Rangeland Management and Monitoring in the Eastern Communal Lands of Namibia

Training Booklet - 2023

(Photo: Lisa-Maricia Schwartz)

Foreword

In the Eastern Communal Lands of Namibia, the livelihoods of its inhabitants depend on the sustainable use of its rangeland by livestock. It is within this context that the NamTip project emerged, bringing together German and Namibian partners in a shared quest for knowledge and understanding. This ambitious socio-ecological research project has set its sights on comprehending the changes that have unfolded across the communal and commercial rangelands of the Greater Waterberg area. Through rigorous investigation, the project seeks to understand the causes of these transformations, assess their impact on livelihoods, and illuminate the ways in which communities have coped with these challenges.

As the reality of desertification looms, compounded by climate change, deforestation, overgrazing, and unsustainable farming practices, our farming practices hold the key to either perpetuating this cycle of degradation or forging a path toward restoration and sustainable rangeland use. Drawing from the wisdom accumulated through focused studies and experiments, coupled with the local experience of rangeland scientists in the region, the manual imparts invaluable rangeland management principles. By embracing these principles, we can better equip ourselves to withstand the ravages of drought and nurture a sustainable coexistence between humans and the land that sustains us. It is our shared responsibility to safeguard its resilience and vitality. We hope this manual serves as a compass, guiding us toward a future where the Eastern Communal Lands thrive once more. Let us, together, embark on a journey of wise natural resource use and restoration to rekindle the fragile flame of hope for generations to come.

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Nam.Tip

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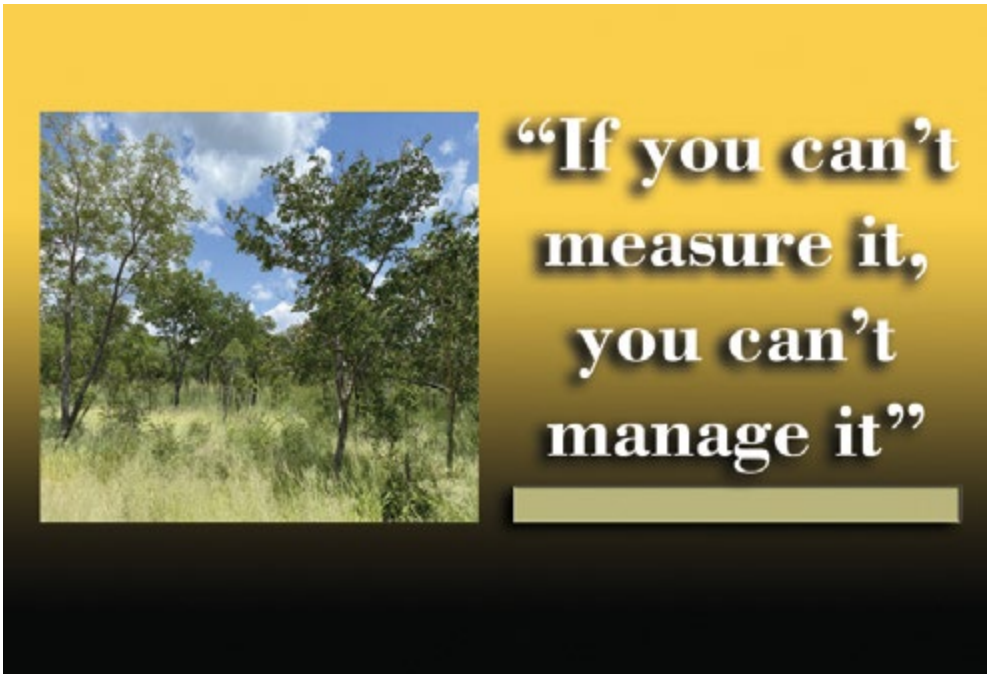
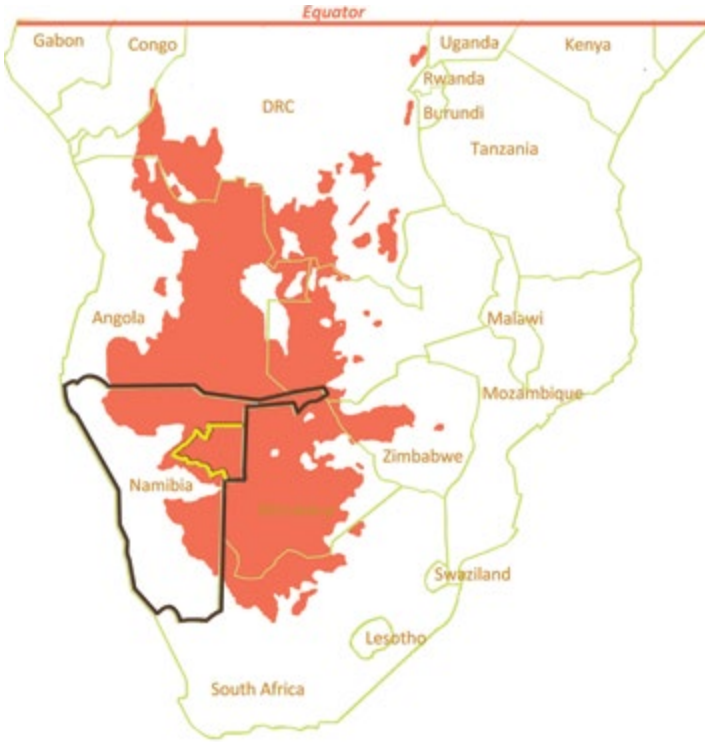

"If you can't measure it, you can't manage it"

1. Background

The Eastern Communal Lands form part of the larger Kalahari Basin that stretches from South Africa, through Botswana, Angola and Zambia to the southern parts of the Democratic Republic of the Congo. The Eastern Communal Lands is considerd a dryland where livestock rearing is the most important type of land-use. Securing livelihoods in this dryland depends on the forage produced by the rangeland vegetation.

The NamTip project is a large social-ecological research project involving both German and Namibian partners. The NamTip project studied the changes that took place in the communal and commercial rangelands in the Greater Waterberg area, as well as the causes of these changes, how livelihoods have been affected and how people are coping with these changes. This manual gives guidance about how to determine the condition of rangeland in the eastern communal areas, options how rangeland that are degraded (in poor condition) can be restored to be productive again and, lastly, important rangeland management principles to ensure sustainable use and to better cope with drought impacts.

The Omaheke ['great sand desert'] forms the western fringe of the Kalahari basin in Namibia. The topography of the Kalahari sand plains is almost flat, although dunes are present in some areas. These Kalahari sands are generally deep and well drained. Because it is so sandy, however, these soils have a low water-holding capacity and are leached, which means that it has a low nutrient status. This constraints plant growth and herbivores may experience nutrient deficiencies, such as phosphorous deficiency, if grazing takes place in these areas without supplements. Moderate fertile areas may occur in lower parts such as *Omiramba* and around pans, but these cover only small parts of the landscape.



Map 1: *Location of the Eastern Communal Lands (Source: Mendelsohn & Obeid, 2002)*

The Eastern Communal Lands experience summer rainfall followed by a dry-cool winter and a dry-hot spring season. Large differences in rainfall may occur from year-to-year. Water availability is the main driving force of vegetation in arid environments. The climate is relatively uniform, with a rainfall gradient ranging from just

under 400 mm per year in the south to about 500 mm per year in the north. The seasonal occurrence of rainfall also means that forage accumulation can only occur during the rainy season. The accumulated forage is then used during the dry season to sustain herbivores until the next rainy season. Frost is not unheard of in winter, with between 5 days of frost in the north and 30 days or more in the south. Early frost can cause early leaf loss in trees.

Map 2: *The NamTip research was conducted on both commercial farms and in communal places*

Veld fires used to be more common within the area, but high stocking rates now prevent enough fuel material to accumulate, thereby preventing fires around villages and water points. Fires is one of the factors that control bush densities and as a result bush encroachment is often most severe where livestock impacts are highest. In areas far from water, fires still occur and bush densities in these areas tend to be lower with a well-developed perennial grass layer.

The study area, where the NamTip project was conducted, consists of six commercial farms east of Okakarara and three communal villages between Okakarara and Otjinene. The studies were conducted over several years.

