Orange-Senqu River Basin

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Vegetation Baseline Survey

Demonstration Project on Community-Based Rangeland Management in Lesotho

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Orange-Senqu Strategic Action Programme

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Demonstration Project on Community-Based Rangeland Management in Lesotho

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Contents

1. Introduction

Following South Africa's accession to the Ramsar Convention the Orange-Senqu River mouth was designated a Ramsar Site, i.e. a wetland of international importance, on 28/06/1991 (Cowan, 1995), because of (a) being one of only nine perennial coastal wetlands on the southern African west coast, (b) its supporting more than 20,000 waterbirds of about 60 species, (c) its supporting an appreciable assemblage of rare and endangered water bird species, and (d) supporting more an 1% of the world and southern African population of several species of waterbirds. Namibia ratified the Ramsar Convention in 1995, after which the designated area was enlarged and the Namibian part of the wetland was designated too. Following national bird counts in the 1970s and 80s, the estuary was recognised as being one of the most important estuaries in South Africa in terms of its waterbird populations (Turpie, 1995), and as a top priority in terms of its overall biodiversity conservation importance (Turpie et al., 2002; Turpie and Clark, 2007). It has also been designated as an Important Bird Area (Barne Agriculturally and ecologically sustainable utilization of rangelands remains a challenge around the world, particularly where relatively high population densities of people rely on livestock for their livelihoods and way of life. Increasing population pressures and associated increasing numbers of livestock, coupled with a consequent reduction in land area and gradual resource degradation have compounded the impacts that livestock have on vegetation, and consequently on the environment at a landscape scale. Livestock and their impacts can have a significant influence on biodiversity, hydrology, soil conservation, food security and the livelihoods of associated communities.

Although still at the speculative stage, it is possible that changing weather patterns further exacerbate the impacts of livestock on vegetation by modifying vegetation production patterns and composition. These changing weather patterns are considered to be a consequence of global climate change. Associated with the global change are the rising levels of carbon dioxide (CO2) in the atmosphere, which can potentially influence vegetation composition significantly. In particular, plants that follow the C3 photosynthetic pathway are gain a competitive advantage over plants that follow the C4 photosynthetic pathway in the presence of increased levels of CO2. Of relevance here is that shrubs like Chrysocoma ciliata are C3 plants, while many of the natural rangeland grasses are C4 plants. This implies that the significant increase in density and range of shrubs like Chrysocoma ciliata may be as a result of inappropriate grazing management and increased CO2 levels. Strategies for sustainable utilisation of rangelands in future have to take these aspects into consideration.

In recent years, the focus of rangeland management around the world has moved from emphasising agricultural (livestock) production to incorporate conservation, biodiversity and ecosystem services, with the strong realisation that rangeland management affects communities far removed from the communities who live in the area. In particular, biodiversity and ecosystem services such as carbon sequestration and water production (hydrological cycle) have been emphasised. This implies that the communities living in and existing off particular rangelands have a responsibility and obligation to communities far removed from those rangelands, to utilise and manage the rangelands in a sustainable manner. This should also imply that communities who manage their rangelands in a responsible and sustainable manner, which benefits society as a whole, should benefit in some way for this.

The present project is focused on involving local communities in the Mount Moorosi area in the Quthing district of Lesotho in scientifically based rangeland management, with a view to improving livelihoods and food security, as well as ensuring ecological sustainability in all its facets. The project is focused on four villages under the Telle Community Council in Mount Moorosi, namely: Ha Koali, Ha Sekhonyana, Ha Mantsoepa and Ha Moqalo.

The demonstration project is viewed as a pilot project, with the intention developing appropriate techniques and approaches of management by the community and then applying these approaches elsewhere. Attempts to address and reverse rangeland degradation must therefore involve the land users (local households) and needs to offer tangible benefits to these households so as to incentivise changes while avoiding deterioration in food security and increase in poverty.Anderson, 1998).

1.1 Vegetation of the project sites

The project sites are located in the Mount Moorosi district of southern Lesotho. The most recent and up to date description of vegetation in southern Africa was produced by Mucina and Rutherford (2006). From Figure 1, the Mount Moorosi sites fall into the Mesic Highveld Grassland Bioregion.

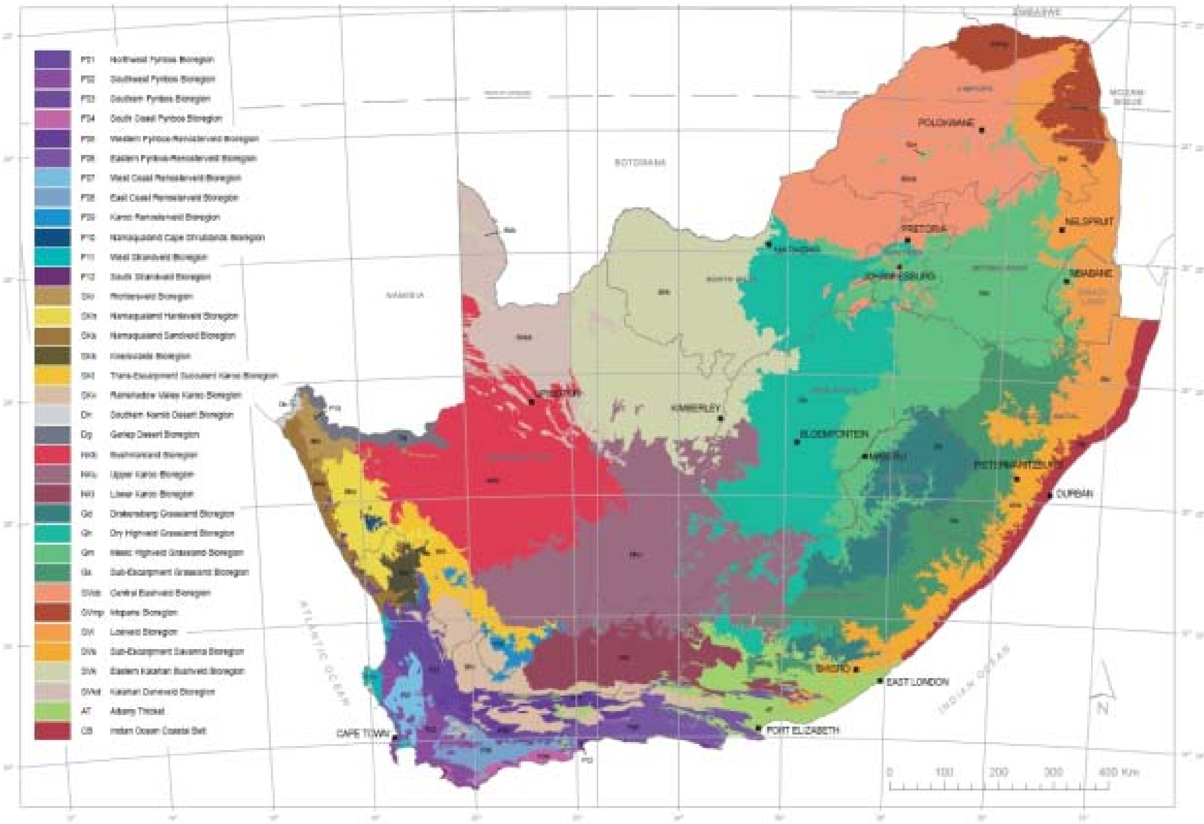

Figure 1. Bioregions of southern Africa, showing the Mesic Highveld Grassland Bioregion in light green covering the western Lowlands and the Senqu River valley in the south-eastern parts of Lesotho (Mucina and Rutherford 2006).

Within the Mesic Highveld Grassland Bioregion, the study site falls into the Senqu Montane Shrubland unit. This is indicated in Figure 2, with Mount Moorosi shown and in Figure 3 showing the approximate location of the study sites. This vegetation unit is found along the Senqu River, and covers the valley slopes and valley floor. The vegetation comprises grassland dominated by a number of evergreen shrubs. Soils are generally shallow away from the valley bottom, with some of the soils in the higher lying regions extremely shallow. Soils are generally derived from sandstone, and are consequently relatively highly leached and infertile.

