# PROSPECTS: seeing the wood and the trees

*A major difference between trees and grasses is that trees grow from the tips of their branches while grasses grow up from their roots. Trees thus grow from top to bottom, and any damage to their growing tips, for example from browsers, fire, or frost, impedes their growth.*

Trees grow and die, each sapling adding to a forest or woodland. Every death is a loss, but also an opportunity for new growth. The push and pull between growth and death varies across the country, and from year to year. The result is a patchwork of richly varied habitats. These are the natural conditions of Namibia's woodland environments, the consequences of evolutionary selection over tens of millions of years. However, substantial changes to natural environments have occurred recently. These are changes bought about by people, particularly through their use of land for agriculture. Livestock farming was introduced to Namibia about 2,000 years ago, and the first land was probably cleared for crops roughly 1,100 years ago.[1] But conditions changed most radically during the last century when the number of people increased very greatly, largely as a result of modern medicine and better food production. The increased population has led to great demands for wood for fuel and the construction of houses. More land is used for crop farming, and more livestock ave led to and greater grazing and browsing pressures.

Namibia's woodland resources have suffered from these demands, and the detrimental impacts continue. It is on aspects of these influences that the chapter begins, describing the process and effects of woodland loss, especially those caused by the clearing of land for farming, and bush fires. The use of woodland resources has been non-sustainable because resources are removed from the landscape at a rate greater than the pace at which they grow or regenerate. This is foolhardy exploitation in the short-term at the expense of access to longer-term benefits. And so how can we begin to match greater demands on woodlands with better management to ensure that resources remain available for generations to come? And how can we derive additional benefits from these natural habitats to enhance the economy of Namibia? These are big questions for the people and government of Namibia.

## Land clearing

Large areas of woodland and forest have been cleared for crop farming (Figure 27), particularly in northern Namibia where soils and rainfall are better suited to crops than in the more arid areas to the south. Cereals are produced on the majority of fields, the vast majority being dryland fields where crops depend on rainfall for moisture. About 70% of all areas cultivated for cereals are under pearl millet (locally known as *mahangu)* and sorghum, while maize and wheat make up 25% and 5% of production, respectively. Approximately 90% of cleared land belongs to subsistence farmers. Their fields are small, each farmer usually cultivating between one and five hectares. Fertilizers or manure are seldom applied, with the result that soil nutrients are generally depleted after several crop seasons. New fields are then cleared, especially in in Kavango and Caprivi. As a consequence, most areas cleared of trees now lie abandoned and much more land has been cleared (about 20,000 $km^2$) than is used for crops in any one year (3,000 $km^2$). In addition to fields from which nutrients have been exhausted, other fields were cleared following cycles of unusually high rainfall. These fields were then abandoned when conditions reverted to the more normal mix of good and bad years. About 18,500 $km^2$ of cleared woodland and forest is in communal areas, and the remaining 1,800 $km^2$ on freehold farms.

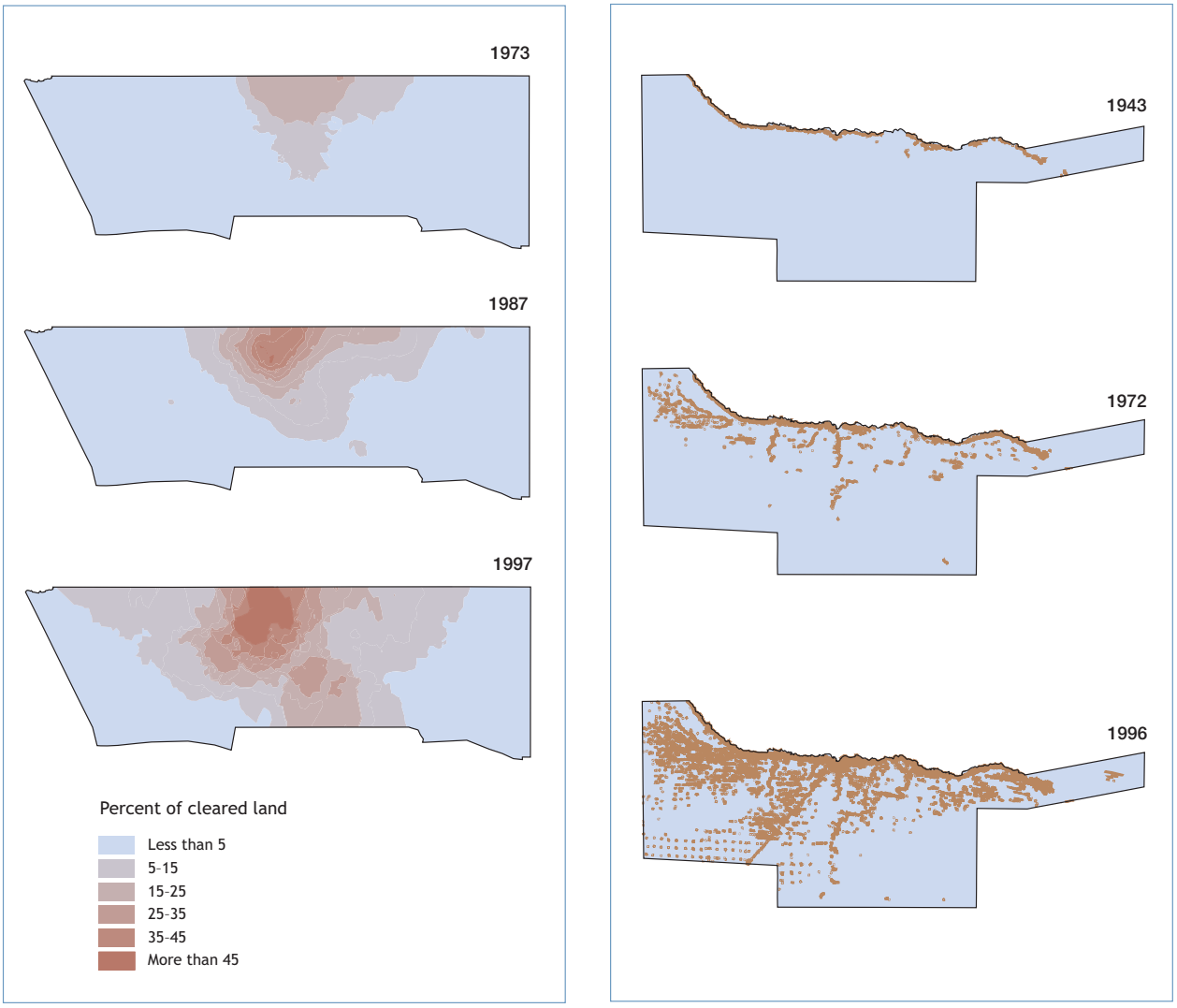
The Kalahari sands and woodlands that cover much of northern Namibia (see Figure 9 on page 31) are poorly suited to subsistence cultivation. As a result, fields have mostly been cleared in three localised landscapes within and around these sands. The first is on patches of more clayey soils along river courses, around pans and in linear valleys between sand dunes that formed during much drier periods. This is where most fields in Caprivi, Kavango, north-eastern Otjozondjupa and eastern Oshikoto and Ohangwena are located, and the majority of cleared trees are species that prefer such clayey soils. The second landscape is on raised patches of ground above the salty soils in the oshana drainage lines of the Cuvelai Drainage system in Omusati, Oshana and western Ohangwena and Oshikoto. Mopane and Silver-leaf Terminalia are the main species to have been cleared. However, in both landscapes farmers have often left standing larger, valuable fruit and shade species, such as Marula, Bird Plum, Mangetti and Jackal Berry.

*Huge areas of woodland and forest have been cleared for crop production. Most of these areas now lie fallow, abandoned as scrubby, shrubby patches devoid of large trees.*

The third landscape is on loamy soils in valleys that surround the Otavi-Grootfontein-Tsumeb mountains. This is Namibia's so-called maize triangle, where large-scale, freehold farmers mainly grow maize, wheat, sunflowers and cotton, often in fields that are irrigated. The most prominent trees cleared off these relatively large fields are Tamboti, Purple-pod Terminalia, Peter's Fig and various Acacias. Many of the fields have been abandoned over the years and are now dense thickets of Sickle-bush and Purple-pod Terminalia.