2. What is land degradation, desertification and tipping points and why do we need to avoid these from happening?

Land degradation describes a loss in the usefulness of the land for a specific purpose such as livestock farming. Speaking to elders in our communities, we realise that the land, the soil and its ability to sustain livestock have often deteriorated over the last decades. What used to be once productive savannas with few trees and bushes and palatable, perennial grasses are now taken up by land where bushes and other unpalatable plants dominate. Where grasses still occur, perennial grasses made space for unreliable annual grasses, and a large proportion of the soil surface is often bare for long periods. Bare soil gets hotter during the day, lose more water due to evaporation and is prone to water and wind erosion. Soil erosion strips the land of the topsoil where most nutrients and organic material that plants need to grow, are situated. Under these conditions the land can sustain fewer animals and forage shortages are frequent during the dry season and droughts, resulting in low animal production and increased mortalities.

Desertification is the process by which once productive land becomes more like a desert. This can happen due to a variety of factors including climate change, deforestation, overgrazing and other unsustainable farming practices.

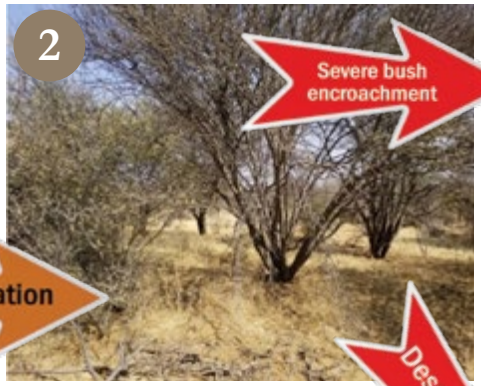
In some cases, degradation can be easily reversed by removing the factor that caused the degradation. For example, if we overgraze an area for a short period, perennial grasses may be replaced by annual grasses. Because the overgrazing was over a short time, some perennial grasses or their seeds survived and if we provide sufficient resting time, the perennial grasses will again increase and eventually dominate the grass layer. If overgrazing continuous for a long time, however, we might lose all perennial grasses and their seeds. In this case resting alone will not be enough for the perennial grasses to come back. In this case an **ecological tipping point** has been reached and surpassed. It is like bending a stick. When we bend it a little bit, it will spring back if we release the tip – the grazing system is resilient. If we keep on bending the stick further, eventually it will make cracking noises (approaching the tipping point) before snapping in two pieces (crossing the tipping point). The stick is now broken, and we will need a lot of effort (restoration) to repair the stick, in other words the grazing system, again.

> ***"Land degradation describes a loss in the usefulness of the land"***

Figure 1: *A NamTip researcher measuring herbaceous biomass (Photo: Vistorina Amputu)*

3. What are the signs of degradation and desertification in the eastern communal areas?

In Figure 1 the different states of rangeland along a degradation gradient are shown for the eastern communal areas. On the left (state 1) is an example of rangeland and its characteristics in a healthy state. State 2 describes rangelands that show signs of degradation such as loss of perennial grasses and increase of problem plants. If more pressure is placed on the rangeland, a tipping point is reached, and the rangeland becomes desertified (state 3) or become severely bush encroached.



Degradation

Desertification

Signs of healthy state

- **Ongumba** (*Stipagrostis uniplumis*), **otjisepa** (*Triraphis ramosissima*) and curly-leafed love grass (*Eragrostis rigidior*) grasses still present.
- Low soil erosion.
- Fat cattle.
- Increased milk production.
- There are open spaces between bushes.

Signs of degraded state

- Sparse grass density.
- Annual grasses dominate.
- **Ohorotito** (*Sida cordifolia*) & **ohongwe** (*Tribulus terrestris*) may be abundant.
- Bush encroachment evident
- Animals show signs of poor nutrition.

Signs of bush encroachment

- High tree and bush cover.
- No grass layer, even in small openings.

Signs of desertification

- Bare soil or with **ohorotito** (*Sida cordifolia*) and/or **ohongwe** (*Tribulus terrestris*) very dominant.
- Accelerated wind erosion.

Figure 2: *The different states of rangeland along a degradation gradient in the eastern communal areas. Desertification is when almost all plants have been lost, resulting in unprotected soils with no to very low productivity (Source: Diego Menestrey Schwieger 2022)*

3.1. Rangelands in a healthy state

Rangeland in a healthy state has the following traits:

- The herbaceous layer is dominated by palatable, perennial grasses.
- The soil surface is well covered with few bare areas visible.
- The soil surface is loose.
- The soil surface is adequately covered by litter.
- Trees and shrubs occur at low densities with few seedlings present.
- Very few signs of soil erosion are present.

Rangelands with these traits are highly productive and offer high quality forage for both grazing and browsing animals. The soil is protected and much of the rainfall that is received infiltrates the soil where plant roots can access the water and replenish ground water sources deeper down. Rangeland in a healthy state also builds up more soil carbon, which improves how much water and nutrients the soil can hold. Below are some species associated with healthy rangelands.

> *"An unhealthy rangeland has negative impacts on the livelihood of people"*

Stipagrostis uniplumis
(Ongumba)

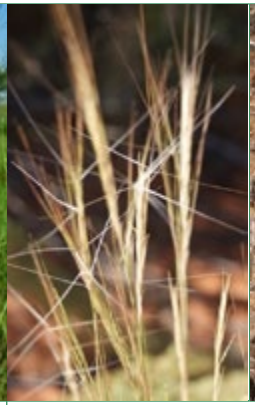
Eragrostis rigidior

3.2. Grass species abundant under heavy, continuous grazing

If the palatable grass species do not get enough time to recover after being grazed, the tufts of these species become smaller and eventually die. Continuous grazing also does not allow for seeds to be produced. Other species that thrive under these heavy and continuous grazing conditions then take the place of the desirable perennial grasses. These species are either annuals or tend to be unpalatable and can thus tolerate these conditions better. Below are examples of such grass species:

Eragrostis lehmanniana (**Ombidangolo-O**)

Eragrostis trichophora (**Ombadangolo-O**)



Aristida species (**Oruhoke**)

> ***"Soil erosion strips the land of the topsoil where most nutrients and organic material that plants need to grow, are situated."***

3.3. Desertified state

The dominance of ohorotito (*Sida cordifolia*) and ohongwe (*Tribulus terrestris*) are good indicators of desertification, in addition to large bare spaces devoid of any vegetation. These plants take advantage of severely overgrazed areas when the competition from grasses is weak and soil disturbance high due to the trampling effect of livestock and people.

Ohorotito (*Sida cordifolia*)

Ohongwe (*Tribulus terrestris*)

4. Current status of rangeland in the study area

What is the status of the grazing areas in the Namtip study? To answer this question the Namtip researchers used various methods to determine rangeland health in both the commercial and communal study sites. These included measurements of the vegetation by human observers, using drones (see picture) and even interpreting information from satellites that orbit the earth.

The research found that the communal lands had a much higher tree and shrub cover than the commercial farms and a lower cover of grasses and forbs (herbaceous plants).

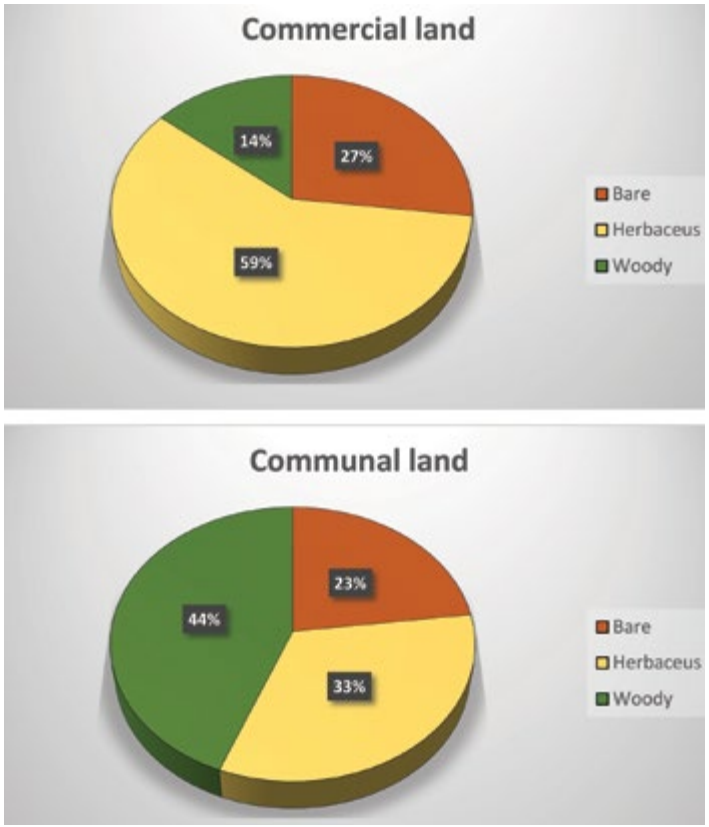


Figure 3: *Average % cover of bare ground, herbaceous and woody cover on commercial farms and communal areas measured by NamTip researchers*

NamTip researchers also found that the soils in the communal areas had fewer grass seeds compared to the soils in the commercial areas.

