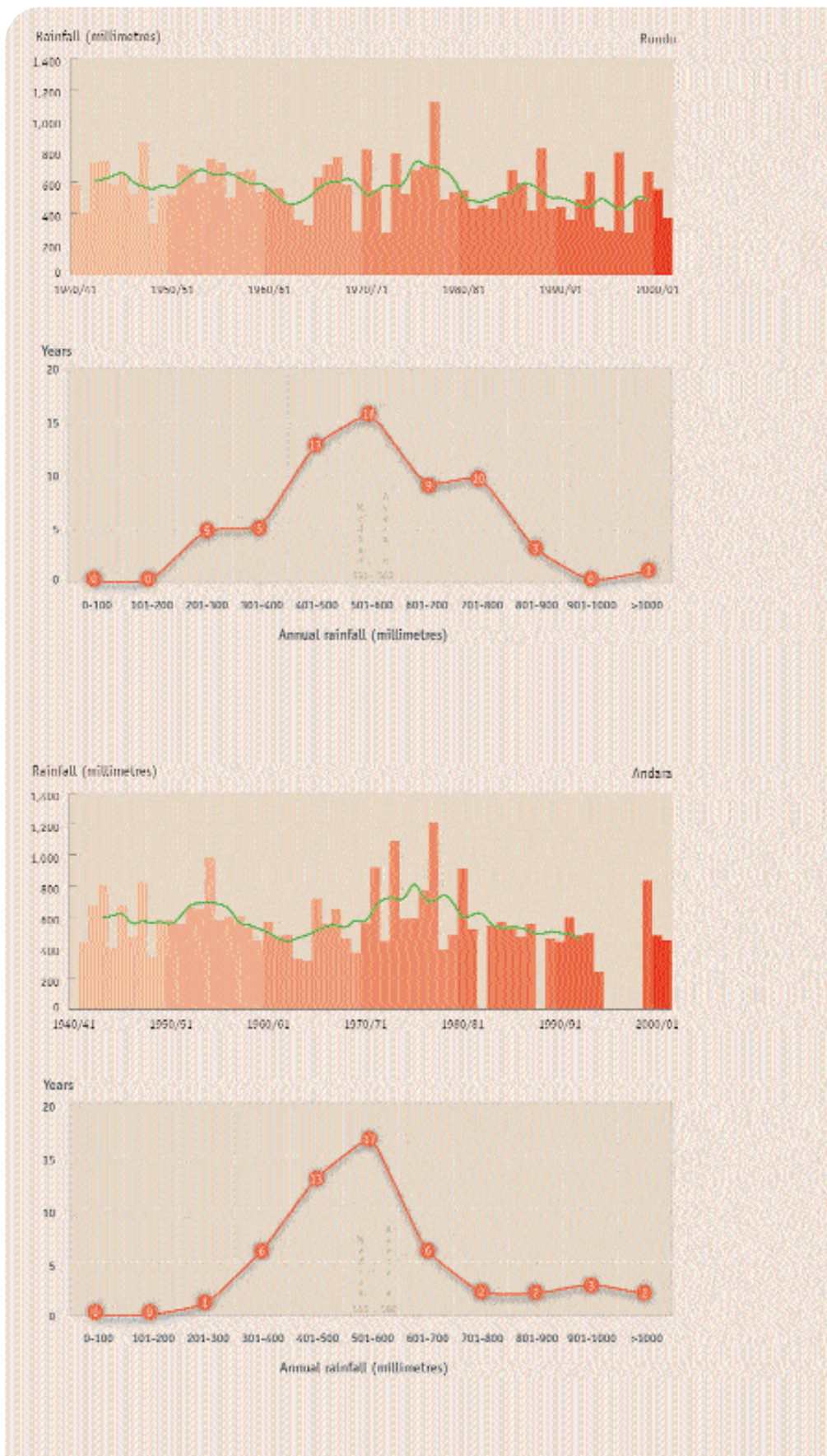
Place and years of data	Average	Minimum (year)	Maximum (year)
Andara (52 years)	579	247 (1994/1995)	1,204 (1977/1978)
Rundu (62 years)	563	274 (1972/1973)	1,120 (1977/1978)
Nkurenkuru (36 years)	610	330 (1995/1996)	1,058 (1973/1974)

The first rain shower of the season in November 2002 produced this pool of water along the Mururani-Rundu road. These children immediately took advantage of the pool to wash clothes.





FIGURE 14- Annual totals of rainfall vary substantially from year to year, as shown by these records from the past 60 years at Rundu and Andara. The second graph shows the number of years during which different amounts of rain fell. (The green line shows the five year moving average.)



during the 1970s, and then a long recent dry spell since the early 1980s. These cycles are similar to those seen in rainfall records at places in the Caprivi, north-western Botswana and to the south-west in the Grootfontein area.

FIGURE 14 also shows the numbers of years during which different total amounts of rain fell at Andara and at Rundu. Total falls of more than 500 millimetres can be expected in most years (85% of years at both Andara and Rundu), while totals of more than 600 millimetres can be expected in about 65% of all years at both places. By contrast, drier years with less than 400 millimetres were recorded in nine out of 60 years at Rundu and seven of 52 years at Andara.