Expanses of woodland cleared for crops have increased a great deal in recent decades. Examples are given for two areas in Figure 27, one being in Kavango and the other the former Owambo region. In both regions, zones of cleared land expanded away from core areas. In Kavango, the

Figure 27. Large areas of woodland have been cleared for crop farming in north-central Namibia and in Kavango. The maps of former Owamboland (below left) show percentages of different areas cleared for crops in 1973, 1987 and 1997, while the three maps of Kavango (below right) show areas that had been cleared in 1943, 1972 and 1996. Approximately 4% of additional land was cleared each year between 1943 and 1996 in Kavango, while rates of clearing in former Owambo varied between 2% in the most densely populated areas and 9% in more outlying, unoccupied zones.[2]

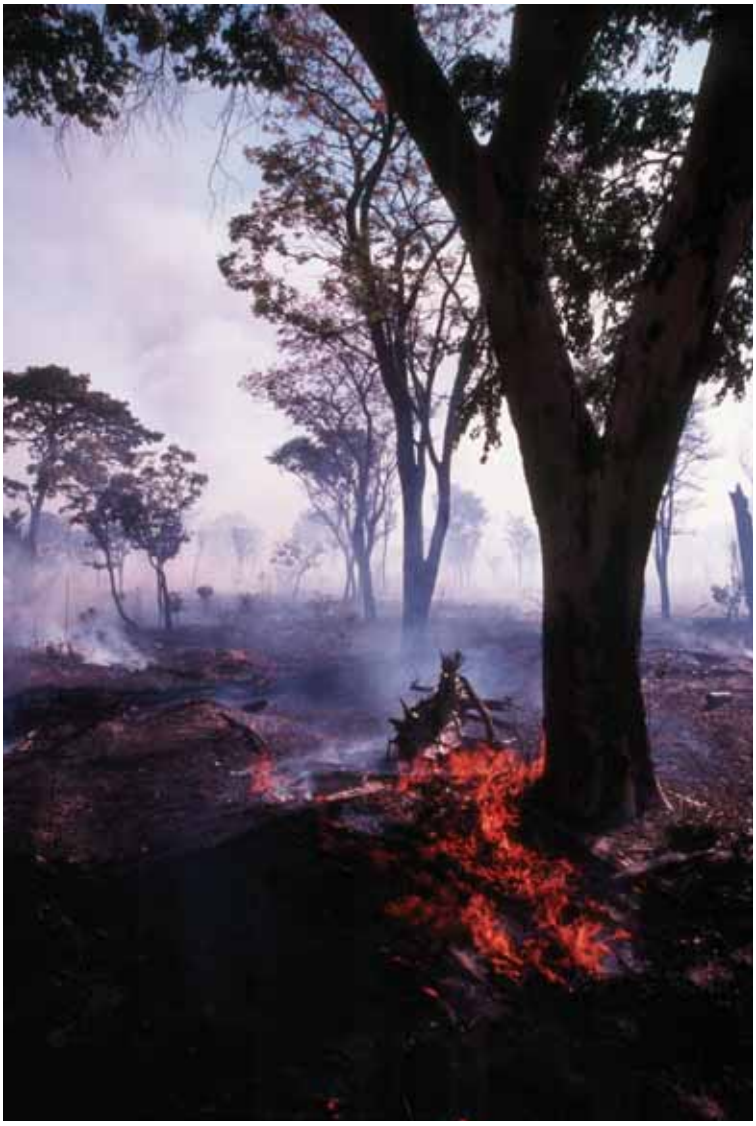


core was along the Okavango River where the only cultivation was practiced in 1943. By 1972, scattered fields had been cleared along many of the fossil river valleys (or *omurambas*) and inter-dune valleys, mostly within 50 kilometres of the river. The extent of clearing then spread further south between 1972 and 1996. While much of the land was cleared as the number of people increased over this period, a large part of the clearing was also due to farmers clearing new fields when their old ones became less productive. By 1996, a total of about 4% of the region had been cleared for cultivation. Figure 27 shows how woodlands cleared for farming also expanded in former Owambo from a core area along the Angolan border. The proportion of land cleared in this region rose from 2.1% in 1973, to 5.2% in 1987 and 10.4% in 1997.

## Scorched woodlands and forests

It is widely agreed that fires have been a feature of the African landscape for millions of years, and it is well known that fires occur more widely and frequently in Africa than on any other continent. Africa is a 'burning continent' for three reasons. The first is that well-defined wet and dry seasons occur in many areas, and regular fires only occur in areas with extended wet and dry periods. The growth of trees and grass is stimulated and sustained when it rains, and then dry season cut the plants back. Secondly, most grasses have low nutritional value because of the relatively poor nutrient quality of soils. The grasses are little grazed and therefore remain standing as fuel for bush fires. Thirdly, the prevalence of fires might be due to the abundance of savannas in Africa, since the layer of grass provides a carpet of fuel for fires to spread widely and wildly. That savannas burn often is clear, but it is also likely that savannas were themselves moulded by repeated burning, the fires maintaining the mix of tree and pasture growth.[3]

Fires vary greatly in intensity, depending on the quantity of combustible material, wind strength, and dryness of the fuel. The more fuel, the more intense and high the fire, and the greater the chance that trees will be burnt. What is important about the quantity of fuel is its density (biomass/hectare), since fuel that is sparsely distributed does not burn easily. For example, dry leaves in a tree canopy do not burn as readily as compacted layers of dry grass. There is also a clear relationship in African woodlands between rainfall and fire intensity. The higher the rainfall, the more grass and thus the hotter the fire. Of course, the frequency and intensity of burning diminishes in areas where rainfall is either very high or low.



*About 17% of Africa south of the Sahara burns every year, creating great palls of smoke that hang over the continent's savannas. Over one-third of north-eastern Namibia is burnt annually.*