In addition, soil organic carbon in the first 20 cm of the soil was almost half that as measured in the commercial farms. In the commercial farms, soil carbon originated more from herbaceous plants while more from the woody plants in the communal areas. This therefore reflects the bush encroached situation in the communal areas. Deeper in the soil the carbon concentrations were similar, indicating that the changes developed during the last decades. The good news is that soil carbon can be restored if the cause of its depletion is addressed. This will be addressed in the next sections of the book. Soils are one of the most important factors influencing rangeland productivity. Soil organic matter is an indicator of soil fertility and soil health and is affected by how we manage the rangelands. For example, in the sandy soils of the study area, the percentage carbon in the soil influence how much water the soil can hold. The more water the soil holds, the more water will be available for plant growth. The storage of carbon in the soil is also very important for climate change mitigation as it means that less carbon dioxide is released into the atmosphere, causing the earth to further warm up.

Concluding, the rangelands in the communal areas showed signs of widespread degradation such as loss of perennial grass cover, increase in bare areas, and encroachment of bushes. This affected the soils negatively.

5. Causes of Rangeland Degradation and Desertification

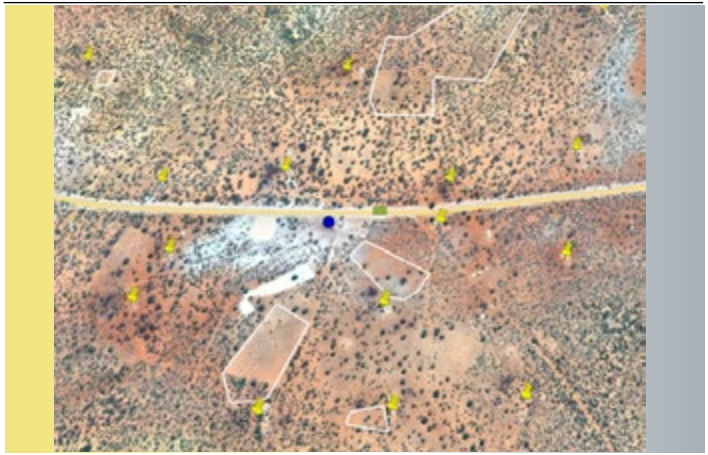
So why is the communal land more bush encroached with less palatable grass species, have more bare ground close to water points and fewer grass seeds and carbon in the soil?

The root cause of rangeland degradation in the eastern communal lands of Namibia is the continuous application of poor rangeland management practices.

Figure 4: *Bare ground as a result of continuous overgrazing (Photo: Florian Männer)*

Due to high livestock densities and continuous grazing around a single water point, it very often happens that palatable, perennial grasses are continuously over grazed, which gives the less palatable and annual grass species an opportunity to take over.

Figure 5: *Degraded rangeland on a commercial farm (Photo: Gunnar Dressler)*



Map 3: *A central water point with at least 15 households (Onganda) scattered around it in Ozongarangombe village (Map: Google Earth)*

Poor rangeland management practices can be reduced to two major components, namely overgrazing and overstocking. These two concepts are very often loosely used by farmers and practitioners and tend to confuse people.

Overgrazing is to continuously graze perennial grasses without giving them adequate time to replenish their root reserves and to produce seeds. If done for too long on a continuous basis, the perennial grass plant will run out of reserves and will eventually die. If no seeds are produced, reproduction is also prohibited, and the species becomes locally extinct. As perennial plants are most vulnerable during droughts, overgrazing coinciding with a drought can result in a tipping point being reached with the rapid disappearance of desirable grass species from a grazing area.

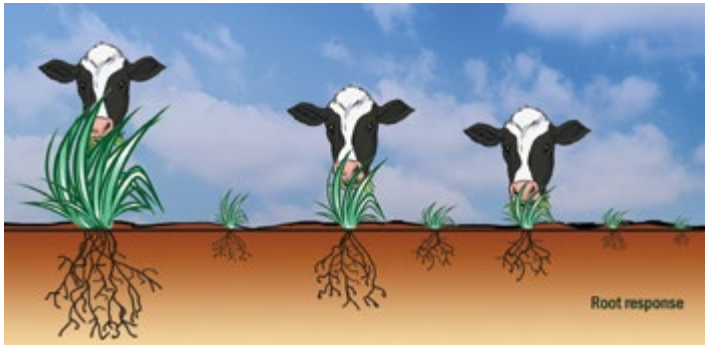


Figure 6: *Illustration of overgrazing (Illustration: Michael Degé)*

A planned grazing system that allows sufficient time for perennial grasses to recover, is of paramount importance in rangeland management. A resting period should be long enough to allow the plant to replenish its root reserves after being grazed. Absence

from a camp or certain grazing area is not necessarily a sufficient rest period, especially if this takes place during the dry season. The amount, frequency, and spatial distribution of rainfall during the growing season to a large extent determine the time required for an efficient resting period. A whole rainy season long resting period is considered the best by some rangeland scientists. This can be achieved by following a grazing strategy that incorporates resting periods.

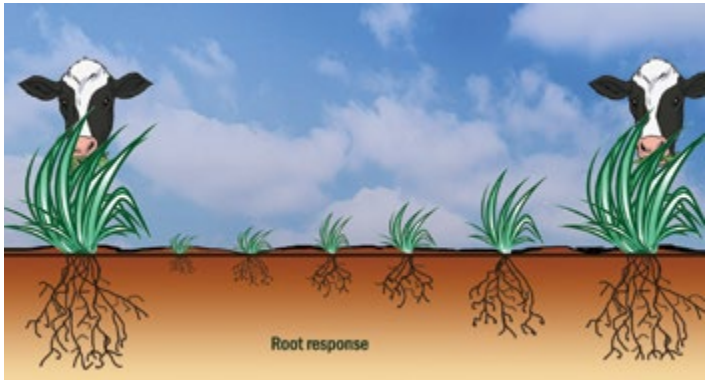


Figure 7: *Illustration of planned grazing (Illustration: M. Degé)*

Overstocking on the other hand, means that more livestock and game are kept than what the available forage resources allow for. The result of overstocking is poor livestock condition, reduced reproduction, and ultimately the death of the animals. These two concepts are not directly related to each other. An area can be understocked and is still overgrazed.

6. Effects of Rangeland Degradation and Desertification

An unhealthy rangeland has negative impacts on the livelihood of people who depend on it for their livelihoods.

Figure 8: *Fodder shortages lead to starvation of animals (Photo: Diego Menestrey)*

Degraded rangeland does not have adequate forage for the livestock, especially during the dry season and droughts. This leads to deterioration in livestock condition and ultimately death of the animals.

Figure 9: *Fodder shortages lead to lean cows with no calves (Photo: Diego Menestrey)*

Cows under forage stress will have a low calving rate. She will not come on heat and will not conceive to deliver a calf the next season. A low calving rate directly impacts on the ability of the farmer to generate money out of the farming business.

7. How can desertification be avoided or degraded rangelands restored?

It is important to capture communal farmer's perceptions and insights on a local level when addressing current problems of degradation. Existing indigenous knowledge and proactive activities, useful things that we do before the problem occurs, that are already applied or planned will provide learning opportunities and examples of how to adapt. Research by NamTip scientists provided very interesting information. They used focus group discussions in the Okahitwa, Ovitatu, Ombooronde, Ozongarangombe and Ohamuheke villages. They wanted to find out how communal farmers in the Okakarara area perceive the future in the face of land degradation and what they think can be done about it. Lastly, they also questioned farmers about the barriers they encounter to implement solutions to the problems.

Figure 10: *Focus group discussions in local villages (Photos: Hleni TN Heita and Nali Moyo)*

All farmers predicted that bush encroachment will increase in the future (Figure 11). Most farmers also predicted that annual grasses would increase, while the cattle population will decrease. Most farmers also think that the size of grazing land will decline, unpalatable plants will increase, and droughts will become more frequent.

