

## Pressures on the environment

People place many demands on the natural environment, and some of these lead to degradation of the region's natural resources. About a third of all households along the river are reported as catching fish in the river on a regular basis, and the effects of 20-30 thousand people<sup>20</sup> harvesting fish along a stretch of river about 400 kilometres long may affect their abundance and diversity. About 92% of homes are built of wood, and locally-harvested firewood is used for cooking by 97% of households. The large commercial timber industry for the production of furniture has now come to an end, but great numbers of kiaat and false mopane trees were felled for timber. These and other trees are also used for the production of craft and curios. There are conflicts between people and wildlife, especially in and around Mahangu and the Caprivi Strip. Some of these involve the poaching of wildlife, while lions and elephants damaging livestock and crops cause other conflicts.

All of these pressures are important to a greater or lesser degree, but the clearing of land for cultivation and burning perhaps have the greatest impacts on the region's natural resources.

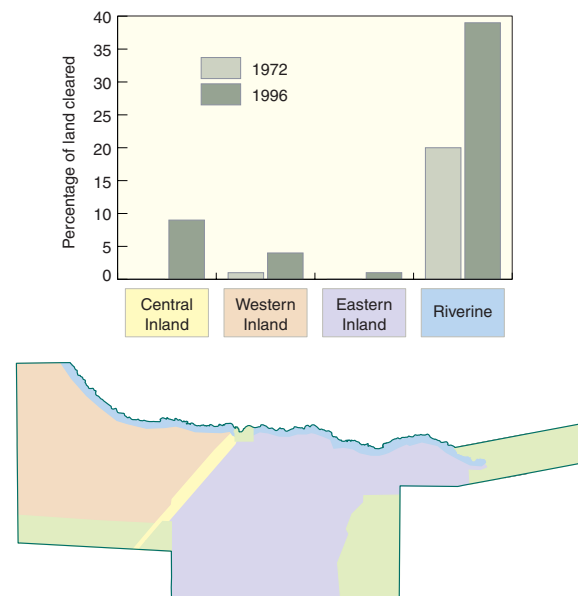
The clearing of land to plant crops has obvious immediate benefits in providing people with food and income. Figure 48 shows areas that had been cleared for cultivation in 1972 and those cleared in 1996. Measurements of the sizes of these areas indicate that about 70 000 hectares had been cleared in 1972. By 1996 that area had grown to over 192 000 hectares at an annual rate of increase of about 4%. The greatest rate of increase was in the inland areas, especially in the central inland zone where cleared land increased at a rate of 18% per

year (Figure 47). Most of that increase probably occurred after the construction of the main Mururani-Rundu road. In the western and eastern inland areas land was cleared at an annual rate of 5% and 6%, respectively, between 1972 and 1996 (Table 13).

Most of the inland fields in 1972 were relatively close to the river and people who chose to move inland probably selected the closest and most accessible places. Over the years, suitable places close to the river would have been become more and more limited, thus forcing new settlers to move even further inland. That would explain why there are fewer cleared areas further away from the river.

Areas cleared for cultivation along the river increased at only 3% per year, such that the proportion of the whole riverine area enlarged from about 20% in 1972 to almost 40% in 1996 (Figure 47). Since many parts of the riverine area consist of areas not suited to crops, for example, floodplains that are often flooded, reed beds, patches of very sandy soils, and the river itself, it seems certain that little land now remains available for the clearing of new fields.