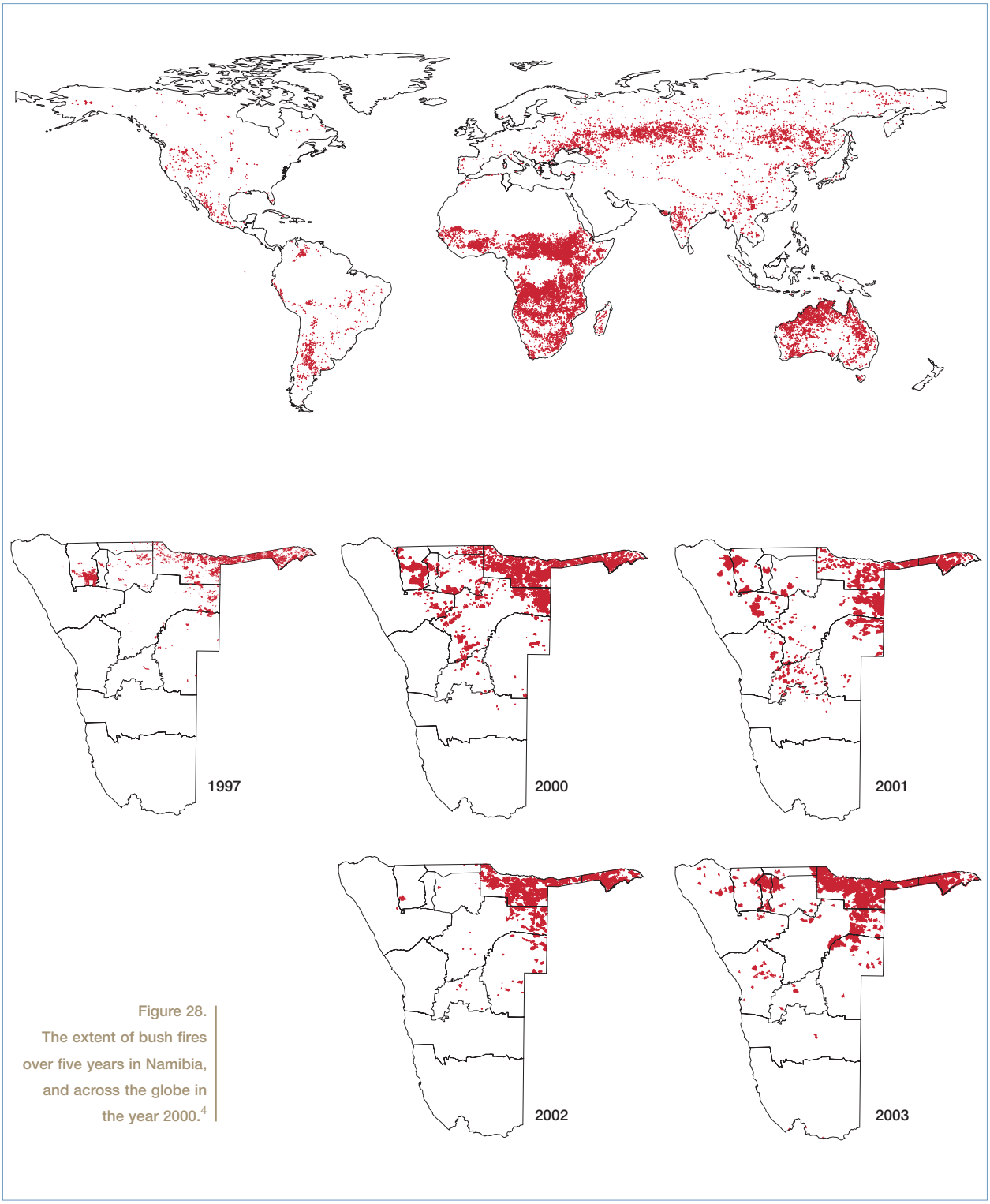



Figure 28.
The extent of bush fires over five years in Namibia, and across the globe in the year 2000.[4]

An estimated 168 million hectares or 17% of the area south of the Equator in Africa burns each year.[5] Much less of Namibia burns than this because there is so little grass in the extensive arid areas of the country. However, a high percentage of the north-east is burnt each year. For example, an average of 43% of Caprivi and 34% of Kavango burnt each year during the five years shown in Figure 28.

While large areas of the north-east burn each year, the southern parts of the country only burn when there is an abundance of dry grass following wetter summers. This was the case in 2000 when fires covered 6% of the Khomas region, and there were many more individual fires than in 1997, a relatively dry year.

People start the great majority of bush fires, usually to encourage the growth of new grass for their livestock or to attract wild animals (the flushes of growth are due to the release of nutrients caused by the combustion of dry plant material). Other fires are set to clear new fields or to remove old growth from existing fields. Fires set to clear dry grass beneath Ushivi trees are said to be a major cause of widespread burning in the Caprivi Strip (once the cover has been cleared, people can easily collect fallen Ushivi seeds which they eat as a cooked relish). Many fires run out of control, especially during the windy months between August and September (Figure 29). A fire started with a single match may spread to burn thousands of square kilometres of woodland and pasture.

**Percentages of Kavango and Caprivi that burnt between 1989 and 2002. Over half of these two regions burnt during 5 or more of these 13 years.[6]**

| |
|---|
| 11% of the area never burnt |
| 16% of the area burnt in 1 or 2 years |
| 19% of the area burnt in 3 or 4 years |
| 23% of the area burnt in 5 or 6 years |
| 17% of the area burnt in 7 or 8 years |
| 14% of the area burnt during 9 to 13 years |

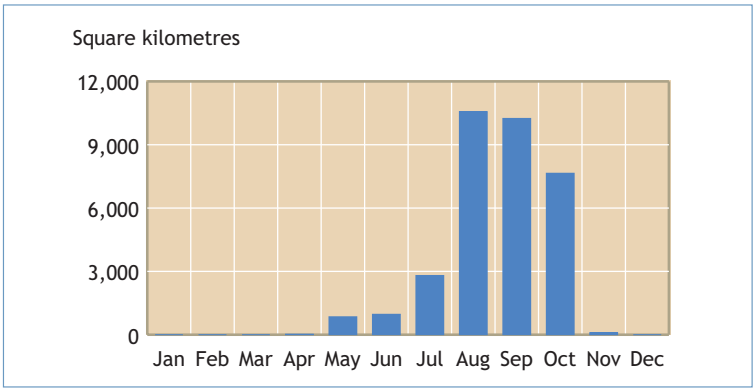



Figure 29.
Most fires in Namibia burn in the late winter and autumn months. Fires may then spread wildly because these are the windiest months and the grass is driest. The graph shows the total area burnt during each month of 2003.[7]

It is true that fires were commonplace in Africa long before people started to have a major impact on its savannas. However, the key change in recent decades is that woodlands now burn much more frequently than before because there are many more farmers who clear land and keep livestock. Indeed, much of north-eastern Namibia burns every one or two years, as shown by the figures given in the table below. The burning of the same areas year after year has several undesirable impacts on woodlands. First, many mature trees - including valuable timber trees - are killed, with the result that tens of thousands of dead trees are now scattered across north-eastern Namibia. The best place to see this is along the road from Divundu to Kongola across the Caprivi Strip. Another area that is burnt excessively is the Caprivi State Forest, where the forest inventory found that 53% of all Burkeas, 37% of Kiaats, 15% of Zambezi Teak and 15% of Ushivi were dead, mainly as a result of fire.[8]

Second, the recruitment of trees is limited. Young seedlings are killed by fire, while saplings need several years free of fire to grow tall enough to escape the effects of burning. Many areas are characterised by the presence of small, bushy trees that have coppiced repeatedly, each bout of sprouting following a fire that has burnt away their stems, branches and leaves. Repeated fires therefore prevent or slow down the emergence of mature trees to replace those that have been killed. Third, frequent fires accelerate the rate at which soil nutrients are lost, thus reducing soil fertility. The effect happens in

two ways: carbon, nitrogen and sulphur are lost to the atmosphere in volatile molecules, and fires increase the rate at which nutrients are bought to the surface from where they can escape through burning. This is the simple result of roots tapping nutrients from below the surface, and putting them into leaves, twigs or wood. These later fall to the ground as dead material and many of the constituent nutrients are lost through subsequent burning. There is usually a more even distribution of nutrients in the soil profile in places that seldom burn, whereas nutrients are concentrated near the surface in areas exposed to regular fires.

These are all effects on woodlands, but fires have other impacts. The most obvious is the loss of grazing, which must be substantial if an average of over one third of Kavango and Caprivi burn each year. Wildlife, livestock and people are killed, and homes and other property are destroyed from time to time. Frequent, extensive fires also release pollutant gases into the atmosphere, particularly methane and nitrous oxide. It is sometimes claimed that the emissions add significantly to the effects of global warming caused by the greenhouse effect. However, a recent analysis found that the volumes of greenhouse gases produced annually by Namibian fires are considerably lower than the amounts absorbed by plants in the country. Thus, about 54,000 metric tons of methane and 2,000 metric tons of nitrous oxide are released by bush fires per year, but in carbon dioxide equivalents these emissions amount to only about 4% of the carbon dioxide absorbed by bush-encroached areas alone.[9]

The maps in Figure 28 show fire scars in each of five years but also reveal three areas that seldom burn. The biggest is the western and southern deserts and semi-deserts where there is hardly any grass to burn. The second consists of places that are densely populated by small-scale farmers, especially along the Okavango River and in the Cuvelai Drainage system. The high density of livestock and grazing pressures in these areas leave little grass to burn. The third zone is the freehold faming area in eastern Namibia, largely in Omaheke and Otjozondjupa. The absence of fires here is due to much of this being cattle ranching

*Most trees die as a result of successive burns over a number of years. The problem begins with an accumulation of leaf litter on the lee side of a tree trunk, usually on the south-west because of north-easterly prevailing winds. The burning litter forms a small scar in the trunk, which then fills with even more litter during the next dry season. The next fire burns deeper into the tree trunk, killing off more wood. The cycle of increasing litter accumulation and burning into the wood continues until the tree eventually dies (left). The skeletons of large Burkeas, Zambezi Teak and Kiaat are prominent features in the Caprivi Game Park and Caprivi State Forest (below). These areas are little grazed because there are few livestock. Intense fires thus sweep across the protected areas in most years.*

country where fires are strictly controlled to avoid the loss of grazing. Tellingly, most of these farms are so heavily encroached by bush that there is little grass to burn, and it is to this problem that the chapter moves.