Rainfall is relatively low, with a likely range of about 550mm to 700mm. Most of the rainfall is convectional, usually in the form of heavy storms during summer. Winters are cold and dry. As a consequence, the growing season for vegetation is relatively short, which affects overall vegetation productivity and also exacerbates forage shortages for livestock during winter. High levels of runoff exacerbate drought symptoms, and reduce the amount of soil moisture available for plant growth. In extreme situations, this leads to a condition known as "hyper-aridity".

The implication is that the Orange-Senqu River mouth may lose its status as a Ramsar Site unless the condition of the saltmarsh can be restored.

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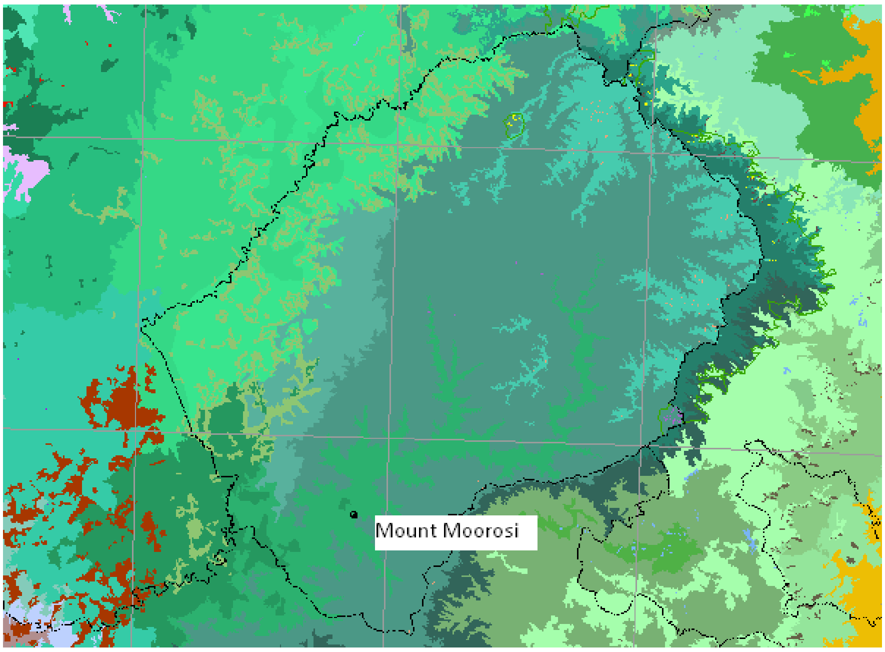


Figure 2. Vegetation units of Lesotho, indicating the position of Mount Moorosi in the Senqu Montane Shrubland (Mucina and Rutherford 2006).

Much of this vegetation unit is transformed or degraded. The main cause of transformation is cultivation for crops. Significant areas of the land previously cultivated for crop production is no longer used for that purpose, and has reverted to a poor quality, low diversity, unproductive secondary grassland. Large areas of this secondary grassland has been eroded, with significant soil loss occurring. Degradation of the uncultivated areas appears to be as a result of injudicious livestock management and over-utilisation.

The Senqu Montane Shrubland borders on, and interfaces with, the Lesotho Highland Basalt Grassland. This grassland occurs at higher altitudes and on soils derived from basalt. The vegetation comprises grassland, with small shrubs.

The relatively low and erratic rainfall, shallow soils, excessive runoff and short growing season combine to limit the production potential of the vegetation. Commonly, where soil depth is below 300mm, then the production potential for forage is significantly impacted. Many of the soils on the slopes of the valleys in the Senqu Montane Shrubland are shallower than 300mm. Grassland that has been transformed by cultivation is usually irreversibly transformed, at least in terms of timescales relevant to current land users. Most of the transformed (previously cultivated) grassland is on the deeper soils, because deeper soils were usually selected for cultivation. This means that most of the areas with relatively higher production potential have been transformed, reducing their productivity. Any disturbance of the soil, such as cultivation, destroys the soil structure, reduces soil organic matter and destroys the seed bank of indigenous vegetation. Old cultivated lands that are no longer used for crop production typically revert to an unproductive, low diversity stand of weedy grasses and non-grasses that are of limited forage value. This is undesirable both from an agricultural as well as a conservation perspective.

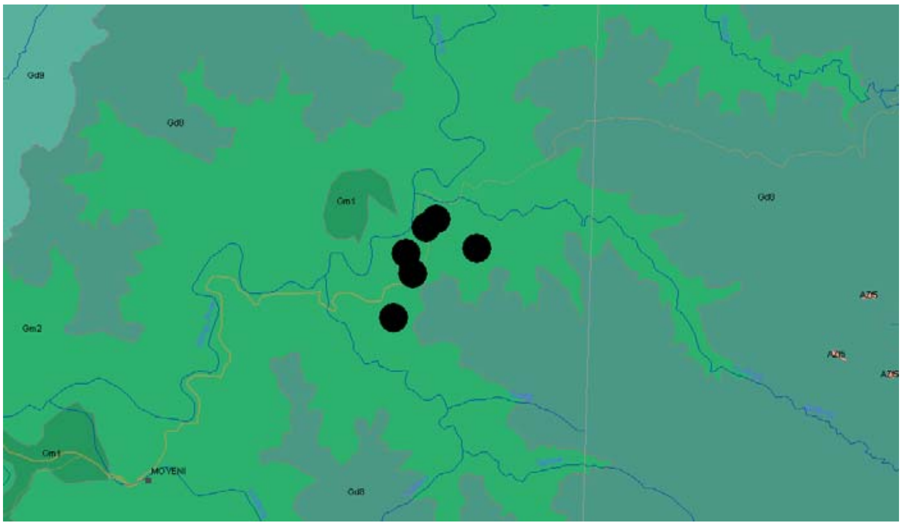


Figure 3. Approximate location of the study sites around Mount Moorosi, indication their location in the Senqu Montane Shrubland indicated by black circles (labelled Gm2) (Mucina and Rutherford 2006).

1.2 Objectives of rangeland management

Livestock owners in Lesotho face unique challenges, in that they live at relatively lower altitudes and have to make use of high altitude grasslands during the summer and the mid- to lower altitude grasslands close to and around homesteads during winter. The higher altitude grasslands are unsuited to winter grazing because of the severe cold weather and frequent snowfalls, coupled with the significant drop in forage quality during winter.

The mid- to lower altitude grasslands have to carry livestock for a significant portion of the year. It is usually the lower altitude grasslands close to settlements that have been impacted by cultivation, which lowers the potential for carrying livestock.

The complete grazing system is a complex interaction of summer grazing in remote high altitude areas, coupled to the grazing in the lower altitude areas in winter. The high and low altitude areas are not disconnected, but need to be considered as parts of the whole grazing system. For example, if a community has access to a relatively large summer grazing area and they are able to carry a large number of animals through the summer in a good condition, and they have limited are for winter grazing, then the winter grazing area is going to be under pressure and is likely to suffer degradation. Conversely, if a community has access to a large area of winter grazing, and is able to maintain a large number of animals in good condition through winter, but has limited summer grazing area, then the summer grazing area is likely to be impacted.

Rangeland management decision making in communally owned areas is a complex process. However, decisions can be made and implemented to benefit cattle owners and the environment, provided all parties involved in the decision making process have access to information, and have a good understanding of the issues and of the consequences of their decisions. In addition, all parties need to see an advantage in management programme.

General objectives of any rangeland management intervention would include:

- Livestock production:
  - Community livelihoods; and
  - Food security.
- Conservation:
  - Biodiversity;
  - Soil protection; and
  - Water conservation.
- Sustainability of both livestock production and conservation.

