Veld Health Check

A Manual for Southwest Kgalagadi Farmers

Developed by the communities of Bokspits, Vaalhoek, Inversnuit, Struizendam & Rappelspan collaboration with the Indigenous Vegetation Project

INDIGENOUS VEGETATION PROJECT
BOTSWANA • MALI • KENYA

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Staying in an area too long is like wearing the same dress for years; it gets worn out.

Female farmer, age 65, Six Mile Cattle Post

It is not possible to be a cattle farmer in a place like this: you have to be a grass farmer.

Male Farmer, age 74, Hereford Farm

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1 Purpose of this Manual

Anyone who has walked any distance in the Kalahari bush, knows the importance of knowing precisely where you are going, and how you're going to get there. They also know the value of recognising nature's signposts to make sure they're going the right way: clues from the sun and stars, or which side of a tree the weaver bird builds its nest. Similarly, it is not easy for a farmer to embark on a journey towards good veld management without knowing precisely where he or she is going, or how to get there. With no knowledge of nature's warning signs, they don't realise they are lost until it is too late, and will have problems finding their way back to the path.

The purpose of this manual is to provide farmers in southwest Kgalagadi with a range of different routes (management options) to reach their destination (sustainable veld management). It is designed to help farmers read nature's warning signs, so they can tell if their management is leading them towards better or worse veld. With this knowledge, a farmer can soon tell if their management is working, and if not, make changes to get back on course. Any farmer with experience of the veld has some knowledge of these signs. However this knowledge is rarely voiced or shared with others. This manual therefore shares the knowledge of Southwest Kgalagadi farmers about warning signs and management solutions to common veld problems. This knowledge has been combined with the knowledge of researchers from around the world, and carefully evaluated by community groups from Southwest Kgalagadi, in addition to researchers and extension workers.

Spread of thorn bushes is an increasing problem in Botswana

The manual is designed to help farmers improve the quality of their veld by recognising and responding to veld damage caused by livestock. Although some of the worst damage happens during drought, this manual is *not* designed to help farmers predict when a drought will happen. However, it can help farmers work out if lasting damage has been caused by livestock during a drought, or at any other time, and choose the best way to respond.

The purpose of this manual is therefore to enable farmers to:

1. a) Recognise warning signs that the condition of the veld is likely to become worse in the future
   b) Change veld management to prevent this from happening

2. a) Recognise areas of the veld that are already badly damaged
   b) Focus efforts on these areas to restore them to better condition

Many books and manuals have been developed for ranchers, but there has been little help for farmers who use unfenced, communal land. This manual is therefore primarily designed for use by communal farmers, although it will still be useful for ranchers (particularly for monitoring). The warning signs and management options have been specially selected so that they can be used easily by anyone with no need for training.

2 Using this Manual

This Chapter explains how to use the manual to check and improve the health of your veld. A step-by-step summary is provided at the end of the chapter.

Warning signs can be used accurately by anyone to work out whether veld condition is getting better or worse, and point them to management options that can help keep it in healthy condition. For this manual, Southwest Kgalagadi communities have selected warning signs that are easy for anyone to use without extra training or equipment (Chapter 4). Before including them in the manual they were tested for accuracy by researchers, extension workers and community members. Management options were also collected from and discussed by members of the community, and then weighed against available evidence by researchers and extension workers before being included (Chapter 5). Therefore, anyone should be able to use the warning signs in this manual to identify veld change and respond in the most effective way to protect its future productivity for livestock.

Spotting the Warning Signs

Just using one or two warning signs may be misleading. To give an accurate picture of veld health and likely future problems, you must look for a number of different signs. For example, it is not possible to accurately work out veld condition from the plants alone. You need to look for signs in the soil, insects and wild animals, as well as the livestock and people who depend on the veld. It is therefore recommended that you look for at *least* three warning signs from each of the following categories:

- Plants
- Soil
- Insects/Wild Animals/Livestock/ or People

Look for warning signs during or soon after rain

You can look for more than three signs in each category if you wish. There are a number of different warning signs to choose from: choose the ones you think are most relevant for your veld. However, once you have chosen these indicators, you should keep using the same ones year after year.

Looking for these signs only once may also be misleading; it will be necessary to look for these signs regularly if you want to find out whether the veld is getting better or worse. For example, if you have seen a person genuinely upset once, you cannot conclude that they are depressed: they may have simply had a bad day. But if month after month they grow more and more upset, you may conclude that there is something more seriously wrong. This is particularly important in Botswana, where drought is so common: what may look like a serious veld problem during drought may recover completely after the rains return. For this reason, although it is useful to look for warning signs all year round, it is best to look for warning signs during or soon after the rainy season.

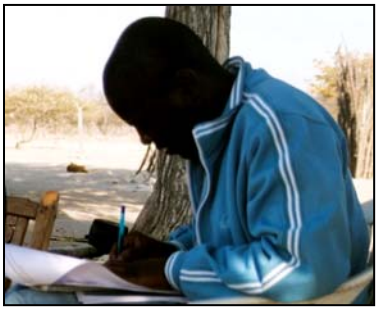
If you want to see how the health of your veld is changing from year to year, you will have to record what you have seen. To make sure the changes you record aren't just because of rainfall, you will have to choose a similar time of year to do this, for example a week or two after the first heavy rainfall of the year. During drought years, it is still worth looking for signs, but you should note that it was a drought year for future reference. You only need to take action if warning signs persist after the rains have returned.

Look for warning signs in a variety of different places. It can be interesting to do it with others and discuss what you find.

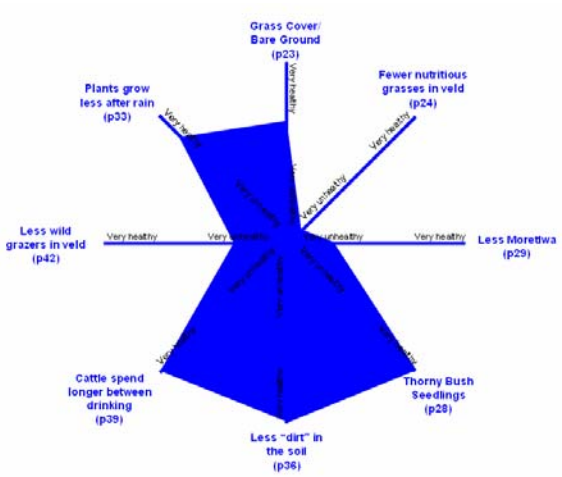
You should also look for warning signs in a variety of places: some close to your borehole, some far away, and some in between. You should look for signs in at least one place at each of these locations, but the more places you look, the more accurately you will be able to tell how your veld is changing. You may want to choose some places that you already think are problem areas so that you can see how they change as you try different things to improve them. Although it is tempting to follow roads and cattle tracks, it is worth walking away from them a little before you start looking for warning signs, as these areas will be much more heavily used and therefore won't give you an accurate picture of what's going on in your veld. You need to mark the places you plan to use each year – it

is easiest to use existing landmarks (give them a name and description so you can go back there next year), but you could paint a post or tree, or take a photograph if you have a camera (this can also be useful for tracking grass and tree cover from year to year).

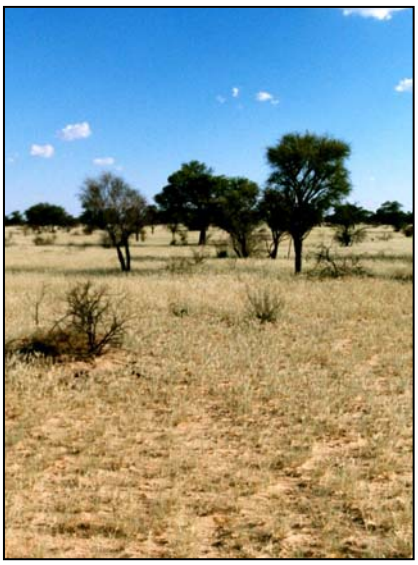
Recording what you find



To make it easier to see how warning signs are changing from year to year, you can display them on a wheel chart (below). Blank wheel charts can be found in Chapter 6. Each spoke represents the different warning signs you have chosen, and you can grade each sign from very healthy to very unhealthy. Chapter 4 describes how each sign should look in very healthy and very unhealthy veld. These descriptions should help you decide if the signs in your veld are very healthy, quite healthy, quite unhealthy or very unhealthy. Since these decisions will be based on your own opinion, you may score the same veld differently to your neighbours. However, if you repeat the analysis regularly you should be able to make a consistent assessment from year to year. Some researchers in southern Africa have suggested specific points at which warning signs reach dangerous levels (e.g. % bush cover). However, it can be difficult to measure many signs accurately enough without special equipment to work out if they have reached dangerous levels. Also, there is little scientific evidence to suggest what these levels should be, and what is a dangerous level for one farmer may be quite acceptable to another farmer, depending on their objectives.



How is the veld changing?



It will obviously take time to answer this question: you will need to be able to see how your veld has changed over a number of years before you can tell if your management is having the effect you want. Although the best way to tell if your management is working is to compare your veld to the way it was in previous years, you will have to use a different approach for the first few years.

One approach is to compare your veld against an area of veld that is in the kind of condition you would realistically like the rest of your veld to reach (your "target veld"). Ideally, this should be veld that you know recovers well from drought to support livestock year after year. This can be part of your

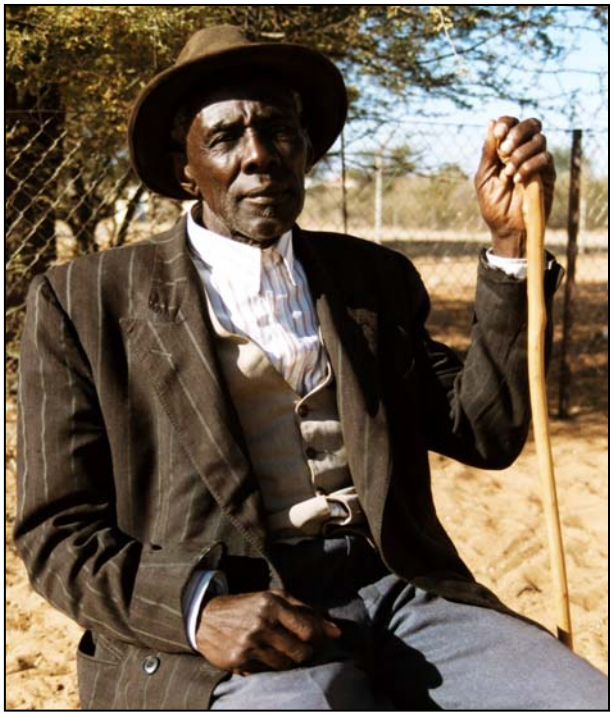
own veld or from nearby veld (you shouldn't look too far away from your veld in case the rainfall or soil is different).

If it is not possible to find an area like this to compare your veld against, you can use parts of the veld that are used less by livestock (e.g. places further from your borehole). However you should note that you are unlikely to ever be able to get the rest of your veld to this kind of condition unless you significantly reduce stocking levels (in addition, under-used veld is rarely as good for livestock as veld that is grazed wisely). Again, make sure that the soil is similar to the rest of your veld – if the veld is good because the soil is too shallow for shrubs and trees to grow, or is in a dip that collects water, you will never be able to make the rest of your veld like this through management.

Use the signs in Chapter 4 to check that there are no major problems with the veld in the place you have chosen. So that you can get an accurate picture of your target veld (and in case something happens to it e.g. fire), look for signs in a few different parts of your target veld.

Once you have chosen your target veld, you can then compare the rest of your veld to it: how much worse is it and how much work needs to be done? And once you've changed your management, you can start to see if it is making the veld better or worse the following year. Although you may not reach the ideal condition you're aiming for, you can at least see if things are going in the right direction, or if you need to consider a different kind of management. Once you've been looking for signs for a few years, you can start comparing it to how it used to be. In this way, you can begin to see what you have achieved more easily.

Management Options



The manual suggests various management options you can use to respond to different warning signs to improve or protect the health of your veld (Chapter 5). However it is important to note that the manual is designed to build on farmer knowledge, and is one tool among the many that farmers have built up through experience. It does not attempt to provide perfect recipes that can be followed step-by-step to find answers to veld problems. Such an approach would be misguided, as not all indicators or management suggestions will be relevant in all circumstances. Instead, the manual is designed to supplement the already extensive knowledge and experience of farmers in Southwest Kgalagadi. It is hoped that this manual will lead to the exchange of more ideas between farmers, by stimulating discussion about the resources upon which we all depend.

Step-by-Step Guide

1. **Choose the kind of veld you're aiming for.** Find parts of the veld you know recover well from drought to support livestock year after year ("target veld"). If this is not possible, find an area that is used less by livestock but beware that this is an unrealistic target unless you are prepared to reduce your herd. Check that your target veld is in healthy condition using signs from this manual (see Step 4). Look for warning signs in your veld and compare them to your target veld to see whether your management is having the desired effect. Once you have been looking for signs for a few years, you can start comparing your veld to the way it used to be instead, which will give you a more accurate indication of whether your management is working.

2. **Choose where you want to regularly check the health of your veld.** Choose a number of different places, close to the borehole, further away and in between (at least two places in each area). Make sure you can find these places the following year (e.g. choose places near landmarks or paint trees or poles).

3. **Choose which warning signs you will use.** Choose warning signs (Chapter 4) that you will look for regularly in each of the places you have chosen. Choose *at least* three from each of the following categories: i) plants; ii) soil; and iii) insects & wild animals/ livestock/ or people. Write each warning sign next to a spoke on a wheel chart (in middle of manual). Use the same warning signs each year so that you can see how they change. You will notice that there are also wheel charts with *early* warning signs – these have been chosen to show if there is a danger that future problems are *about to happen* in your veld.

4. **Look for the warning signs.** At each of the places you have chosen: (1) look for the warning signs you have chosen; and (2) look for the early warning signs listed in Chapter 4 and marked on the smaller wheel charts in Chapter 6. Decide if they are very healthy, quite healthy, quite unhealthy or very unhealthy and place a mark on the relevant spoke of each wheel chart. Join up the marks you have made on the spokes to see what shape of wheel represents your veld (it may be easier to see if you colour in the shape). See Chapter 6 for more detailed instructions.

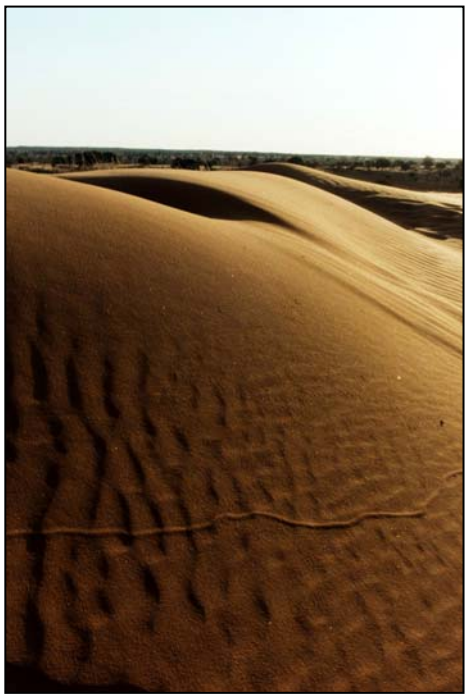
5. **Decide what to do about the current health of your veld.** On the large multicoloured wheel chart, look at the lumps (quite and very healthy signs that show your veld is doing well) and dents (quite and very unhealthy signs that show you have problems) in your wheel. If your wheel is generally large and circular (most signs are quite or very healthy), your veld is healthy – keep up the good work. If it is small (most signs are quite or very unhealthy) or there are particularly big dents in certain places, you may need to take action. Refer back to the pages describing the warning signs that were unhealthy (Chapter 4), and these pages will suggest management options you could try to improve the quality of your veld.

6. **Decide what to do about the future health of your veld.** On the second (smaller) wheel chart, look for the lumps (quite and very healthy signs that show your veld is going to be healthy in the future) and dents (quite and very unhealthy signs that show you are going to have problems in the future) in your wheel. If it is small (most signs are quite or very unhealthy) or there are particularly big dents in certain places, you may need to take action to prevent future problems from happening. Refer back to the pages describing the warning signs that were bad (Chapter 4), and these pages will suggest management options you could try to prevent future problems in your veld (Chapter 5).

3 Basic Veld Management

This Chapter summarises some of the main veld problems experienced by farmers in Southwest Kgalagadi, and combines the wisdom of many local farmers into four "secrets" of good veld management.

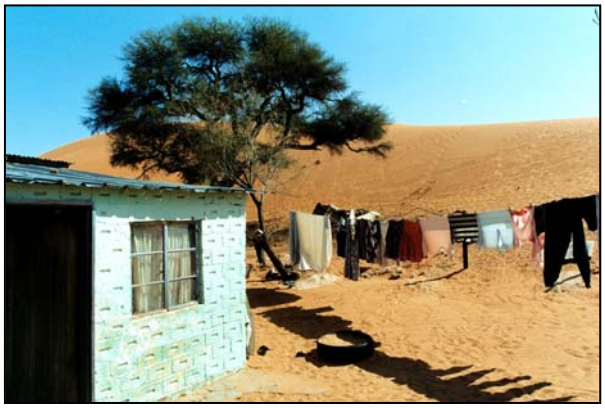
Southwest Kgalagadi



Dunes near Struizendam

Southwest Kgalagadi is the driest part of Botswana. Rainfall is more variable and unpredictable, and severe droughts happen more often than anywhere else in the country. Satellite images have shown an increase in bare dunes and the amount of bush growing between dunes over the last 20 years (mainly Mokurubane – Driedoring, Threethorn or *Rhigozum trichotomum*). Other research has shown that Mokurubane and poor grasses are becoming more common in southwest Kgalagadi TGLP ranches.

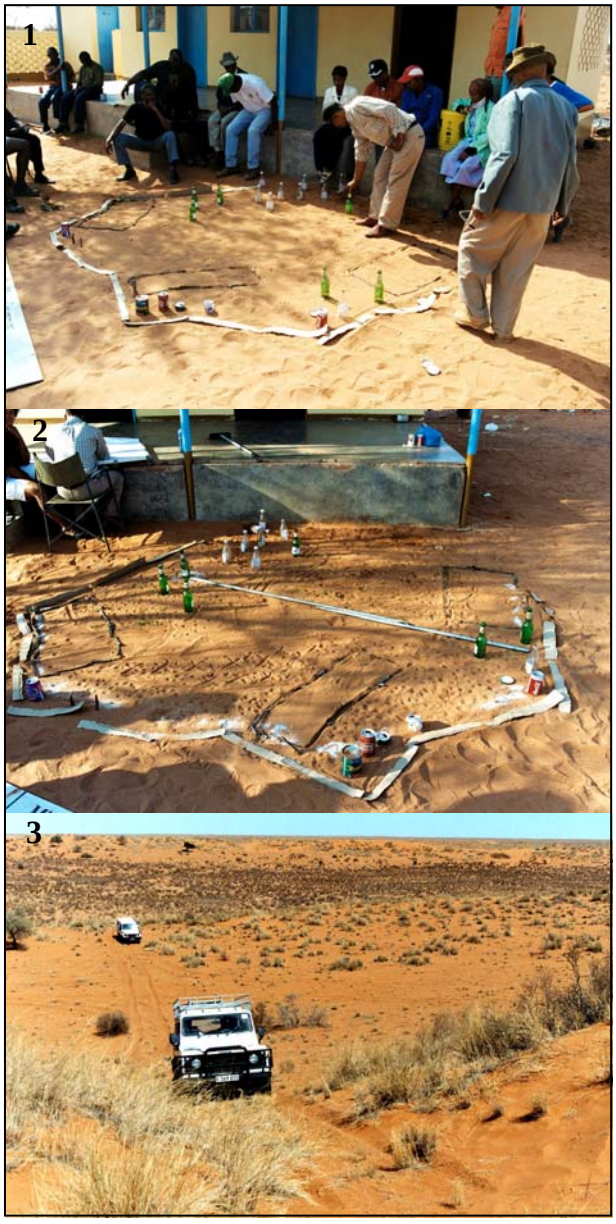
However, the vegetation map (pull-out 1) and satellite image (pull-out 2) also show that these problems are restricted to a relatively narrow strip along the Molopo dry riverbed, and around certain boreholes (e.g. TsaneTsane) where there are moving dunes, and mainly poor grasses and Mokurubane. The problem area extends about 3-4 km around settlements, and 1-2 km around certain boreholes and elsewhere along the riverbed. The dunes are a particular problem for the houses and roads that share the land along the river. Although livestock fodder is a problem along the river and around settlements and boreholes, there is good fodder beyond these areas.