## THE PLOT THICKENS: BUSH ENCROACHMENT

Anyone driving between Otjiwarongo and Otavi will see extensive tracts of very dense bush alongside the road. Over the last few decades the thickets have replaced savanna woodland characterized by tall trees, scattered bushes and a carpet of pasture for cattle and wildlife. Bush encroachment is to be seen in many places. Its main features are an increase in woody plant biomass, a reduction in grass cover, and a change in the kinds of uses and benefits of land, both for people and other organisms. Farmers now keep fewer livestock and produce less meat. Contributions to the Namibian economy from farming are reduced, perhaps by as much as N$700 million per year.[10] There is also a loss of biological diversity, since grass and any wildlife and other animals that depend on grass are largely absent from highly encroached areas.

Losses in grass production are not compensated by increased wood biomass. Most invasive or encroaching species are not palatable to browsers because they are thorny or have high tannin levels in their leaves. The invasive trees are generally bushy and produce little wood of value. Most stems and branches are too thin for charcoal production, never mind other timber products. Bush encroachment furthermore leads to a loss of soil moisture as a result increased run-off and the fact that bushes transpire much more water than grass.

Nine species are generally considered to cause most bush encroachment: Yellow-bark Acacia, Sandveld Acacia, Black Thorn, Purple-pod Terminalia, Silver-leaf Terminalia, Driedoring, Mopane, Rooihaak and Sickle-bush. The only estimate of areas affected by bush encroachment amounts to about 260,000 square kilometres, or about one-third of Namibia (Figure 30). However, bush densities in encroached areas vary considerably and some areas with very high densities in north-eastern Namibia are not shown in Figure 30. The map is, however, correct in illustrating the order of magnitude of the problem. It is important to recognize that bush encroachment is a relative condition, and one that changes as bush densities increase and grass cover declines. Any addition of bush and simultaneous reduction in grass production amounts to encroachment. Farmland considered free of encroachment typically supports several hundred woody plants per hectare, whereas heavily thickened areas have more than 3,000 bushes per hectare. The most encroached areas have densities ranging from 10,000 to 24,000 bushes/hectare.

A variety of factors are thought to cause bush encroachment, and the reader is referred to a recent review on bush encroachment for a thorough discussion of these.[12] The relevance and importance of the different causes appears to vary across the country, and four conditions probably explain most encroachment. Firstly, the thickening of bush is strongly related to rainfall (Figure 31). This is largely due to the growth of trees being highly

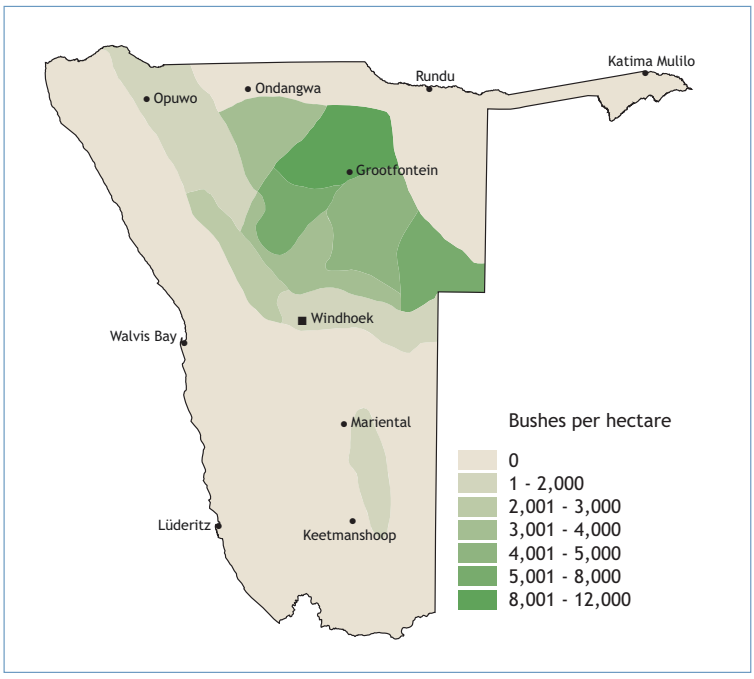



Figure 30. Roughly one third of Namibia is considered badly affected by bush encroachment. Each area shown in the map is characterized by different invasive species at the approximate densities of bushes shown in the legend.[11]

dependant on an adequate supply of water, and even small changes in rainfall are associated with rather large differences in numbers of bushes. A few years of higher than normal rainfall therefore probably result in substantial increases in the germination and survival of bushes.

Second, encroachment is closely linked to modern farming practices, both here in Namibia and in other parts of the world. Most bush encroachment has developed on cattle ranches, and very dense thickets of Sickle-bush and Purple-pod Terminalia have developed on abandoned fields around Tsumeb, Otavi and Grootfontein. Many sheep farms in the south-eastern regions suffer from invasive Driedoring.

Thirdly, bush encroachment is associated with over-grazing and a loss of grass. This is explained using the two-layer hypothesis, which suggests the following mechanism. Grasses draw moisture from the top layer of soil, thus limiting water availability to the roots of bushes that extend to a deeper layer. Woody plants boom once grass has been removed because they then have greater access to soil moisture. The idea is logical and simple, but it does not explain encroachment in areas where there is only a single, shallow layer of soil and in places where grazing pressures are light.

The loss of grass cover has another effect, which leads to the fourth cause of encroachment. This is the absence of fires. Bush fires just can't burn if grass fuel is lacking, either as a result of over-grazing or a thick cover of bush. Most Namibian grasses do not grow well in shade, so there is seldom enough grass beneath trees and bushes to fuel a fire hot enough to kill invasive bushes. A variety of experimental and circumstantial evidence indicates that woody plants flourish in the absence of fires, and it is indeed fire that maintains savanna as a mix of trees and grass. In the absence of fires, most savannas would become forests. Many people endorse the value and use of fire as a tool to manage pastures for this reason.

Many farms in the most encroached areas in eastern and north-eastern Namibia have not seen a hot fire for decades, and there is a striking correspondence between the most encroached areas

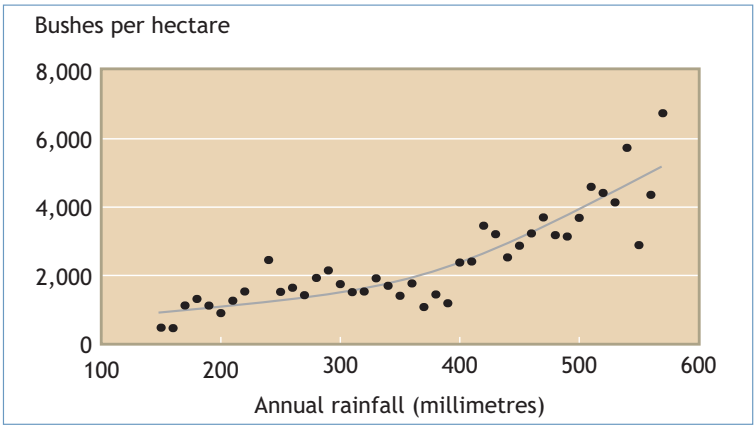



Figure 31.
Bush encroachment is much greater in higher than lower rainfall areas. These figures come from samples of bush density taken from west to east across the central half of Namibia.[13]

*Sickle-bush flowers resemble delicate lanterns, images of beauty giving lie to their role in causing much of the bush encroachment problem in many areas of Namibia.*

*Fungal infections cause Black Thorn trees to curl over and die. The infections occur in patches, but have had little impact in helping to curb bush encroachment.*

shown in Figure 30 and the absence of fires in eastern Namibia, as shown in Figure 28. The role of fire in limiting woody growth is also evident on several farms protected from frequent burns in the north-eastern woodlands. Examples are the Sachinga Livestock Research Station in Caprivi and the Mangetti farms in southern Kavango, where bush densities are very much higher than in the surrounding areas.