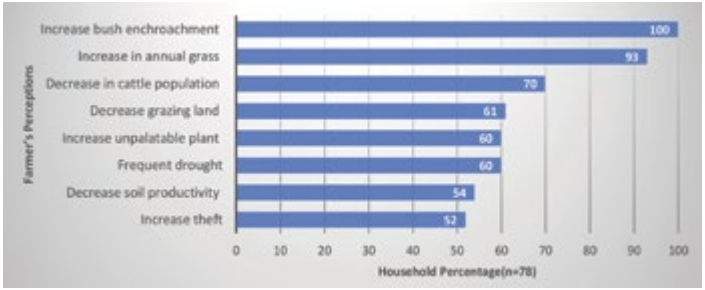


Figure 11: *Farmers' views on the Future Changes in their Rangelands (Source: Hleni TN Heita and Nali Moyo 2022)*

The most common techniques offered by the interviewed farmers to overcome future farming challenges were, in order of importance, increase drought preparedness, controlling encroacher bush and destocking (Figure 12). Reseeding with desirable grass seeds and control of private camps were also mentioned as solutions to these challenges.

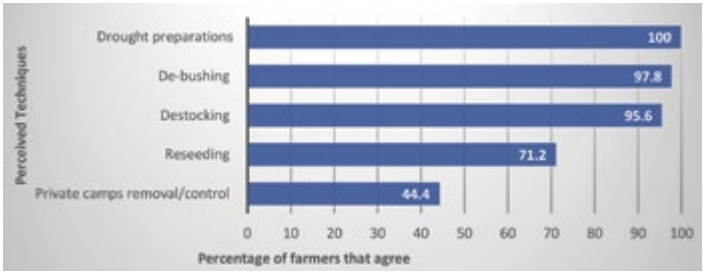


Figure 12: *Perceived future techniques to overcome challenges (Source: Hleni TN Heita and Nali Moyo 2022)*

Farmers interviewed also identified barriers to proactive management implementation, which are listed in Table 1.

Table 1: Barriers to pro-active management given by interviewed farmers in the communal study sites.

Proactive management activity	Barriers (most important ones are in bold)
Destocking and restocking	Lack of adequate knowledge
Rotational grazing	**Risk of overgrazing, limited space**, lack of time, disputes, no active herding
Barricades/Enclosures	**Limited space,** policy
De-bushing and bush thinning	Policy
Brush packing/Mulching	**Lack of tools, expensive**, time, limited space, environmental limit (poor soils)
Reseeding	**Limited space** (during recovery period), lack of adequate knowledge, lack of time, disputes
Construction of hydration barriers (micro/macro catchments)	**Lack of adequate knowledge**, environmental limit (poor soils), lack of time
Night penning (bomas)	**Lack of adequate knowledge, lack of active herding, expensive**, disputes, **theft**
Fertilisation (organic & inorganic)	**Expensive**, environmental limit (rainfall and soil)
Weeding	**Time**, expensive, no tools

Proactive management activity	Barriers (most important ones are in bold)
Minimal tilling	**Time**, policy

Some of these refer to cropping such as weeding, minimal tilling and fertilisation.

8. Reversing desertification

Up to this point we have explored how the eastern communal rangelands are currently degraded and local areas even desertified. We also looked in more depth into the causes and consequences of degradation and desertification. We also see that participatory research showed that farmers are aware of these problems, but also that solutions exist to overcome these problems by acting. This will not be easy and barriers that needs to be overcome were also identified by the farmers themselves. Here we look at practical ways that communities can apply to restore their rangelands to a more productive state.

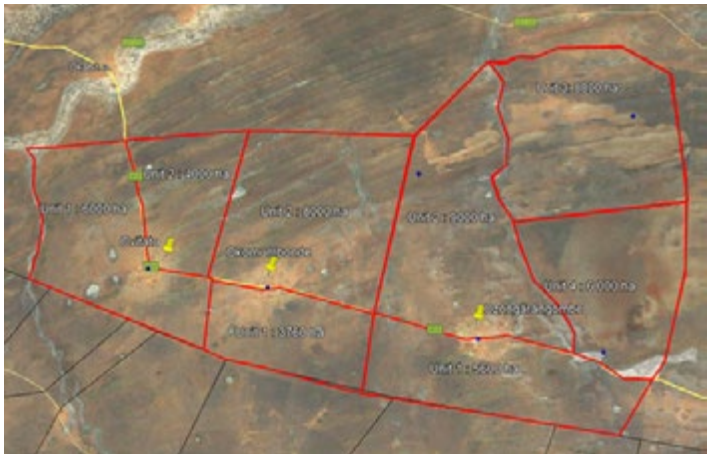
8.1. Introducing rotational resting

The principle of sufficient rest to prevent overgrazing is important. What is very often not so easy in practice, is to efficiently apply it under different scenarios. Not all areas have camps where rotational resting can be applied. In most of the non-title deed areas there are no fences, and it is challenging to apply sufficient rest to rangelands. Where there are no camps available, like in open non-title deed areas, a starting point would be to restrict animals on one half of the area or farm for an entire season, while resting the other half. This is called the Split-Ranch grazing strategy.

Three of the villages that formed part of the Namtip study are of the opinion that resting of veld around the villages will not be possible, unless provision is made for a cattle post with own water, allowing them to move away during the growing season. It is the purpose of this document to discuss possible options that the communities in each of the three villages can implement to ensure adequate resting periods. These options are based on the split-ranch system where half of the grazing area is grazed for a whole year and movement of the livestock to the rested half in August/September. This approach is currently being tested by commercial farmers in Namibia and elsewhere and it looks promising, provided livestock numbers are adjusted to the available forage at the end of the growing season. This adjustment seems to be a major challenge for many communal farmers.

In the following discussion an example of how rotational grazing/resting can be introduced is suggested. During the training sessions this can serve as a starting point to illustrate one possibility, which is then refined in a participatory manner. The goal is that communities take ownership and build on local knowledge of the area.

> *If the palatable grass species do not get enough time to recover after being grazed, the tufts of these species become smaller and eventually die*



Map 4: *Possible grazing plan for Ovitatu, Okomumbonde and Ozongarangombe villages (Map: Google Earth)*

Map 4 is derived from an illustrative map of the three villages provided by Namtip researcher Diego Menestry and is not on scale. Each village is made up of several grazing units:

8.1.1. Ovitatu

Unit 1 is roughly 6 000 ha while Unit 2 is about 4 000 ha. The two units are separated by the gravel road that runs from the east up to the village and then in a northerly direction. There is only one borehole in the village. A split ranch system could be implemented where unit 1 is grazed for a full year while unit 2 gets a full year rest. In August/September the livestock could move to unit 2 and stay there for a full year. In the beginning care should be taken that stocking rates are not too high, especially because the areas seem to differ significantly in size.

8.1.2. Okomumbonde

The Okomumbonde grazing area is split in two by the road running from east to west through the village. Unit 1 is approximately 3 760 ha, while unit 2 is 8 000 ha. This huge size difference between the units poses a large problem when implementing the split-ranch system. It is however a good starting point to rest Unit 1 for as long as possible, while grazing is concentrated in Unit 2. When utilising Unit 1, care should be taken that it is not overstocked, and animals must be removed in time. As a next phase the possibility of extending the pipeline in a northerly direction should be investigated to allow for more even and flexible grazing.

8.1.3. Ozongarangombe

The grazing area has four water points, well distributed over the whole area. Unit 1 is only 5 600 ha in size, while the rest north of the road (units 2-4) is 20 800 ha. It is therefore recommended that, over the long run, the grazing area north of the road be demarcated in 3 grazing areas, as indicated on the map. This will provide the community more flexibility to implement a split-ranch system with units 1 and 2 in a group (14 600 ha) and units 3 and 4 in another group (14 800 ha).

The advantage of the split-ranch system is that the half that is grazed is kept short and productive with high quality grazing that will enhance livestock production. The other half receives then a whole year rest to recover from grazing, accumulates as much as possible forage for the next season and allows for maximum root growth and replenishment of reserves. It also reduces the risk of

running into forage shortages in that half of the grazing area will have rested with sufficient accumulated forage for the dry season.