The specific objectives of the demonstration project are to:

- Increase awareness of the condition of the rangeland resources among the communities dependent on the rangelands.
- Initiate restoration projects where necessary, including:
  - Clearing of the invasive shrubs (mainly *Chrysocoma ciliata*);
  - Re-seeding of degraded areas and areas cleared of shrubs;
  - Developing erosion control structure such as stone packs and gabions in severely degraded areas; and
  - Implement periods of rangeland resting to facilitate recovery where necessary.
- Quantify the initial condition of the rangeland in all sites, including restoration areas and adjacent unrestored areas, with the assistance of staff from the Department of Range Resource Management in the Ministry of Forestry and Land Reclamation.
- Develop a monitoring program to be implemented over time by the staff from the Department of Range Resource Management.
- Involve livestock owners and members of local communities in monitoring range condition.
- Consider and develop innovative approaches to rangeland restoration.
- Consider alternative sources of forage for livestock in order to relieve grazing pressure on the rangelands, with particular reference to planting suitable forage grasses on abandoned crop lands.

To date, the project has been initiated, and significant progress has been made in various facets, including withdrawal of project sites from grazing to facilitate recovery, clearing of shrubs (mainly *Chrysocoma ciliata*), building of erosion control structures (stonepacks and gabions) and reseeding of cleared areas and other degraded sites with Eragrostis curvula (Weeping lovegrass) seed. At the time that the project was initiated, it was impossible to carry out vegetation surveys with any degree of reliability because of the difficulty with vegetation identification at that time of the year. Consequently, it was decided to carry out the baseline surveys during April 2012, at which time the identification of vegetation is more reliable.

Where rehabilitation in the form of reseeding or clearing had taken place, adjacent uncleared areas were selected and surveyed for comparison purposes to be able to evaluate the impact of the rehabilitation activities over time.

1.3 Survey methods

The baseline surveys were carried out by staff from the Department of Range Resources Management in the Ministry of Forestry and Land Reclamation. These staff have considerable experience in rangeland assessment and management in the local environment, and will be tasked with ongoing monitoring as well as assuming responsibility for extending the projects to new areas.

In keeping with their usual approach to rangeland assessment, the following approaches were followed:

- Site description and mapping: All four sites, Ha Koali, Ha Sekhonyana, Ha Mantsoepa and Ha Moqalo were mapped. Reference sites were selected and surveyed to represent the unrehabilitated condition, and surveys were carried out on the rehabilitated areas. Follow up surveys will be done at intervals over time to quantify the impacts of the rehabilitation efforts. Coordinates were recorded for each transect (Annex 1).
- The metric belt technique (Schmutz et al. 1982) was used to assess the rangeland condition. This is a quadrat based technique that can be used to measure cover, composition and production of vegetation. It can also be used to calculate frequency, distribution and plant density. This technique is used as a standard technique by the staff from the Department of Range Resources.
- A visual assessment was also carried out on each site, using a scorecard to estimate plant cover, botanical composition, vigour, soil surface condition and insect and rodent damage. This is a subjective assessment (using a scale 1 to 10 for each parameter), but provides valuable additional data about each site, and can also be used for monitoring changes over time. Again, this technique is used as a standard by the staff in the Department of Range Resources.

2. Results

The results presented here are summarised from Annex 1. Bearing in mind that the reference sites and rehabilitated sites are separate and different, irrespective of the rehabilitation measures carried out. Consequently, a cursory comparison is valuable, but the real value in the data will come from follow-up monitoring on each site, where trajectories of change can be monitored on both the reference sites and the rehabilitated sites. This will allow an objective means of measuring the impacts of the rehabilitation.

2.1 Site stability

Site stability has been estimated in terms of vegetation cover, rock and bare ground (Table 1). Higher vegetation cover and lower instances of bare ground indicate greater stability. Rock cover is also considered to contribute to stability, so is added to vegetation cover to give total cover.

Table 1. Site stability data.

		Vegetation	***Rock***	***Bare***	***Total cover***
Ha Moqalo	Reference	73.98	5.95	20.07	79.93
	Rehab	82.61	0	17.39	82.61
Ha Mantsoepa	Reference	55.61	2.96	41.43	58.57
	Rehab	92.68	0	7.32	92.68
Ha Koali	Reference	79.72	3.23	17.05	82.95
	Rehab	92.16	0.48	7.36	92.64
Ha Sekhonyana	Rehab	38.59	32.57	28.84	71.16

While it is difficult to compare between the reference and rehabilitation sites at this stage, because of the reasons outlined above, there are some differences that should be noted. For example, in the Ha Mantsoepa site, the high occurrence of bare ground in the reference site compared to the rehabilitated site is likely to be due to the impact of clearing shrubs. In the reference sites, the shrubs were particularly dominant, and effectively outcompeted the grass layer, causing significant bare areas. In the rehabilitated site, the combination of clearing and exclusion of grazing animals resulted in a significantly more vigorous grass layer, with consequent higher cover and less bare ground. This effect was also seen in Ha Koali. This already gives a strong indication that the clearing of shrubs is likely to have a significant positive impact on grass cover and productivity. This should in turn have a positive impact grazing capacity as well as water infiltration, hydrology, erosion reduction and probably biodiversity. Further monitoring over time should confirm this.

2.2 Species composition

Data from the vegetation surveys (Annex 1) have been summarised in Table 2.

*Table 2. Species composition from the four project sites on the reference sites (ref) and rehabilitation sites (rehab). Where species names are not known, the abbreviation "spp" follows the genus name. Names marked with * are local common names.*

	Ha Moqalo		***Ha Mantsoepa***		***Ha Koali***		***Ha Sekon-yana***
	Ref	***Rehab***	***Ref***	***Rehab***	***Ref***	***Rehab***	***Rehab***
Aristida bipartita	1.51			2.48	4.2	17	
Aristida congesta	5.03			4.29			5.6
Aster filifolius			1.6		6.8		
Brachiaria serrata		2.63					5.5
Chrysocoma ciliata			1.1				
Cotula socialis						2.1	
Crassula pellucida			0.7				
Cymbopogon excavatus	9.05						5
Cyperus spp		2.63				1.3	
Dicoma anomala			0.2	0.23			0.5
Digitaria sonata						8.2	
Elionurus muticus			7.3	8.58		3.1	
Eragrostis capensis	10.05	2.63	8.2	4.29	0.5	4.6	
Eragrostis chloromelas	1.51	0.53	0.2		2.4		2.5
Eragrostis curvula	2.51	10.53					1.7
Eragrostis gummiflua		1.58		1.13			
Eragrostis racemosa	1.01			3.16			
Erica maesta					1.1	0.8	0.5
Felicia spp	3.02				0.3	1	
Ficinia filiformis	2.01	6.32			3.6	7.2	
Forb 1	2.01				0.3		
Forb 2				0.9		0.3	
Forb 3			2.9	0.9			
Forb 4			0.9				
Forb 5			0.2				
Gazania krebsii		2.11	0.4	0.45		0.3	
Gerbera spp					3.2	13.1	
Helichrysum dasycephalum		5.26	13.3	5.64	0.5	0.5	0.2
Helichrysum spp				4.06		0.3	
Hermannia depressa	9.05	2.11	0.7				1
Heteropogon contortus	1.51	13.16	6.7	26.86		18.3	25.7

	Ha Moqalo		***Ha Mantsoepa***		***Ha Koali***		***Ha Sekon-yana***
	Ref	***Rehab***	***Ref***	***Rehab***	***Ref***	***Rehab***	***Rehab***
Hyparrhenia hirta	2.51	27.37					12.4
*Karana				0.9			
*Leharasoana				0.23			
Melica decumbens							21.7
Microchloa caffra	7.54	0.53	1.1	3.61		0.5	
*Mofasa toeba			0.2				
Moss							0.3
Oxalis spp						3.6	
Passerina montana	2.01	2.11		7	1	1.5	
Ranunculus multifidus			45.9		69.4		
Rhus spp					1.6	1.5	
Sebaea spp							0.5
Sedge						1.3	
Setaria incrassata	1.51		2.2	3.61	1		0.2
Setaria sphacelata						0.5	
Senecio asperus							8.4
Sporobolus africanus							1
Stachys rugosa	2.01	3.68		11.51			
*Taraputsue	29.65	10.53					4.6
Themeda triandra				6.77			
Trachypogon spicatus			2.4		0.5		1.3
Trichoneura grandiglumis	6.04	6.84					
Tristachya leucothrix				2.4			
Turbina oblongata			3.8	0.9	3.6	10	
Wahlenbergia spp							0.3

These data serve as a baseline for assessing change in future, and making comparisons of the species composition between and within sites at this stage is premature.