The challenge for farmers is to protect the good grazing they have, whilst if possible restoring the damaged areas around settlements and boreholes. The fact that livestock numbers have been steadily rising over the last 50 years (see graphs on p11), despite a number of serious droughts, suggests two things: 1) the veld is highly productive and quick to recover from drought; but

2) the veld cannot continue to support livestock expansion at this pace for ever, and the problems that are being experienced along the river and around boreholes may spread unless action is taken.

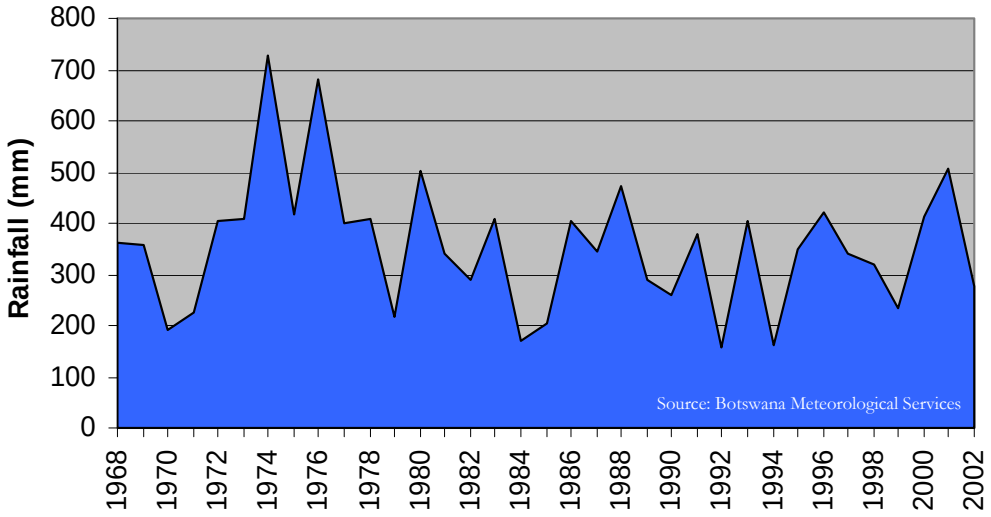
The majority of people in Botswana depend on livestock for their livelihoods. But when the health of the veld declines, it becomes increasingly difficult to support livestock. There are too few reserves in both the livestock and the veld for them to survive drought without expensive supplementary feeding. Although some people have suggested that livestock numbers in Botswana simply mirror rainfall, recent censuses show that cattle numbers have failed to recover since the 1980s drought, despite better rainfall (see graphs below). This suggests that there are causes other than drought for the decline in the national herd. An increasing number of observers are suggesting that changes in veld management have led to a decline in the health of the nation's veld, which may account for the decline. Poor veld management is known to cause a range of problems in the soil and plants which have a knock-on effect on livestock as well as wild animals. These impacts eventually will affect the livelihoods of the people who depend on animals.



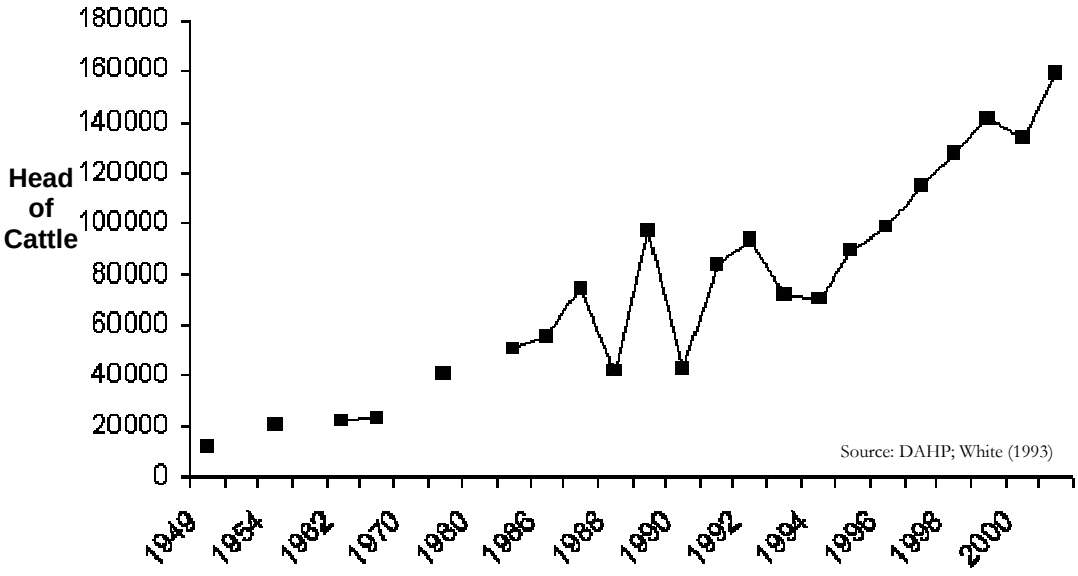
Vegetation and land use maps were developed by communities from Bokspits, Vaalhoek, Inversnuit, Struizendam and Rappelspan.

1) Maps were drawn in the sand using objects and markings to denote different kinds of vegetation or land use; 2) These maps were transferred to paper; and 3) locations were checked by vehicle using a Global Positioning System that works out precise locations on the ground using signals from satellites.

The maps that were produced were then checked against satellite images of the area before being digitised (see following pages)



Rainfall records from Tsabong 1968-2002 showing regular droughts but no long-term drying out



Livestock census data for South Kgalagadi District

Following page: Land use map and (on reverse) vegetation map for southwest Kgalagadi

Common Veld Problems

The veld is like a person: there are fat and thin people and no matter how much you feed some people, they remain thin. If the soil becomes poor, no matter how much it rains, nothing will grow.

Male farmer, age 82, Kutlwano Cattle Post

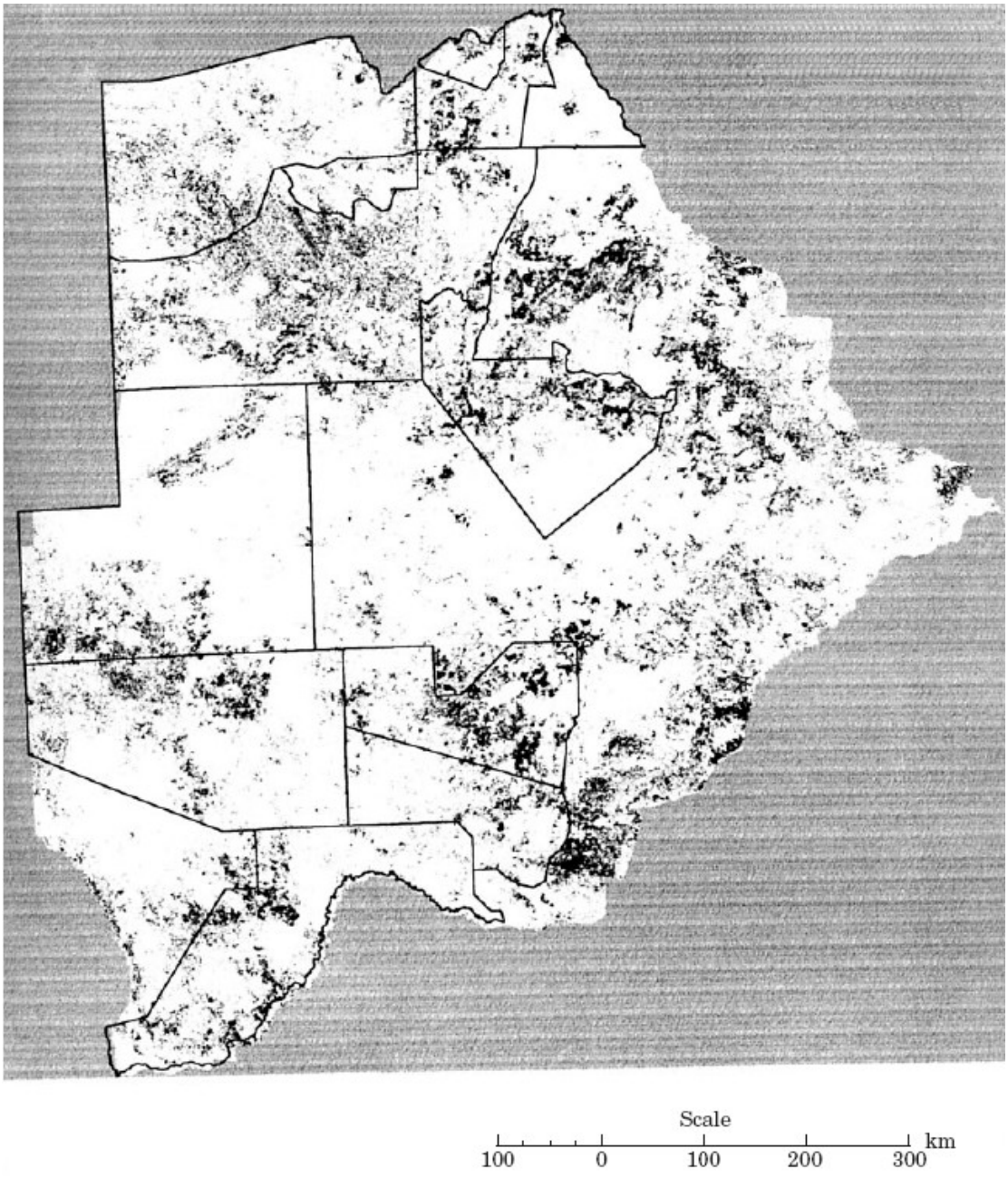
Thorny bush invasion

1. How big is the problem?

Mongana (Swartaak, Blackthorn or *Acacia mellifera*)

Thorn bushes grow naturally in grass veld, and are useful for smallstock and during drought. However they cause major problems for livestock production if they take over, as they severely limit the grazing that is available for cattle. Although they can be used by goats and sheep, the profitability of smallstock-based bush systems is much lower than the species-rich, mixed-stock grass-veld systems they replace. Examples of bushes that cause particular problems include Swartaak (Mongana, Blackthorn or *Acacia mellifera*), Sekelbos (Moselesele, Sickle Bush or *Dichrostachys cinerea*) and Haak-en-steek (Mosu, Umbrella Thorn or *Acacia tortilis*).

Continuous, heavy grazing by cattle can lead to impenetrable thickets of thorn bushes



Map showing the extent of bush cover in Botswana (indicated by dark areas) [pending copyright permission]

Thorn bushes have invaded millions of hectares of formerly productive veld in Botswana (dark areas on the above map). They now cover over 6 % of Botswana, and these bushy areas are beginning to join up in some parts of the country. They have been observed to extend up to 9 km from some boreholes, resulting in impenetrable stretches of bush for tens of kilometres. Interviews with elders suggest that this level of invasion occurred in less than 40 years.

2. How does it happen?

By selecting grass and avoiding thorny plants, cattle give thorn bushes an advantage over grass in the veld. Grass normally crowds out bush seedlings by capturing most of the light and water. But grazing keeps the grass short, allowing more light and water for the bushes that are allowed to continue growing unchecked by the cattle. As they grow older, many bushes put down tap roots and are able to reach water and nutrients that are out of reach from the grass, and some also put out long roots just below the surface of the ground where they attempt to capture water that would otherwise have been used by the grass. As they grow taller, they are then able to capture more and more of the light for themselves too. There are few resources left for the grass, which becomes harder to find. Under natural conditions, fires keep the number of bushes in check. But where bushes grow into big thickets, there is not enough grass to keep fires alight, and those fires that do reach the bushes are not hot enough to kill them. The bushes in this case have successfully invaded the veld and barricaded themselves in. Active management will be necessary to restore the veld to its original potential (see Chapter 5).

Swaartak roots can stretch twice as far as its branches, less than 30 cm from the ground surface

Other plant problems

In general, poor grazing management means there are less different kinds of plants in the veld. But farmers tend to be most concerned about the loss of certain valuable plants, and their replacement with plants that have little or no value for people or livestock. Livestock eat the most nutritious plants first, and if grazing pressure is too high (especially during drought), these species are unable to survive. This gives the less nutritious plants an advantage and they gradually take over the veld. For example, it is common to see perennial grasses (that come up year after year from the same roots) replaced by less nutritious annual grasses (that come up from seed each year). Vast areas are now covered by Suir gras (Sour Grass or *Schmidtia kalahariensis*) that provides cattle with nutrition only for a short time when it is still green after rain. Because their roots are less substantial, they do little to hold the soil together in the dry season. Although many annual plants provide impressive ground cover after the rains, this is often short-lived: after a few months the ground will be bare again.

Annual plants rarely provide ground cover for long

In addition to thorny plants, poisonous plants become more common as the condition of the veld deteriorates. For example Slangkop (Snake's Head Lilly, Setswana and Latin) causes diarrhoea, bloated abdomen, heart failure and sudden death in livestock. Since there are few effective remedies for poisoning, it is better to try and prevent poisonous plants getting established in the first place through good veld management.

In addition to these problems, over-used vegetation doesn't respond to rainfall with as much growth as plants that are used more lightly. There is little rainfall in Botswana at the best of times: unhealthy veld can't even make the best of the rainfall it receives.

Of course, people can overuse the plants too: over-harvesting of trees has led to major fuel-wood shortages in some parts of Botswana, and in other places thatching grass is becoming increasingly difficult to find in sufficient quantity.

For ideas about how to manage areas experiencing these kinds of problems, see Chapter 5.

Soil Problems

1. What's in the soil?

Churned up soil is more easily eroded

Soil in this area is known to have very few nutrients for plants to feed on. This means that the plants themselves are not very nutritious for animals, which may need licks and other supplements. Because the areas around boreholes and villages are used by livestock more heavily, they are enriched with manure and urine. However where livestock are concentrated (e.g. if kraals are not moved around), these nutrients can reach poisonous levels and prevent the growth of vegetation for many years. Over-used soils away from boreholes or villages tend to have less dead plant material in them (rub the soil in your hands – they become less dirty). This material provides structure and nutrients to soils in more healthy veld. This dead plant material is slowly returned to the soil by ants, termites and beetles and becomes available to support plant growth in future years. Therefore, leaving *some* dead plant material on the ground through a dry season is an important way to improve grass growth in following years.

Healthy soils in this area have a living surface crust. Well developed living crusts are easy to spot, as they are coloured (usually brown or black) and bumpy, but young living crusts are invisible, and only possible to see if you prod the surface of the soil. Soils with living crusts break into thin, fragile plates, and if you lift them up you can see small fibres dangling beneath with grains of sand attached to them. These should not be confused for mineral crusts which are usually a sign of soil problems (they usually only occur on pan soils in this area). Living crusts benefit the soil in a number of ways:

Black bumps on the soil: living crusts

- Dissolving nutrients from sand and rock which can become available for plants to use
- Converting nitrogen from the air into a form that can be used by plants in the soil
- Binding the soil together, preventing it from being blown away and loosing nutrients
- Water is held for longer in the surface layers of the soil where grass roots are found.

2. Where's it going?

Livestock break up living soil crusts with their hooves, and if there are too few plants to hold the soil together, it can become easily transported by the wind. Dust-storms are an increasing problem, and may reduce the fertility of the already poor soil. In this area, it does not collect into dunes, but can sometimes be found collected around the base of bushes or against walls and other objects.

Dust storms are becoming more frequent

Secrets of Good Veld Management

1. Manage the veld, not just the livestock

As one local farmer put it, "It is not possible to be a cattle farmer in a place like this: you have to be a grass farmer." Livestock management is short-term, making changes from day-to-day and from month-to-month, rarely considering more than a year in advance. Veld management is a long-term activity that must be considered over a period of years.

To manage the veld effectively it is important to know how it has changed, and how it is likely to change in the future. There are a number of signs that can help answer both of these questions (Chapter 4). Only with this knowledge is it possible to select the most appropriate form of management to prevent the veld becoming worse or help it recover. If a short-term increase in your herd destroys the soil and plants upon which they depend, long-term losses are inevitable.

2. Set targets for your veld

"He that wavers is like a wave of the sea, driven with the wind and tossed."

Proverb

Without clear targets a farmer is at nature's mercy, riding on the crests of good years and hoping they will not be submerged by the troughs of drought. The majority of farmers have clear economic targets (whether this is in financial terms, or the number of livestock they aspire to own). However, far fewer set targets for their veld. Veld targets can be small or ambitious, but they should be achievable. For example, you may target a problem area of your veld for improvement, or you may wish to change the balance between grass and bush throughout your veld. A precise target is easier to work towards than a vague ambition: try and define your target as clearly as possible at the outset. For example, "I would like the dense patch of bushes between the borehole and the road to be thin enough to allow cattle to walk through", or "I would like the area between the borehole and the road to be dominated by grass with very few bushes". If your targets are ambitious, you are more likely to reach your target if you split them up into smaller, more achievable targets.

One easy way to set targets is to identify areas of the veld that you would like the rest of your veld to look like, for example parts of the veld that you know recover well from drought to support livestock year.

3. Prioritise and plan your management

Once you have set targets for your veld, you can start to think about which management options are going to help you meet your targets. In this way, you can prioritise your management activities, focussing on specific problems or areas to improve the productivity of your veld as efficiently as possible.

You will need to choose management options that suit your resources and available time. Some management strategies are costly, but if you have plenty of time or labour, you may be able to use cheaper alternatives. This manual provides a range of different options to suit different budgets, time-frames and available labour.

4. Manage for variety

Changes in veld management practices can lead to a reduction in the number of different kinds of plants in the veld. Plants that become problems if they take over, are often useful in small amounts. Veld that contains a variety of plants is valuable for a number of reasons:

- **Surviving drought:** Too many bushes can cause problems, but they should never be entirely removed from the veld. The leaves and pods that fall from thorn bushes can help cattle survive drought. If the veld is grazed intensively during drought, enough grass can be protected under thorn bushes to re-seed the veld and help it recover after the rain returns. They can also reduce the amount of soil that is eroded by the wind – the soil (and any seeds with it) is collected in by the branches of the bushes. The Motlopi tree (Shepherd Tree or *Boscia albitrunca*) is a well known source of feed during drought, and pods can be harvested from thorn tress like Mosu (Camel thorn or *Acacia tortilis*).

Bushes like Rosyntjiebos can be an important resource at certain times of the year

- **Providing food at different times:** When spring arrives, bushes become green first (often before rains) and edible bushes like Rosyntjiebos (Moretlwa, Velvet Raisin, Wild Raisin, Berry Bush or *Grewia flava*) can be an important source of feed for livestock. Edible bushes like this are also better able to make use of small rainfalls during the dry season. Throughout the year, different plants are important in livestock diets – without this variety, farmers are forced to supplementary feed more often.

- **Escape from insects and diseases:** If the veld consists mainly of one valuable species, an insect attack or disease that affects this species could be devastating. If you have a balance of different species, it doesn't matter so much if one species suffers heavily from insects or disease – the livestock have other options to fall back on.

In addition to this, some plants that may not appear to be valuable may provide food for the caterpillars of insects that pollinate valuable plants.