It is ironic that Namibia suffers from too many fires in the north-eastern communal areas but too few on the eastern freehold farms. Ever since freehold cattle ranching was started there has been opposition towards bush fires because of the obvious loss of grazing. Even controlled fires are generally loathed since there is always the possibility of them raging out of control on to neighbouring farms. These views were embodied in law in the Soil Conservation Act of 1952. Provisions in the Act banned the setting of bush fires unless the special permission of the Minister of Agriculture was obtained.

In summary, most encroachment in Namibia is probably due to the following combination of events. Dense stocking rates of cattle lead to overgrazing, which together with fire controls, lead to the elimination of bush fires. Bush growth flourishes in the absence of fires, especially following years of above average rainfall. Growth rates are probably enhanced by less competition for water and nutrients from grass. These conditions most likely apply to the eastern and central cattle ranches. In the north-eastern communal areas, patches of bush encroachment are probably due to an absence of fire. The south-eastern areas are so arid that fires are unlikely to play any role in limiting bush growth, and so encroachment in these areas is probably due to over-grazing by sheep.

Two main methods of getting rid of bush are used in Namibia: herbicide poisons sprayed from aeroplanes or applied manually to each plant, or mechanical destruction by cutting and uprooting each bush. The methods share one feature – high cost – and few farmers have therefore attempted to clear bush on a large scale. In addition, ground from which bush has been removed requires after-care management to prevent the invasive problem from recurring. Hopes have been raised that encroachment might be controlled naturally by fungal infections, especially by fungi belonging to the genus *Phoma*. The infections have killed or retarded the growth of large numbers of Black Thorn in certain areas, but there is no evidence to suggest that the fungi will help reverse the problem of bush encroachments. Research to find ways of increasing the infections to combat bush encroachment has not been successful.

Are there any benefits to bush encroachment? Some people have taken the opportunity of clearing bush mechanically to produce charcoal, which is marketed as an environmentally friendly product made from invader bush. The whole charcoal industry has grown considerably in recent years (see page 64), but most charcoal is now produced from selected plants with thicker stems and branches. Smaller bushes are left and even those that have been cut later sprout to generate new growth, making this more of a harvest than a solution to encroachment. Some non-invasive trees are also harvested. Methods of producing wood chips from invasive bush and compressing them into blocks of fuel have been developed recently. Production costs

appear high and it is not known if market demand will be strong enough to sustain the enterprise.

Finally, here is a surprising potential benefit. Namibia's expanses of dense bush probably absorb carbon dioxide to such an extent that they represent a significant carbon sink which helps reduce the effects of global warming. Any measures or resources that remove greenhouse gases qualify to be traded as credits in terms of the Clean Development Mechanism of the Kyoto Protocol, but countries or individuals intending to sell carbon credits must meet three conditions. First, activities qualifying as credits should be shown to have a net benefit to the atmosphere, which is true for bush encroachment. Second, they should have been developed deliberately to reduce emissions or reach certain greenhouse gas targets. This is not the case for bush encroachment. Third, the activities must be sustainable in the sense of not incurring environmental or economic costs. This, too, may not hold for bush encroachment, since it can be argued that encroachment leads to reduced biodiversity and lower economic returns as a result of lost grazing. This is the theory behind trading carbon credits. Some of the reasons for not trading bush encroachment could fall to legal argument, and Namibia may earn credits for its 'carbon farms' at some point in the future. For the time being, however, government policy supports measures that aim to restore encroached areas to savanna woodland.

## ADDITIONAL CHALLENGES

Several other processes increase pressures on Namibia's woody resources. Ephemeral and fossil rivers are lined by margins of denser, taller trees than those in the surrounding more arid areas. These linear oases supply a range of resources. In the most arid areas, the riverine woodlands provide the only available shade, fodder, fuel wood and nest sites for birds, for example. The germination and growth of many of the trees depends on occasional flows of water after heavy falls of rain in upstream catchments, since the flows recharge aquifers in the sands that fill the river valleys. However, two activities have an impact on those water resources. First, water is pumped from the aquifers to supply farms and towns, especially the coastal towns of Lüderitz, Walvis Bay and Swakopmund. Pumping rates are often greater than the rate at which the aquifers recharge, with the result that the growth of trees has probably slowed and rates of mortality have increased. Ana Trees along the lower Kuiseb River appear particularly vulnerable to the depletion of aquifers due to water abstraction for Walvis Bay and Swakopmund.

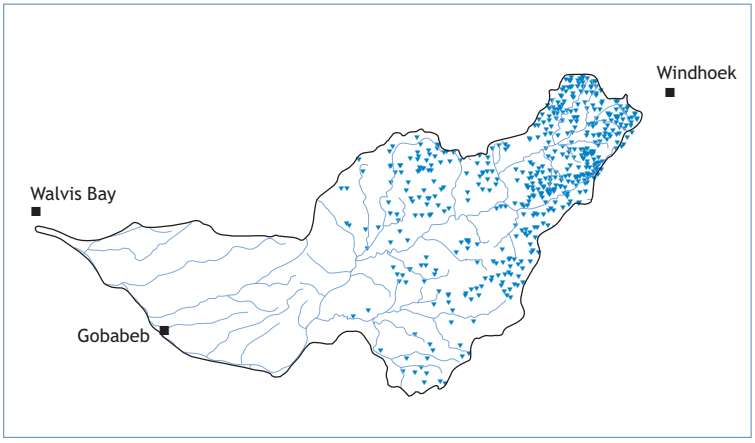



Figure 32.
Thousands of dams have been built over the years along Namibia's ephemeral rivers and their tributaries. The catchment of the Kuiseb River stretches over about 250 kilometres from east to west and covers approximately 14,850 square kilometres. However, it is only in the hilly eastern areas that rain falls sufficiently often and heavily enough for water to flow and be dammed. [15]

Downstream water flows are also affected by the damming of upstream tributaries. The Kuiseb River is again an example. To supply their livestock with water, farmers have built approximately over 5400 dams in its catchment (Figure 32). Many of the smaller impoundments remain dry for much of the time and cover less than a hectare. However, it is easy to imagine the cumulative effects of so many dams withholding water from the roots of riverine trees downstream. These effects are probably greatest in seasons with low or average rainfall, whereas the dams fill and overflow when above average rains fall.[14]

Unluckily for trees, elephants are largely browsers, and large browsers at that! Huge quantities of foliage are eaten each day. The animals also often tear down branches or whole trees to reach fresh leaves and fruit. This is not a problem in woodlands where there are few elephants, but conserva-

*Much of the thick riverine forest in the Mahangu Game Reserve has been lost as a result of damage caused by elephants. In this case, the trunk of a Baobab has been badly scarred (left). The number of elephants in Namibia will probably double 15 years from now, and very much greater losses of trees are then expected. Water held in a typical dam nestling in a valley of an ephemeral river is not available to downstream woodlands growing along the river's banks (right).*