It is worth noting, however, that where shrub clearing has taken place, the proportion of grasses relative to shrubs was markedly higher. Further monitoring over time will confirm the trend and quantify the impacts of the clearing. Monitoring will also allow for detection of change in the ecological categories of grasses present, which in turn have a direct impact on grazing capacity.

2.3 Productivity and grazing capacity

The metric belt assessment technique allows for estimation of the vegetation biomass at the time of the survey. Because the surveys were carried out during April, which is the end of the growing season, and assuming that no grazing took place over the growing season, then the estimates should be a reasonably reliable indicator of annual productivity.

Productivity values for the four sites ranged from 343 kg/ha in Ha Sekhonyana to 804 kg/ha in Ha Koali. These translate to a calculated grazing capacity of 9.7 ha/AU/year and 6.54 ha/AU/year respectively.

The relatively low productivity and consequent grazing capacity is a reflection of the shallow soils, poor species composition, shrub encroachment and short growing season typical of the area. Rehabilitation and appropriate grazing management can reduce shrub encroachment and improve species composition, which can have a significant impact on grazing capacity.

2.4 Summary and conclusions

The mobilisation of local communities to become involved in rehabilitation and active rangeland management appears to have galvanised the communities into enthusiastic action. The rehabilitation activities carried out so far, particularly the clearing of shrubs, appear to have already yielded some positive results, although improvements in rangeland condition take time and need to be monitored over time. The resting of the rangeland for the growing season also appears to have been an appropriate action to have taken.

The measurement of the effectiveness of the erosion control structures and stonepacks will take longer, as these structure have to trap soil before any vegetation can be established above the structures.

The impacts of the reseeding with *Eragrostis curvula* will also take some time to assess. There has been good establishment in some reseeded areas, but further assessment is required to evaluate the survival of the young seedlings through the winter. It would also be very useful to monitor the natural establishment of grasses in areas cleared of shrubs. This can be done over the next few years during the routine monitoring.

The practice of reseeding degraded areas is critically important. The current practice of using purchased *Eragrostis curvula* seed is practically viable and should succeed in establishing grass cover. However, it may be more beneficial from a biodiversity, ecosystems services and also livestock production perspective to consider utilising locally harvested indigenous species of grass for rehabilitation. With this in mind, a proposal for initiating this is attached as Annex 2.

Critical factors for success include full, active and willing participation from local communities and cattle owners, with a view to benefitting from resource conservation. To increase community participation, it is recommended that community member become involved in the monitoring of the rangeland condition and the interpretation of the results, and that these results are then actively incorporated in their decision making processes.

References

Mucina L and Rutherford MC (eds.), 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.

Schmutz EM, Reese ME, Freeman BN and Weaver LC, 1982. Metric belt transect system for measuring cover, composition and production of plants. Rangelands 4(4) 1982.

Annex 1: Baseline range inventory

During the demonstration project's conceptualisation phase, it was decided that a baseline study shall have to be undertaken so that at the end of the project; the baseline should provide a benchmark for measuring change. However, due to the timing of season when the project commenced; it was very difficult to identify the grasses andtherefore decided to postpone the survey until after the onset of the first rains. As a result, there was a lag of seven months period in between; in which period, some rehabilitation measures were initiated. It was agreed that the "untouched" areas just adjacent the rehabilitated sites, will be used as reference points which would, more or less, give an indication of how the area was before intervention. The findings of this report should therefore be utilised bearing this mind.

Background

Rangeland degradation in Lesotho is mostly associated with poor grazing control which is characterised by continuous grazing that does not allow for the rangelands to rest and or recover. Continuous grazing as opposed to rotational grazing renders rangelands susceptible to depletion of desirable climax species which are replaced by undesirable plant species. On extreme cases, for example, continuous grazing could lead to exclusion of certain species on site and decreased species diversity and richness. This enigmatic state of degradation on rangelands has over the years been an area of concern for the Government of Lesotho. To address the situation this Demonstration Project on Community-Based Rangeland Management tries to address water and land conservation issues, and alleviate poverty through a holistic approach based on integrated watershed management principles and the needs of the local people. The integrated watershed management approach applied in this demonstration project entailes: the removal of undesirable plant species (shrubs) on the rangelands; to allow for regeneration of desirable grass species, reseeding of degraded rangelands with more palatable grass species (*Eragrostis curvula*) to supplement the rangelands and construction of stone-lines and silt traps across severely degraded slopes to conserve the soil. All these rehabilitation works were achieved with the voluntary involvement of community members residing in the demo project sites.

Objectives of the baseline survey

The objectives of conducting a baseline range inventory survey are outlined as follows:

- To assess the extent of land cover under current land use practices and therefore determine the carrying capacity of the rangelands;
- Using scientifically derived data, support community based management of rangelands with advice on technical and institutional aspects, as may be required;

As a result, the project team, with technical expertise from the Lesotho Department of Range Resources Management commissioned a baseline range inventory survey with the view to:

- Establish fixed monitoring points in the form of transects that will be used in the current baseline assessment and subsequent periodic monitoring exercises;
- To determine rangeland health and productivity based on site stability, plant diversity, carrying capacity and stocking rate;
- To determine the level of exploitation and effects of mitigation measures; and
- To undertake research and propose appropriate strategies on rangelands management, conservation and rehabilitation of ecosystems.

Site description

The four - pilot villages considered under this range inventory survey are: Ha Moqalo, Ha 'Mantsoepa, Ha Koali and Ha Sekhonyana, located within Mount Moorosi in the district of Quthing. Ha Moqalo catchment drains into Quthing river, Ha "Mantsoepa catchment drains into Mokhoromeng river, Ha Koali catchment drains into Sebapala River while Ha Sekhonyana catchment drains into the Senqu River.

Survey methods

Vegetation surveys were conducted by a team of eight officers, five Range Resources Technical Officers, two officers from Serumula Development Association and a plant identification expert from University of KwaZulu-Natal. At Ha Moqalo, Ha 'Mantsoepa and Ha Koali, assessment was conducted both on rehabilitated sites where shrubs were cleared and reseeding of *Eragrostis curvula* done and on reference sites where shrubs were not cleared. Similarly, assessment at Ha Sekhonyana was done on rehabilitated sites where stone lines were constructed and untouched adjacent area served as reference.

Rehabilitation works are currently underway on all sites and these are closed for livestock grazing. The metric belt sampling method was used to undertake the actual measurements of vegetation parameters on these areas. Tape measure and a 0.1 m^2 quadrant were used along a 7.9m transect for grass covered areas and 15.8m transect for shrub dominated areas.

Topographic maps (1:50,000) were used to demarcate and delineate the pilot area boundaries at Ha Moqalo, Ha Mantsoepa, Ha Koali and Ha Sekhonyana and locations of permanent transects were marked on the map. Finepix camera was used to capture photo points and GPS was used to capture the coordinates which locate the position of transects. The following coordinates were recorded from each transect:

- Ha Moqalo 30°14 13.96 S 30°14 09.96 E;
- Ha 'Mantsoepa 30°15 05 S 27°55 08 E, 30°15 07.19 S 27°55 01 30°15 10.90 S 27°55 13.14 E, 30°15 19.95 S 27°55 10.24 E;
- Ha Koali 30°17 28.46 S 27°52 34.11 E, 30°17 21.83 S 27°52 24.32 E, 30°17 21.41 S 27°52 20.14 E, 30°17 16.41 S 27°52 09.49 E;

- Ha Sekhonyana 30°15 21.88 S 27°52 20.23 E, 30°15 20.41 S 27°52 14.32 E, 30°15 28.74 S 27°52 03.19 E, 30°15 34.71 S 27°52 08.13 E.