4 Warning Signs

This Chapter describes signs that can warn you when the health of your veld is deteriorating and when it is getting better. The signs are linked to management options in the following Chapter that could help your veld become better, or at least prevent it from getting any worse. Before using the warning signs in this Chapter, refer to Chapter 2: "How to Use this Manual".

Introduction

Early Warning Signs

Many of the signs described in this Chapter are designed to warn you when your veld is in poor health, and suggest what you can do to heal it. Some of them are *early* warning signs – they can warn that your veld is beginning to have problems that could lead to poor health in the future. Appropriate management action at this early stage could prevent the health of your veld becoming worse in the future – these changes in management are likely to much less expensive or time-consuming than the kinds of actions that may be necessary if the veld becomes damaged. If you think your veld is healthy now, it is therefore important to look out for these signs if you want it to remain that way. Early warning signs are shown in blue text.

By spotting early warning signs you can prevent future problems with veld health

Different signs for different parts of the veld system

Plants and the soil are usually the first parts of the veld to show signs of over-use, before there is any noticeable effect on the people, livestock or other animals that depend on them. Some plant and soil signs are therefore useful early warning signs. They can help you identify changes in management that can prevent the health of your veld getting worse or restore it to its full potential, so that livestock can continue to thrive.

Plant Sign

Soil Sign

In combination with plant and soil warning signs, certain changes in livestock, wild animals and insects can point to serious problems with the veld. Because these signs also appear during drought, they can only be used to diagnose problems with veld health if you can also see plant and soil signs. These signs usually only start to appear in veld that hasbeen experiencing problems for some time. Urgent action is required to protect your livelihood if you are seeing livestock, wild animal or insect signs – if nothing is done you will start to see the effects in your household.

Wild Animal or Insect Sign

Livestock Sign

People Sign

Summary

Early warning signs are shown in blue text.

Plant Signs

Soil Signs

Livestock Signs

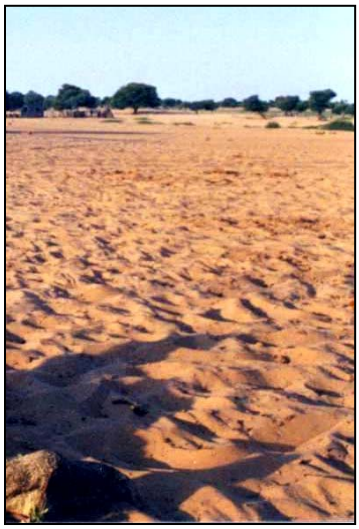
Wild Animal & Insect Signs

People Signs

Plant Sign

Vegetation Cover and Bare Ground

If the health of your veld is getting worse, one of the first and most obvious things you will notice is that there is less vegetation covering the ground, particularly grass, and more bare ground than usual after the rains.



Very Unhealthy → **Very Healthy**

Little or no vegetation, particularly grass (mainly bare ground), even after rain.

Plentiful vegetation, particularly grass, after rain. Little bare ground

Management Options:

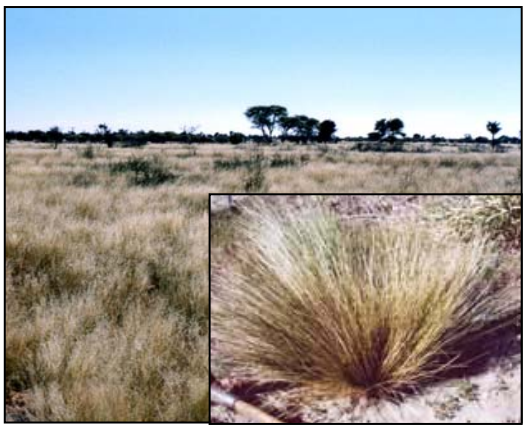
- Borehole Rotation p48
- Shifting Grazing p50
- Reduce Veld Pressure in Drought p51
- Change Livestock Breeds p54
- Protect and improve the soil p68
- Make dunes stable p71
- Manage Trees p75
- Consider Game Farming p55

Early Warning Sign

Plant Sign

Fewer nutritious grasses in the veld

Cattle eat nutritious grasses first, leaving less nutritious grasses to thrive. If the veld is not left to rest, sweet grasses gradually die out and are replaced by less nutritious grasses. In addition, heavy grazing and trampling can uproot or damage the grasses that come up year after year in tufts and these are often replaced by grasses that come up from seed each year. But these grasses are often only valuable for livestock when they are young and green. As the dry season progresses, these grasses die back and leave the soil bare once more. In contrast, healthy veld dominated by grasses that come up year after year may look bare in the dry season at first glance, but you can find stumps in the sand waiting to produce grass as soon as the rain comes. Cattle that are forced to eat poor grasses may develop Stiff Sickness (Aphosphorosis) (see p29)



Very Unhealthy → **Very Healthy**

The only grass that appears is from seed and is only useful while young and green.

Mainly nutritious grasses that come up year after year in tufts from the same roots

Management options:

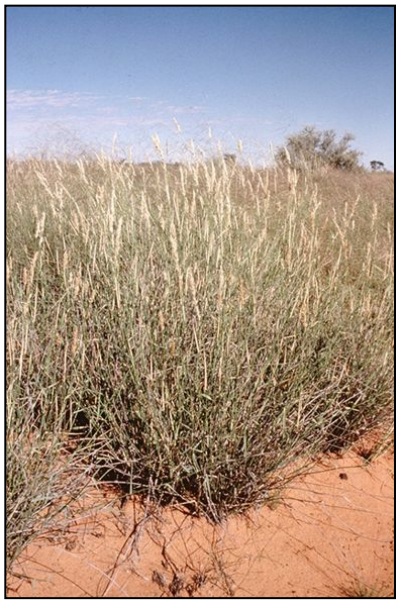
- Borehole Rotation p48
- Shifting Grazing p50
- Reduce Veld Pressure in Drought p51
- Change Livestock Breeds p54
- Protect and improve the soil p68
- Make dunes stable p71
- Manage Trees p75
- Consider Game Farming p55

Early Warning Sign

Examples of grasses to look for

An increase in Suir gras (Sour Grass or *Schmidtia kalahariensis*) indicates poor veld health.

Gha gras (Blankhaar or *Centropodia glauca*) (left) and/or Knietjies gras (Lehmann love grass or *Eragrostis lehmanniana*) (right) indicates healthy veld.



Plant Sign

Thorny Bush Invasion

To understand more about why and how thorny bushes invade productive grassland, see Chapter 3 (p10-11). The most common problem species in this area are Mokurubane (Driedoring, Threethorn or *Rhigozum trichotomum*) and Swartaak (Mongana, Blackthorn or *Acacia mellifera*) (see following page).

Very Unhealthy → **Very Healthy**

While still young, bushes may become so dense that cattle cannot pass through them (top). As they grow older, they thin out but little is able to grow between them (bottom)

Occasional bushes at very wide spacing

Management options:

- Bush Management 2: Control p60
- Bush Management 3: Adapt p64
- Better use of Mokurubane p57

Mokurubane (Driedoring, Threethorn or *Rhigozum trichotomum*)

Swartaak (Mongana, Blackthorn or *Acacia mellifera*)

Plant Sign

Thorny Bush Seedlings

If there are few thorn bushes in your veld, it may be useful to look for bush seedlings. If there are many seedlings and little grass, bushes may be about to become a problem. However, if there is thick grass cover (that hasn't been cropped to the ground), you need not worry – few of the seedlings are likely to grow into large bushes.

To understand more about why and how thorny bushes invade productive grassland, see Chapter 3 (p10-11). The most common problem species in this area are Mokurubane (Driedoring, Threethorn or *Rhigozum trichotomum*) and Swartaak (Mongana, Blackthorn or *Acacia mellifera*) (see previous page).

Very Unhealthy
Many thorny bush seedlings in veld *and* little grass cover

Very Healthy
There are few thorny bush seedlings in the veld, or if there are many seedlings, there is thick grass cover

Management options:

- Bush Management 1: Prevent p59

Early Warning Sign

Plant Sign

Less Rosyntjiebos

Rosyntjiebos berries (left) and flowers (right)

Among their many uses, these bushes are nutritious for both smallstock and cattle. Nutritious bushes like these are important because they can provide livestock with fodder during drought, provide the fodder before the first grass of the rainy season and help protect the soil from being blown away. What is the condition of your Rosyntjiebos (Moretlwa, Velvet Raisin, Wild Raisin, Berry Bush or *Grewia flava*) bushes? Are they looking less healthy than they used to after rain; are there less of them or less different kinds in your veld nowadays? If so, this is often one of the first signs that your livestock are putting too much pressure on the veld, and that there will be problems ahead. If there have never been any of these bushes in your veld, there is no need to be concerned about their absence – they are probably naturally absent from your part of the veld (do not use this sign).

Rosyntjiebos bushes in the dry season

Very Unhealthy → **Very Healthy**

There are few or no Rosyntjiebos left in the veld, and any that are left are in poor condition

There are plenty of healthy-looking Rosyntjiebos bushes in the veld (circled in red)

Management Options:

- Borehole Rotation p48
- Shifting Grazing p50
- Reduce Veld Pressure in Drought p51
- Change Livestock Breeds p54
- Protect and improve the soil p68
- Consider Game Farming p55

Early Warning Sign

Plant Sign

Less Witgat

The evergreen tree Witgat (Motlopi, Shepherd's Tree or *Boscia albitrunca*) is a valuable source of fodder and shade throughout the year (in addition to numerous other uses). This makes it particularly valuable during the dry season and drought. If these trees become scarce, livestock can be more vulnerable to drought. For this reason, it is taboo to fell these trees throughout most of Botswana. However, heavy browsing from smallstock can stunt young trees and prevent seedlings growing to maturity. This may lead to a slow reduction in the number of Motlopi over time. Remember that these trees naturally do not grow in some places – their absence from these areas is nothing to be concerned about. It should only be cause for concern in areas that have historically hosted the trees.

Very Unhealthy → **Very Healthy**

Few Witgat trees in areas that used to have many. Those that survive may be badly stunted from browsing.

Tall Witgat at wide spacing, no change from historical numbers of the trees

Management options:

- Manage Trees p70
- Borehole Rotation p48
- Shifting Grazing p50
- Reduce Veld Pressure in Drought p51
- Change Livestock Breeds p54
- Consider Game Farming p55

Witgat (Motlopi, Shepherd's Tree or *Boscia albitrunca*) with its characteristic while bark

Plant Sign

Less Vaalkameeldoring

Vaalkameeldoring (Mokholo, Grey Camel Thorn or *Acacia haematoxylon*) is an important browse tree for smallstock, and cattle eat the highly nutritious pods when they fall. Although never dense or tall, healthy veld is scattered with numerous Vaalkameeldoring. If they start to disappear, it is an indication that the health of your veld is declining.

Very Unhealthy → **Very Healthy**

No Vaalkameeldoring

Numerous small Vaalkameeldoring at wide spacing

Management options:

- Manage Trees p70
- Make Dunes Stable p71
- Borehole Rotation p48
- Shifting Grazing p50
- Reduce Veld Pressure in Drought p51
- Change Livestock Breeds p54
- Consider Game Farming p55

Vaalkameeldoring (Mokholo, Grey Camel Thorn or *Acacia haematoxylon*)

Plant Sign

Plants grow less after rain

Vegetation in healthy veld can produce more than twice the amount of plant material than vegetation in unhealthy veld with the same amount of rainfall. If the plants in your veld don't appear to respond as fast or well to rain as they used to, there may be problems ahead.

Very Unhealthy
Plants respond slowly and produce less material after rain

Very Healthy
Plants respond rapidly and produce large amounts of material after rain

Management options:

- Borehole Rotation p48
- Shifting Grazing p50
- Reduce Veld Pressure in Drought p51
- Change Livestock Breeds p54
- Protect and improve the soil p68
- Make dunes stable p71
- Manage Trees p75
- Consider Game Farming p55

Early Warning Sign

Plant Sign

Less thatching grass

If veld health is getting worse, it will become harder to find thatching grass. Examples of the kind of thatching grass that become harder to find are: ***Aristida meridionalis*** [Afrikaans/Setswana/English?] and Kalahari Duin Gras (Dune Reeds or ***Stipagrostis amabilis***).

Left: *Aristida meridionalis;* ***Right:*** *Kalahari Duin Gras (Dune Reeds or Stipagrostis amabilis).*

Management options:

- Regulate collection of thatching grass
- Make dunes stable p71
- Protect and improve the soil p68
- Reduce Veld Pressure in Drought p51

Signs that the soil is being blown away

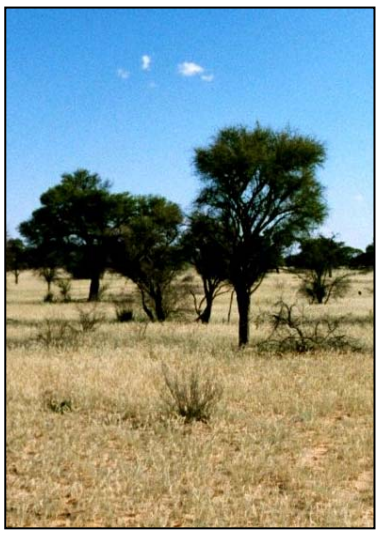
There are a number of soil warning signs that may appear if the veld becomes damaged. Some of the easiest to spot are signs that the soil is being blown away. This usually happens because: a) there are fewer plants to slow down the wind and hold the soil together with their roots; and b) living crusts (that hold the surface of the soil together and fertilise it) have been destroyed (see p13).

The three easiest ways to tell if the soil is being blown away is to look for: 1) an increase in the number and size of sand dunes that have no vegetation; 2) sand ripples; 3) tree roots becoming uncovered; and 4) small mounds or dunes collecting around the base of bushes (be careful not to confuse these with ant heaps which usually have a dip in the centre for the ants to enter, next to the stems).

Ring-shaped mound created by ants around bushes are not warning signs

Management Options:

- Make dunes stable p56
- Protect and improve the soil p74
- Reduce Veld Pressure in Drought p59
- Borehole Rotation p50
- Shifting Grazing 1: Seasonal p52
- Shifting Grazing 2: Annual p53
- Change Livestock Breeds p62
- Consider Game Farming p63
- Manage Trees p75



Very Unhealthy → **Very Healthy**

More and larger sand dunes with no vegetation growing on them, tree roots uncovered, and/or sand collecting around the base of bushes

No new, growing or moving sand dunes; sand dunes are covered with vegetation; tree roots remain underground, no sand collecting around bushes

Soil Sign

Soil becomes looser

Livestock break up the living crusts that bind the surface of the soil together with their hooves (see Chapter 3, p12-13). If livestock use is heavy and there are too few plants to hold the soil together, it can become easily carried away by the wind. This may reduce the fertility of the already poor soil.

Very Unhealthy
Soil is loose and churned up, runs through your fingers when you pick it up

Very Healthy
Soil looks undisturbed, the surface forms small plates when you pick it up

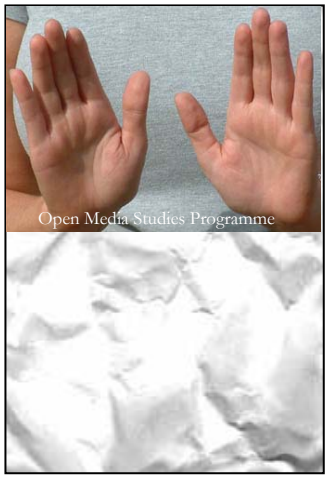
Management options:

- Protect and improve the soil p68
- Make dunes stable p71
- Manage Trees p75
- Reduce Veld Pressure in Drought p51
- Borehole Rotation p48
- Shifting Grazing p50
- Change Livestock Breeds p54
- Consider Game Farming p55

Soil Sign

Less "dirt" in the soil

Fertile soil is needed to produce nutritious grass. One of the signs that the soil is becoming less fertile is how dirty it is. Take some soil in your hands and rub them together – do they become dirty? Alternatively, add some water to some soil to make a paste and rub this on paper – does it make the paper dirty? If so, your soils are probably fertile. However, if your hands or paper remain pretty clean, there may be problems. Remember that the soil can vary naturally from place to place, but if the soil is getting cleaner each year, this may be cause for concern. If you use paper to do this test, you can keep the sheets for future reference.



Very Unhealthy
Soil is clean

Very Healthy
Soil is dirty

Management options:

- Protect and improve the soil p68
- Make dunes stable p71
- Manage Trees p75
- Reduce Veld Pressure in Drought p51
- Borehole Rotation p48
- Shifting Grazing p50
- Change Livestock Breeds p54
- Consider Game Farming p55

Early Warning Sign

Declining livestock condition and weight

You need to be careful not to mistake livestock experiencing drought or disease with livestock that have lost condition or weight due to the poor health of your veld. The management options suggested here will only work if you can see plant and/or soil signs *in addition to* changes in livestock condition. However, if you see these signs together, you can be sure that unless management action is taken soon, your livelihood will start to suffer. Most farmers are familiar with the signs of general condition and weight in their livestock: hair looses its gloss and becomes matted and/or dirty, shoulders and ribs become more visible etc.

Very Unhealthy
Despite rain and no disease, ribs and shoulders clearly visible, hair dull and matted, weak, dry nose etc.

Very Healthy
No bones visible, hair glossy and bright, strong etc.

Management options:

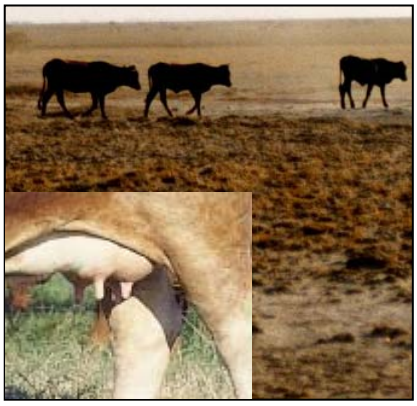
- Look for signs of disease or call Veterinary Services to make sure this is not the cause. If disease and drought cannot be blamed:
- If possible, focus management on the underlying cause of the problem rather than temporarily supplementing your livestock's diet
- This may involve temporarily moving your livestock to more healthy veld
- Supplement diet with fodder cut from trees (e.g. Motlopi leaves or Acacia pods) or purchased. Remember that this is only a short-term solution – you will need to tackle the underlying problem of veld health.
- Borehole Rotation p48
- Shifting Grazing p50
- Reduce Veld Pressure in Drought p51
- Change Livestock Breeds p54
- Consider Game Farming p55
- Protect and improve the soil p68
- Manage Trees p70

Motlopi (Shepherd's Tree, *Boscia albitrunca*)

Livestock Sign

Lower calving rate, milk yields and calf survival

Again, these can be signs of drought or disease, but in combination with plant and soil signs they provide further evidence that veld health is very poor.



Very Unhealthy
Despite rain and no disease, few if any calves are born, little milk is produced, and many of the calves that are born do not survive

Very Healthy
Many calves are born, the vast majority survive and milk is plentiful

Management options:

- Look for signs of disease or call Veterinary Services to make sure this is not the cause. If disease and drought cannot be blamed:
- Borehole Rotation p48
- Shifting Grazing p50
- Reduce Veld Pressure in Drought p51
- Change Livestock Breeds p54
- Consider Game Farming p55
- Protect and improve the soil p68

Livestock Sign

Cattle spend longer between drinking

If your cattle are spending longer between drinking, and have been doing so for a period of weeks and months (or longer), this may be a sign that there are problems with the health of your veld. As the condition of vegetation around your water point becomes worse, cattle walk further to find nutritious fodder. In order to reach more distant fodder, they are forced to stay away from the borehole for days at a time. Because of the extra energy they use walking, they are unable to maintain or gain weight as well as cattle in more healthy veld. This sign should not be used during the wet season or when Tsama (water) melons are available, as cattle naturally spend long periods away from water at these times.