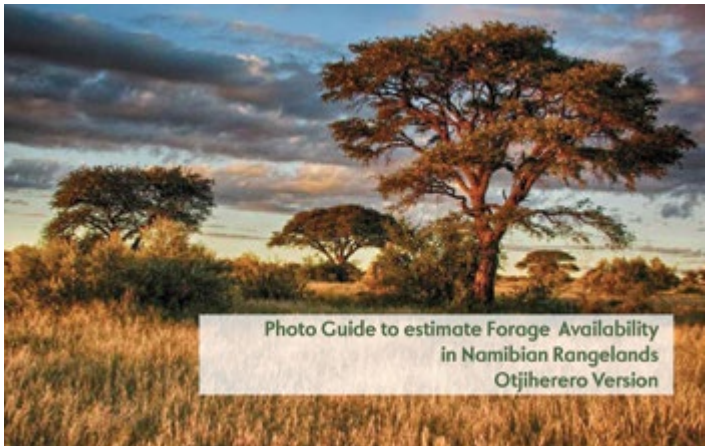
9. Determining forage availability and annual stocking rates

9.1. Forage availability

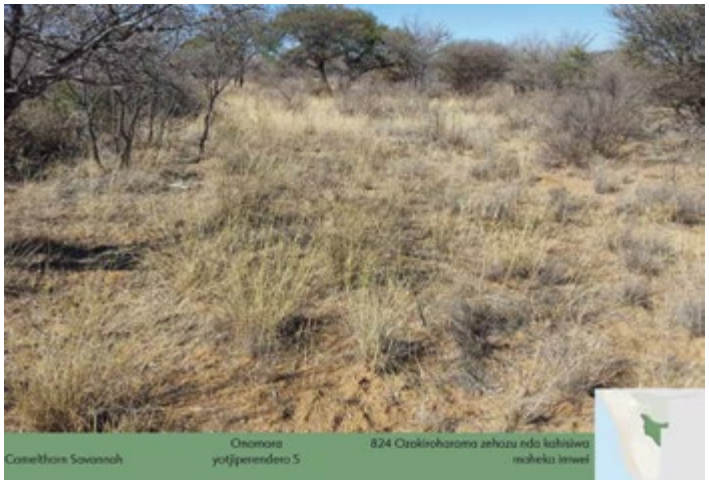
An important activity in rangeland management is to balance the number of livestock that utilise an area with the forage available for the animals. Because rainfall is received in summer, little forage growth takes place in the dry season, therefore we need to make sure that we have enough forage resources left at the end of the growing season to provide forage for our animals during the dry season. The first step is therefore to estimate the availability of forage at the end of the rainy season in April-May.

To determine the availability of grazing resources, the Photo Guide to Estimate Forage Availability in Namibian Rangelands is used. In the guide, a range of pictures of rangelands with varying forage availability scenarios is presented.

For each major vegetation type in Namibia, a series of photos with different forage availability scenarios are provided, starting with picture #1 with very little forage and ending with very high forage availability for that area. The picture guide is specific to a vegetation type; therefore, the correct set must be chosen. For the eastern communal rangelands, the Camelthorn Savannah or Forest Savannah & Woodlands vegetation zones should be used in the guide.



By using this picture guide, a number of sites representing forage availability in the grazing area can easily be estimated. Several sites are chosen and the forage availability at a site is compared with the most appropriate picture in the guide and the kg Dry Matter/hectare value recorded for that site. For example, the pictures on page 16 correspond with 620 kg dry grass material/ hectare in the top picture, while the bottom picture represents rangeland with 824 kg dry matter/ha. One hectare is 100 m by 100 m in size, roughly the size of a soccer field. These estimates are recorded at several places in the grazing area in such a way that it represents the entire area. The recorded values are then averaged for the grazing area, which, if it is multiplied with the size of the grazing area in hectare, gives the total amount of forage dry matter available in the grazing area.



9.2. Balancing animal numbers with forage availability

A big challenge for livestock farmers in Namibia is to adjust livestock numbers to the forage available in a specific year, because forage availability changes from one year to the next. When forage availability is in balance with how much animals will eat during the dry season, no problems are to be expected. However, if for example less rain was received, resulting in lower forage production, a forage shortfall can be expected, which will result in animals losing condition, overgrazing taking place and if the shortfall is severe, may lead to livestock mortalities. This combination of high livestock stocking rates during droughts is probably the most important reason why perennial grasses disappear from our grazing areas.

Good practice in rangeland management is to utilise not more than 50% of grass plants: take half - leave half. This ensures that the soil remains covered and considers losses due to trampling and consumption by other organisms, including insects and other decomposers. In the table below, the number of cattle that can be kept for every 1000 ha of the total grazing area (rested and grazed) if the 50% utilisation rule is applied, is shown:

Estimated biomass as kg Dry Matter/ha	Number of cattle for which forage is available/1000ha*
50	8
100	16
150	24
200	32
250	40

Estimated biomass as kg Dry Matter/ha	Number of cattle for which forage is available/1000ha*
300	48
350	56
400	63
450	71
500	**79**
550	87
600	95
650	103
700	111
750	119
800	127
850	135
900	143
950	151
1000	159
1050	167
1100	175
1150	183
1200	190
1250	198
1300	206
1350	214
1400	222
1450	230
1500	238

* The average mass of an animal in a herd was taken as 350kg/head.

To calculate for how many head of cattle there will be sufficient herbaceous forage available, the number of cattle per 1000 ha is multiplied by the total size of the grazing area divided by 1000. The total grazing area consists of both the rested and grazed areas if rotational grazing is practised. For example, if the average kg Dry Matter/ha determined for the grazing area was 500 kg/ha, 79 head of cattle should have sufficient forage during the dry season and early rainy season. To find out how many cattle this means for the total grazing area, which is for example 7 500 ha in size, the 79 number of cattle per 1 000 ha is multiplied with 7 500/1 000 = 593 head of cattle for the entire grazing area.

If the current number of cattle is much more than the calculated stocking rate, drastic steps are needed to reduce these numbers. In a village setup it is much more difficult since many people must cooperate. Using the example above, if the recommended stocking rate for the village grazing area is 593 head of cattle, and there are currently 670 cattle in the area, it means that the area is currently overstocked with 77 cattle. This represents an overstocking of 13%. A fair way to reduce stock numbers will be to find consensus that each cattle owner reduces livestock numbers with 13%. This means that the larger herd owners will have to destock more numbers than the smaller herd owners. Other options to cope with the situation are also possible, such as moving some animals to better grazing negotiated elsewhere and incorporating bush feed early on.

10. How to manage droughts

Drought should be seen as a normal phenomenon in the driest country in Southern Africa and careful awareness and planning

are needed to prepare for it, cope with it and quickly recover after the drought. There seem to be many definitions for drought, but an agricultural drought is when there is insufficient moisture for average crop or range production. This condition can arise even in times of normal rainfall where rangelands have severaly degraded or desertified. It is unfortunatly expected that the frequency and severity of droughts will increase with climate change, making coping with droughts an important part of rangeland management.

Being drought "prepared" is divided into three components, namely 1) reduce vulnerability to drought, 2) mitigate the impact of drought, and 3) enhance speedy recovery after the drought. The best way to deal with a drought is to be prepared for it. This is done during the years leading up to the drought and includes interventions like:

- Constantly improve rangeland condition through planned grazing, which could include; revegetation/reseeding, removal of undesirable plant species and resting of grazing areas and setting areas aside as drought reserves. Improved rangeland condition ensures resilience through improved water use efficiency, less run-off and evaporation losses and more biomass production, even in years of lower rainfall.
- Farm with livestock breeds that are better adapted to drier environments. Ensure also that breeding herds are functionally efficient and avoid keeping too large animals not adapted to arid conditions. Avoid introducing animals unfamiliar with browsing bushes and trees.
- Timely (on an annual basis) adjust livestock numbers to available forage, at the end of the rainy season as discussed above. This is the first line of defence against drought. If by end of February the area has not received at least 70% of its average annual rainfall, alarms should start sounding. The difference between a 'normal' and 'drought' year is **when** the decision is made to destock - February or May?
- Build up a drought reserve during the good years through resting of areas permanently earmarked for droughts, cutting grass and storing it, making bush feed during the good years and storing it, and planting cultivated pastures and drought-resistant fodder crops. Note that these activities, except bush feed, are only possible during normal and good years, but the products can be used during droughts.

When in a drought very little can be done to provide for additional forage, except for making bush feed (discussed below). The most important decisions are:

- Determine forage availability and decide on how many animals to be removed from the area or the number of animals that can be accommodated in the drought reserve areas, if available.
- Identify all marketable animals and market them without delay. Keeping them too long will not only reduce their body condition, but they will also consume fodder that is meant for other animals, like the breeding herd.
- Identify dysfunctional animals, using the "TTT" method. Old animals with poor teeth (teeth) should first be identified and marketed. Usually, these old cows will have suckling calves that can provide a problem. In a drought, the most vulnerable

animal is an old cow with a small calf. Wean the calves as early as possible and feed the old cows until they reach a reasonable condition and market them. Early weaning is also a general practice recommended for all cows since it allows for cows to recover their body condition in time for the new calf and to have some reserves for the lean times ahead. Other animals to be identified for early marketing include those with long hooves (toes) and dysfunctional udders (teats).