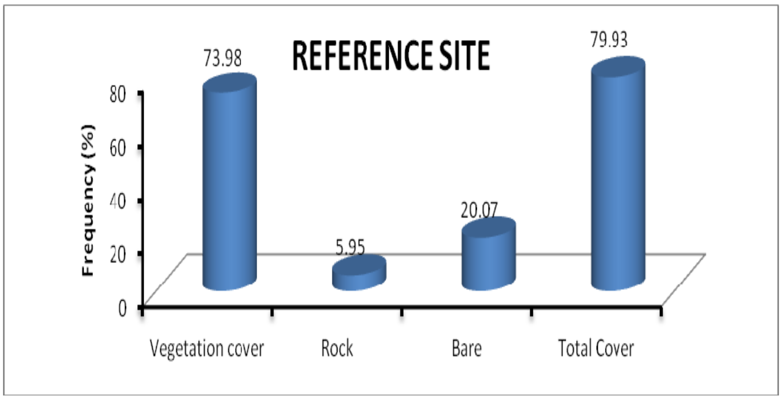
Vegetation parameters that have been measured using this method include plant identification, species frequency and forage production. Using visual assessment techniques, a score card was used to estimate plant cover, botanical composition, vigor, soil surface condition and insects and rodents damages.

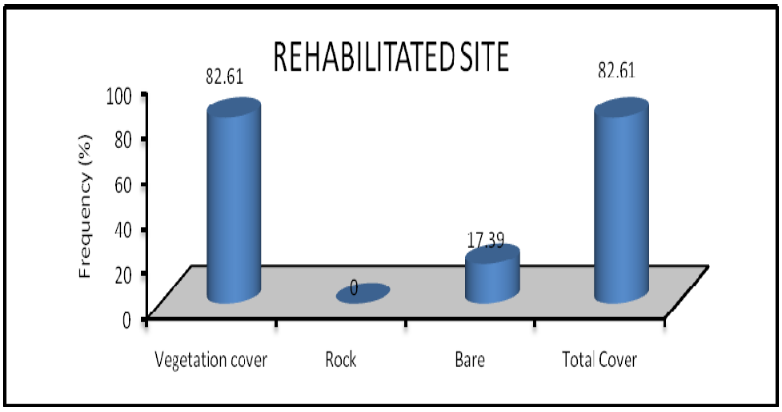
The following score card rating was used to determine the condition of each parameter measured:

Very poor	0 to 3.5
Poor	3.5 to 4.5
Satisfying	4.5 to 5.5
Good	5.5 to 6.5
Very good	6.5 to 7.5
Excellent	7.5 to 10

Results and discussion

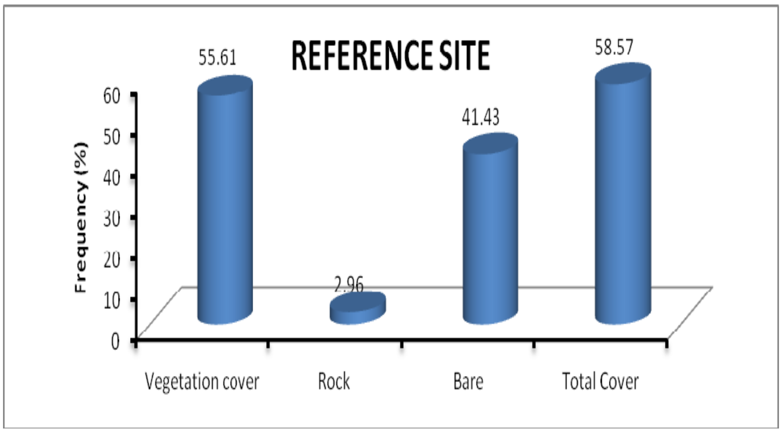
Site stability - Ha Moqalo

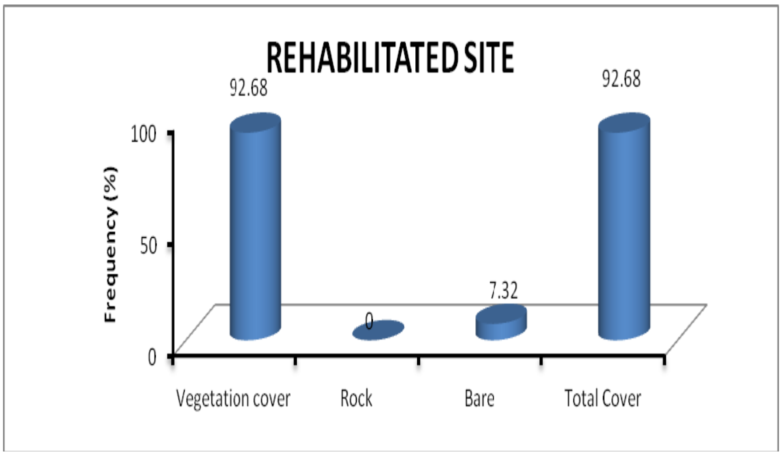




Rehabilitated site of Ha Moqalo is considered to be more stable than Reference site with no rock recorded even though more bare patches were recorded in both sites. The stability of this site is stressed by high frequency of vegetation cover and total cover which is greater than 80%. Most of bare patches recorded in Rehabilitated site were encourage by the uprooting of shrubs. The reason could be that rehabilitation activities and grazing control has resulted in vegetation regeneration.

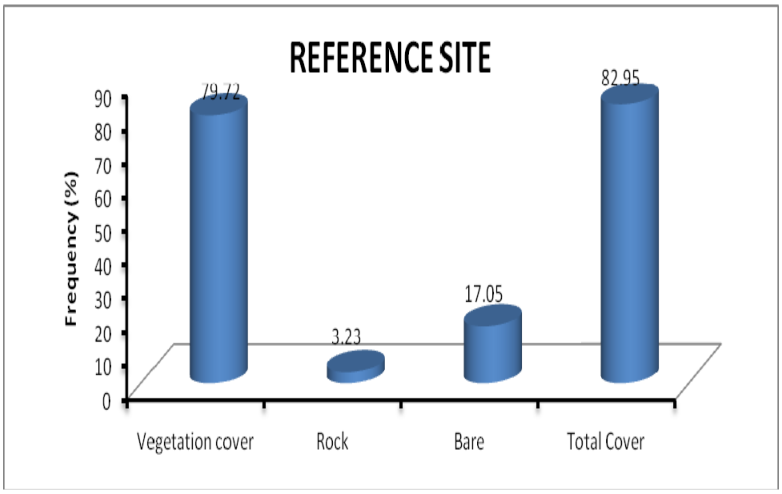
Site stability - Ha Mantsoepa

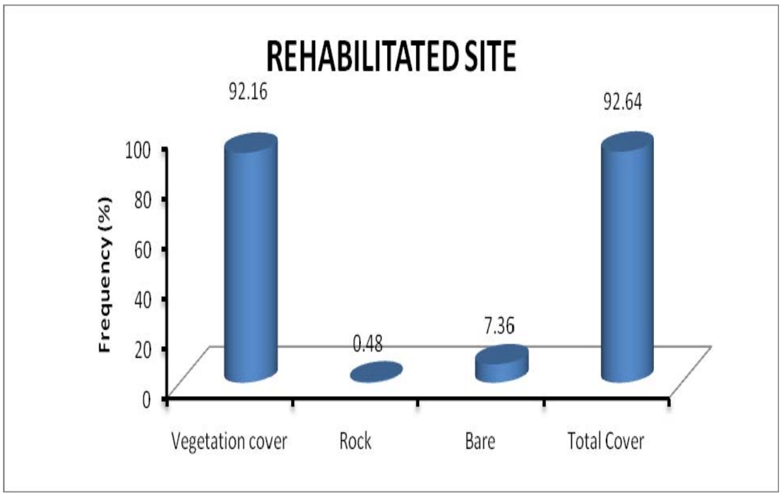




Based on high vegetation cover and total cover frequency (92.68%) and low bare patches frequency (7.32%), Rehabilitated site of Ha 'Mantsoepa measured to be stable as compare to Reference site. Reference site seemed to be severely degraded (unstable) with low vegetation cover and total cover frequency which is equal to or less than 60%, more bare patches frequency 41.43% and few rocks and the site is severely susceptible to soil erosion. In most cases the experience of more bare patches, is the result of poor grazing management and burning of rangelands as signs of burning observed.