Very Unhealthy
Cattle spend more than two days in the veld before returning for water

→

Very Healthy
Cattle return for water every day

Management options:

- Borehole Rotation p48
- Shifting Grazing p50
- Reduce Veld Pressure in Drought p51
- Change Livestock Breeds p54
- Consider Game Farming p55
- Protect and improve the soil p68

Early Warning Sign

Stiff Sickness (Aphosphorosis)

Although malnourished livestock become more susceptible to many sorts of diseases, it is difficult to prove a direct link between most diseases and veld health. The only disease that can reliably tell you about the health of your veld is Stiff Sickness. This can occur in any livestock but is most commonly seen in cattle grazing poor veld. It is caused when they are forced to eat poor grasses that lack enough nutrition, usually because there are no nutritious grasses available in unhealthy veld. Livestock that are suffering from Stiff Sickness tend to suffer from the following:

- Loss of appetite
- Bones become soft and deformed
- Bone are easily broken
- Lameness
- Lower milk production
- Less fertile

Very Unhealthy
Stiff sickness common among herd

Very Healthy
No stiff sickness in herd

Management options:

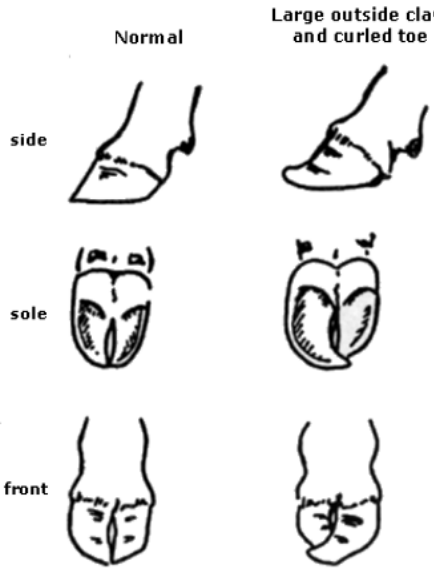
- If possible, focus management on the underlying cause of the problem rather than temporarily supplementing your livestock's diet
- This may require temporarily moving your livestock to veld that has more nutritious grass

- Supplement diet by cutting fodder from trees – the pods of most Acacia trees are high in phosphorus, and if they can be collected in sufficient quantity can be a cheap alternative to buying supplements. Remember that this is only a short-term solution – you will need to tackle the underlying problem of veld health
- Purchase a phosphorus supplement from your local supplier
- Borehole Rotation p48
- Shifting Grazing p50
- Reduce Veld Pressure in Drought p51
- Change Livestock Breeds p54
- Consider Game Farming p55
- Protect and improve the soil p68
- Manage Trees p70

Livestock Sign

More cattle suffer from "long claw"

If the soil has become loose, cattle's hooves are not worn away as fast as they would be in more healthy veld. Unless clipped, this leads to long, claw-like hooves which can make it difficult for the animal to walk.



http://www.dpi.nsw.gov.au/agriculture/livestock/beef/breeding/bulls/structural-soundness

Management options:

- Clip hooves more often
- Protect and improve the soil p68
- Make dunes stable p71

Wild Animal Sign

More mice

You are likely to find more mice in unhealthy veld – look for their holes and droppings.

http://www.montereybay.com/creagrus/Mouse_Striped-Jy05KGNP-w.jpg

Very Unhealthy → **Very Healthy**

An increasing number of mice — Few mice

Management options:

- Borehole Rotation p48
- Shifting Grazing p50
- Reduce Veld Pressure in Drought p51
- Change Livestock Breeds p54
- Consider Game Farming p55
- Protect and improve the soil p68

Insect Sign

Less and different kinds of ant in the veld

Ants are well known signs of veld health. As the health of your veld becomes worse, you are likely to see less ants and different kinds of ant – you are likely to keep coming across the same kinds of ant. The most easily recognised ant that prefers poor veld in this part of Botswana (particularly bushy areas) is known in Setswana as "Malelekatou" (*Pachycondyla sp.*). It has a large, grey abdomen, no sting and an unpleasant smell.

Very Unhealthy
There are less different kinds of ant in the veld, and Malelekatou are increasingly common

→

Very Healthy
There are many different kinds of ant in the veld, including a few Malelekatou

Management options:

- Borehole Rotation p48
- Reduce Veld Pressure in Drought p51
- Protect and improve the soil p68
- Shifting Grazing p50
- Change Livestock Breeds p54
- Consider Game Farming p55

Wild Animal

Less wild grazers in the veld

If livestock are allowed to over-use the veld, there is nothing left for wild animals. Because grass is usually the one of the first parts of the veld to suffer, wild grazers that prefer to eat grass will be the first to stop visiting your veld. Examples of the kinds of wild animal to leave the veld first include Gemsbok, Eland, Hartebeest and Wildebeest.

Very Unhealthy
Veld is never visited by wild grazers

→

Very Healthy
Veld is regularly visited by wild grazers such as Gemsbok, Eland, Hartebeest or Wildebeest

Management options:

- Borehole Rotation p48
- Reduce Veld Pressure in Drought p51
- Protect and improve the soil p68
- Shifting Grazing p50
- Change Livestock Breeds p54
- Consider Game Farming p55

Early Warning Sign

People Sign

Travel further to collect firewood

It is harder to find firewood in poor veld, and this requires people to travel further to find it, incurring time and costs.

Very Unhealthy → **Very Healthy**

Have to travel far to find firewood

Easy to find firewood nearby

Management options:

- Manage Trees p70
- Borehole Rotation p48
- Shifting Grazing p50
- Reduce Veld Pressure in Drought p51
- Change Livestock Breeds p54
- Consider Game Farming p55
- Make sand dunes stable p71

People Sign

Have to buy more veld products and feeds

When the veld is badly damaged, people are forced to buy products they used to get from the veld. Examples given by local people include honey, roofing materials, certain medicines and veld fruits and vegetables. There is also greater need to buy supplementary feed for livestock.

Very Unhealthy → **Very Healthy**

No longer able to find fruit and vegetables, thatching grass, honey, certain medicines and other products from the veld

Able to find plentiful fruit and vegetables, thatching grass, honey, medicines and other products from the veld

Management options:

- Manage Trees p70
- Borehole Rotation p48
- Shifting Grazing p50
- Reduce Veld Pressure in Drought p51
- Change Livestock Breeds p54
- Consider Game Farming p55
- Bush Management 2: Control p60
- Bush Management 3: Adapt p64
- Better use of Mokurubane p57

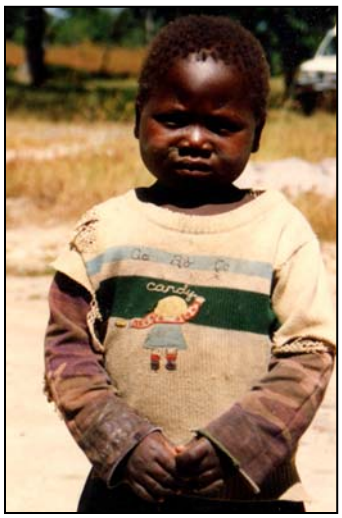
People Sign

Less money earned from livestock

Whilst costs are likely to rise in unhealthy veld, it also likely to be increasingly difficult to earn money from livestock because:

- There will be fewer calves born and those that are born are less likely to survive
- There will be more deaths because poorly fed livestock are more vulnerable to disease
- They will not maintain or gain weight well, so they will not fetch high prices
- If selling privately, signs that livestock are in poor condition can reduce the price people are willing to pay

As livestock become less and less profitable, people turn to other places to earn and save money. There are many other reasons why it can become hard to earn a living from livestock, so this sign can only be used to warn about how serious veld health has become if you can also see plant and soil signs.



Very Unhealthy
Not possible to earn money from livestock

→

Very Healthy
Livestock are highly profitable

Management options:

- Change Livestock Breeds p54
- Consider Game Farming p55
- Borehole Rotation p48
- Shifting Grazing p50
- Reduce Veld Pressure in Drought p51
- Bush Management 2: Control p60
- Bush Management 3: Adapt p64
- Better use of Mokurubane p57

5 Solving Veld Problems

This Chapter presents a range of management options that can improve the health of your veld, or at least prevent it from becoming worse. It focuses on the management of shared land without fences.

Introduction

Although there has been much written about the management of fenced veld (whether privately or communally owned), there is little guidance available to farmers who share unfenced veld. As a consequence, the majority of management options presented in this Chapter were suggested by local farmers, and further developed through collaboration between farmers and extension workers.

Although veld is being fenced throughout Botswana, the majority of farmers still share unfenced veld. In addition, whilst providing many benefits, fencing can also create a number of problems. For example, it is much easier to regulate stocking density, supplementary feeding and breeding in fenced veld. However, the vast tracts of land that are needed to support livestock are expensive to fence, making it harder to profit from improved production. If fencing can be afforded there are additional problems. Most notable is that fencing prevents livestock moving to better areas during drought. Unless the farmer owns other land, they are forced to rent land or supplementary feed. However, even with supplementary feeding, leaving livestock on fenced land during drought can cause irreversible damage to the veld. Some farmers therefore resort to dropping their fences during drought or use their community's shared veld and save their fenced areas for times of drought. Sharing fenced land among communities may be one solution to the problems of fencing and trials are about to start through the Indigenous Vegetation Project and the Ministry of Agriculture.

Scenes like this are often used to promote fencing. However they are often (as in this case from near Bray) simply an illustration of the effects of over-stocking: with or without a fence, if the stocking levels on the left of the picture had been applied in the veld on the right, there would be much less difference in the vegetation

Continuous, year-round heavy use by livestock is probably the single greatest cause of poor veld health in shared land. Problems are worse if only cattle are kept. As different kinds of animal select different diets, unless the part of the veld that they rely on (e.g. grass for cattle) is rested, it is unable to survive. The problem becomes most severe if livestock are allowed to use the veld through a drought. For example, in their search for food, cattle uproot and trample valuable grasses that become unable to regenerate from their root-stock and are replaced by less valuable grasses and other plants when the rains return. In a fenced ranch, veld is usually rested by dividing the land into fenced camps and moving the livestock from camp to camp. However, different strategies are required for unfenced land.

This Chapter presents a range of different management options for shared veld, but if there are simply too many animals, few of these options will work effectively. It may therefore be necessary to reduce the number of livestock before changing the way you manage the veld. By focussing on old cattle and donkeys first, it may be possible to reduce pressure on the veld and improve the productivity of the most profitable animals in your herd.

Summary

Borehole Rotation

Summary

Livestock from at least three boreholes are combined into a super-syndicate. The borehole with the most damaged veld is rested in the first year, while the herd is split between the remaining boreholes in the super-syndicate. The resting borehole is rotated each year.

What are the benefits?

- By resting the veld around your borehole regularly, you can improve its health and make sure it is possible to produce livestock successfully on your land year after year, into the future
- During times of drought, veld around the resting borehole can be used to reduce pressure on other boreholes in the super-syndicate. This can be done without reducing the number of livestock in your herd and prevents livestock from damaging the veld during drought when it is most vulnerable (if drought persists it may still be necessary to move elsewhere or sell livestock)

What do I need?

- You will need to be able to combine your herd with herds from at least two other boreholes to form a super-syndicate
- Boreholes should not neighbour each other (to prevent cattle returning to their original borehole) and should have high yields of sweet water

How do I do it?

1. Form a large syndicate with farmers from at least two other boreholes that do not neighbour yours;
2. Assess veld health at each borehole using the signs in Chapter 3. Rest the veld that is worst condition first by moving all livestock to the other boreholes in the syndicate. Although some livestock will inevitably use the area, pressure will be much less, giving the veld a chance to recover;
3. Take manure from kraals around the boreholes that are being used, and place piles of it in the veld around the resting borehole. Do not pile manure in bare areas around the borehole, as the soil is likely to have plenty of nutrients from the manure

dropped by watering livestock. The sun will dry the manure so that it can be spread around by the wind. If you do not want to spread species that are valuable for browse, you should avoid using smallstock manure. If browse is limited in your veld, this is an additional benefit of the approach;

4. In the first year, supplementary feeding may be needed to maintain the herd around fewer boreholes (the more boreholes you involve in the syndicate, the less this will be needed). If veld around all boreholes in the syndicate is in very poor health, supplementary feeding may be necessary until the veld around each borehole in the syndicate has been rested. In future years, regular resting and good veld health should enable the herd to be maintained sustainably around fewer boreholes.

What problems might I encounter?

- Everyone knows the challenges of making a syndicate of livestock owners work well together – the more people who are involved, the more challenging this can be
- It is not possible to use this approach in veld where boreholes are spaced closely, or if water yields are low or salty

Shifting Grazing

Summary

Rest veld around villages by a) reducing smallstock browsing pressure in the dry season; and b) reducing cattle grazing pressure in the wet season. Smallstock can be moved to cattle posts away from the village and provided with water by donkey cart or vehicle during the dry season. Herding can be made easier by allocating herds to different valleys between parallel dunes. Cattle can be herded to areas rich in Bitterwaatlemoen (Tsamma melon, wild watermelon or *Citrullus lanatus*) during the wet season.

What are the benefits?

Veld around villages tends to be heavily used by livestock, and can become easily damaged. By resting it annually it may be possible to reduce the amount of damage done, and prevent the area from becoming worse.

Bitterwaatlemoen (Tsamma melon, wild watermelon or *Citrullus lanatus*)

What do I need?

- A donkey cart or vehicle
- A container for transporting water
- Knowledge of where Tsama melons grow and at what times of the year

How do I do it?

1. Use signs from Chapter 3 to identify healthy veld for smallstock to use during the dry season;
2. In the dry season, set up cattle posts for smallstock in healthy veld away from the village and transport water there. If enough people do this, it may be possible to allocate farmers to valleys between parallel dunes along which herd boys or trained dogs can keep herds separate and prevent over-use of less healthy veld. This strategy is less labour-intensive than the traditional methods of herding livestock in different directions every day, which is not considered to be possible with current levels of labour;
3. Identify areas where Bitterwaatlemoen grow and herd cattle to these areas in the relevant season (usually March-June). Cattle can survive for 4-5 months without water in these areas.

What problems might I encounter?

- This strategy will not work during drought (see following page).

Reduce Veld Pressure in Drought

Summary

Some of the most severe and irreversible veld damage is caused by letting livestock use it during drought. If it is not possible to move or sell livestock at the beginning of a drought ("destocking"), generous supplementary feeding is important to reduce pressure on the veld. Given the expense of buying feed, options for growing or collecting your own feed are described.

What are the benefits?

- By reducing livestock pressure on the veld during drought you can prevent severe damage that could be impossible or very expensive to repair;
- Good management in drought is essential to maintain livelihoods and make profits from livestock.

What do I need?

Destocking

- To be in touch with your local agricultural extension officer to find out when droughts are imminent;
- A bank account to save money for restocking after the rain returns;
- If you are in a syndicate, you will need to try and get agreement from other members to destock as well.

Supplementary Feeding

- A high-yielding borehole, money to fence and permission from the Land Board to create an arable plot near your borehole;
- Or alternatively, space around your home to plant fodder crops – if you don't have a fence you will need access to thorn bushes to fence off your yard.

How do I do it?

Destocking

1. The sooner action can be taken, the less likely you are to damage the veld – action should be taken as soon as fodder begins to run out. The distance that cattle are walking to find fodder or the time they spend away from water is a good indication that action needs to be taken to ensure the area within easy walking-distance of your borehole does become irreversibly damaged (p40);

2. Most people have family or friends in other areas where they can move livestock during times of drought. If you do not know anyone in a less affected area that is willing to take your livestock, you should consider selling. In addition to protecting your veld, if you do this early, your livestock will still be fat and healthy, providing you with a good price. This money can be saved for restocking after the rains return, in the knowledge that your veld will be able to recover rapidly from the drought because you did not over-use it when it was most vulnerable to damage. If you are part of a syndicate, it is important to try and get agreement from other members to move or sell their livestock, in order to give the veld a chance to rest and recover;
3. Wait until there has been good rain and the grass has had a chance to respond well before restocking. You may consider restocking gradually. Restocking too much too early can cause as much damage as if you let them use the veld throughout the drought.

Supplementary Feeding

Supplementary feeding at low levels to keep livestock alive through drought can cause serious damage to the veld, as they still rely on whatever they can find, trampling and uprooting valuable grasses and damaging the soil. However, generous supplementary feeding that reduces the reliance of livestock on the veld can protect it from damage. Although it is possible to grow or collect fodder, it may only be possible to get enough to support a much smaller herd. It may therefore be necessary to use this in combination with destocking to protect the veld and your livelihood during drought;

1. Collect fodder from trees, for example Acacia pods or Motlopi leaves;
2. Many people have fenced yards around their houses that could be used to plant fodder crops. If you don't have a fence, material from bush clearance (see p60) can be usefully used to keep out livestock. *Dolichos lablab* is also a nutritious fodder plant and has been shown to be drought-resistant on farm trials in Botswana. Details about how to obtain seeds can be obtained from your local agricultural extension office. Saltbush is also recommended for this area and can provide nutritious and mineral-rich feed for all types of livestock. It is able to tolerate salty water and can reduce the need for salt-licks. However because of its salt content, this plant can only be used as a supplement to other feeds. Seeds can be obtained from local Ministry of Agriculture offices;

3. If you have a high-yielding borehole and enough money to fence a small plot of land, you could consider applying for an arable allocation from the Land Board. If this is located near the borehole, the land is likely to be fertile from the manure of watering livestock and herd boys can easily irrigate the crops. However, beware of locating your plot where there was once a kraal (even if it was moved a long time ago), as the soil in these areas can be toxic to plants.

What problems might I encounter?

Destocking

- It can be difficult to tell if the rains are late or whether there is going to be a drought – it is best to listen to advice from your local agricultural extension officer;
- If you don't sell early enough, your livestock will loose weight and sell for lower prices at the Botswana Meat Commission. If you are selling privately, leaving it too late may result in very low prices indeed.

Supplementary Feeding

- It may take time to get the relevant permission from the Land Board;
- It can be difficult to keep livestock out of yards with people coming in and out.

Dolichos lablab

Saltbush

Change Livestock Breeds

Summary

Certain livestock breeds put less pressure on the veld but can provide you with similar or better returns.

What are the benefits?

Although relatively expensive initially, certain breeds of livestock may put less pressure on the veld whilst providing you with the same or better returns:

- Drought-resistant cattle breeds such as Brahman (and their crosses) are able to walk further than other breeds, spreading and so lessening their impact. It is possible to make similar profits with less stock as they reach marketable weight faster, and they are more likely to survive drought;
- Where markets are available, a small herd of Karakul sheep can provide far higher financial returns than larger herds of other breeds. They are able to walk further than other breeds of smallstock, reducing the impacts on the veld. In addition to this, because lambs are slaughtered before they are able to reproduce, overstocking much less likely than with other breeds.

Karakul lambs

What do I need?

- Access to improved livestock breed through market or artificial insemination

How do I do it?

- Purchasing an improved breed bull can be very expensive, however if you belong to a syndicate it may be possible to split the cost between the members. Although the bull may mate with cows from other herds, if boreholes are adequately spaced, it is likely that your cows will benefit from the large majority of its services;
- Alternatively, you can pay for artificial insemination, where semen from an improved breed bull is inserted into the cow to create a pregnancy. Contact your local Ministry of Agriculture office for details;
- A breeding herd of Karakul sheep must be purchased.

Brahman bull

What problems might I encounter?

- It will not be possible to get pure breeds without using artificial insemination or controlling which cows are mated with fencing
- It may be difficult to find a market for Karakul pelts

Consider Game Farming

Summary

You may wish to consider game farming if your veld is unhealthy for cattle, but the costs and risks associated with this option are considerable.

What are the benefits?

