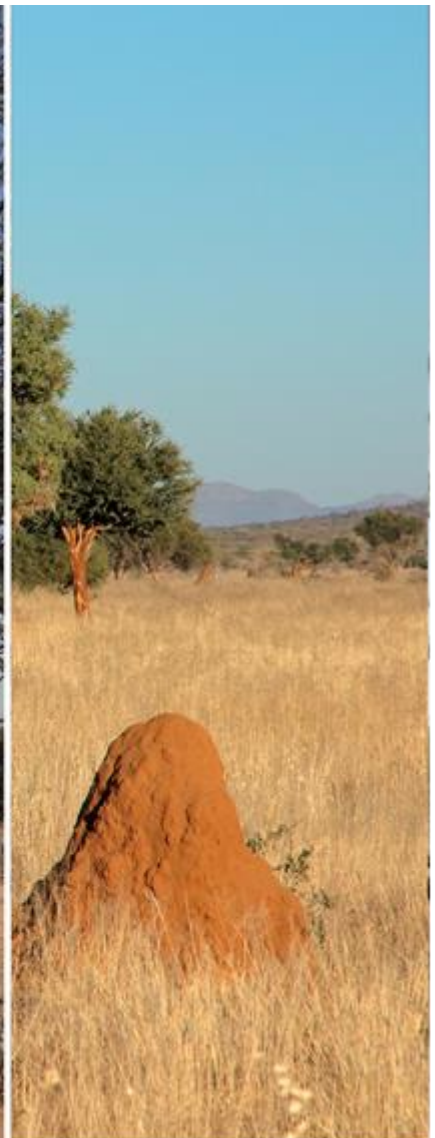


Support to
De-bushing
Project

Strategic Environmental Assessment of Large-Scale Bush Thinning and Value- Addition Activities in Namibia



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Strategic Environmental Assessment of Large-Scale Bush Thinning and Value-Addition Activities in Namibia

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Abbreviations

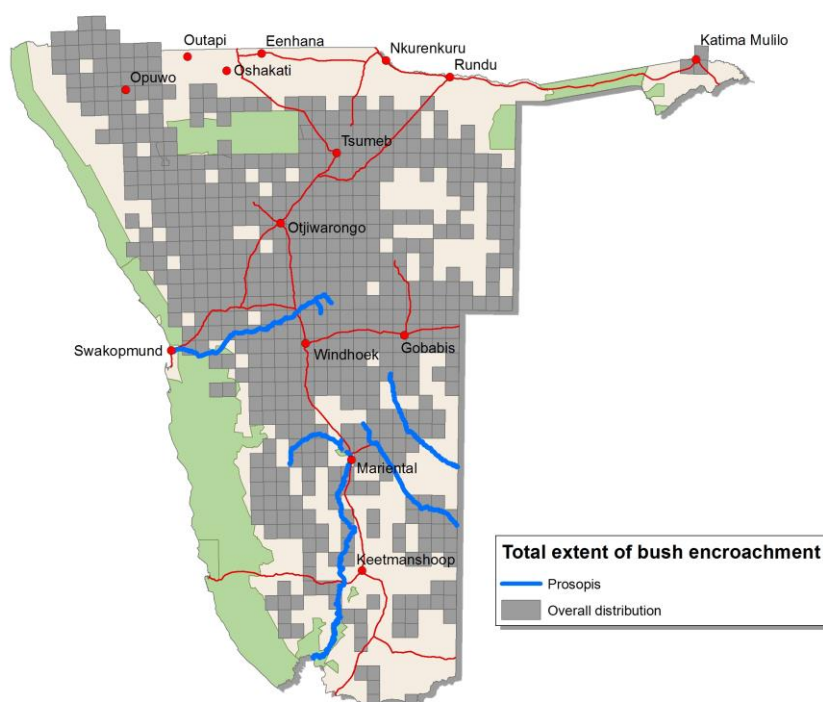
BE	Bush encroachment
CBEND	Combating Bush Encroachment for Namibia's Development
CCF	Cheetah Conservation Fund
DAPEES	Department of Agricultural Productivity, Extension and Engineering Services, MAWF
DARD	Department of Agricultural Research and Development, MAWF
DEA	Directorate of Environmental Affairs, MET
DoF	Directorate of Forestry, MAWF
DRFN	Desert Research Foundation Namibia
ECB	Electricity Control Board
ECC	Environmental Clearance Certificate
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
FSC	Forestry Stewardship Council
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
GG	Government Gazette
GRN	Government of the Republic of Namibia
ha	Hectare
IAP	Interested and Affected Party
IPP	Independent Power Producer
MAWF	Ministry of Agriculture, Water and Forestry
MET	Ministry of Environment and Tourism
MITSD	Ministry of Industrialisation, Trade and SME Development
MLR	Ministry of Land Reform
MoHSS	Ministry of Health and Social Services
MoLSW	Ministry of Labour and Social Welfare
MW	Mega watt (1 MW = 1,000 kW)
MTI	Ministry of Trade and Industry (now MITSD)
NNFU	Namibia National Farmers Union
NAU	Namibian Agricultural Union
NECFU	Namibia Emerging Commercial Farmers Union
NNFU	Namibian National Farmers Union
NPC	National Planning Commission
NRF	Namibia Rangeland Forum
NRMP	Namibian Rangeland Management Policy and Strategy
PRS	Poverty Reduction Strategy
RED	Regional Electricity Distributor
SASSCAL	Southern African Science Service Centre for Climate Change and Adaptive Land Management
SEA	Strategic Environmental Assessment
SME	Small and Medium-size Enterprise
sp	Species (plural spp)
TE	Tree equivalent