Figure 13: *The three "Ts" in Livestock Functionality (Illustration: Michael Degé)*

- Good lick supplementation and maintaining a good animal health status is a pre-requisite for drought mitigation. Don't allow the condition of animals to deteriorate too much during the drought. Strategic lick supplementation can go a long way towards this, but sufficient forage must be available.

It is also important for the farmer to recover as quickly as possible after a drought. It is difficult to buy new animals after the drought because livestock prices are usually higher after the drought than what you sold yours for before or during the drought. This is a normal supply and demand situation. This will need to be discussed and planned for in community meetings.

11. Producing Bush Feed

Producing bush feed to alleviate forage shortages during droughts is recommended as a drought coping mechanism. The Eastern Communal Lands has suitable bush species to harvest, which include encroacher species such as sickle bush, silver cluster leaf and several thorn bush species (black-thorn, red umbrella thorn). Non-encroacher species such as raisin bush species can also be used, but overharvesting must be avoided. No protected tree species must be harvested for bush feed production.

Bush feed must be supplemented with high-quality feeds or nutrients, because of the inherent low nutritional value of the fibre-rich bush material. Supplements to consider include lucerne, maize, pods from camelthorn trees, and commercial supplements available from agricultural businesses. The ratio of supplements to bush roughage must follow nutritional guidelines. It is recommended that the tools provided by the De-Bushing Advisory Services, downloadable from their website at **https://www.dasnamibia.org/farmers-tools/**, are used to balance bush feeds. These tools include the **Feed Formula App,** which allows the user to enter the types of bush and supplements to use, as well as the **Cost Calculation** tool for bush feed production. Alternatively,

the advice of reputable supplementary feeding experts can be followed.

The leaves of species such as silver cluster leaf contain anti-nutrients such as condensed tannins, which lowers the nutritional value of bush feed. The tannin in the feed binds with the protein and renders it inaccessible to the animal and also lowers the palatability of bush feed for animals. It is therefore recommended that tannin-binding feed additives such as Browse Plus be used. Always follow the product instructions or advice from a qualified animal nutrition representative or scientist.

Where possible it is advised that bush feed is made and stored for later use. The storage facility should be dry, and no water must be able to reach the stored feed. Stored feed, like hay, does carry a fire hazard and safety precautions should be implemented in this regard. Storing bush feed has the advantage that bush feed can be made when bushes are in full leaf and that the machinery is optimally used or can be rented out during non-drought years. Bush feed made of green, leafy bush is high in quality, and will require less supplements to nutritionally balance the ration.

When bush feed is made during drought years, production should begin when the drought is still imminent, such as end February-March, before a forage shortage is experienced. To be effective, animals should be slowly introduced to the bush feed to allow their digestive system to adapt to the new forage. A good guideline is to aim for at least 1 kg of bush feed per animal per day.

12. Rangeland management calendar

A management calendar is very useful to keep track of when specific actions need to happen. This is also true for rangeland management activities. In the proposed calendar below a differentiation is made between normal and drought years because of the timing and urgency of drought mitigating actions such as marketing, obtaining additional forage and/or arranging for grazing elsewhere. We suggest that this concept is further developed to incorporate local knowledge and experience, but a practical example is provided in Table 2.

> *“A management calendar is very useful to keep track of when specific actions need to happen”*

Table 2: An example of a rangeland management calendar, summarising when the specific actions should be taken:

If normal of above-normal rainfall is received from January onwards and/or grass production is high	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Move animals to rested half according to the grazing plan	X											
Observe grazing conditions and forage accumulation		X	X	X	X	X	X	X	X			
Do rangeland condition assessment									X			
Determine if a forage deficit or surplus is expected									X			
Adjust animal numbers if needed (selling, fattening for slaughter, etc.)									X	X	X	

If below-average rain is received or not enough grazing produced from March onwards:	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Select the 3 T animals and market in steps, if dry conditions persist, market more animals							X	X	X	X		
Closely monitor grazing conditions								X	X			
Plan to mobilise drought reserves (water facilities, how many animals, grazing rules, etc.)							X	X				
Mobilise drought reserves										X	X	>>>
Plan to start with bush feed operations (check equipment, where to start, logistics of feeding, etc.)							X	X				
Start with bush feeding								X	X	X	X	X

13. Restoring degraded areas

In the following sections, several ways that rangelands can be improved are discussed.

13.1. Combatting bush encroachment and utilising woody products

One of the contributing factors to the poor grass production in the project area is the high density of woody plants, commonly known as bush encroachment. The dense bush competes with grasses for water, nutrients and deprive the grass layer of sunlight. Reasons for bush encroachment include overgrazing which decreases the competitiveness of grasses. Overgrazing also prevents hot fires of occurring. Suppressing fires is an important reason why currently the commercial areas are so encroached with bush. Other reasons for bush encroachment include a lack of large browsers such as elephants and black rhinoceros, which consume and damage bushes while feeding and moving. The increase in carbon dioxide in the atmosphere due to human use of fossil fuels also stimulates bush growth more than grass growth. This is known as the carbon dioxide fertilisation effect.

Livestock such as cattle can adapt their diet to some extend by browsing more bush when grasses are scarce, which is a good coping mechanism. However, much of the browse is too high for livestock to reach, and droughts and frost can cause long periods without leaves on bushes. The most productive situation is where trees and bushes occur at low densities enabling a healthy and productive grass layer, which is the aim of bush control.

To restore bush encroached areas to productive savannas, we can thin out the bush to allow more space, water, and nutrients for grasses to establish. Many different methods can be used to control bush, but all these take effort or cost money to achieve and may have negative impacts that we would like to avoid. An important principle in bush control is that we must allow especially large trees and bushes to live and not clear all woody plants from an area. Large bushes and trees take up nutrients from deeper soil layers and bring them to the surface when leaves, twigs and dead roots decompose and release the nutrients contained in these plan parts. These remaining trees and bushes also act as wind breaks and provide shade and places for other animals to live. Very importantly, large trees and bushes compete with smaller woody plants and slow down their growth, thus help to prevent re-encroachment.

Because bush control is expensive and labour intensive, it makes financial sense if the wood can be used to offset the cost of bush control. This will depend on the current forestry regulations and laws with regards to harvesting woody products and if a reliable market for these products exists. Fortunately, the new **National Strategy on the sustainable Management of Bush Resources for 2022 to 2027** was recently promulgated by the Ministry of Environment, Forestry and Tourism, which opens opportunities to combat bush encroachment and use woody products legally in communal areas. In the past, wood harvesting for commercial purposes was not allowed in communal areas. The requirements and process to obtain a harvesting permit is as follows:

- Land and resource rights need to be obtained. Since customary

land rights are insufficient, two main options are to either register a community forest or a cooperative. The cooperative needs to have a Forest Management plan.

- The harvesting and control of bush needs to be well managed and benefits equitably shared. For this management committees in communal conservancies or community forests are advised.
- Control over overharvesting, monitoring and enforcement of rules will need to be effective.

Several potential wood control/utilisation options are listed below to be considered:

- **Firewood:** If rootstocks are manually removed with the above-ground stems and branches, good local control can be expected, because the entire plant is killed. Where only the above-ground parts are removed, a large percentage of the woody plants will regrow (coppice) and in a few years will reach the same pre-control competition effect on grasses. Uprooting shrubs is, however, a very time-consuming activity and the income from firewood sales must offset the effort and labour costs to be viable.
- **Poles for fencing:** Pruning multi-stem plants and using or selling the straight stems as fencing droppers. Strong regrowth can be expected from the remaining stems, and thus will have a temporal effect as a bush control measure. Silver cluster-leaf (mugaro, omugolo, *Terminalia sericia*) is a good species for this.
- **Charcoal production:** Charcoal production requires thicker stems and thus larger trees and species such as black-thorn (omusona, *Senegalia mellifera*) and Kalahari acacia (*Vachellia leuderitzii*) are suitable species.
- **Biochar production:** Biochar is now produced in some parts of Namibia as a carbon offset strategy, but the process to obtain certification is cumbersome.

13.2. Branch packing and reseeding.

To restore bare patches, branch packing with reseeding with palatable, perennial grass species is a good way to protect the newly introduced seeds to establish. For reseeding the following indigenous grass species is recommended:

- For sandy soils wool grass (*Anthephora pubescens*) or Kalahari quickgrass (*Schmidtia pappophoroides*) and
- Blue buffalo grass (*Cenchrus ciliaris*) in more clayey or calcareous soils.

Unfortunately Silky Bushman grass (ongumba) is difficult to harvest and the seeds have a low germination rate.