Game need less water per head than cattle, are less likely to cause damage to veld vegetation (especially bush invasion) as they browse bushes and are less choosy in what they graze. This also makes game farming suitable in bushy areas (although these are less well suited to game viewing). They are also more resistant to drought than livestock. Game farming for meat can be supplemented by photographic tourism and the sale of hunting licences (at different times of the year). There are examples of unfenced "nature conservancies" and game ranches managed by community groups elsewhere in the Kalahari (particularly in Namibia) that have been highly profitable.

What do I need?

Permission must be sought from your local Land Board and the Department for Wildlife and National Parks, boreholes must be drilled and the land fenced. It will be necessary to either employ someone as a ranger or share this task between members of the consortium. Breeding animals must be purchased.

How do I do it?

Note: this manual provides a basic overview of the kinds of issues you will need to consider. If you are seriously considering establishing a game farm, you should read and consult widely.

1. Do some market research to decide whether you will manage for meat, hunting or photographic tourism. For example, where can I sell bush meat, for how much, how stable is the market? What kind of animal are in most demand? Is it possible to tap into markets in neighbouring countries – what permissions would I need to get? Who else is selling bush meat, where and for how much? How much is it going to cost to provide water, fence, stock and maintain the farm? Where can I buy stock? Similar questions need to be asked about markets for hunting and tourism.
2. Obtain permission to drill boreholes and fence from the Land Board and construct game fences. You may consider forming a syndicate with other farmers to spread costs and risks, and cover a larger area. If it is possible to provide a number of widely spaced water points, it is possible to manage game without internal fences (camps), reducing the cost of fencing. You will need to obtain

permission for this from the Department of Wildlife and National Parks (Tel. 3914955);

3. Choose the game you want to stock the farm with. The following animals are suitable for bush meat and can be kept in southwest Kgalagadi: Gemsbok (grazer), Springbok (browser & grazer), Blue Wildebeest (grazer), Eland (browser & grazer), Red Hartebeest (grazer) and Ostrich (grazer). You will need to vary the proportion of browsers to grazers, depending on the amount of bush and grass in your veld. Most of these species can eat both grass and bush in times of need. However, if your veld is not very healthy or the area of land available for grazing is limited, it may not be wise to stock Blue Wildebeest, as they are not able to switch easily from grass to bush fodder. For photographic tourism, you may want to consider stocking Lion, Cheetah, and/or Leopard;
4. South African researchers have estimated that in a "typical year", Kalahari sandveld can support around 4-6 Animal Units (AU) per 100 hectares (Gemsbok = 0.56 AU; Blue Wildebeest = 0.50 AU; Red Hartebeest = 0.37 AU; Springbok = 0.15 AU; Eland = 1.08 AU). Although it is possible to calculate carrying capacity in order to work out how many game you should keep, there are problems with this approach. Although it is possible to use conventional methods and convert game into Animal Units, many of the smaller antelope are territorial or use very restricted areas, so it would make more sense to work out stocking rates and population size on the basis of the area that a typical antelope occupies. It is also difficult to work out how much the veld is being used by other small wild animals when calculating carrying capacity. Most importantly, the variable and unpredictable nature of rainfall means that carrying capacity changes from year to year. For this reason, it may be more useful to monitor the condition of your veld from year to year using the warning signs in Chapter 4 and change stocking density accordingly.

What problems might I encounter?

The initial cost will be prohibitive to most farmers, and relevant permissions must be obtained. It is essential to draw up business and management plans before embarking on this kind of project. Profitability depends on the availability and size of markets for game meat, photographic tourism and hunting.

Better use of Mokurubane

Summary

Two options for making more productive use of Mokurubane (Driedoring, Threethorn or *Rhigozum trichotomum*) are suggested: 1) grinding the bushes up to make livestock feed; 2) the harvesting of flowers and pods for storage and later use; and 3) using the branches to stabilise dunes (see p71).

What are the benefits?

Although Mokurubane is highly prized by all kinds of livestock (especially smallstock) for its highly nutritious flowers and pods, the flowers only last for 14 days and once the pods have been used, the bush has little value for livestock. The bush is most common in heavily used areas where it takes the place of grass, and is viewed as a problem in South Africa where it is often cleared. However, given its high value for part of the year, opinion is split about Makurubane in Botswana. Clearly, any way to make more productive use of the shrub at other times of the year would be of great value to local farmers.

What do I need?

- To grind Mokurubane you will need access to a hammer mill (see right). Cutting machinery would be useful, but it can be done by hand
- Somewhere dry and dark to store dried flowers and pods

How do I do it?

a) Grinding

1. Young bushes (1-2 years) make the most nutritious fodder. Areas of old bushes must therefore be cut first. They should not be uprooted – in this way they are able to re-sprout from their base and the roots hold the soil together, reducing the amount that can be blown away. The bushes can be cut near the ground using a tractor with bush cutting attachments, or can be cut by hand. This material has been used successfully to stabilise dunes in South Africa (once dunes are stable, grass can begin to take root) (p71);
2. The following year, the branches that have re-sprouted can be harvested;
3. These can then be fed into a hammer mill to produce fodder that can be used by all kinds of livestock.

b) Harvesting flowers and pods

1. Many more flowers and pods are produced than can be consumed by livestock each year. However, it is possible to harvest surplus flowers and pods. This is best done by hand. If there is a danger that all surplus flowers will be harvested, it is better to wait and collect the pods as these are more nutritious. However where it is unlikely that it will be possible to harvest all the flowers, these can be collected before the pods start to appear, before the pods are collected;
2. Dry the pods and flowers, taking care not to let the dried flowers blow away;
3. Store in a dry and dark place for use during the dry season or drought.

What problems might I encounter?

Because Mokurubane only flowers and fruits after 3 years, you can *either* grind whole bushes *or* harvest flowers and pods in any one area. It is not possible to grind whole bushes after they have flowered and fruited as they are too old to be valuable as ground fodder. However, different areas of bush can be used for grinding and harvesting.

Bush Management 1: Prevent

Summary

Good veld management, particularly during drought, can prevent the spread of unwanted bush.

What are the benefits?

If bushes take over your veld, it will become increasingly difficult to support cattle, and in severe cases can limit sheep production. Removing bushes can be expensive and/or time-consuming, so it is worth doing what you can to prevent them becoming a problem in the first place.

How do I do it?

Although many farmers recommend water reticulation to prevent bush taking over, the Land Board will only grant permission under certain circumstances and it can take a long time to get permission. In addition, it will only prevent the spread of bushes if livestock remain at their original numbers – if herd sizes increase to similar densities, reticulation may simply cause bush to spread into new land, creating a much bigger problem.

- Because goats and sheep browse bushes and their seedlings, it is possible to prevent bushes from spreading by increasing the number of smallstock in your herd. Advice about the amount of smallstock you will need varies from one to six smallstock for every cow. You will need to experiment to see how many you need to stop bush seedlings growing to maturity;

- Good veld management is the best way to prevent bush taking over, but this is particularly important during drought. Most of the management options in the Chapter can help prevent the spread of unwanted bush, but options for reducing the impact of livestock on veld during drought (p51) are particularly relevant.

Bush Management 2: Control

Summary

If bushes are already a problem in your veld, there are a variety of ways in which you can control them. A number of options are described, ranging from expensive to cheap and (almost) free.

What are the benefits?

If bushes take over your veld, it will become increasingly difficult to support cattle, and in severe cases can limit sheep production. By reducing the amount of bush in your veld, it can be possible to increase the number of grass and other plants that are valuable for grazing, and therefore increase cattle production.

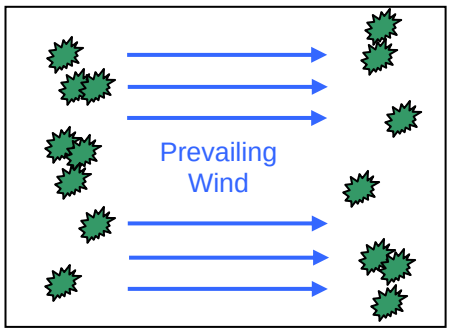
What do I need?

There are various options for controlling bush, varying from expensive and fast methods to methods that will cost you nothing but may take longer or more work to implement:

- Herbicide: if purchased in granular form and applied to the soil at the base of the bush, only the chemicals are needed – no equipment
- Uprooting: Digging machinery is necessary unless it is possible to pay herd boys or work with the rest of the community to uproot by hand
- Stem burning: wood and matches
- Stem cutting: axe or other cutting implement; herbicide, diesel, turpentine-based paint or paraffin if treating cut stems above-ground; spade if cutting stem under-ground
- Smallstock browsing: a herd of smallstock (preferably goats), fencing or the capacity to tightly control grazing patterns through herding

How do I do it?

It is important to remember that having some thorn bushes in your veld can be very useful, particularly to support livestock through drought and to prevent the soil being blown away (see Chapter 3). Widely spaced bushes are natural in most veld, and you should never try to completely get rid of them. If your bush is particularly dense, consider leaving strips of bushes in the veld. If you arrange the strips against the direction of the prevailing wind, you can maximise their ability to protect the soil (see diagram).



a) **Herbicide**

Herbicide should always be used with caution due to the health and environmental risks (to the person applying and wider effects if it gets into the ground water).

Herbicides that can be applied to the soil at the base of the bush (rather than to the plant itself) are usually cheaper and less time consuming to apply. If purchased as granules, they can be applied easily by hand, so it is not necessary to purchase any extra equipment. They should be applied before the rains as the herbicide only becomes active once it has been washed into the soil. They can prevent new bush seedlings from growing for up to 4 or 5 years. Examples of herbicides that can be applied to the soil around bushes include Tebuthiuron, Ethidimuron and Bromacil. For details of where to purchase these products, contact your local Agricultural Extension Office.

b) **Uprooting**

Although this can be done by hand, it is very difficult and time consuming because most bushes have deep tap roots that they can re-sprout from unless it is properly removed. Hiring a digger is therefore recommended for this approach. Although this is expensive, it has been suggested that it may be cheaper than using prescribed fire (because of the lost grazing) or goats (due the cost of buying a large enough herd). A cheaper way to do this is to pay herd boys a small bonus for every bush they uproot. It is easy to count the number of uprooted bushes for payment. Alternatively, members of a syndicate or village can work together to uproot bushes by hand.

If uprooting large areas, leave strips of bush lined against the prevailing wind to prevent soil being lost, and consider breaking the bushes up and laying them over the soil. In addition to protecting the soil, they will protect grass seedlings from grazing until they well established. As they break down, they will release nutrients back into the soil. If the majority of bushes are young (less than 2 years old), you could consider grinding them into feed with a hammer mill.

c) **Stem cutting**

Most bushes re-sprout if you try and cut them, but there are ways to make this approach work effectively:

- Follow up above-ground stem cutting with smallstock browsing (see below);
- Paint the above-ground cut stems with herbicide, diesel, turpentine-based paint or paraffin;
- Hollow out the ground around the base of the bush and cut stems 10-60 cm beneath the ground (cutting lower beneath the ground for larger bushes).

Bushes in on the right of this photograph were cut 10-60 cm beneath the ground by the Ministry of Agriculture, and grazing was excluded for a year to produce this result. Bushes on the left of the photograph were left.

Expensive

Cheap

Fill earth back over stumps.

- If stem-cutting large areas, leave strips of bush lined against the prevailing wind to prevent soil being lost, and consider breaking the bushes up and laying them over the soil. In addition to protecting the soil, they will protect grass seedlings from grazing until they well established. As they break down, they will release nutrients back into the soil. If the majority of bushes are young (less than 2 years old), you could consider grinding them into feed with a hammer mill.

d) **Stem burning**

This approach should only be used in veld where there is very little grass, or else it could start an uncontrollable fire. If there is enough grass to start a hot fire, it is possible to use this to reduce bush cover. However this should only ever be carried out be trained and experienced farmers. For this reason, it is not covered in this manual. Most bushes draw their reserves down into their roots during the dry season. For this reason, although the bush may burn more easily it is unlikely to be killed. Stem burning therefore most successful when bushes are in leaf.

Stem burning is most successful when bushes are in leaf

1. Collect wood and/or dry dung (and a little dry grass or twigs to start the fire). Dung is useful because it smoulders for some time, but it is not essential to use this;
2. Pile your material around the base of the bush (see photo);
3. Light fire and allow to smoulder (because there is very little grass there is little danger of the fire getting out of control).;
4. It may be necessary to do this more than once to some bushes, but two burns will kill most bushes.

This approach is easiest to use on larger, more open bushes, and takes a lot of time. But it is cheap and effective.

e) **Smallstock browsing**

Smallstock browsing alone can prevent bushes from spreading but will not kill them. However in combination with cutting or stem burning, it can be very successful. Follow up stem cutting or burning with heavy smallstock browsing after the bushes have re-sprouted until there are little or no leaves left. In this way it is possible to kill 6 or 7 out of every 10 bushes. The new growth is more nutritious and will attract the smallstock.

What problems might I encounter?

a) **Herbicide**

- Soil applied herbicides do not work for all types of bush. Some need herbicides that can be applied directly to the plant (more expensive, requires spraying equipment and is time consuming to apply).
- Although effective, herbicide is one of the most expensive ways to control bush, and it may take many years for you to regain the money you spent through increased cattle production. If you can afford herbicide, you should only consider using it if the cheaper options described below are not possible.

b) **Uprooting**

- Expensive to do mechanically, but is cheaper if done by herd boys or by the community at large
- Disturbs the soil, which can contribute to it being blown away if large areas are uprooted. If doing this work on a large scale, leave strips of bush lined against the prevailing wind and consider cutting up the bushes and laying them on the soil.

c) **Stem cutting**

Local alternatives to herbicide (e.g. paraffin) have been recommended by farmers, but there have been no systematic trials to demonstrate how effective they are.

d) **Stem burning**

Only stem burn in veld with little grass when bushes are still green. Fires that get out of control can damage vast areas of veld, and may lead to legal proceedings against you

Stem burning in veld with lots of grass can lead to uncontrolled fires. This massive fire in South Africa (seen via satellite) was stopped by a firebreak

e) **Smallstock browsing**

Success depends on browsing the cut area heavily. To make browsing intense enough, it is usually necessary to fence the area first or herd them carefully. The heavy pressure from the smallstock is likely to churn up the soil, and because there is less bush cover it is more likely to be blown away. Once this treatment has been used, it is essential to rest the veld to let it recover, and this too can be difficult without fences.

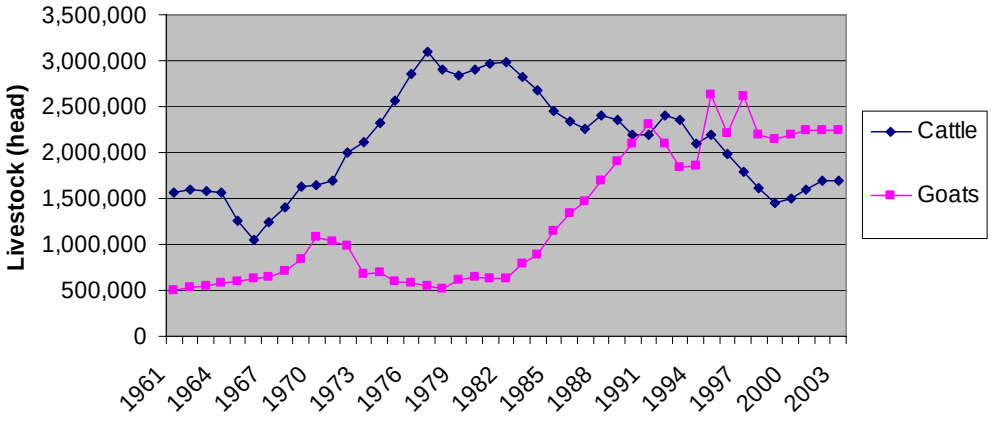
Bush Management 2: Adapt

Summary

An alternative to controlling bush is to make better use of it – look at it a different way and you may realise that your bush is a resource instead of a problem.

What are the benefits?

Chapter 3 described some of the bush benefits that are often overlooked. But they can do more than just provide fodder in drought and protect the soil. For a smallstock or game farmer, they are an important resource to be protected and managed carefully. The number of smallstock in Botswana has increased dramatically in recent years (there are now more goats than cattle). It is unclear to what extent this is due to the Government's Financial Assistance Plan or the increasing amount of bush in the country's veld – it is probably due to a combination of the two.



Cattle and goat populations in Botswana, 1961-2003 (Source: United Nations Food & Agriculture Organisation)

Game need less water per head than cattle, are less likely to cause damage to veld vegetation (especially bush invasion) as they browse bushes and are less choosy in what they graze. They are also more resistant to drought than livestock. Game farming can be supplemented by the sale of hunting licences. There are examples of unfenced "nature conservancies" and game ranches managed by community groups elsewhere in the Kalahari (particularly in Namibia) that have been highly profitable.

If you have access to a good market (e.g. a nearby town), problem bushes and trees can be used to make charcoal. Swartaak (Mongana, Blackthorn or *Acacia mellifera*) has been used successfully to produce charcoal.

What do I need?

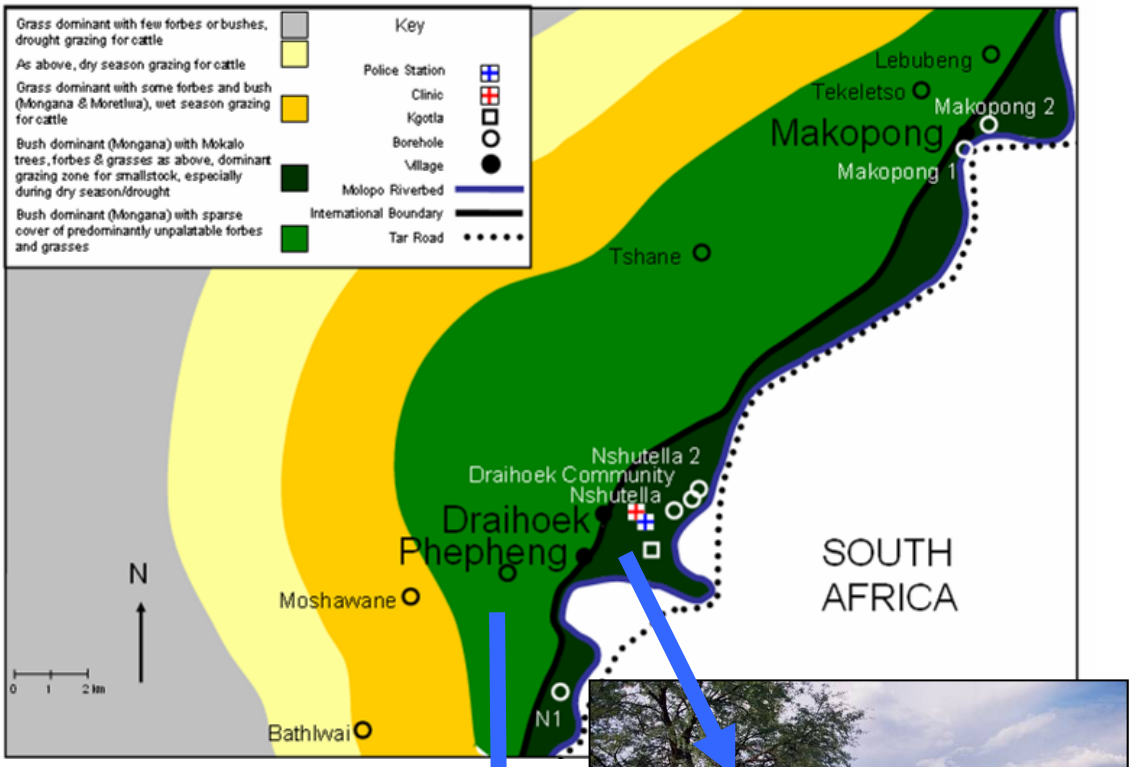
Smallstock: The ability (and desire) to reduce cattle numbers and increase the number of goats and sheep in your herd

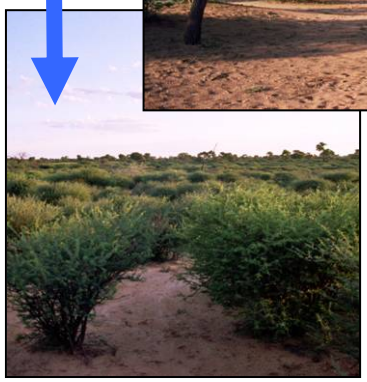
Game farming: See p55

Charcoal production: An old oil drum or other air-tight metal container and a chisel

How do I do it?