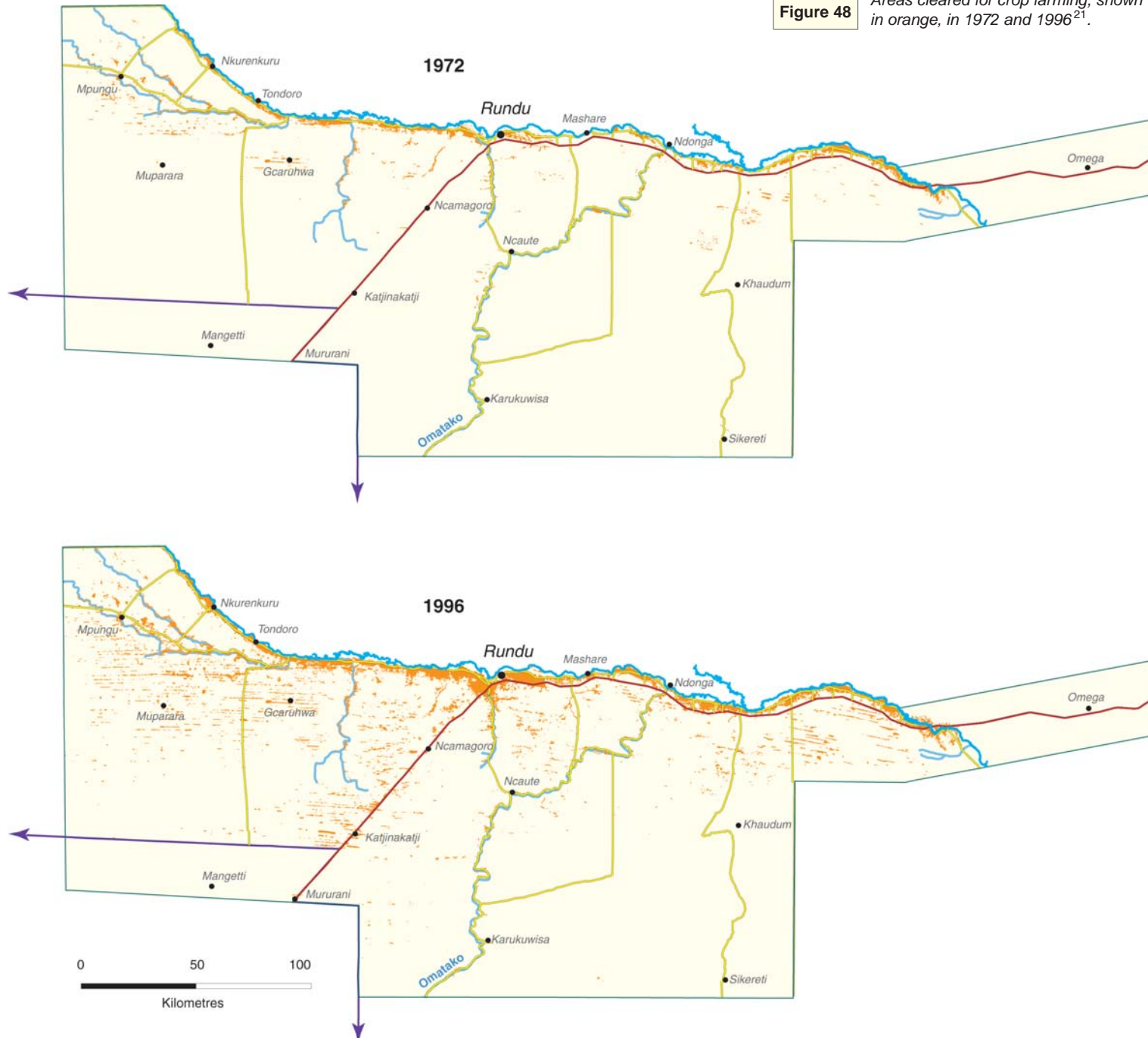
**Figure 47** Areas cleared for crop farming in 1972 and 1996. Parts shown in green are those in which there are few or no fields<sup>21</sup>.



**Table 13:** Areas of the four zones that had been cleared for crop farming in 1972 and 1996.

Region	Cleared land (hectares)		Annual rate of clearing
	1972	1996	
Central Inland	209	11 817	18%
Western Inland	14 607	51 214	5%
Eastern Inland	7 897	34 258	6%
Riverine	47 805	94 684	3%
<b>Total</b>	<b>70 518</b>	<b>191 973</b>	<b>4%</b>

**Figure 48** Areas cleared for crop farming, shown in orange, in 1972 and 1996<sup>21</sup>.



Satellite images received at the Etosha Ecological Research Unit in Okaukuejo were processed to detect areas that had been burnt during four years: 1996 to 1999. While results are only available for the eastern half of the region, it is clear that very large parts of the region burn each year (Figure 49). The fires occur throughout the winter months and the great majority are set by people. Some are probably started deliberately to stimulate the growth of new pastures, while others run-away accidentally when farmers burn small areas to clear land for cultivation or to remove vegetation from waterholes, for example. The apparent absence of fires around the upper reaches of the Okavango Swamps is probably an artefact of the methods used to detect fire scars, and many more fires actually burn in that area than the maps suggest.

While no quantitative studies have apparently been done to assess the effects of fires in the region, it is clear that such frequent and widespread burning has several impacts. First, important grazing pastures are lost, especially when fires rage over large areas. Second, many young trees are killed and there are almost no young trees of several valuable timber species in some areas. Third, large timber trees (and other species) are either killed directly by fires or their trunks are gradually burnt away over several years until they die or fall over. Fourth, large areas become bush-encroached by shrubs of *Terminalia sericea*, *Dichrostachys cinerea* and *Combretum* species. One effect of this is that grazing for wildlife and livestock is reduced. Finally, domestic animals and wildlife may be burnt and killed by fierce fires.