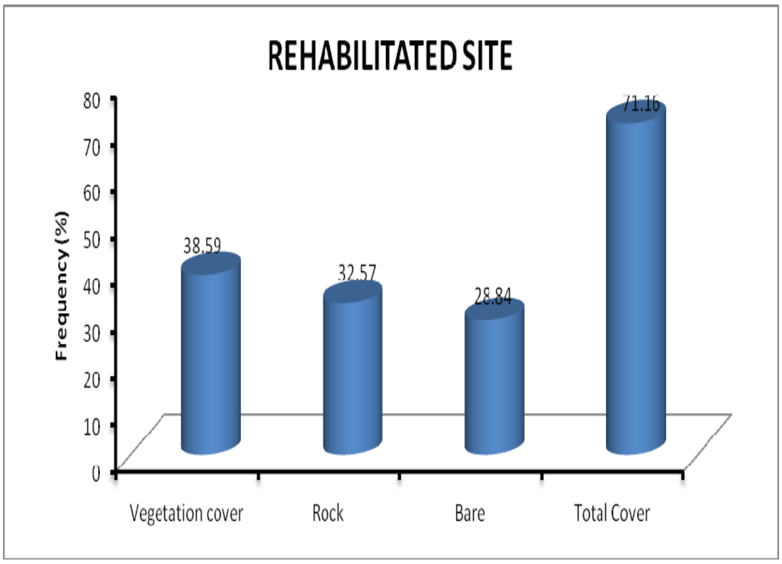
Site stability - Ha Koali





Rehabilitated site of Ha Koali seemed to be stable as compare to reference site, it is emphasised by high frequency of vegetation cover (92.16%) and total cover (92.64%) and low rock and bare patches frequency. The site retained stability after the control of invasive species (shrubs) and exclusion of livestock grazing. Reference site have more bare patches (17.05%) as a result the site is prone to soil erosion.

Site stability - Ha Sekhonyana

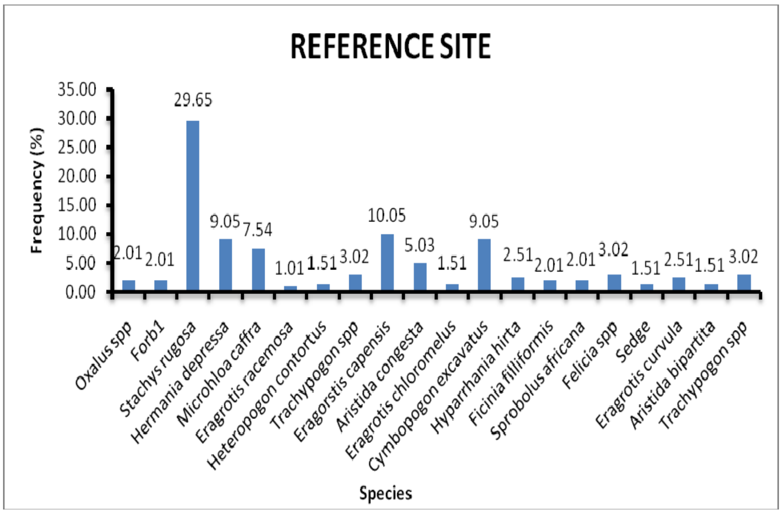


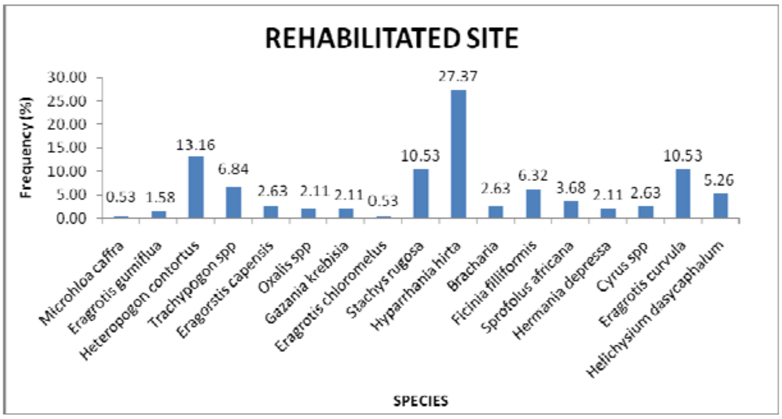
Ha Sekhonyana rehabilitated site was observed to be unstable, the instability of this site is expressed by moderate frequency of total cover (71.16%), and low vegetation frequency (38.59%), high frequencies of rock and bare patches The photo below before the intervention (construction of stone line and exclusion of livestock grazing) reveals severe degradation with poor vegetation cover. However, the current photo below shows the impressive recovery of this site due to intervention.

Figure: 12. Ha Sekhonyana degraded site before the intervention.

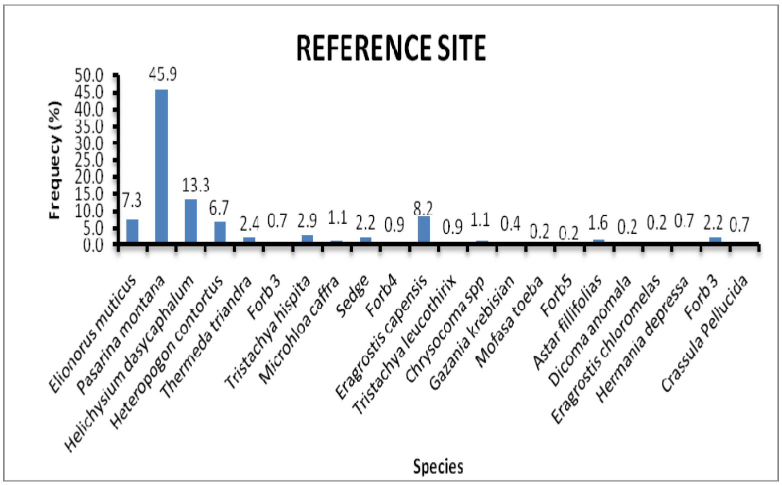
Figure: 13. Recovered site of Ha Sekhonyana.