It is clear that rainfall is often inadequate for crop growth as a result of low rainfall, irregular falls, or long periods of hot and dry weather. Young crops, particularly, then wither and die. The growth of natural pastures is likewise limited as a result of poor rainfall in some years (see page 66). While no clear measures of what might be called drought are available, graphs showing the numbers of days on which different amounts of rain fell provide an indication of how frequently rains of value for crop and pasture growth may fall (FIGURE 15). The graphs are for daily totals of more than five and 10 millimetres respectively.

Based on these graphs, better falls of rain can only be expected from November onwards, and few good falls can be expected after March. January is clearly the month when rain falls both most frequently and in the largest amounts each day. There are slight differences in the onset of higher falls of rain, such that good falls occur earlier in the season in the east (Andara) compared with the west (Rupara/Nkurenkuru).

These, however, are only trends and one of the most obvious features is the great variation in the timing and amount of rain from season to season (FIGURE 16). Some seasons see little rain overall (such as in 1997/1998 and 2001/2002), others have good falls spread throughout the summer (1999/2000), while others look promising but then have periodic dry spells (such as in February 1999 and January 2001 and 2002 (see also page 93). Each season sees a quite different pattern of rainfall, and these unpredictable differences make it difficult for anything and anybody (farmers, plants and animals) that relies on rain.

TEMPERATURES, EVAPORATION, AND WIND

The region's generally warm climate is reflected in FIGURE 17, which shows that temperatures increase very rapidly from the coldest months of June and July to the warmest month of October. This is because there is relatively little cloud cover to shield incoming radiation from the sun in October, whereas increasing cloud cover and rains make the remaining summer months cooler. Average maximum temperatures are above 30° Celsius in all months except for May, June and July.

Temperatures during the winter months seldom approach freezing point, and only in June, July and August are average minimum temperatures below 10° Celsius. Frost is therefore exceptionally rare, and only ever occurs in the low-lying valleys.

Total evaporation rates amount to about 1,950 millimetres per year. About four times more water is therefore potentially lost through evaporation than falls as rain. The greatest rates of evaporation are in September and October (FIGURE 18) when temperatures are high, there is little moisture in the air and it is often more windy than at other times of the year (see below). Lower rates of water loss in the mid-summer are due to the higher humidity and the cooler conditions brought about by cloud cover.

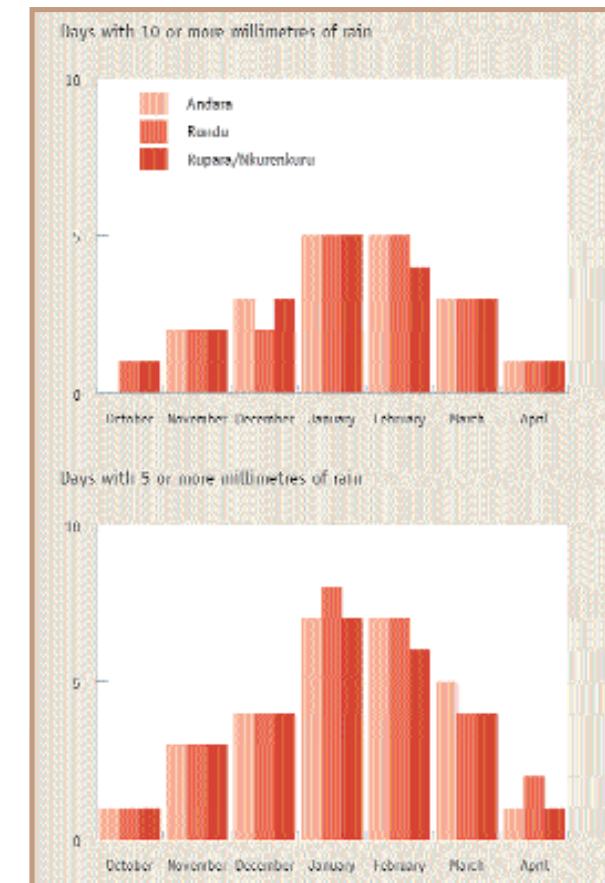


FIGURE 15- The numbers of days on which five and 10 or more millimetres of rain were recorded at Andara, Rundu and at Rupara/Nkurenkuru.²