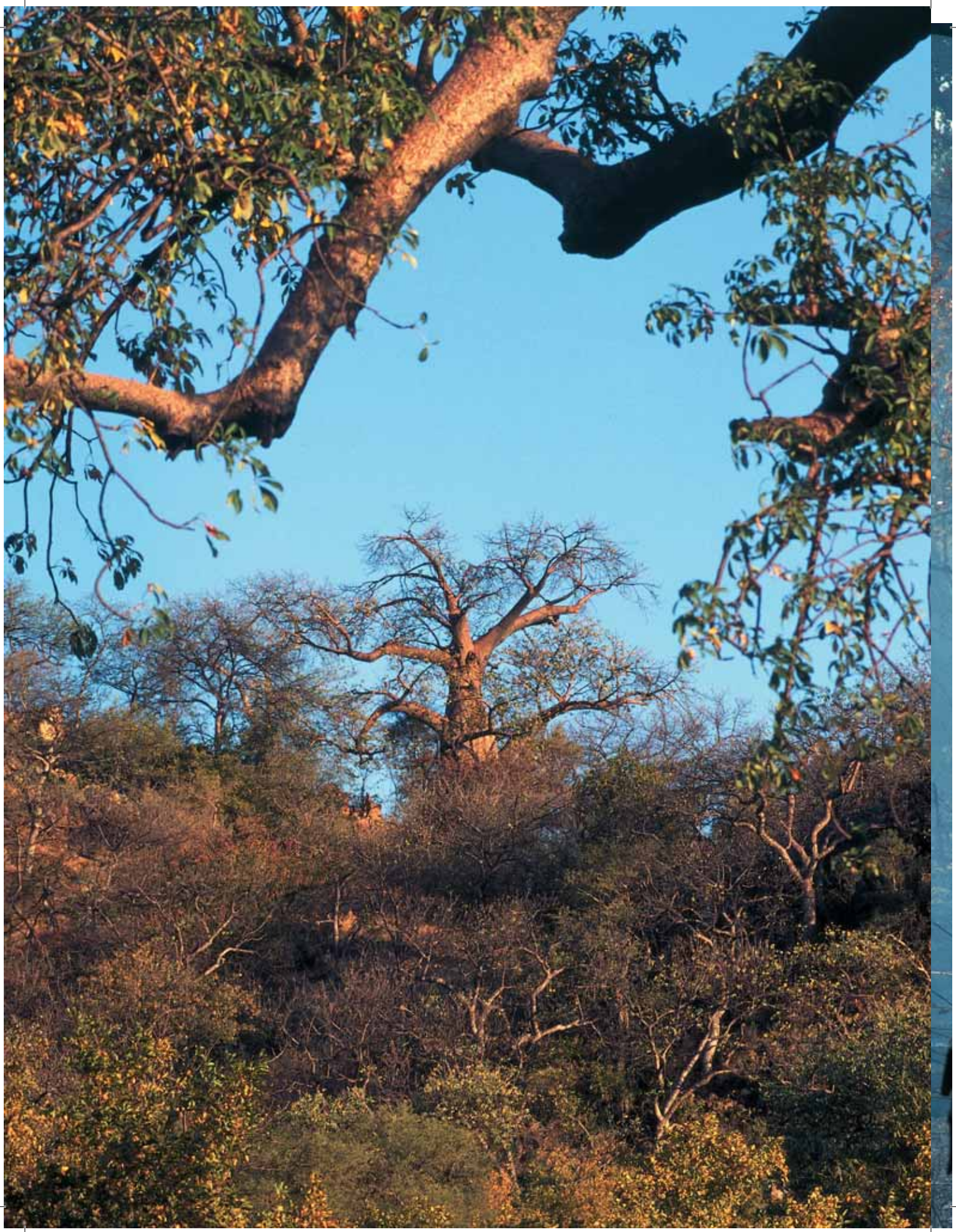
tion programmes in Namibia and neighbouring Botswana and Zimbabwe have been so successful that elephant populations are now skyrocketing.[15] Thus, the total population of elephants in Namibia is estimated to have increased from less than 1,000 in the 1960s to about 18,000 in 2004. The animals are concentrated in and around several conservation areas: about 800 in Kunene, 2,500 in Etosha National Park, 5,000 in Khaudum Game Reserve and north-eastern Otjozondjupa, and approximately 9,000 elephants in eastern Kavango and Caprivi. It is in the north-eastern areas where damage to woodlands is most evident, especially along the Okavango River in the Mahangu Game Reserve and Kwando River in Caprivi. Large numbers of elephants congregate here in winter when water is not available in the surrounding woodlands.

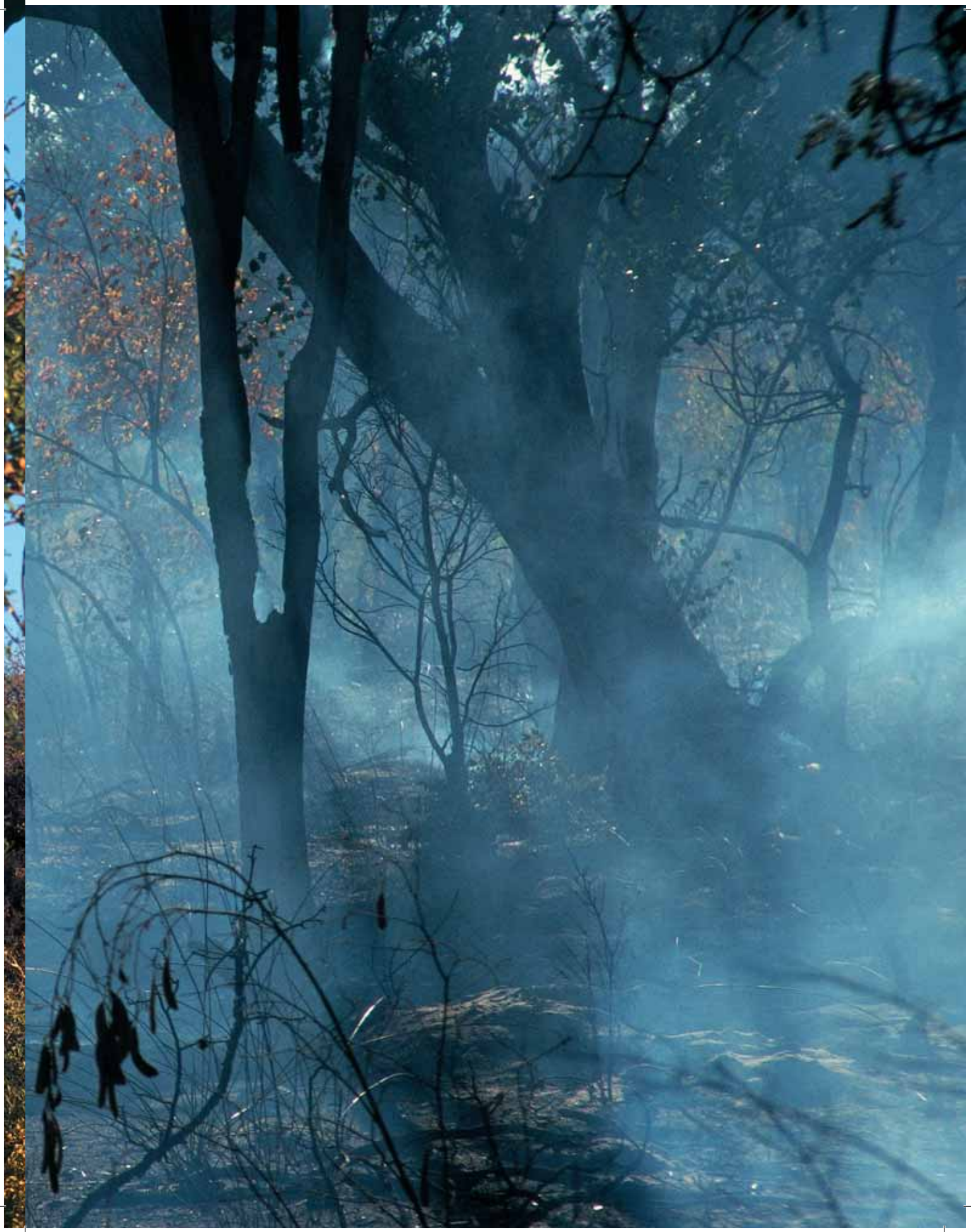
The growth in Namibia's population of elephants is largely due to the better survival of adults. But numbers have also increased as a result of immigration, mainly from northern Botswana and Zimbabwe. Botswana's elephant population has increased at over 6% per year over the past four decades to reach the astounding figure of over 140,000 animals. All forecasts suggest that populations in Namibia and Botswana will continue to boom, perhaps doubling in less than 15 years. Their distributions will also expand and damage to trees will escalate. A troubling aspect is that neither the Namibian nor the Botswana governments have clear plans to control elephants.

One of the latest environmental concerns to sweep the world is climate change, a process that now generates great discussion and considerable speculative hot air. But several aspects are now well established. It is clear that the atmosphere is becoming hotter and that the warming will continue for at least several more decades; for example, average temperatures in Windhoek are now 1.2°C higher than in 1920. The heating is due to two factors: increased greenhouse gases in the atmosphere and a reduction in the capacity of the earth to absorb carbon dioxide because of reduced forest and woodland cover, caused mainly by clearing for agriculture. It is further agreed that all these changes are primarily due to human activities, but scientists and politicians do not always agree on how the changes can be turned around.