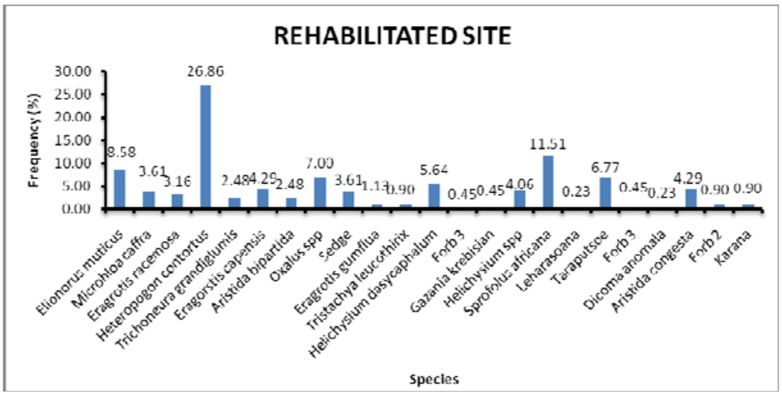
Species composition - Ha Moqalo



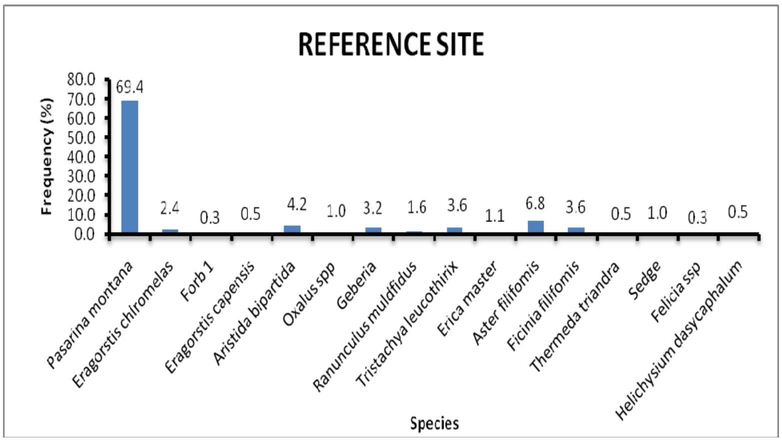


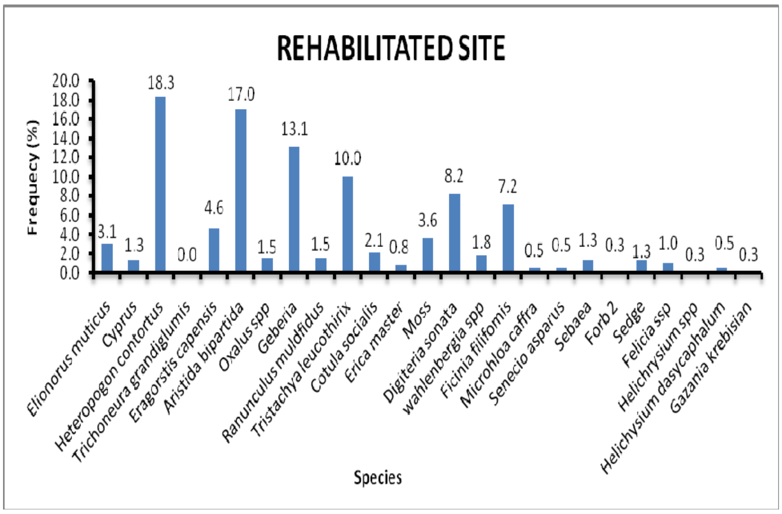
Species composition - Ha Mantsoepa



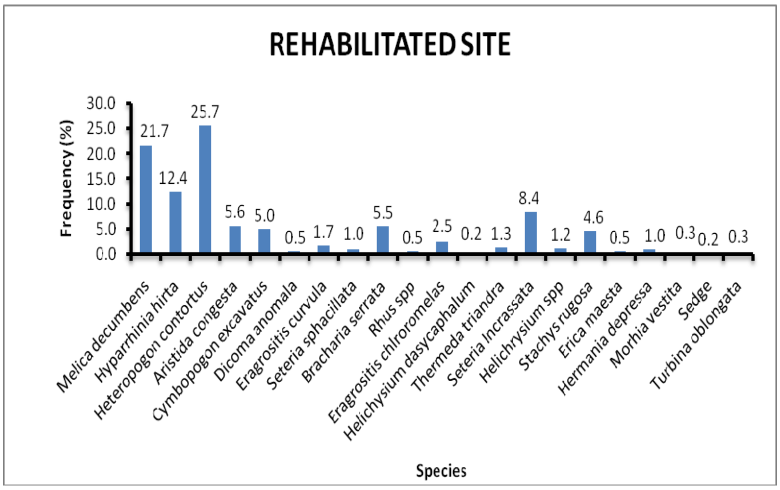


Species composition - Ha Koali





Species composition - Ha Sekhonyana



Life form

	Species	*Frequency (%)*	
		Reference	*Rehabilitated*
Ha Moqalo	Grass/grass-like	54.27	77.89
	Forb	16.08	11.58
	Shrub	29.65	10.53
Ha Mantsoepa	Grass/grass-like	31.9	72.92
	Forb	19.3	20.31
	Shrub	48.8	6.77
Ha Koali	Grass/grass-like	8.9	71.44
	Forb	13.8	27.76
	Shrub	77.3	0.8
Ha Sekhonyana	Grass/grass-like	-	91.3
	Forb	-	3.1
	Shrub	-	5.6

The reference sites of all pilot areas have high frequencies of shrubs (29.69%-77.3%) and forbs (≤15%). At Ha Mantsoepa and Ha Koali *Passerina montana* is the most dominant shrub species while at Ha Moqalo Stachys rugosa dominance is observed (refer to figure 17 below). These invaders compete for light, heat, available moisture and nutrients with desirable plant species (grass) which firmly hold the soil against erosion. Some of these invader species are allopathic, that is; they release poisonous substances which inhibit the life of other plant species below their canopy. They harbor diseases and pests; as a result meat, wool and mohair quality become negatively affected. However, forbs like *Dicoma anomala* and *Hermannia depressa* are useful for medical purpose. Good management and conservation of these natural resources will maintain their sustainability. The existence of invaders is an indication of rangelands degradation.

The frequency of grass/grass-like species in rehabilitated sites of all pilot areas is high (≥70%) compared to other plant form. The reason could be that the current rehabilitation activities and exclusion of livestock grazing have favoured re-growth of grass/grass-like species.

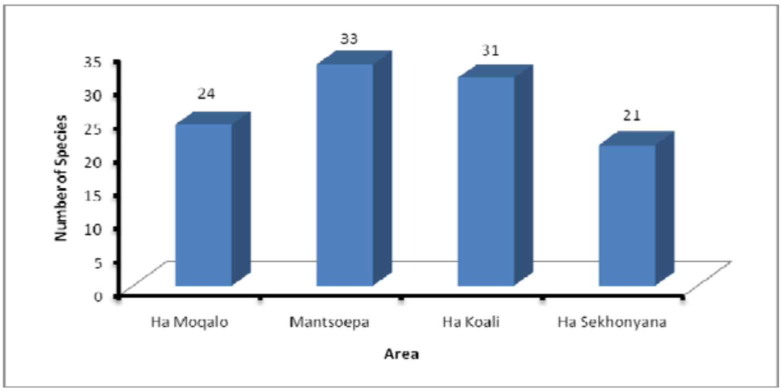
Figure 14. Shrub invasion at Ha 'Mantsoepa pilot site.

Ecological status

	Species	*Frequency (%)*	
		Reference Site	*Rehabilitated Site*
Ha Moqalo	Decreaser	2.01	8.95
	Increaser I	17.59	34.21
	Increaser II	31.15	30.53
	Increaser III	2.01	3.68
	Invaders	47.24	22.63
Ha 'Mantsoepa	Decreaser	2.4	0
	Increaser I	3.8	0.9
	Increaser II	16.2	48.31
	Increaser III	7.3	20.09
	Invaders	70.3	30.7
Ha Koali	Decreaser	4.1	7.2
	Increaser I	3.6	10
	Increaser II	7.1	40.4
	Increaser III	0	3.1
	Invaders	85.2	39.3
Ha Sekhonyana	Decreaser	-	16.2
	Increaser I	-	17.4
	Increaser II	-	35.4
	Increaser III	-	21.7
	Invaders	-	9.3

Invader dominance is clearly observed in all reference sites of pilot areas. The high frequency of invaders –was observed to range between 47.24%-85.2%. The existence of invaders is an indication of rangeland degradation. Increaser II species seem to be the most dominant in all sites (i.e. ≥30%) grass species compare to other plant species in all rehabilitated sites. A large number of Increaser II (*Eragrostis capensis*, *Eragrostis chloromelas*, *Microchloa caffra*, *Heteropogon contorts*, *Trichoneura grandiglumis*, *Aristida bipartite*, *Aristida congesta* and other species) are relatively palatable, except *Eragrostis gummiflua* which have low grazing value. At Ha Moqalo Increaser I frequency is high in both reference site (17.59%) and rehabilitated site (34.21%). Increaser I species such as *Tristachya leucothrix*, *Tristachya hispida* and *Hyparrhenia hirta* are grazeable at early growth stage (season) but in reality *Cymbopogon excavatus* is the most unpalatable (bitter taste). Ha Sekhonyana and Ha 'Mantsoepa rehabilitated sites seem to have high frequency of increaser III species (≥20%). Increaser III species *Elionurus muticus*, *Melica decumbens* and *Sporobolus africanus* have low grazing value and high consumption of *Melica decumbens* is toxic to livestock.