For reseeding, preferably local seeds should be collected, as these seeds are from plants adapted to the local environment. Areas very far from water and in the the road reserves in the commercial farming areas have often good swards of the above species. The seeds must be ripe and about to fall off when harvesting, which is often at the end of the rainy season in April or May, but it may also be ripe earlier during good rainfall years. Seeds harvested must

be kept in paper bags in a dark, dry room for at least 10 months before sowing.

Good places to start with veld restoration are areas where the desirable species are extinct. Bare areas and areas where bush thinning took place could also be considered. Perennial grass seedlings may have difficulties establishing in bush encroached areas. Restoration can also be initiated around water points when these are closed during the resting cycle of the Split-Ranch system. The best would be to establish restoration sites over many small patches rather than a single large patch. In this way, several dispersal points are created from which seeds can effectively spread to the surrounding rangeland once the new grass species are well established.

Figure 14: *Sow climax grasses and cover it with tree branches (Photo: Axel Rothauge)*

Branches should be collected from bush encroacher species and only packed as a single layer on the bare patches. If the branches are packed on top of each other, grasses may not germinate because of too much shade and low soil temperatures. Even on very gentle slopes, branches should be packed in rows following the contour line and with rows spaced a few meters apart. On flat areas, branches are recommended to be evenly spread with spaces in between, e.g. 10 m, so that a larger area can be treated. Once the branches are in place, seeds can be sowed into the laid-down branches by hand, or seeds can be worked into the soil with a hoe or shovel and branches packed over the sowed patch. The best time of year will be during the latter half of the rainy season (after February). This is not a quick process and seeds may take more than a year to germinate and establish.

13.3. Temporal kraaling

It is recommended to use temporal kraals to treat large bare areas where the soil is capped or where sheet erosion removed the fertile topsoil as an alternative to branch packing and reseeding. Temporal kraals are created and and animals are kept overnight in the kraals for a few nights. The animal hoof action breaks the soil surface and creates a more favorable seedbed for germination, while the dung and urine inputs by the animals improve soil fertility. Animals mustn't stay more than a few days, otherwise too many nutrients may cause weeds to grow while harming the growth of desirable species. The kraals can be constructed from branches or fencing material and if a large patch is treated it is advisable to move three sides every few (e.g., 3-5) days to an adjacent untreated area to spread the treatment over a larger area.

In the desertified areas close to homes and water points, enough soil nutrients may already exist in the soil and temporal kraals will probably not be effective as a restoration tool. Temporal kraals should only be used in bare areas further than 500 m away from water points. These kraals should be 20-30 m in diameter but can be bigger if many animals and herders are available. To avoid soil compaction, this method should only be used during the dry season.

14. Monitoring the Resource Base

To measure is to know. If we monitor our rangelands every year, we will have a record of how effective our management strategies were to help us optimise our farming productivity and to learn from mistakes. Another very important part of monitoring is to help us focus on the important components of our farming system and to learn how to 'read' the landscape that provides our animals with forage. Below we discuss a simple but effective way that livestock and rangelands are monitored.

14.1. Monitoring Cattle Condition

Condition of livestock reflects condition of rangeland and the availability of forage. Regular assessments can provide early warning. Livestock condition is unrelated to breed, age and sex, and if done regularly, it can provide farmers with information to make timely decisions. To be able to assess livestock condition, a photo guide with a range of livestock condition classes is needed.

Figure 15: *Different cattle condition classes (Photos: Arnold !Gaseb)*

Livestock condition class 1 depicts an animal in very poor condition, while the animal in livestock condition class 5 is very fat. By using this guide, the farmer can regularly score the condition of his cattle. On a monthly basis, select at least 25 cattle and assess their body condition using the assessment photo guide.

14.2. Monitoring Rangeland Condition

Monitoring rangeland condition over time will help the farmer to detect if his/her rangeland is deteriorating or improving. To be able to do that, rangeland condition assessment sites must be set up. Select a representative number of permanent sites that represent all veld condition scenarios on the farm. Permanently mark them and take GPS readings or mark the spot where the point is selected.

Identify a permanent landmark in the background and take two pictures, one a close-up and the second a panorama-type wide angle view in the same direction. The photo is taken from the exact same spot and in the same direction. The time of day should preferably be the same, and the season should also be the same, unless you are comparing the effects of season and the photographs were taken in the same year. It is preferable that the focal length of the lens be the same. While focusing on the close-up area score the current veld condition using the score sheet.

The following indicators are used:

14.2.1. Soil Cover

This indicator provides an indication of the extent of soil cover by life grasses around a specific marker in the veld.

Different categories for the determination of Soil Cover					
Score	**1**	**2**	**3**	**4**	**5**
Short Description	About the whole area is bare	¾ of the area is bare	½ of the area is bare	¾ of the area is covered by life plants	The whole area is covered by life plants
					

> *A big challenge for livestock farmers in Namibia is to adjust livestock numbers to the forage available in a specific year*

14.2.2. Capping of the soil surface

The soil surface is sometimes capped preventing water to infiltrate and seeds to establish. It often happens that lichen bind soil particles to form a capped surface.

Different categories for the determination of Capping					
Score	**1**	**2**	**3**	**4**	**5**
Short Description	About the whole area is capped	¾ of the area is capped	½ of the area is capped	¼ of the area is capped	There is no capping of the soil surface visible
					

> *Good practice in rangeland management is to utilise not more than 50% of grass plants: take half - leave half*

14.2.3. Litter on the soil surface

Leaves and stems of plants assemble on the soil surface and is called litter. It forms a protective blanket on the soil surface that limits evaporation and that protects the soil surface against the direct impact of rain drops. This litter also provides shade for soil microbes.

Different categories for the determination of Litter					
Score	**1**	**2**	**3**	**4**	**5**
Short Description	There is no litter on the soil surface	¼ of the area is covered by litter	½ of the area is covered by litter	¾ of the area is covered by litter	The whole soil surface is covered by litter
					

14.2.4. Soil Erosion

Soil erosion occurs when soil particles move or are transported from one place to the other by water or wind. If moved evenly, it is referred to as sheet erosion. Sometimes the occurrence of grasses on "pedestals" is a good indication of soil erosion. Extreme forms of erosion are gully or donga erosion.

Different categories for the determination of soil erosion					
Score	**1**	**2**	**3**	**4**	**5**
Gullies	The whole area is covered by gullies	More than half of the area is covered by gullies	Half of the area is covered by gullies	Less than half of the area is covered by gullies	There are no gullies visible
Rills	The whole area is covered by rills	More than half of the area is covered by gullies	Half of the area is covered by gullies	Less than half of the area is covered by gullies	There are no gullies visible
Pedestals	The whole area is covered by pedestals	More than half of the area is covered by pedestals	Half of the area is covered by pedestals	Less than half of the area is covered by pedestals	There are no pedestals visible
Sheet erosion	The whole area is covered by sheet erosion	More than half of the area is covered by sheet erosion	Half of the area is covered by sheet erosion	Less than half of the area is covered by sheet erosion	There are no sheet erosion visible
Soil deposition	The whole area is covered by soil deposition	More than half of the area is covered by soil deposition	Half of the area is covered by soil deposition	Less than half of the area is covered by soil deposition	There are no soil deposition visible

14.2.5. Botanical composition of the rangeland (annual vs perennial grasses)

Annual grasses only live for one season and must establish each year from seed. Perennial grasses live over several seasons and start growing as soon as growth conditions improve.

Different categories for the determination of rangeland composition					
Score	**1**	**2**	**3**	**4**	**5**
Short Description	There are no perennial grasses.	¾ of all the grasses are annual	There is an equal occurrence of annual and perennial grasses	¾ of the grasses are perennial	The whole area is covered by different perennial grasses
					

14.2.6. Perception of problem plants

Problem plants that replace perennial grasses and that are not beneficial to livestock farming include poisonous plants and encroacher and invader bushes.