There are few natural barriers to fires in the region and in the absence of firebreaks it is clear that fires can spread rapidly and widely. Figures in Table 14 suggest that at least half, if not more of the region burns each year, so the loss of half of the region's pastures for part of each year must have a substantial impact on livestock farming.

**Figure 49** Areas (in red) that were burnt in 1996, 1997, 1998 and 1999 in and around eastern Kavango.

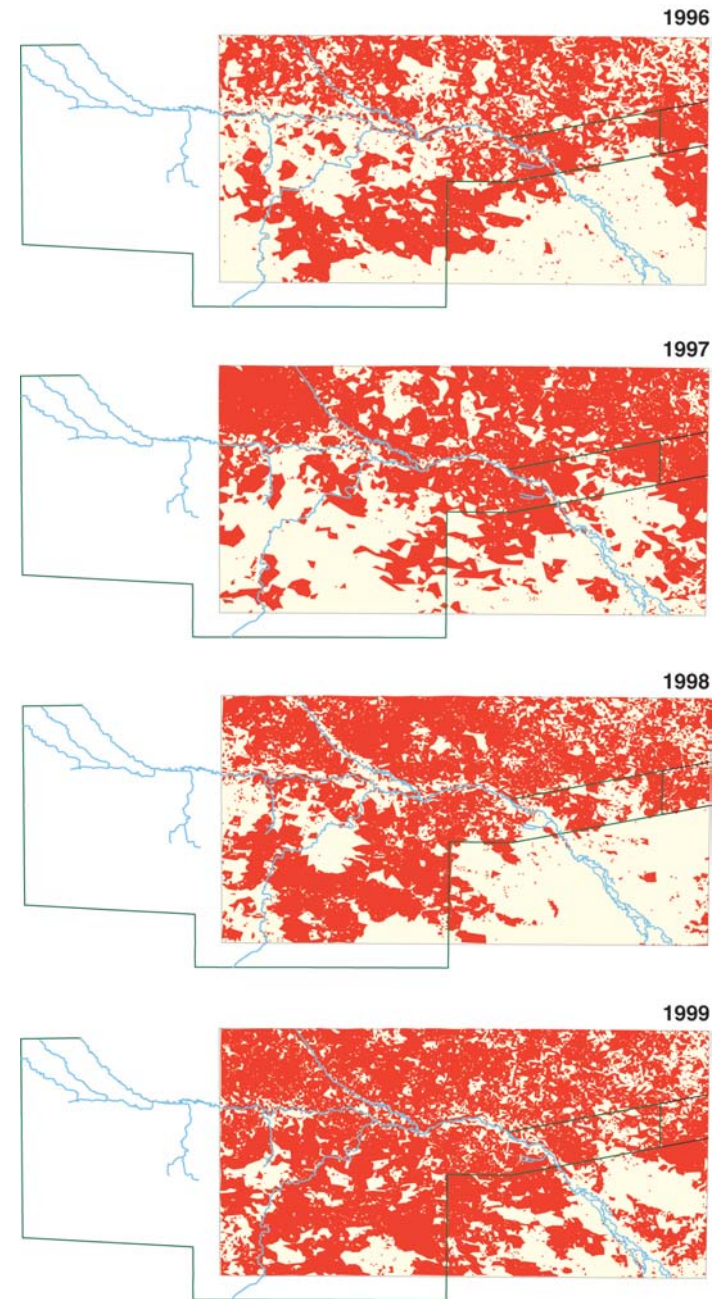


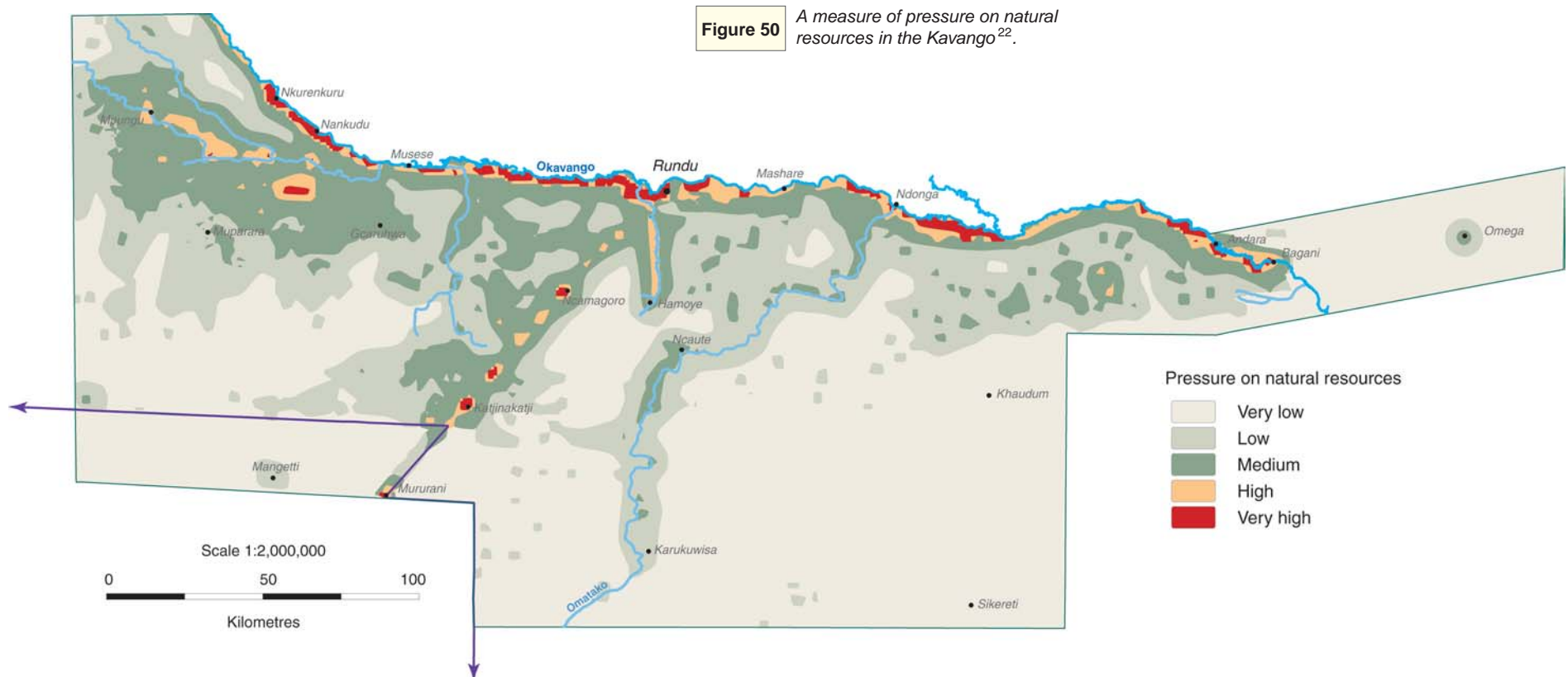
Table 14: Estimates of the proportion of the rectangular block that burnt in each year.

Year	Percentage burnt
1996	45
1997	53
1998	51
1999	65

Figure 50 provides a perspective on pressures on natural resources in the region. The index of pressure was obtained by adding together densities of people, cattle and goats since these are the major consumers of resources such as natural vegetation, water, fish and wildlife. By far the greatest pressures are along the river where the highest concentrations

of people and livestock are found. However, there is quite a measure of variation from place to place, and demands for natural resources are relatively low in some stretches of the riverine belt. Other areas where pressures are high are along the omurambas and the main road from Mururani to Rundu, and in a broad area between Mpungu and Musese.

All of these areas are likely to have relatively little natural vegetation as a result of heavy grazing pressures, extensive clearing of land for crops, and the collection of wood to build homes and for cooking.



## Acknowledgments, notes and sources

1. This work was done using a variety of sets of data that were kindly made available to us and we are especially grateful to all the organizations that collected these data: Central Statistics Office, Directorate of Environmental Affairs, Directorate of Surveys and Mapping, Etosha Ecological Research Institute, Ministry of Agriculture, Water and Rural Development, Ministry of Basic Education, Sport and Culture, Ministry of Health and Social Services, and the Namibian Meteorological Services. The role of Lux-Development in supporting so many data collecting and mapping activities in Kavango needs to be specially acknowledged. We are also thank Yves Baudot, Chris Brown, Brian Jones, Mbaye Kébé, Nils Odendaal, Sylvia Thompson, Tom Tolmay and Alvis Weerasinghe for their help during the compilation of this document.

All the work that went into producing this book took place in Windhoek, and budget constraints meant that it had to be done within a very short time. The book is thus limited by two important factors that need to be borne in mind. The first is that it was not possible to spend time in the region so as to obtain a clear understanding of issues and processes that make Kavango the way it is. Second, there was little time to review the many publications on the region. These limitations should be corrected when a complete profile of the region is compiled.