Species richness



Productivity

Calculations based on animal consumption rate = 3,322 kg/AU/a

$$\text{Carrying capacity (AU)} = \frac{\text{Total usable forage (kg/a)}}{\text{Animal consumption rate (kg/AU/a)}}$$

$$\text{Stocking rate (ha/AU)} = \frac{\text{Area (ha)}}{\text{Carrying capacity (AU)}}$$

Ha Moqalo	
Area	39.36 ha
Yield	413.47 kg/ha/a
Total usable forage	16,274.2 kg
Carrying capacity	5.0 AU
Stocking rate	8.0 ha/AU

Ha 'Mantsoepa	
Area	26.49 ha
Yield	502.75 kg/ha/a
Total usable forage	13,317.80 kg
Carrying capacity	4.0 AU
Stocking rate	6.6 ha/AU

Ha Koali	
Area	26.49 ha
Yield	804.80 kg/ha/a
Total usable forage	21,319.20 kg
Carrying capacity	6.4 AU
Stocking rate	4.1 ha/AU

Ha Sekhonyana	
Area	41.99 ha
Yield	343.02 kg/ha/a
Total usable forage	14,403.40 kg
Carrying capacity	4.3 AU
Stocking rate	9.7 ha/AU

Conclusions

In Lesotho, the ideal stocking rate is 4 ha per AU; below 4 the area is considered highly productive, above 4 is considered low productive. Ha Koali and Ha `Mantsoepa have stocking rates of more than 6 ha/AU are more productive as compared to Ha Moqalo and Ha Sekhonyana which range between 8 and 10 respectively. The reason behind the comparably lower productivity of the rangelands at Ha Sekhonyana could be due to high frequency of shrubs and rocks; more or less the same situation is seen at Ha Moqalo grazing area. If proper range management practices can be put in place, at Ha `Mantsoepa and Ha Koali areas a ideal stocking rates can be attained.

The conclusion drawn from this exercise is that rehabilitated sites of Ha Moqalo, Ha 'Mantsoepa, and Ha Koali seemed to be stable as compared to reference site. This is emphasised by high frequency of vegetation cover and total cover. However, Ha Sekhonyana rehabilitated site was observed to be unstable with high frequency of bare patches. In terms of diversity; grass species' dominance is clearly observed in rehabilitated sites of all pilots areas, compared to other plant species, while shrub species dominance is observed in reference sites. This impact has been experienced after one year of project implementation.

Rehabilitation activities and setting aside area as *leboella* for restoration were the primary range management tools applied for sites restoration.

Recommendations

It is recommended that:

- Resource-user groups associations should be established to promote sustainable use of natural resources.
- Trainings on range management issues are essential for sustainable community-based natural resources management programs.
- Grazing management plans should be established to maintain the sustainable use of the rangelands.
- A basic monitoring programme (vegetation survey) should be designed for implementation by communities.

Annex 2: Proposal for native seed restoration

Background

Large areas of grassland in Lesotho have become degraded over time due to inappropriate grazing and livestock management. In addition, over-zealous cultivation of marginal lands has lead to large areas of cultivated land being abandoned and no longer planted to crops. These abandoned lands do not recover to resemble natural grassland, both in terms of species composition or productivity. The species composition remains poor, with low diversity, species richness and cover. These old lands are frequently the primary sites for the start of erosion.

Restoration efforts in Lesotho have been commonly focused on physical rehabilitation works and in some areas, reseeding with commercially available seed.

The current re-seeding efforts on the project sites in the Mount Moorosi area have focused on the use of the grass *Eragrostis curvula*. This is an indigenous grass, which does occur naturally in the area. *Eragrostis curvula* seed is available commercially and in large quantities. However, this is seed that has been collected in various parts of South Africa, and bred for particular traits like productivity and palatability so that it can be used as a pasture grass in commercial agriculture. This means that the *Eragrostis curvula* seed purchased is unlikely to be similar to the local varieties, and may be less well adapted to the local (cold) environment with its short growing season and long cold period. In addition, *Eragrostis curvula* is not very palatable, unless fertilised with nitrogen fertilizer in particular, as it is usually when grown as a pasture grass. In natural veld, it is usually not a preferred grass. It has been used as rehabilitation species in the Cathedral Peak region of the KwaZulu Natal Drakensberg, with some success from a soil stabilization perspective. However, where it has been successfully established it dominates as a near mono-specific stand for decades. Research results indicate that a pure stand of *Eragrostis curvula* resists invasion by other species. This could be viewed positively if that is the desired state, or negatively if the desired state was a greater level of species diversity.

Currently, there is not much alternative, because of a lack of locally adapted grass seed available. So, the use of *Eragrostis curvula* as a re-seeding species is positive from a soil stabilization perspective, but is not the best option from a biodiversity option and arguably not the best option for livestock production.

Concept

There is a possibility of using indigenous grass species for re-seeding. This has been done successfully in other parts of the world in various rehabilitation efforts. The most common examples of success are from the US prairie grasslands, where there have been successful native species reseeding efforts for decades. There has been some success in South Africa, with promising results on the restoration of open cast mines. There are several advantages, some problems and some opportunities with such an approach.

The advantages include the following:

- The local species are adapted to the local environment;
- Several species can be established, which is desirable from a biodiversity perspective;
- A diverse range of species is likely to offer greater soil protection than a single species;
- A diverse range of species is likely to lead to better livestock production than a single species (such as *Eragrostis curvula*); and
- It could open up significant opportunities for training and developing local expertise, with the potential of developing small-scale entrepreneurial opportunities.

The problems include:

- Indigenous grass seeds are difficult to harvest, store and plant and the whole process would have to involve careful management to improve the success rate;
- Indigenous grass seeds are often slow to germinate and establish;
- There is currently no source of indigenous grass seed available, other than "improved" pasture species such as *Eragrostis curvula* and a few others; and
- There would a requirement for specific expertise.

In the context of this demonstration project opportunities would include:

- The development of local expertise (which could address gender issues);
- The development of small business opportunities (which could also address gender);
- The improvement of grazing potential, biodiversity and soil stability; and
- The generation of interest and funding from a range of potential funders, because such a project could potentially generate widespread interest if successful.

Such an approach, if adopted, would take time to develop and implement, and would not replace the current seeding with *Eragrostis curvula*, but could rather complement it. In the current project, areas of grassland are due to be rested for up to 3 years to allow for recovery of the grassland. These rested areas should produce reasonable amounts of seed of a variety of grass species, which could be harvested, dried, stored and planted on trial sites, preferably old abandoned crop lands. The approach, if successful, could become a high profile conservation flagship, putting communities at the forefront of conservation, while looking after livelihoods.

Implementation

Grasses usually flower from December through to February/March, with different grasses flowering at different times of the season. Grazing animals have to be excluded from the area to be harvested, to ensure that all palatable species produce seed. The process of flowering involves:

- Development of flower;

- Pollination;
- Development of seed;
- Ripening of seed; and
- Seed fall.

The process of the development and ripening of seed has to be monitored carefully to ensure that seed is harvested at the right time. Once the seed is ripe, it can be harvested in a number of ways on a small scale:

- Using gloves, the seed can be plucked from each inflorescence and placed in a suitable bag;
- Flowing stems can be cut using a sickle or other suitable blade and collected.

Once the seed is harvested, either by plucking seed or cutting whole inflorescences, it must be dried as soon as possible to prevent it from going moldy. The most suitable way of drying it is to lay it out on a sheet of plastic in a well ventilated room. The seed should be turned over several times a day for several days until it is dry. Then it can be placed in suitable bags for storage until the beginning of the next growing season. This storage time helps to break the dormancy that is experienced by seed of some species of grass, and also allows for planting at the beginning of the next growing season to give the new seedlings as much time as possible to grow before the onset of winter. Planting can be done by hand, using established techniques used by most farmers.

The most critical stages in the process are:

- Harvesting seed at the correct time;
- Ensuring that the seed is dried adequately;
- Maintaining suitable storage conditions, namely cool and dry; and
- Planting at the right time of the season.

Germination and emergence is usually slow and erratic compared to agricultural crops, but experience has shown that germination percentages are reasonable, and that reasonable cover can be achieved, with reasonable levels of diversity.

This approach has not been tested in Lesotho, and would need to be tried experimentally to evaluate its potential, develop local expertise and to adapt approaches for local conditions.

A phased approach may be the best way of initiating the process. Phase one should include working with a community on a site to go through the process outlined above from identifying a suitable site, through exclusion of animals, identifying and harvesting seed, drying and storing seed to planting and managing a test site.