It is also generally accepted that temperature changes will affect global circulation and pat-

*Such thunderstorms may be less frequent in the future as a result of climatic change caused by increased concentrations of greenhouse gases and global warming. As a consequence, water availability for forest and woodland growth might be reduced in Namibia.*





*Much of the thick riverine forest in the Mahangu Game Reserve has been lost as a result of damage caused by elephants. In this case, the trunk of a Baobab has been badly scarred.*

terns of rainfall. Many studies on the effects of global warming attempt to model how rainfall will change and what that might mean for aspects of life that are themselves affected by rain, such features as flooding, water supply and, of course, forests and woodlands. Just such an assessment has recently been completed for Namibian vegetation, and it draws the following conclusions.[17] Our climate will probably become increasingly arid during this century and that will have impacts on the structure, functioning and distribution of woodlands. Desert and shrub-land should expand, savanna woodlands and grasslands will shrink, and overall plant production should decline. These bleak trends are, however, confounded and possibly compensated by enhanced plant growth due to higher levels of carbon dioxide. Species that cause bush encroachment are then expected to spread and grow more rapidly.

Namibia probably absorbs more greenhouse gases than it produces, and it thus contributes little to global warming.[17] Other than adding to the international lobby for the implementation of international conventions on climate change, such as the Kyoto Protocol, Namibia's ability to reverse the process is limited. However, we can help to reduce forest and woodland losses caused by changing atmospheric conditions. For example, more could be done to protect plants most vulnerable to increasing aridity, perhaps by reducing grazing pressures or the frequency of fires.

## CHANGING VALUES, RESPONSIBILITIES AND ACTION

A good deal of this book has been devoted to the values of forests and woodlands. Many of the values are particularly high because of the relative scarcity of these habitats in Namibia's dry environment. Each tree counts because there are so few of them! Values also vary greatly from place to place. A grove of Prosopis growing in the very arid south of the country is extremely precious to a poor household nearby. The same trees in a river in the centre of the country are viewed as invasive aliens, with all the contempt implied by the label.

Values applied to other natural resources vary even more arbitrarily. Much of the world jumps up and down if an elephant or a rhino is killed, but daily massacres of forests and woodlands raise much less concern. Why is so much attention focused on wildlife while trees are frequently neglected? Ironically, it was a botanist who initiated the idea of formal nature conservation in southern Africa. Ludwig Pappe was concerned about deforestation and habitat degradation in the Cape Colony, and his views were translated into the first forest law in 1846. The annual celebration of trees – Arbor Day – began way back in 1872 in the USA. Notwithstanding these early initiatives, it is wildlife preservation that has dominated conservation motives over the past century.

But views on forests and woodlands have increased a great deal over the years, especially in the recognition of many more different values. Thirty years ago, most people would have dismissed the idea of special programmes for non-timber forest products. Estimating the economic value of woodlands as part of the nation's national accounts would have been thought absurd. Emphases have shifted, and nowhere clearer than in Namibia. German colonial government efforts focused on growing trees to supply wood to freehold farmers, whereas the South African government devoted most of its forestry interests to the harvesting of timber from Kiaat and Zambezi Teak. During its first 15 years, the Namibian government has embraced the importance of broad management and conservation of forests and woodlands as a priority, often to enhance rural livelihoods. Much of this was done under the auspices of the Ministry of Environment & Tourism, but emphasis could now be given to agro-forestry after the recent move of the Directorate of Forestry to the Ministry of Agriculture, Water and Forestry.

While perceived values have risen, they remain grossly under-priced. We take some care of the resource, but more remains to be done. What are the most urgent and useful measures Namibia can take to manage and benefit from its forests and woodlands? Three broad categories of activity are

required: more protection of these habitats, greater promotion of their importance, and increasing the benefits through wise use and management.

### Protection

Fire and the clearing of land destroy far more forest and woodland annually than any other activity. Almost all of this happens in communal areas in the north of the country (Figure 33), where management of the land is the responsibility of rural communities (see Figure 3, page 15). It is the members of these communities who decide to clear land and to set fires. Judging from the number of fields cleared and individual fires lit each year, both practices are common and important to many people. The government has largely withdrawn itself from measures to control fires, hoping instead that community based forest management and education programmes that highlight the dangers of fires will reduce the extent of burning. This is too little to stay the destruction of what is rapidly becoming a non-renewable resource. The hope further rests on assumptions that the interests of the common good will prevail over those of people who set fires, that communities will perceive and receive greater benefits from controlling than allowing fires, that individuals who want to set fires will bow to community opinion, and that communities will put in place actual mechanisms to control fire. Even if these assumptions hold good, they will only be implemented in the few small areas covered by community forests (see page 93).

Most people would agree to the need for rural farmers to clear forests and woodlands to plant crops. The whole practice appears justified by policies to reduce poverty, promote rural development, achieve food security and redress past discrimination that kept people in tribal areas. However, there is also need for care in promoting the clearing of natural vegetation for crop production. We offer four arguments in support of caution.[19] First, subsistence crop farming is characteristically a low input, low output production system. This is a consequence of infertile soils, unreliable rainfall, small investments of labour, fertilizers and manure, and a high potential of crop failure due to drought, disease and pests. Farming is a high-risk business, and efforts to produce decent yields are often lacking. Fields are frequently cleared but soon abandoned, and not because the soils have lost their fertility. Farmers that have access to other more lucrative and reliable incomes lack incentives to invest more seriously in growing crops. All these constraints make it hard to shift a system into producing higher outputs which would better justify the loss of natural habitats.

Second, the many wealthy people having other incomes that far surpass the value of food from their crops generally have much larger fields than those of poorer households. Most of these fields are really luxuries cleared at the expense of resources now lost to everyone, including nearby poverty-stricken households. Third, it is often possible or likely that woodlands would provide greater socio-economic benefits if they were used for purposes other than small-scale crop farming. Tourism is an example of such an alternative. Finally, many agricultural development projects are based on the partial assumption that farmers will be able to sell surpluses. However, marketing is often difficult for small scale farmers because of the low population (and thus market demand) in rural areas, the distances and costs of transporting goods to concentrations of customers in more distant towns, the need for packaging and storage of products, and the difficulty of competing with cheaper products delivered more reliably from wholesalers elsewhere.

There is an urgent need for the Directorate of Forestry to lead a determined campaign to reduce losses due to both fire and clearing creative and coordinated. The campaign should be implemented in conjunction with agronomists and all local leadership structures, rather than concentrating on community forests. All fires should be banned in eastern Kavango and Caprivi, and stiff penalties imposed on those who disregard this. Such an embargo would not stop all burning, and fires would still occur frequently enough to maintain the open savanna landscapes.

Likewise, the Directorate should develop policies for the clearing of forests and woodlands for crops. The guidelines should be translated into controls that local leaders can implement to ensure that natural habitats are only cleared when absolutely necessary. Furthermore, interventions to reduce burning and clearing should become part of a broad agro-forestry programme. Agro-forestry normally concentrates on the cultivation of trees, but this could be widened into a programme that encourages rural farmers to plant and *protect* trees.

In terms of the Forest Act of 2001, State Forests and Regional Forests can be proclaimed as legally protected areas. However, no areas have been set aside in terms of this legislation. The Caprivi State Forest also has no legal status and it is not managed as a state forest, since much of it burns every year with the result that a high proportion of its trees are now dead (see page 109).

Farmers from local villages graze their cattle, set most of the fires and harvest wood in the Caprivi State Forest. In essence, there is a need to take the protection of this and other forest and woodland areas seriously.

## Promoting forests and woodlands

At the risk of repetition, why should State or Regional Forests be treated less seriously than those set aside for wildlife? Why are housing and lodge developments along the coast seen as serious environmental issues that demand intensive impact assessments (EIAs), and yet no one assesses the impacts of clearing or burning forests and woodlands? There is no need to repeat the answer, only to stress again the importance of promoting the value of woodland habitats as discussed elsewhere (see page 78).