2. Estimates of numbers of people in each constituency were obtained by overlaying their borders with a grid set of data on population density.
3. Much of the information on the Okavango's drainage was gleaned from Crerar, S. 1997. The hydrology of the Okavango River upstream of the Okavango Delta. In *Feasibility study on the Okavango River to Grootfontein link of the Eastern National Water Carrier. Department of Water Affairs, Ministry of Agriculture, Water and Rural Development*. The graphs of water flows were derived from analyses of hydrological data kindly provided by Sylvia Thompson in the Department of Water Affairs.
4. Information on underground water was largely summarized from Namibian Groundwater Development Consultants, 1991. *Groundwater investigations in Kavango and Bushmanland*. Report for Ministry of Agriculture, Water and Rural Development.
5. Graphs of numbers of days with different amounts of rainfall were derived from analyses of the daily rainfall records. Figures from Rupara were used to fill in missing data over a number of years at Nkurenkuru (Rupara is approximately 60 kilometres south-east of Nkurenkuru).
6. Based on results from InterConsult. 2001. *Natural resource mapping of the Kavango*. Report for the Directorate of Environmental Affairs, Windhoek.
7. Based on analyses of the Population Survey of the Kavango Region by Lux-Development in 1999. This survey delimited a number of enumeration areas, which we grouped into four zones to analyse possible differences between households and farming practices in different areas. Annual Agricultural Surveys used different enumeration areas, which could only be grouped into riverine and inland areas.
8. Based on analyses of the 1991 Population and Housing Census.
9. Demographic information has been derived from several sets of data: population censuses in 1960, 1970, 1981 and 1991, the 1996 InterCensal Demographic, and Lux-Development surveys of Rundu (1998) and rural Kavango (1999).
10. Population densities were estimated by linking to each household the average number of people per household in each enumeration area, as analysed from the 1991 Population and Housing Census data. Positions of households were mapped by the 1996 Directorate of Surveys and Mapping 1:50 000 mapping project and by the Caprivi Environmental Profile project (Mendelsohn, JM & Roberts, CS. 1997. *An environmental profile and atlas of Caprivi*. Directorate of Environmental Affairs, Windhoek). Densities were then estimated by "spreading" the number of people at each household over 1 kilometer. Finally, the estimated density was increased by a growth factor by 6.3% to account for population growth between 1996 and 2000. The growth factor was based on population projections compiled by the National Planning Commission.
11. Based on Sentinel Surveys by the Ministry of Health and Social Services.
12. Based on data collected by the Annual Education Census of the Ministry of Basic Education, Sport and Culture
13. Analysis of the 1996 InterCensal Demographic Survey by the Central Statistics Office.
14. Survey by Keyler, S. 1995. *Economics of the pearl millet subsector in northern Namibia. A summary of baseline data*. International Crops Research Institute for the Semi-Arid Tropics. Working Paper 95/03.
15. Results from Annual Agricultural Surveys done in 1996/97, 1997/98 and 1998/99 give estimates of average cultivated areas of between 2 and 3 hectares per household, whereas other surveys generally report averages of between 4 and 7 hectares.
16. Based on analyses of the Annual Agricultural Surveys done in 1996/97, 1997/98 and 1998/99 by the Central Statistics Office.
17. From the annual reports of the Directorate of Veterinary Services.
18. Cattle and goat densities were estimated by first calculating average numbers of animals per household from the Lux-Development 1999 population survey data in four zones. These averages were then attached to point data for all rural households (as available from the 1996 Directorate of Surveys and Mapping 1:50 000 mapping project). Densities of cattle were then estimated by "spreading" the number at each household over 10 kilometers. For goats, the corresponding area was 5 kilometres. ArcView's Spatial Analyst Density function was used with the kernel method.
19. Analyses of data collected by the 1994 Income and Expenditure Survey by the Central Statistics Office.
20. We estimate the number of people along the river as about 67 000 with another 45 000 in Rundu. The sum of these numbers can be multiplied by 32% as the proportion of people who fish along the river estimated by Van der Waal, BCW. 1991. A survey of the fisheries in Kavango, Namibia. *Madoqua* 17: 113-122.
21. Areas cleared in 1972 were derived from the 1:50 000 maps produced on the basis of aerial photographs taken in 1972, while those for 1996 were obtained from aerial photographs taken in 1996, as available from the Directorate of Surveys and Mapping.
22. Units of pressure were derived by adding together the number of people, cattle and goats per square kilometre, except that the number of goats was divided by eight to obtain an assumed figure of eight goats corresponding to one large stock unit. The five categories are as follows: very low = less than 1; low = 1-10; medium = 10-40; high = 40-80; very high = more than 80 units.