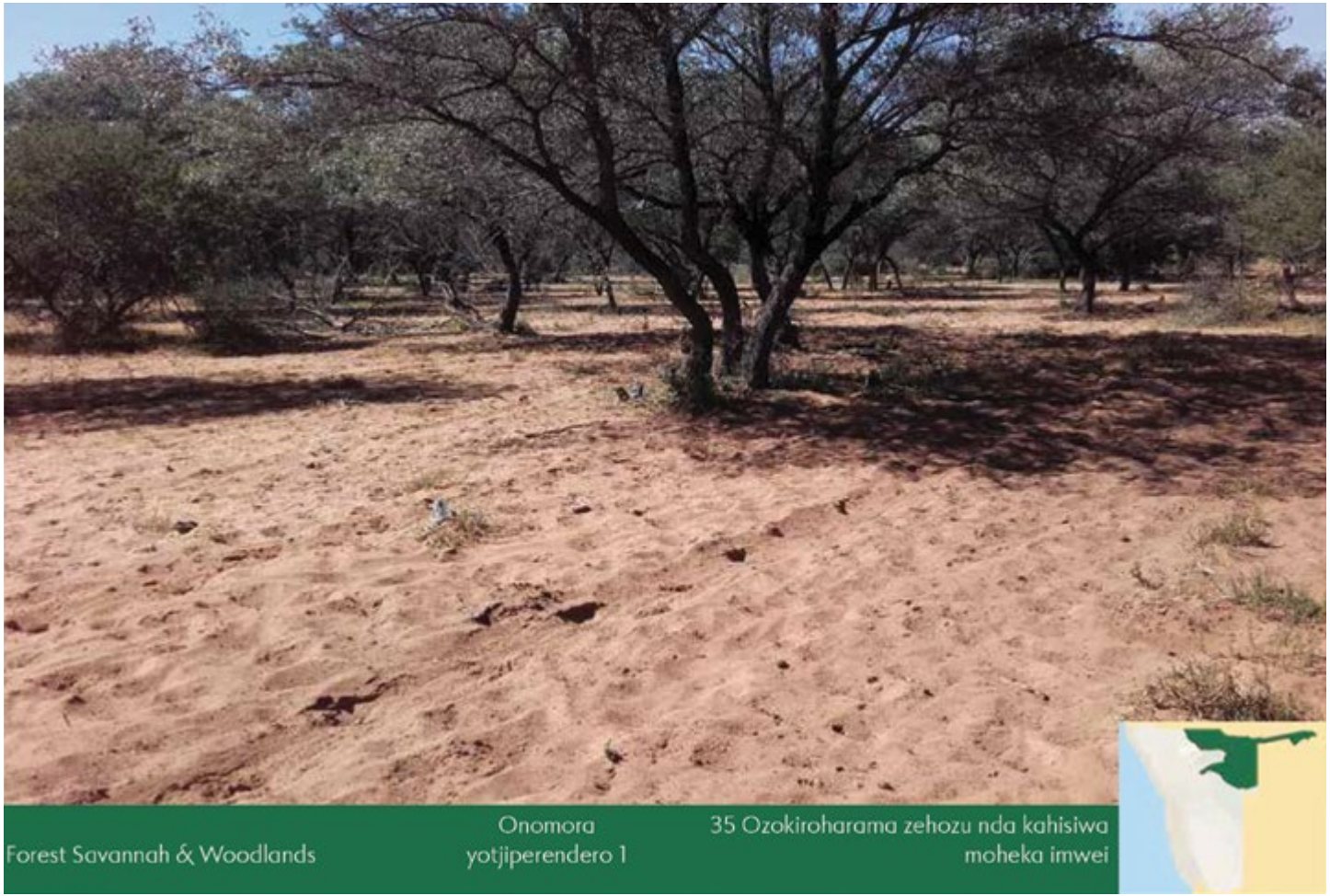
Different categories to determine problem plants					
Score	**1**	**2**	**3**	**4**	**5**
Short Description	There are many problem plants and farmers indicate stock losses	Problem plants expand to new areas	Farmers are getting concerned about problem plants	Farmers are aware of problem plants	Problem plants are no threat
					

"Land degradation describes a loss in the usefulness of the land"

Special Note:

On the next pages we have included pictures from the **"Photo Guide to estimate Forage Availability in Namibian Rangelands"**.

The pictures are taken from the **"Forest Savannah and Woodlands section".**



Forest Savannah & Woodlands

Onomora yotjiperendero 1

35 Ozokiroharama zehozu nda kahisiwa moheka imwei


Forest Savannah & Woodlands
Onomora yotjiperendero 2
397 Ozokiroharama zehozu nda kahisiwa moheka imwei

Forest Savannah & Woodlands

Onomora yotjiperendero 3

591 Ozokiroharama zehozu nda kahisiwa moheka imwei

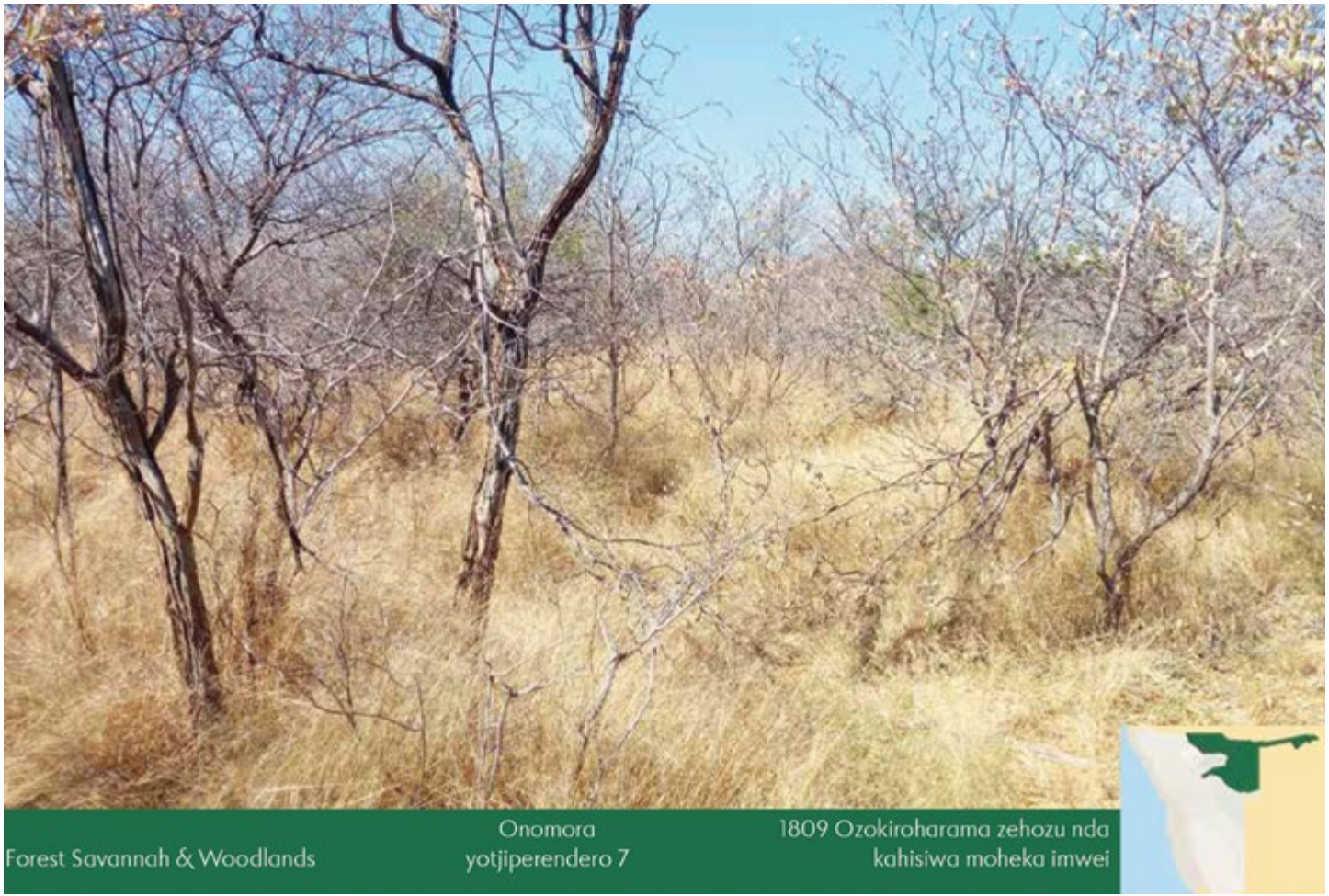

Forest Savannah & Woodlands
Onomora
yotjiperendero 4
974 Ozokiroharama zehozu nda kahisiwa
moheka imwei


Forest Savannah & Woodlands
Onomora
yotjiperendero 5
1205 Ozokiroharama zehozu nda
kahisiwa moheka imwei

Forest Savannah & Woodlands

Onomora
yotjiperendero 6

1404 Ozokiroharama zehozu nda
kahisiwa moheka imwei


Forest Savannah & Woodlands
Onomora
yotjiperendero 7
1809 Ozokiroharama zehozu nda
kahisiwa moheka imwei


Forest Savannah & Woodlands
Onomora yotjiperendero 8
2921 Ozokiroharama zehozu nda kahisiwa moheka imwei