One aspect to be discussed here, though, is the need for a vigorous programme of research and investigation, one that delivers more product and far less process. Results are needed, and their implications need to be documented and widely disseminated. Three areas of research are needed urgently. First, far too little is known about growth, production and recruitment rates, especially as

*Large fruit and shade trees, such as Marula, Bird Plum Jackal Berry trees, have been protected in most small, fenced farms in northern Namibia. These good practices and new efforts to encourage the planting of indigenous trees may lead to the re-foresting of many areas in the north.*

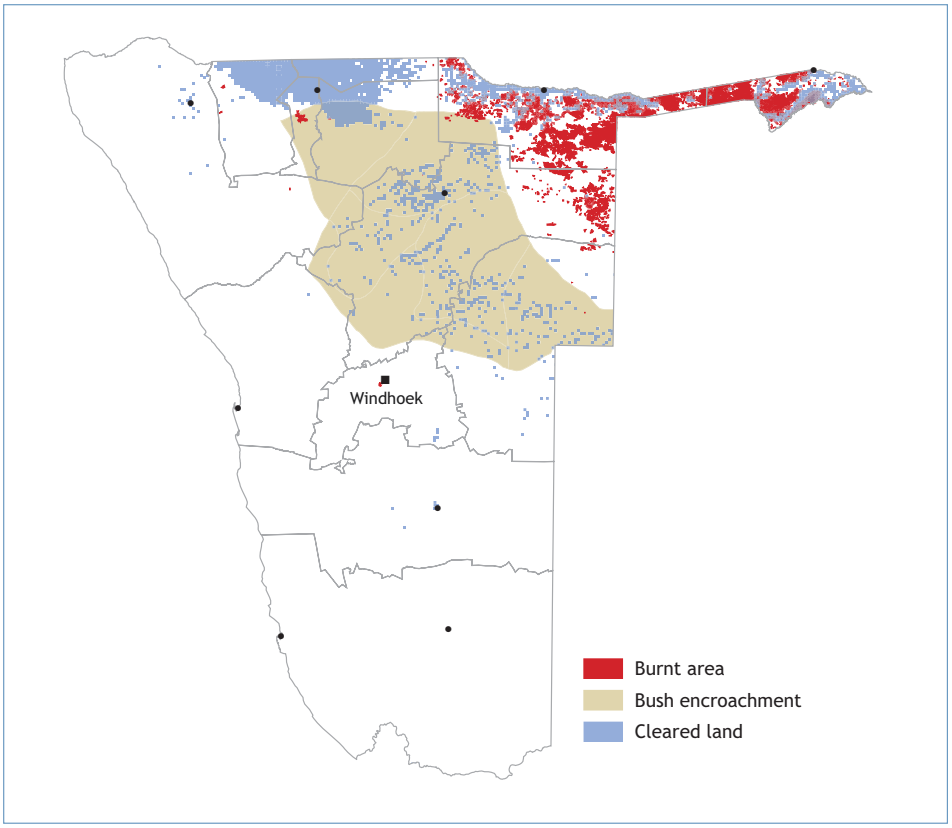



Figure 33. A composite of major impacts on forests and woodlands derived from the percentage of land cleared for crops, the frequency of bush fires and density of bushes.[20]

they relate to the potential harvesting of timber trees. In addition to factual information, a good understanding must be developed of these processes, especially so in the context of Namibia's semi-arid environment where rainfall varies greatly from year to year. If, for example, most significant germination and early growth only occurs during years of good rain, tree production may be much more tenuous than assumed. We don't know this for sure, hence the need to find out. Likewise, agro-forestry initiatives to plant indigenous trees in north-central Namibia will be more successful if they are based on a good grasp of growth and production rates. It might be pointless trying to plant large numbers of trees of certain species if useful production can't be attained in a reasonable time. This must be tested.

Secondly, a much greater understanding of the effects of fire must be assembled. For example, in areas burnt most often (Caprivi State Forest, Caprivi Game Park, and eastern Kavango), our observations suggest that there is almost no annual increment of wood to be harvested from sizeable trees. Instead, there seems to be a net loss, which means a growing loss of Namibia's stock of wood. Although there are many small trees in these areas, most appear to have coppiced as a result of being burnt down in most years. Perhaps this conclusion will be proved wrong once the matter is investigated.

Thirdly, there is the whole issue of bush encroachment. If the idea is correct that most encroachment is caused by a lack of fire and over-grazing, then the only ways of reversing the problem will remain expensive manual or herbicide treatment. Even if grazing is stopped, there is too little grass to fuel fires hot enough to kill the woody plants. The problem is then a compounding one: too much bush → too little grass → less chance of fire →

more bush growth → less grass and less fire, and so on. This is not a happy conclusion, and studies are needed to find alternative solutions.

The focus here has been on issues that have practical implications on the health of forests and woodlands. There are many other topics that require study, and research should not be limited to questions having practical value. Much more basic investigation, sometimes and unfairly called esoteric research, is also needed to add to the store of information available, and to improve our understanding of the processes and principles that govern forest and woodland environments.

*The production of seeds by Candle-pod Acacias is the first step in the generation of new trees. Later survival and growth and is a tenuous process, particularly in the relatively harsh Namibian environment. As much as we reap the benefits of trees, so too should we keep additional hazards induced by people to a minimum.*

## More benefits

During the past 15 years, Namibia has made substantial progress towards enhancing the value of benefits from forests and woodlands, especially by developing indigenous plant products (see page 72) and community forests (see page 93). What more can be done, however? It should be clear that forests and woodlands have many potential values of which we know nothing. Indeed, many of the indigenous plant products now being tested for their commercial potential were unknown until recently. Vigorous, creative exploration and investigation is certain to yield many more products that have similar, or perhaps quite different uses. The more we search and think about possible benefits, the more will be found, both as direct uses and as added values. The many indirect values of forests and woodlands – shade, wildlife habitats, browse and the absorption of carbon dioxide, for example – need to be publicly promoted as well. Too many people know too little of these benefits.

The most important innovation of the community forest programme is the creation of opportunities for rural people to own, manage and derive greater benefits from woodland habitats. Values and ownership go hand in hand. There is now a need to accelerate the programme and to declare as many community forests as possible. Enthusiastic determination in the Directorate of Forestry should lead the process. The greatest values from forests and woodlands are likely to come from wildlife and tourism, and a much stronger linkage – preferably amalgamation – with conservancies is desirable. These more lucrative enterprises, which bring additional income through multiplier effects and job creation, will do more to alleviate poverty than small incomes from the sale of a few bundles of firewood, for example. They will also provide more sustainable incentives for communities to manage and conserve forests and woodlands. Furthermore, local empowerment should be strengthened by providing legal rights, institutional arrangements, procedures, and management and monitoring tools which are robust and easy for communities to use.

Forestry is not an activity indigenous to Namibia, but much has been achieved by building systems and policies to take better care, and make greater use of our forests and woodlands. Of course, much more has to be achieved, both in the short and long term. Recall that Namibian trees are slow growers, often taking one or two hundred years to reach sizes where they provide useful shade, timber or other fruit. We can easily remove and harvest trees, but we can't replace them rapidly. A tall Camel Thorn, Ushivi or Zambezi Teak killed today will only be replaced by an equally large tree one or two centuries from now. Only then, several generations later, will people to whom we bequeath Namibia's forests and woodlands enjoy the same shade, timber and fruit.

## Key points

- Three processes induced by people have led to the biggest losses of large areas of woodlands and forests: the clearing of land for crop cultivation, the frequent burning and killing of trees in the north-east, and bush encroachment in the central and eastern regions.
- Other significant damage to forest and woodland habitats has been caused by the damming of tributaries of ephemeral rivers, water abstraction from aquifers and large populations of elephants.
- Global warming and climate change may lead to lower rainfall and a loss of trees, but it is also possible that increased carbon dioxide in the atmosphere could promote plant growth.
- Namibia should offer greater protection to forest and woodland habitats, promote the importance of these habitats, and increase benefits derived through the wise use and management of woodlands and forests
- Most valuable, indigenous trees grow very slowly in Namibia. Those killed today by farming practices or bush fires will only be replaced by trees offering equivalent benefits and uses a century or more from now.