EXECUTIVE SUMMARY

Bush encroachment remains a major agricultural problem in Namibia, covering about 45 million hectares of the country's savannas, and reducing livestock productivity significantly. At the same time, this woody resource offers opportunities for commercial utilisation. Growing interest in the opportunities for value-addition from bush, with support such as the MAWF/GIZ De-bushing Project, raises the issue of significant negative environmental impacts from a 'de-bushing boom'. This Strategic Environmental Assessment was commissioned by GIZ to address such impacts, and to help ensure that environmental concerns are integrated in the decision-making process. Specifically, the work involved developing a Generic Environmental Management Plan that could facilitate the process of permitting and Environmental Clearances for all bush utilisation projects.

The first output of this SEA was a revision of the map showing extent of bush encroachment in Namibia (**Chapter 2**, see map below). This was motivated on the basis that the map compiled by Bester in 1995 was outdated but was still widely used to show the immensity of the bush encroachment problem in literature and decision-making. The map was revised using data from the Tree Atlas of Namibia (2005) and opinions of nine Namibian botanists and bush experts. It is presented as an incremental improvement on the 'Bester map' but cannot be considered to be very accurate as it is not based on recent hard data from ground and/or aerial surveys. According to this map, approximately 45 million hectares of Namibia are bush encroached. A recommendation in this report calls for further improvement that would serve as a current baseline showing the areas where different encroacher species predominate, their densities and biomass.

Total Extent of Bush Encroachment



Chapter 3 discusses the ecological principles that are important in Namibia's savannas, emphasising that de-bushing activities should aim for selective bush thinning rather than clearing. This is important for the restoration of savannas that will improve the carrying capacity (good for farmers and beef export markets), help to sustain the natural biodiversity and aesthetics (good for tourism), and most importantly, help to restore groundwater recharge (good for reducing the vulnerability to droughts). Optimum benefits are derived from rangelands that are thinned of bush, and that are maintained that way after initial bush thinning. These principles should guide all bush thinning activities.

The various bush-thinning and clearing activities are described, and information drawn from other studies on the variety of products that can potentially be made from encroacher bush.

Chapter 4 provides an overview of the legal and policy framework that underlies bush harvesting activities. There is overall consistency in the message from the Constitution, a range of policies (e.g. Agriculture Policy, Rangeland Management Policy and Strategy) and legislation (e.g. Forest Act and Regulations, Soil Conservation Act, Environmental Management Act) that bush harvesting should be done sustainably and with least environmental harm.

Any activity that requires a permit under the Forest Act (i.e. all wood harvesting and wood value-addition activities) requires Environmental Clearance under the Environmental Management Act. Compliance with this law is very poor. However, this SEA sees an important role for the Environmental Clearance procedure through the Directorate of Environmental Affairs, to improve the control and management of activities that are expected to grow in the de-bushing boom.