Smallstock: This manual assumes a basic knowledge of smallstock management. It should be noted that in areas where bushes have been dominant for many years, there is less browse available than in areas that have been invaded more recently. As they grow older, they become more widely spaced and much of the foliage becomes out of reach for smallstock. Usually bushes invade around boreholes first, and gradually spread out into the surrounding veld. It may therefore be advisable to create a smallstock kraal further from the borehole, near the edge of the bushy zone where bushes are younger, more dense and more easily within the reach of smallstock.





Top: Transporting water to smallstock kraals to the light-green area enables them to make use of younger bushes

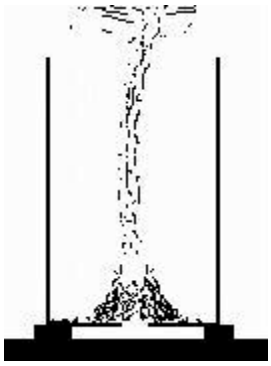
Middle: As bushes grow older, they become more widely spaced and foliage can become out of reach from smallstock

Bottom: The foliage of younger bushes is closer to the ground and they often grow more densely

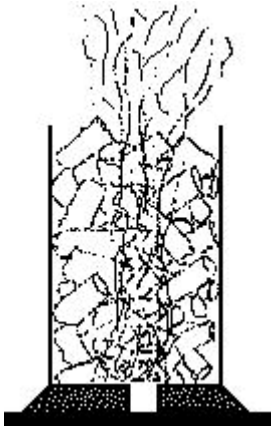
Game farming: For suggestions on how to start a game farm see p55.

Charcoal production:

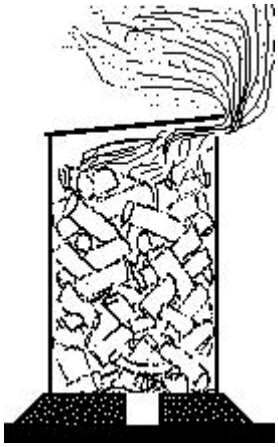
You will need to get hold of an old oil drum (or larger metal container – the following notes are based on a 55 gallon oil drum but can be easily adapted for larger containers)



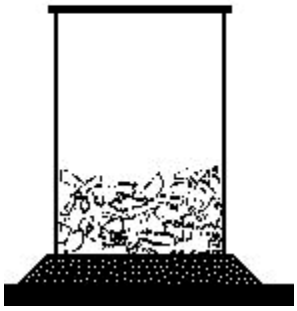
1. Using a chisel prepare the drum by making five 50mm (2in) holes in one end and completely removing the other. Knock-up the cut edge of the open end to form a ledge (Note, the lid will have to placed back on this ledge and made airtight)
2. Position the drum, open end upwards, on three bricks to allow an air flow to the holes in the base
3. Place paper, kindling and brown ends (incompletely charred butts from the last burn) into the bottom of the drum and light



4. Once it is burning well, load branchwood at random to allow air spaces until the drum is completely full. Keep the pieces to a fairly even diameter but put any larger ones to the bottom where they will be subjected to a longer burning



5. When the fire is hot and will clearly not go out, restrict the air access around the base by using earth placed against it, but leaving one 100mm (4in) gap. Also place the lid on top, leaving a _small_ gap at one side for smoke to exit
6. Dense white smoke will issue during the charring process. When this visibly slows, bang the drum to settle the wood down, creating more white smoke



7. When the smoke turns from white (mainly water being driven off) to thin blue (charcoal starting to burn) stop the burn by firstly closing off all air access to the base using more earth, and secondly by placing the lid firmly on its ledge, and making it airtight by the addition of of sods and soil as required. The burn will take between three and four hours
8. After cooling for about 24 hours, the drum can be tipped over and the charcoal emptied out onto a sheet for grading and packing.

Source: Raymond Tabor (1994) Traditional Woodland Crafts. London: Batsford

What problems might I encounter?

Smallstock: Currently the Botswana Meat Commission buy few smallstock, and most are sold privately. This means that the market is not as stable as it is for cattle – prices can change dramatically.

Game ranching: See p55

Charcoal production: You need to find a good market for your charcoal if this is to be profitable.

Protect and improve the soil

Summary

There are a range of different options for protecting and improving the soil that take little time or effort.

What are the benefits?

By protecting and improving the soil, you can produce more nutritious fodder that will benefit livestock production.

What do I need?

A shovel, and a vehicle or donkey cart for transporting manure

How do I do it?

Any action that helps maintain vegetation cover will help prevent the soil being blown away. Research in southwest Kgalagadi has shown that severe soil loss occurs if vegetation cover drops below 14%. For this reason, most of the management options in the Chapter are relevant for preventing soil from being lost or damaged. Maintaining vegetation cover is particularly important during drought, when most soil is lost to the wind (see p16-17). In addition to the other management options in this Chapter, you may consider the following:

- Avoid felling trees near boreholes where vegetation cover is likely to be lowest. Trees slow the wind down, reducing its ability to move sand;
- If there are no other trees available, try pollarding the trees near your borehole (see p70);
- If you are clearing bush, leave strips of bush lined against the prevailing wind to prevent soil being lost ("windbreaks") (see p60);
- Move kraals around regularly so that they do not make the soil poisonous for plants.

Few farmers can afford to apply artificial fertilisers to their veld, but there are other ways to improve the soil's fertility:

- Manure and urine builds up in kraals and can prevent plants growing there for many years. However, if the manure is collected and transported elsewhere in your veld, you can prevent the kraal soil becoming poisonous at the same time as enriching the soil elsewhere. Few farmers have the time or resources to spread manure, but you can let the sun and wind do the job for you. Pile your manure in open parts of your veld in the dry season – the sun will dry it out and

the wind will scatter it around for you.

- If you are clearing bush, break the bushes up and lay them over the soil. In addition to protecting the soil, they will protect grass seedlings from grazing until they well established. As they break down, they will release nutrients back into the soil.

What problems might I encounter?

- It may take time for dung to be properly distributed and incorporated into the soil. The time it takes will depend to an extent on weather conditions (wind and rain) and these are never predictable.

Manage Trees

Summary

Careful use of trees in certain areas can protect the soil and help continue to provide resources from trees into the future.

What are the benefits?

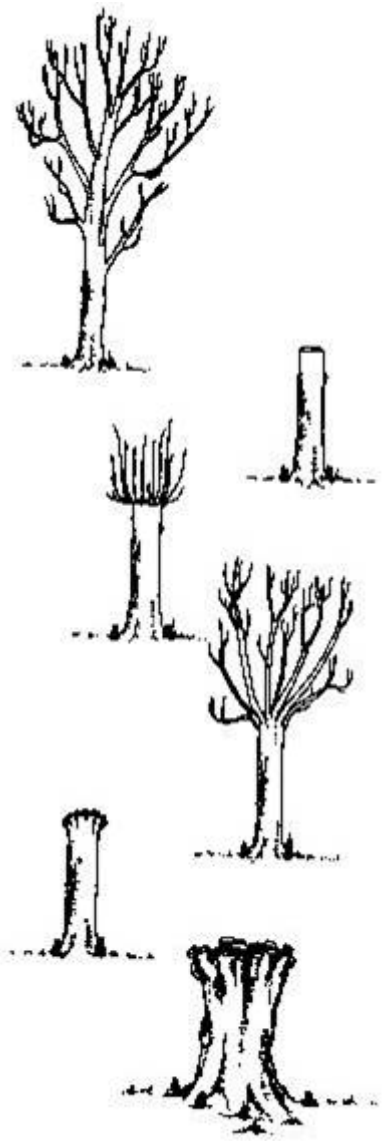
Trees provide numerous important resources, including fodder for livestock during drought from leaves and pods, and prevent the wind from blowing the soils away. Careful use of trees in certain areas can therefore bring many benefits.

What do I need?

An axe

How do I do it?

- Avoid felling trees near boreholes where vegetation cover is likely to be lowest. Trees slow the wind down, reducing its ability to move sand;
- If there are no other trees available, try pollarding the trees near your borehole – instead of cutting them at the base, cut them at shoulder height where the re-growth will be out of reach from browsing animals. The diagram to the right shows how a tree that has been cut at shoulder height produces shoots which grow into new branches that can be harvested again. Pollarded trees can give you a long-term source of wood (and fodder, depending on the kind of tree), and by keeping trees near your borehole you minimise damage to the soil from the wind.



What problems might I encounter?

Not all kinds of tree pollard, and it is not known which of the trees that grow in this area will successfully pollard. Most Acacias are known to pollard well.

Make dunes stable

Summary

Two methods for making dunes stable are described. Although likely to be less effective than fencing and re-seeding, cuttings from bush clearance are a significantly cheaper alternative.

What are the benefits?

Bare dunes are no use to livestock and can threaten buildings and roads. Plants are unable to take root and get established on moving dunes. However, if dunes can be made stable, grasses and other nutritious plants have a chance to grow, making the dunes even more stable, as well as useful.

What do I need?

- Fencing or material from bush clearance to protect dunes from livestock while they are being treated
- Seeds collected from local plants if no bush material is available

How do I do it?

a) Fence and seed

1. Fence off dunes, leaving corridors for livestock to reach water if dunes are located around a borehole;
2. Collect seeds from local plants: nutritious grasses that come up year after year have well developed root systems that will help make the dune stable, and will be useful for livestock at a later date. Kalahari Duin Gras (Kalahari Dune Grass or *Stipagrostis amabilis*) (p73) is well suited to dunes and will grow easily, in addition to being palatable for cattle, sheep and donkeys (especially after rain) and useful for thatching. Seeds from trees and/or bushes are also needed. Choose species that will be useful for browse and that you have observed growing successfully on dunes e.g. Vaalkameeldoring (Mokholo, Grey Camel Thorn or *Acacia haematoxylon*) (p73);
3. Leave to regain vegetation cover. Once the dune is stable, you can try allowing a small number of animals in to the enclosure to use the fodder that has grown. This must be done with the agreement of other syndicate owners, perhaps prioritising

sick animals. However it is important to check carefully that there are not too many animals and to remove them if they are reducing the vegetation cover.

b) Stabilise with bush cuttings

1. If you are clearing an area of bush (see Bush Control, p60), you can use the cuttings to make dunes stable. First, clear the bushes and remove branches roughly (they do not need to be cut small, but bushes should not be left whole);
2. Spread bush cuttings over dunes soon before the rainy season. Pods from the bushes will provide seeds to help make the dune even more stable, and the branches will also trap grass (and other) seeds from the wind. This gives you little choice over the plants that end up growing on the dune, but you can add seeds that you have collected from plants you want to grow. If bush cuttings are laid densely enough, they are likely to offer seedlings enough protection from livestock to give them a chance to establish themselves.

What problems might I encounter?

Chopping and spreading thorn bush branches is an unpleasant task. Although likely to be less effective than fencing and re-seeding, it is significantly cheaper.

Vaalkameeldoring (Mokholo, Grey Camel Thorn or *Acacia haematoxylon*)

Kalahari Duin Gras (Kalahari Dune Grass or *Stipagrostis amabilis*)

Further Information

To find out more about how this manual was developed, the evidence to support the signs and management options, or to suggest corrections or improvements for future editions, see:

http://homepages.see.leeds.ac.uk/~lecmsr/allpubs.html

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- From the internet: http://homepages.see.leeds.ac.uk/~lecmsr/allpubs.html
- Or at cost price (including postage) from the University of Leeds (contact details above). Send an international money order (available from your local bank) for £5 made payable to the University of Leeds (orders take approximately 2-3 weeks to arrive in Botswana). You can pay extra to receive your manual via special delivery (4-5 days) – contact Mark Reed to find out the cost before sending your money order.

6 Wheel Charts

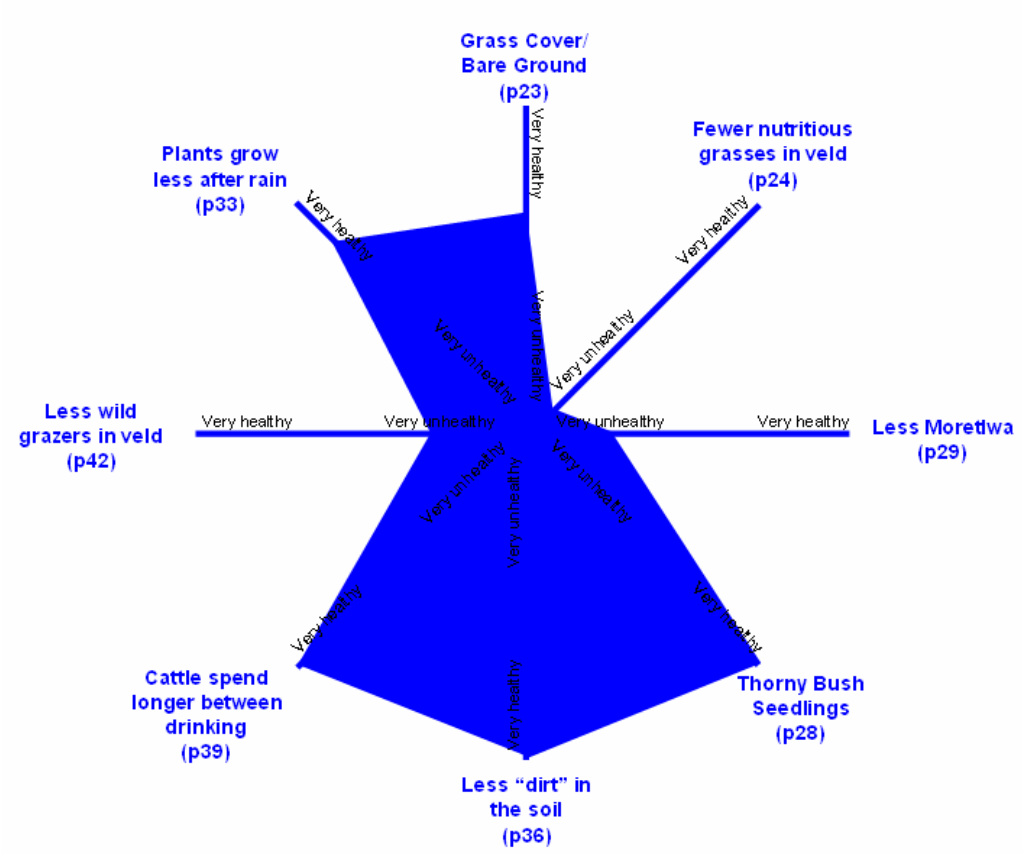
This final Chapter explains how to record what the warning signs have told you. You can refer back to this record in future years to see how your veld is changing. The rest of the chapter contains blank wheel charts for you to make your records.

Instructions

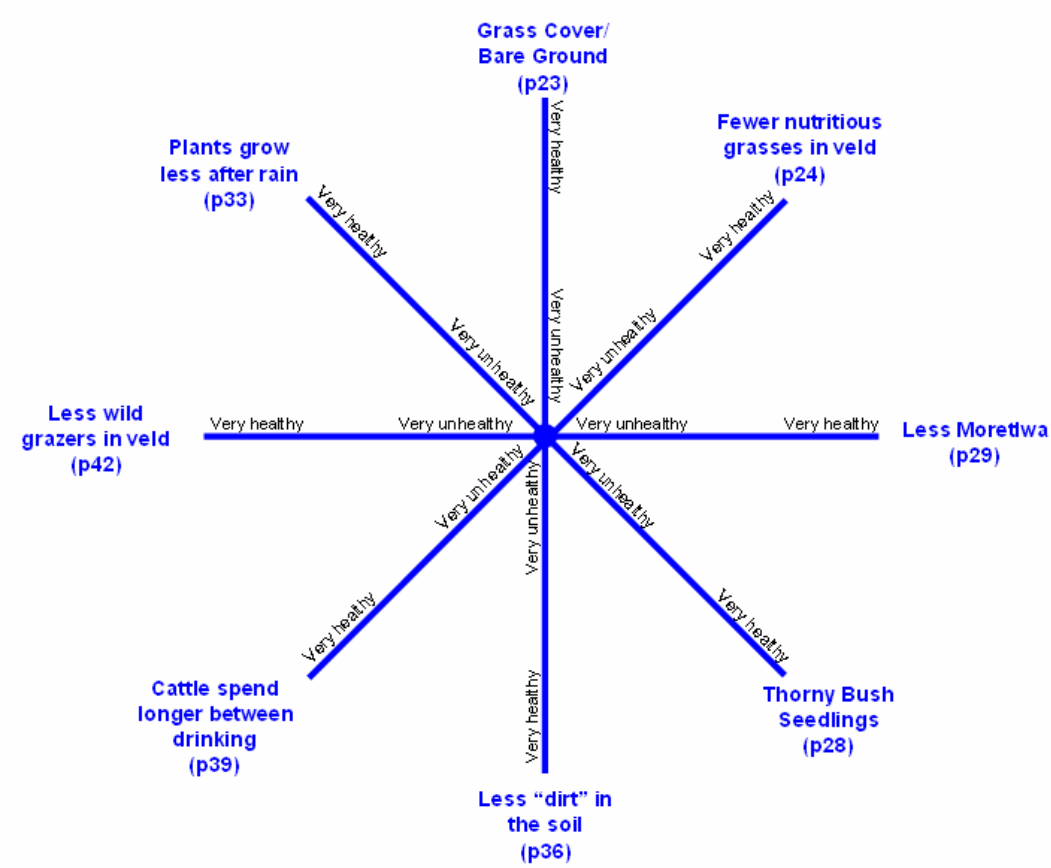
1. **Choose which warning signs** you want to look for each year. You must choose at least three plant signs and three soil signs. In addition, you should choose three from livestock, wild animals, insects or people (it doesn't matter if you choose all three of these signs from only one category). If there aren't enough warning signs you feel able or interested in looking for, you can choose early warning signs (you'll have to mark these on both wheels);
2. **Write the warning signs** you have chosen next to the spokes of the large multi-coloured wheel on the following page. It is useful to write the page number where the sign is described (Chapter 4) here too. If you have chosen more than three from any of the categories, you will have to add extra spokes by hand between the ones already drawn on the chart;
3. **Record a few things** that will help you work out how your veld is changing in future years:
   - Write the date on which you are recording what the signs look like in the corner of the page, and the length of time since it last rained;
   - Record any changes you have made to the way you are managing your livestock and the veld during the last year;
   - Record any other things that may have affected the health of your veld in the last year, for example the number (and breed?) of livestock you (and others in your consortium) are keeping at the borehole, diseases or pest outbreaks that have affected the veld in the past year, or any change in the area of veld available to your livestock (e.g. due to fencing);
4. At each of the places you have decided to look for warning signs (see Chapter 3 or the Step-by-Step Guide on p7), **decide whether the sign looks very healthy, very unhealthy or somewhere in between** and make a mark on each spoke. Do this for each of the warning signs you have chosen in addition to the blue early warning signs;
5. **Join up the marks** you have made. If you were unable to observe a particular sign this year, just join the marks on the two spokes either side;
6. **Decide what to do about the current health of your veld.** On the large multicoloured wheel chart, look at the lumps (quite and very healthy signs that

show your veld is doing well) and dents (quite and very unhealthy signs that show you have problems) in your wheel. If your wheel is generally large and circular (most signs are quite or very healthy), your veld is healthy – keep up the good work. If it is small (most signs are quite or very unhealthy) or there are particularly big dents in certain places, you may need to take action. Refer back to the pages describing the warning signs that were unhealthy (Chapter 4), and these pages will suggest management options you could try to improve the quality of your veld;

7. **Decide what to do about the future health of your veld.** On the smaller blue wheel chart, look for the lumps (quite and very healthy signs that show your veld is going to be healthy in the future) and dents (quite and very unhealthy signs that show you are going to have problems in the future) in your wheel. If it is small (most signs are quite or very unhealthy) or there are particularly big dents in certain places, you may need to take action to prevent future problems from happening. Refer back to the pages describing the warning signs that were bad (Chapter 4), and these pages will suggest management options you could try to prevent future problems in your veld (Chapter 5).