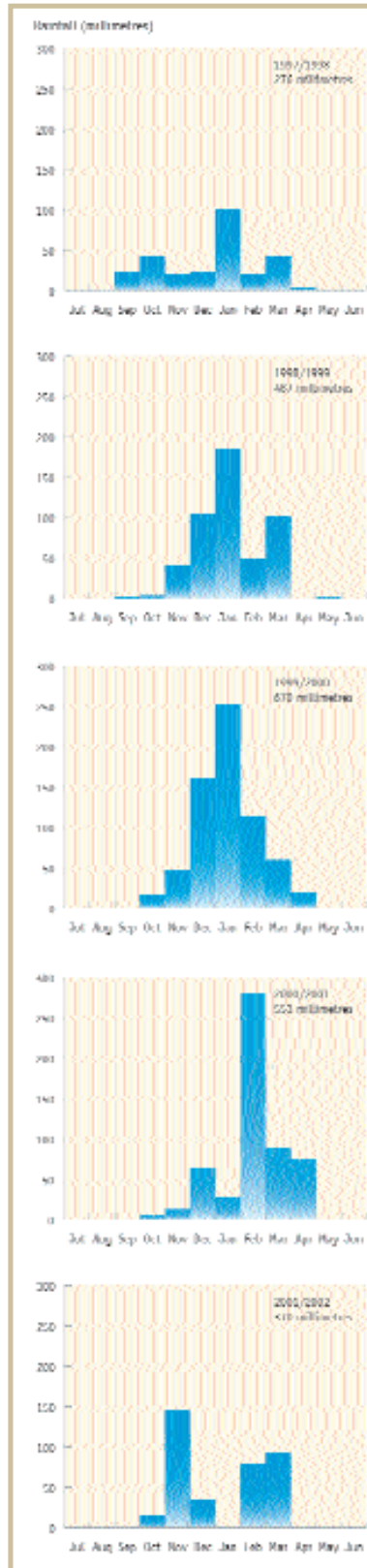


FIGURE 16- (Left) Patterns of rainfall vary from season to season, as shown by rainfall recorded each month at Rundu over five summer seasons from 1997/1998 onwards. The total amounts recorded in each season are given in the top right corner of each graph.

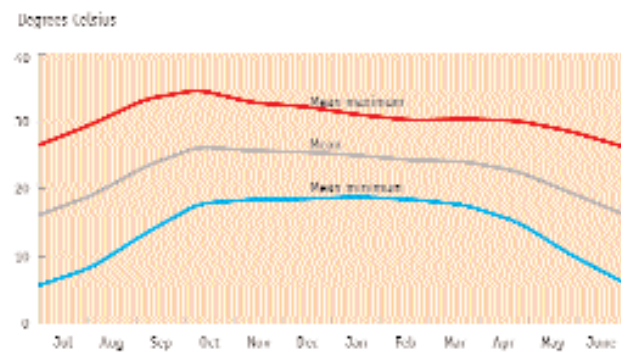


FIGURE 17- Temperatures rise most rapidly in September and then gradually decline after October. The greatest differences between the lowest and highest temperatures each day are in July and August when maximums are often 20° higher than minimum temperatures.

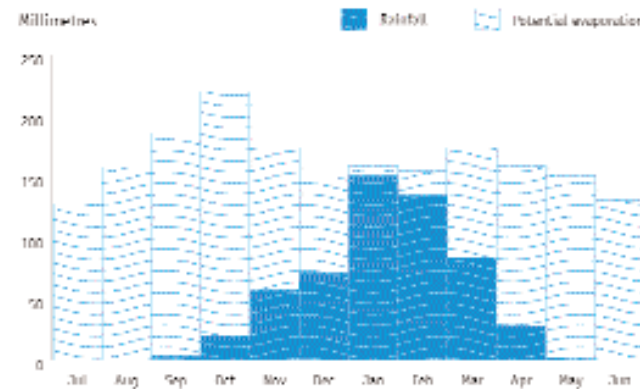


FIGURE 18- Almost two metres of water potentially evaporates each year, about four times more than the total rainfall. Rates of evaporation are highest in October as shown in this graph, which also provides comparative figures for monthly rainfall at Rundu.

Wind speeds are generally low, rising from averages of about three kilometres per hour in the mornings to about 12 kilometres per hour in the early afternoon, before dropping again to about three kilometres per hour in the evenings (FIGURE 19). Morning and evening winds are strongest in

October and November, whereas winds in the afternoon are lightest in December and January. In most months, however, it is completely calm for over half the time. Most winds are from the east, between north-east and south, and only in January is there appreciable wind from the west.

FIGURE 19- Kavango is not a windy place, and it is calm for over half the time. The graph shows average wind speeds measured in Rundu at eight in the morning, two in the afternoon and at eight in the evening. Wind roses show the proportions of time recorded from different directions in January, April, July and October. The numbers at the centres of each rose are the percentages of time that it is calm.



Some records

- The wettest season was in 1977/1978 when 1,204 millimetres was measured at Andara.
- The driest season was in 1972/1973 when only 221 millimetres was measured at Rupara.
- The day with the highest recorded rainfall was on 26 December 1977 when 190 millimetres was recorded at Rupara.
- The lowest temperature recorded at Rundu was -0,8° Celsius on 30 May 1994.
- The highest temperature recorded at Rundu was 41° Celsius on 20 November 1987.

Key notes

- About 80% of all rain falls during four months from December to March.
- The timing and amount of rainfall varies greatly from year to year, month to month and day to day. Dry periods and heavy falls of rain thus occur regularly.
- Rainfall was generally low during the 1980s and 1990s.
- Temperatures increase rapidly from the coldest months of June and July to the warmest month of October. Temperatures seldom reach freezing point and frost is extremely rare.
- Almost two metres of water is potentially lost each year as a result of high evaporation rates. This is about four times more than the total average rainfall each year.
- Winds are generally light, and it is completely calm for over half the time during most months.