For example, the wheel above has big dents for "less Moretlwa", "fewer nutritious grasses in veld" and "less wild grazers in the veld". This suggests that no matter how healthy your veld looks now (the multicoloured wheel that you fill in will tell you this), there are likely to be problems in the future. Look up the pages in Chapter 4 describing the warning signs that showed up as dents in your wheel, and you will find a choice of management options that could prevent your veld becoming unhealthy in the future. You will be referred to detailed discussions of these management options in Chapter 5.


Grass Cover/
Bare Ground
(p23)
Fewer nutritious
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(p24)
Plants grow
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(p42)
Less Moretlwa
(p29)
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(p39)
Thorny Bush
Seedlings
(p28)
Less "dirt" in
the soil
(p36)
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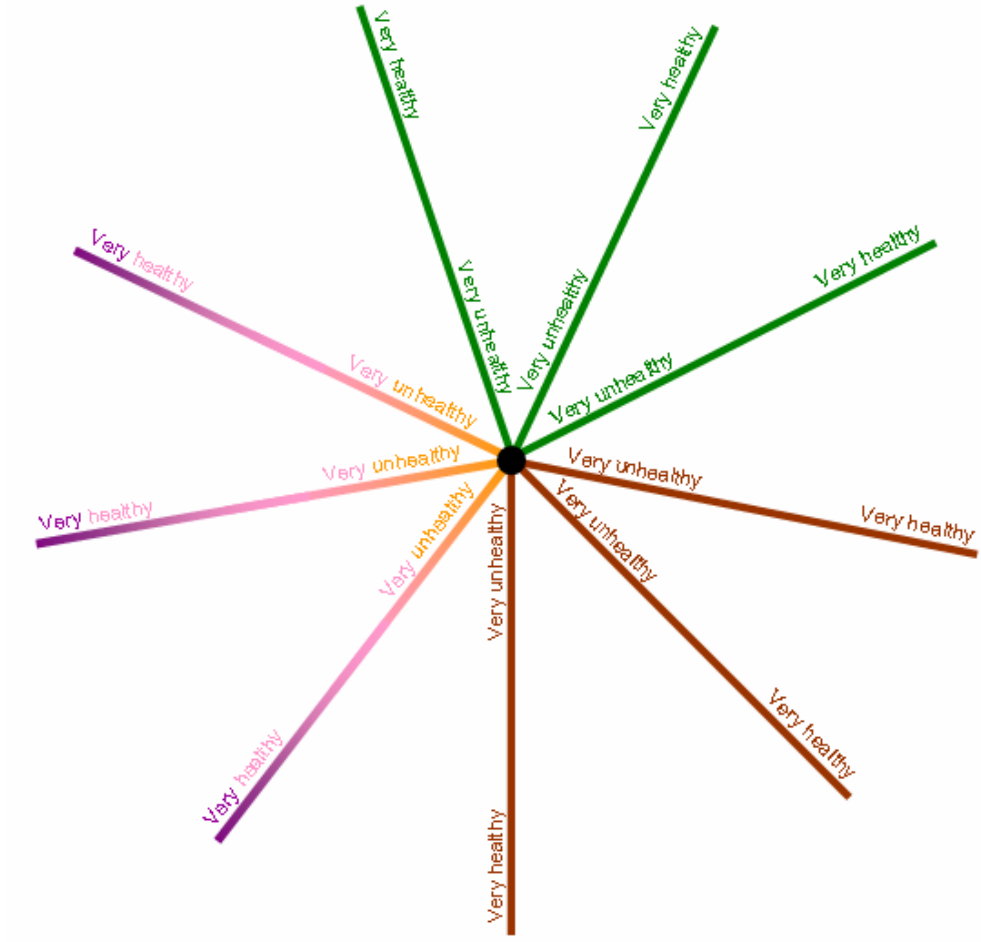
Very unhealthy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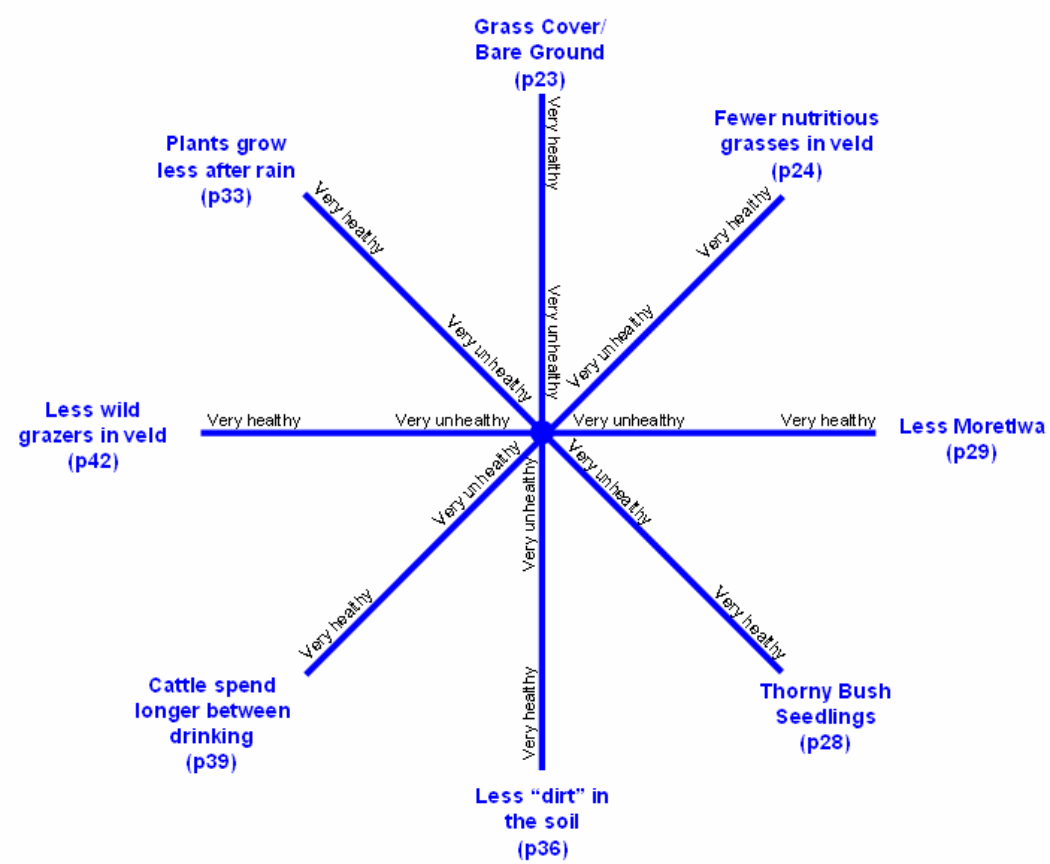
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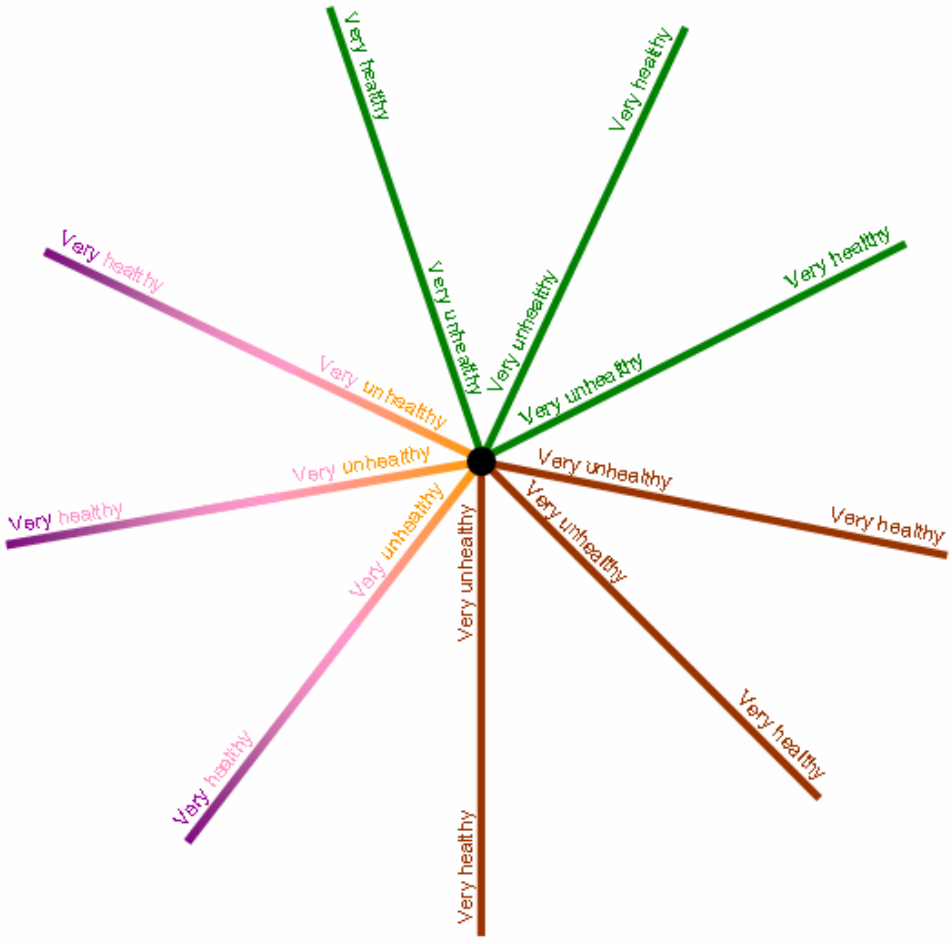
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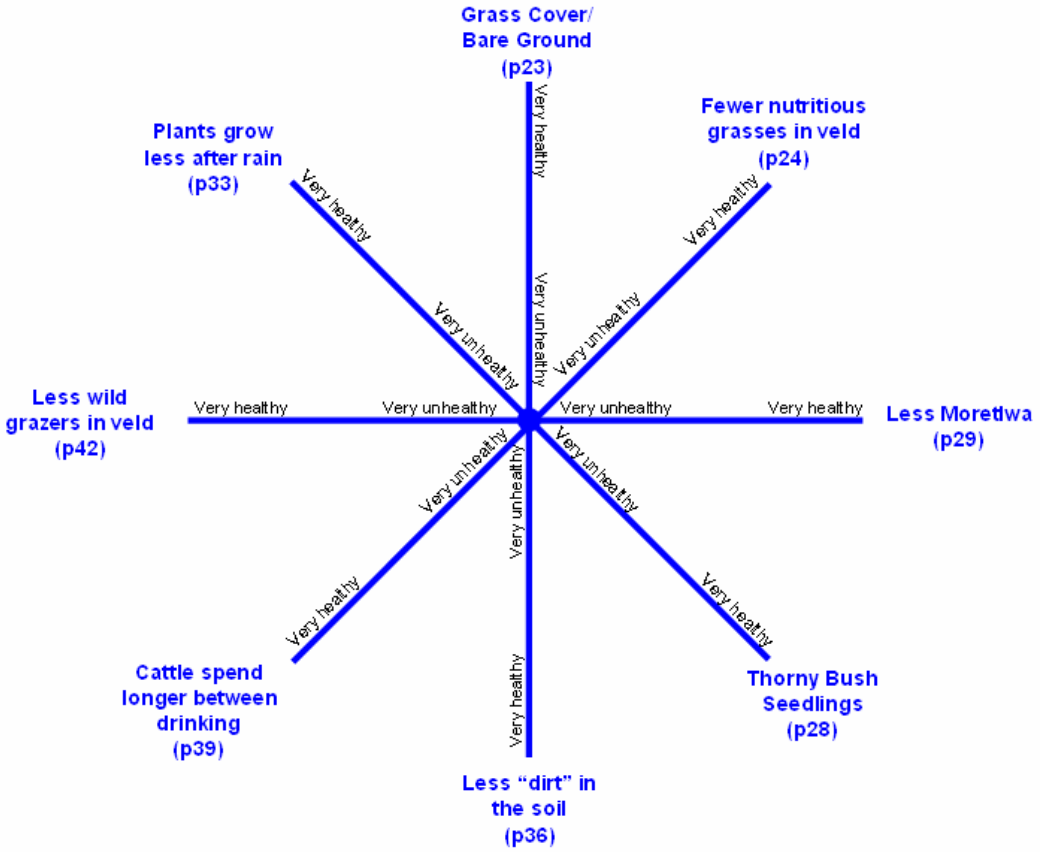
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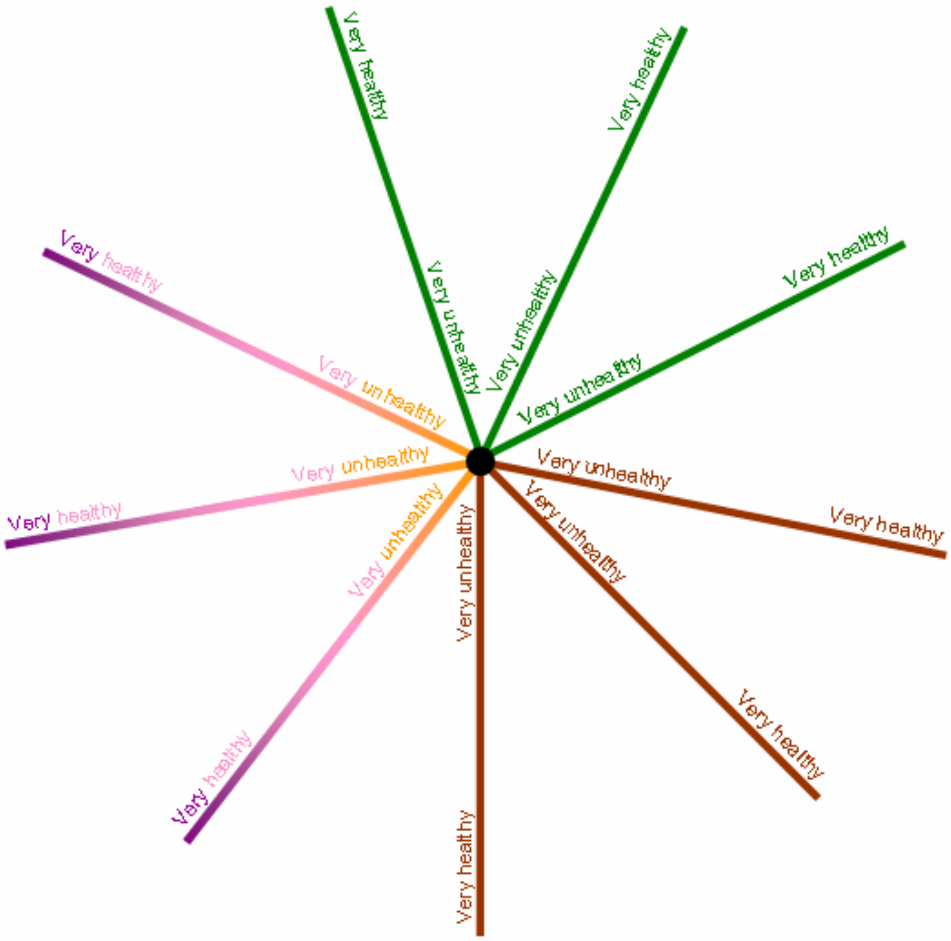
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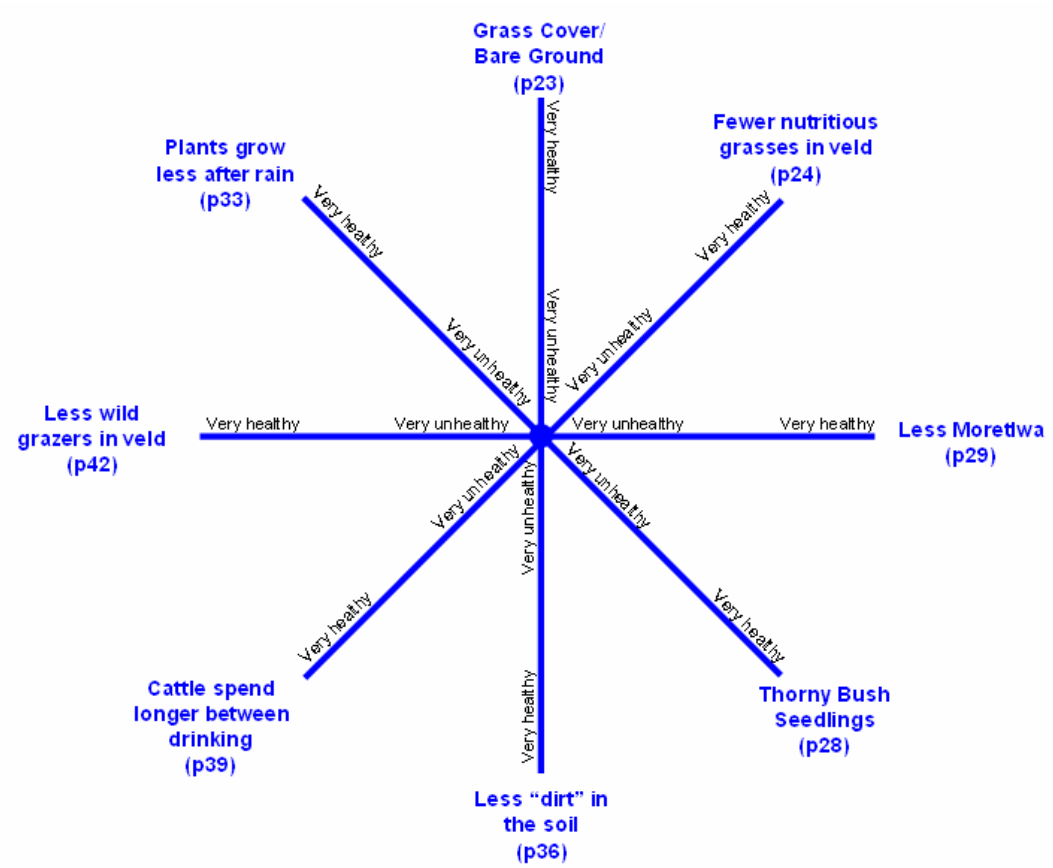
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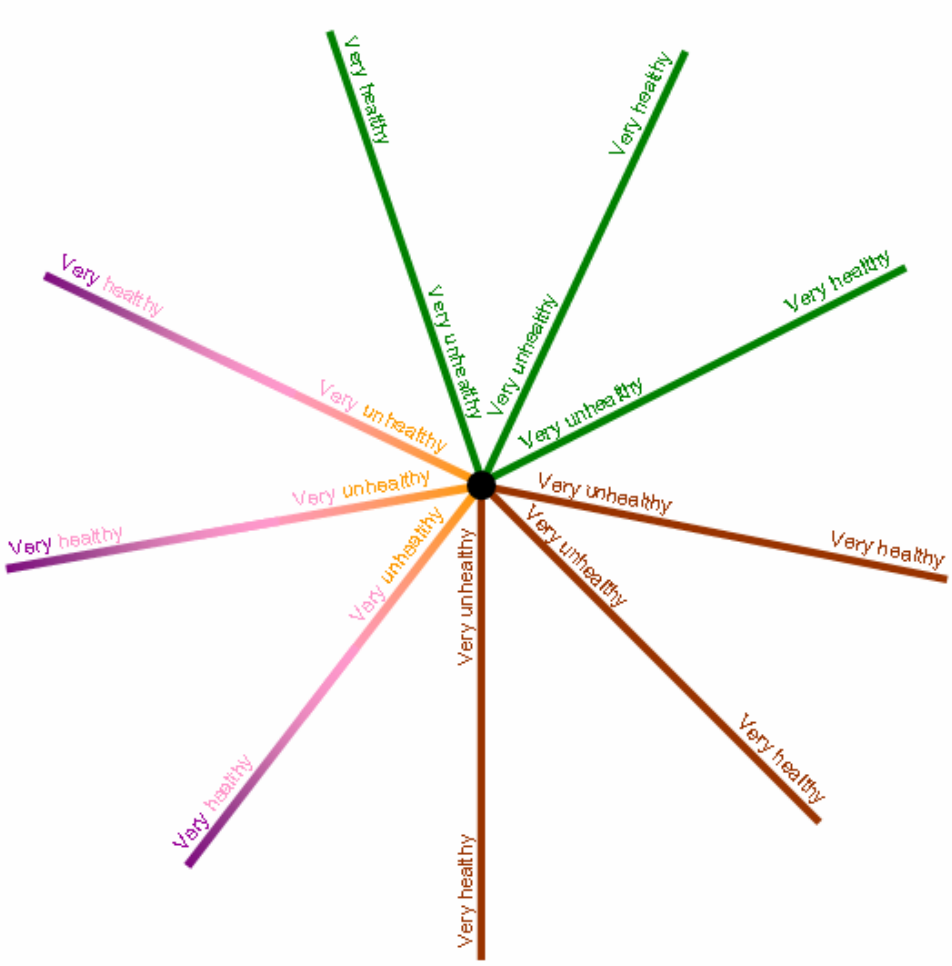
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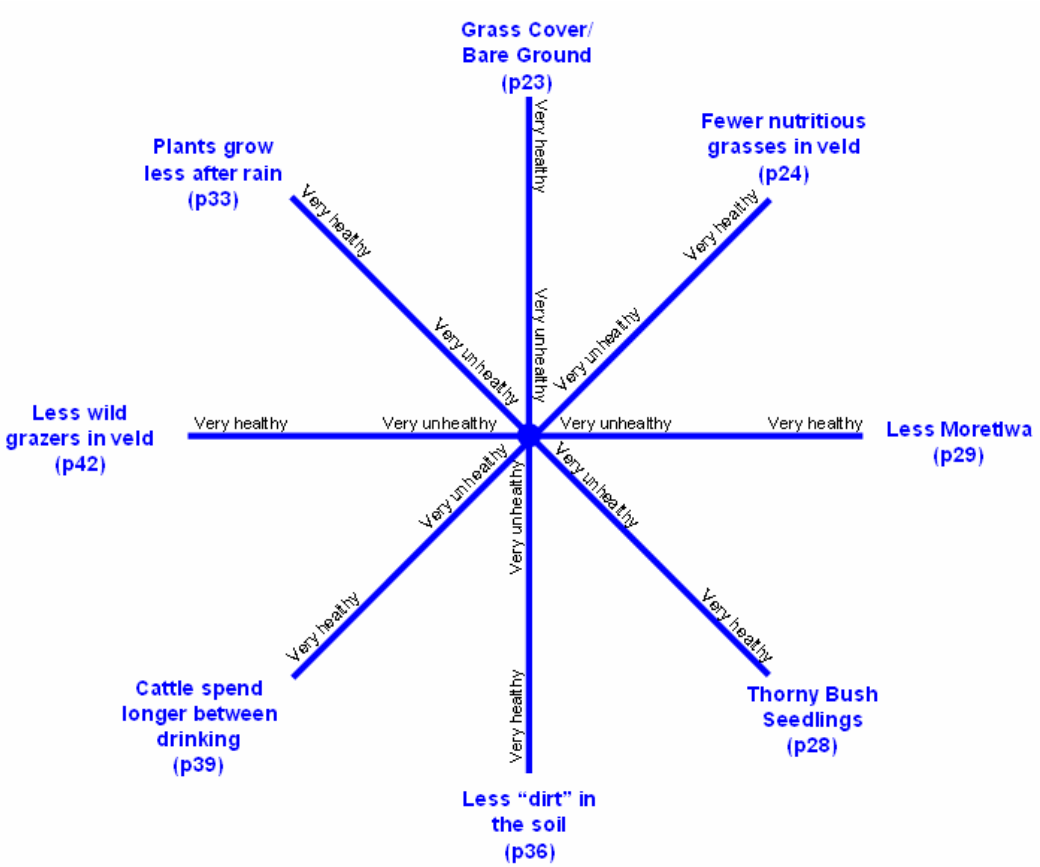
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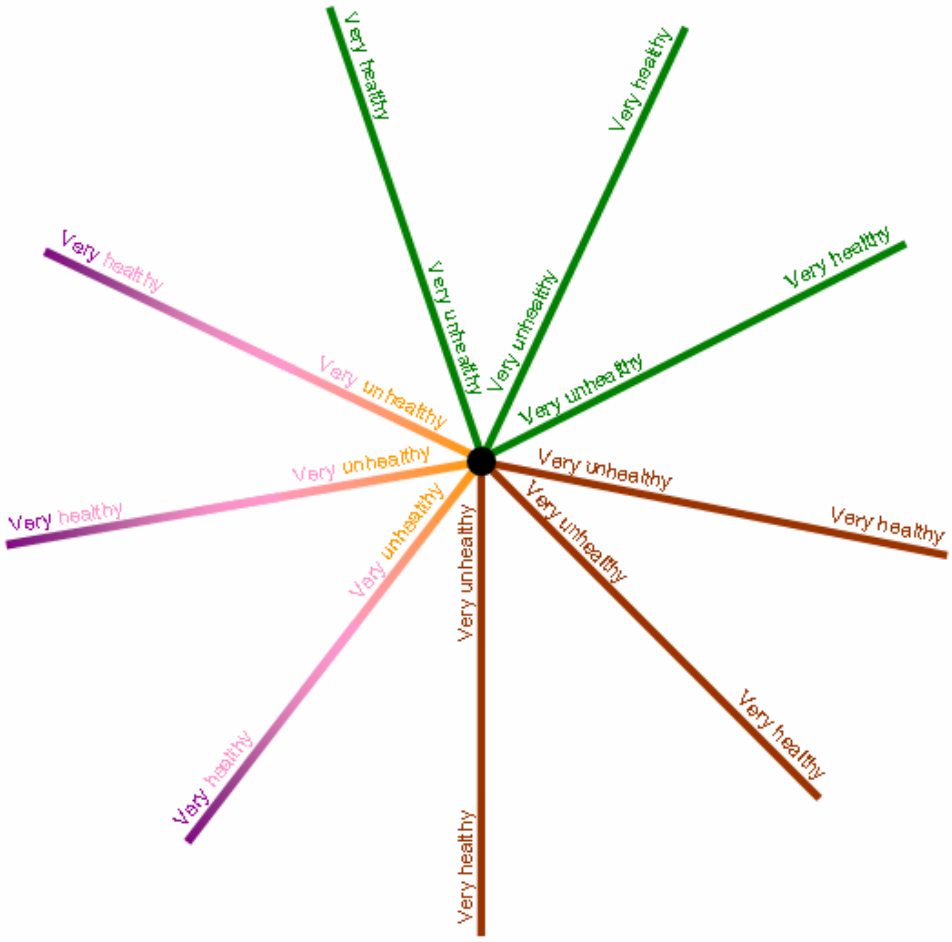
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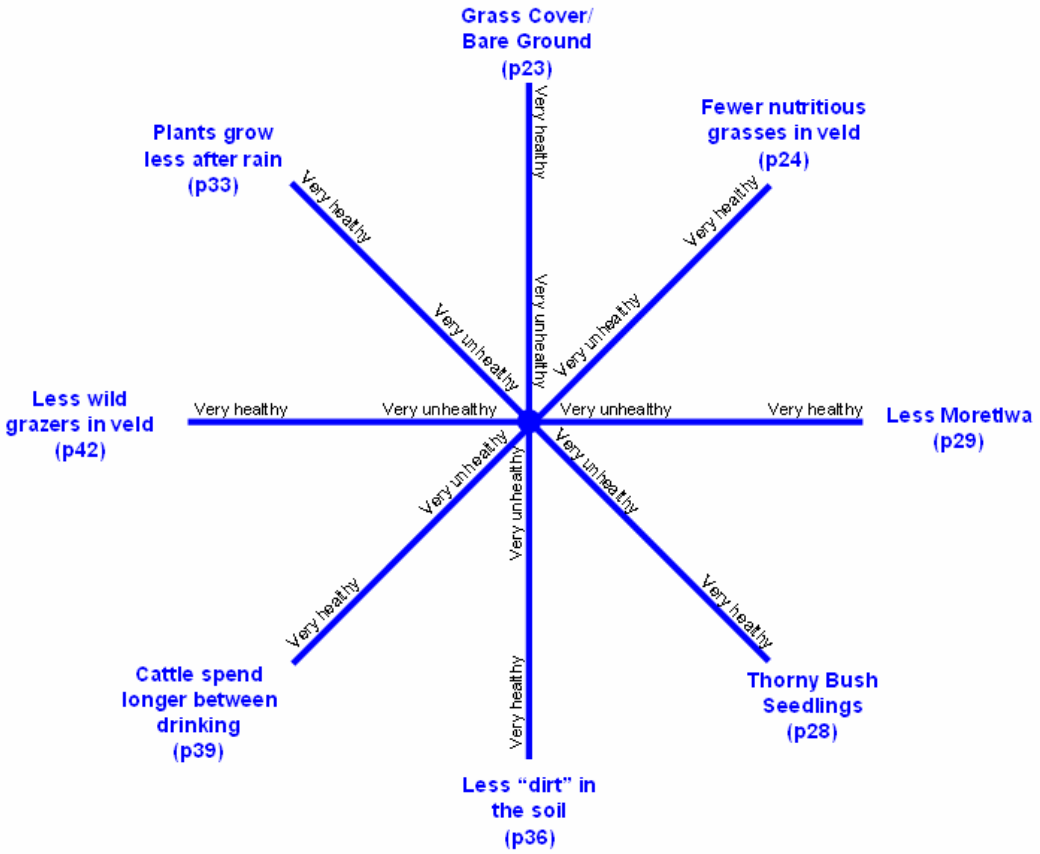
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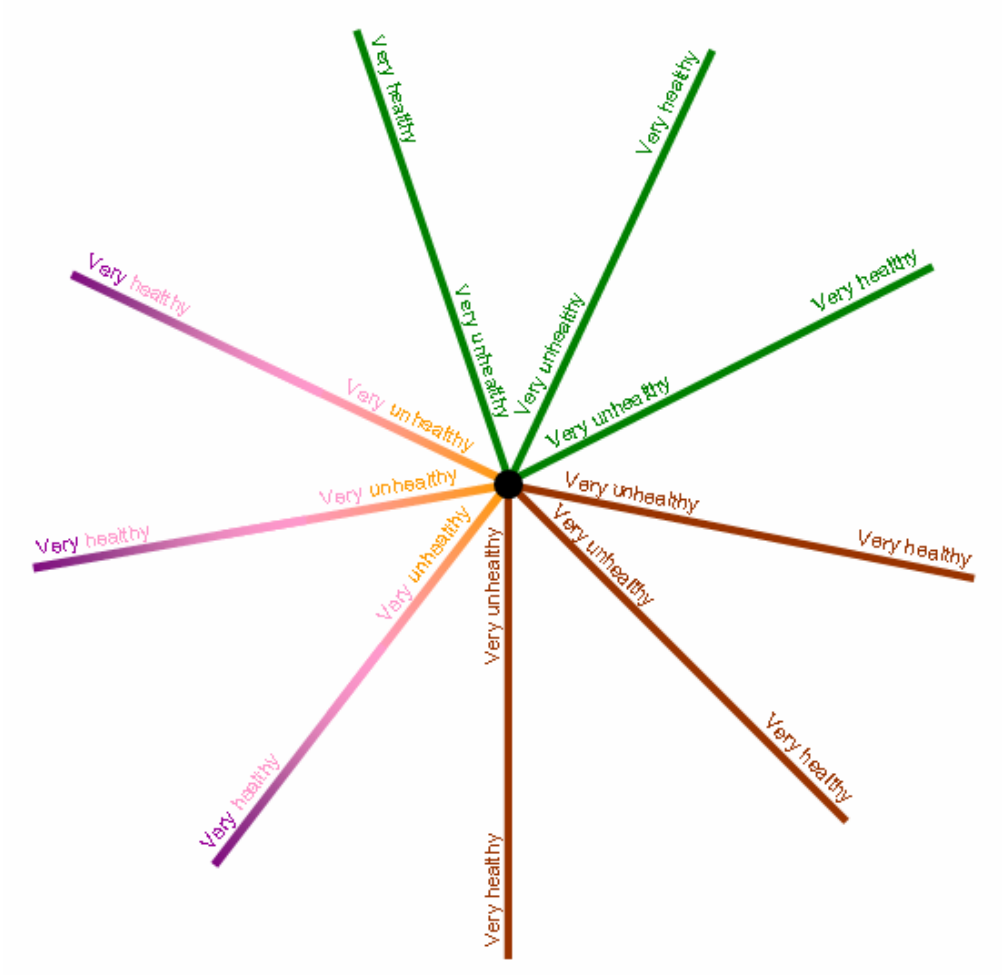
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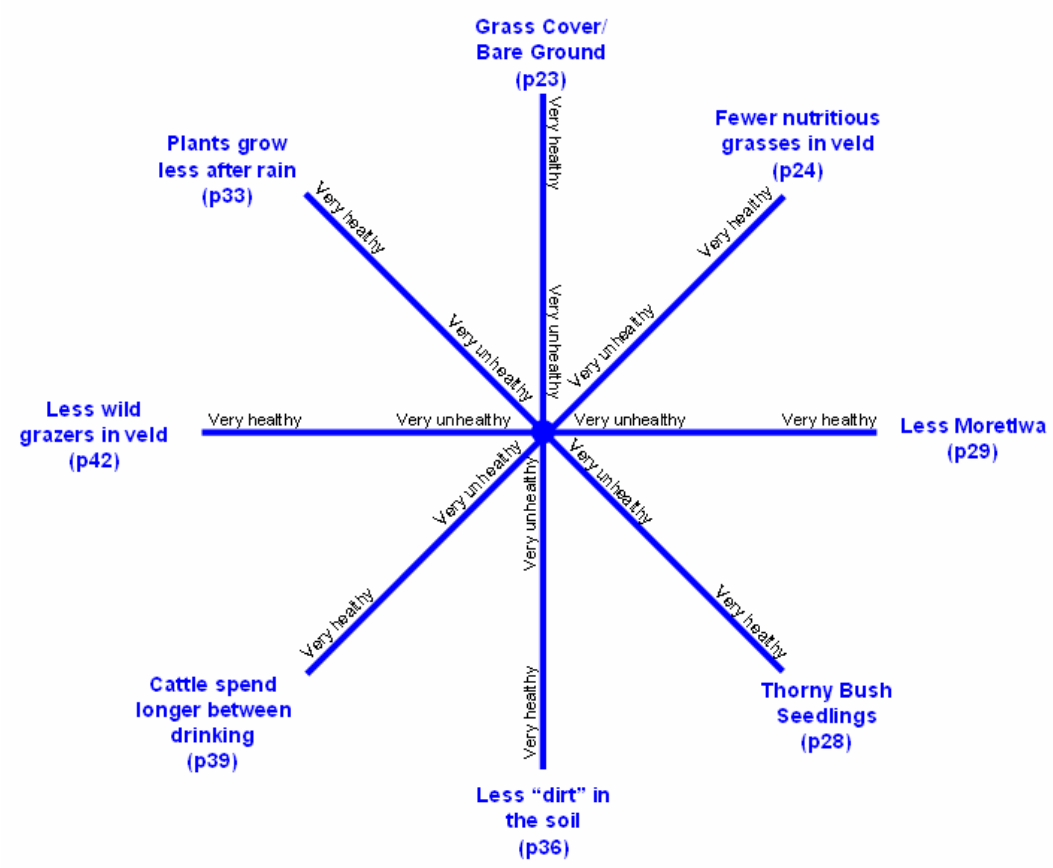
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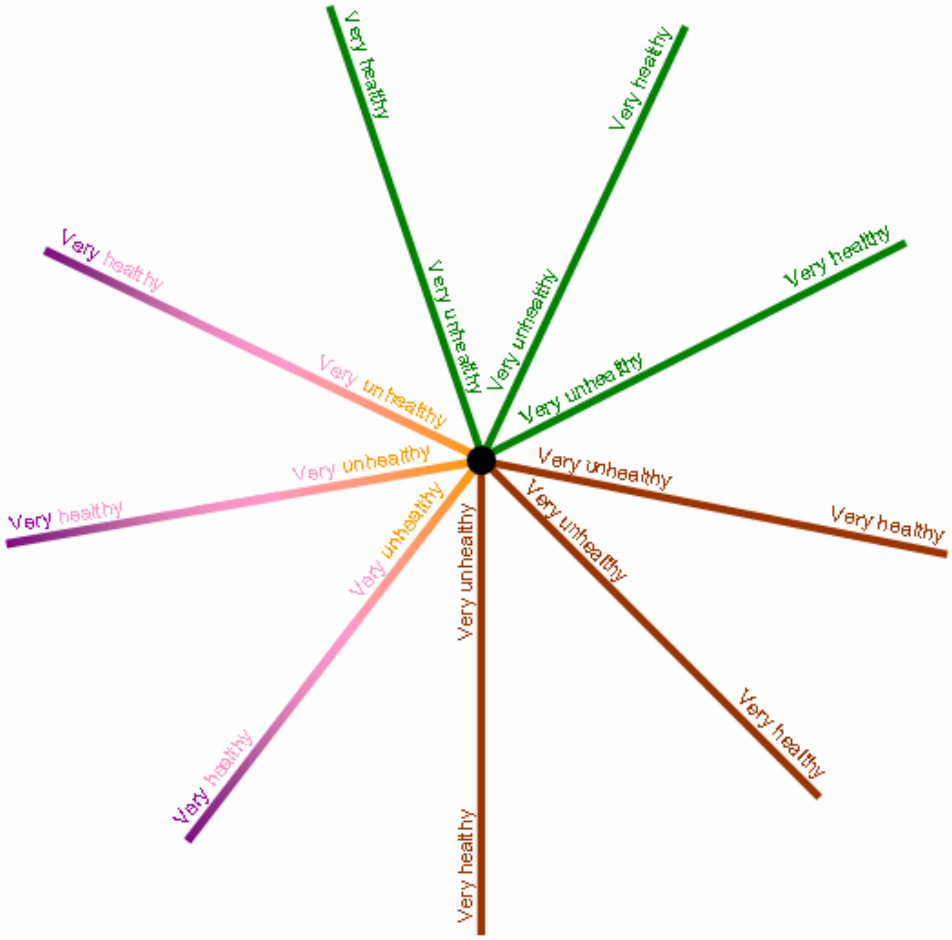
(p33)
Less wild
grazers in veld
(p42)
Less Moretlwa
(p29)
Cattle spend
longer between
drinking
(p39)
Thorny Bush
Seedlings
(p28)
Less "dirt" in
the soil
(p36)
Very healthy
Very unhealthy


Very healthy
Very unhealthy