There is some confusion about the applicability of forestry regulations to bush, which leaves the Forest Act weak in its role of controlling bush harvesting activities. This is especially relevant to the recent regulation (2015) that prohibits aerial spraying of arboricides. There are also impractical regulations regarding fires and fire-breaks. Many stakeholders in the sector find that the permitting procedure for harvesting, transport and export of wood products is inefficient and ineffective in controlling bush harvesting activities. The fact that harvesting permits are issued for only three months at a time is a disincentive to investors in this sector, who want security that proposed bush harvesting operations will not be obstructed unnecessarily at short intervals. The Forest Act and its Regulations need to be revised (see Chapter 6).

The Draft Bush Encroachment Policy was initiated in 2004 but has been dormant since then. The SEA recommends that this policy is finalised, as part of the National Rangeland Management Policy and Strategy (NRMPS) (see Chapter 6). The NRMPS provides useful guidelines for reversing the adverse impacts of bush encroachment. Importantly, it sees a role for Government agriculture departments (such as Research and Training, Extension Services), together with tertiary institutions such as UNAM and NUST, to combat bush encroachment.

Overall, the legal and institutional framework is aligned with the principle of selective bush thinning, but there needs to be greater integration between responsible institutions, especially the Directorate of Forestry (MAWF) and the Directorate of Environmental Affairs (MET). Involvement of stakeholder organisations (such as Community Forests, charcoal organisations) is also needed to bring stronger management and controls if the de-bushing boom does happen.

Chapter 5 addresses the impacts of bush harvesting practices. Although this SEA did not allow time for rigorous field investigations, we included samples of the activities of a few farmers who are involved in combating bush encroachment. Workshops held in Otjiwarongo and Windhoek also provided information on practices and problems.

Arboricides appear to be safe, although there are issues that deserve further investigation, particularly the impacts of adjuvants and impurities in the chemicals, and long-term effects. Bush clearing, without being selective, is environmentally harmful, and mechanical methods that cause soil disturbance simply make the problem worse due to heavy re-infestation afterwards. Mechanised methods that have a 'soft footprint' and can selectively pick the target species, probably have the least impact. Farmers are generally wary about using fire due to the risks of spreading, and fire is not used to clear bush since there is usually not enough fuel (grass) to sustain it. Fire, nevertheless, is an important component of a well-functioning savanna, and it should not be withheld as this is one of the factors that makes bush thicken.

Any commercial utilisation of bush carries the possibility that over-harvesting will happen. This is already the case in the charcoal industry, where there are concerns that large beneficial trees are being cut in preference for the smaller problem bushes, because the large trees provide more wood of better quality. This is the most important impact, in individual projects and cumulatively for the whole de-bushing boom. Much stronger control of bush harvesting permits needs to be implemented, and this needs to be backed up by the real possibility that an Environmental Clearance Certificate for a bush operation can be withdrawn if there is non-compliance with the Environmental Management Plan.

There is also concern that widespread bush clearing, especially in sandy soils, will lead to overall depletion of nutrients. This is more of a problem on sandy soils since they are naturally rather less fertile, being made up of mainly quartz grains, and most nutrient cycling in these ecosystems is driven by trees. Excessive removal of the trees will deplete these areas of their main nutrient source.

Nutrient depletion is a potential consequence of a 'bush farming' approach, where bush is allowed and even encouraged to regrow after harvesting, so that it can be reharvested in 10 to 15 years time. Bush farming will probably not lead to recovery of groundwater levels in rangelands. Other ecosystem services that derive from healthy rangelands, such as fertile soil, a variety of habitats for optimum biodiversity, and improved livestock production, are likely to be less or experienced for shorter periods, under a bush farming regime.

Chapter 6 addresses the changes and improvements that are suggested for legislation concerning bush. Firstly, the draft **Bush Encroachment Policy** needs to be finalised, and its logical place would be as a component of the National Rangeland Management Policy and Strategy. We recommend that the NRMPS should be refined and promulgated as an enforceable Act, identifying clearly the roles and responsibilities of the government (e.g. MAWF, MET, MITSD) and non-government (e.g. farmer's unions) institutions. It must encourage the control of problem bush on ecological principles, recognising the importance of economic viability.

The SEA recommends that the **Forest Act and Regulations** should be revised, to give greater clarity on the application of its rules to areas which are bush encroached but not 'forest'. Harvesting permits issued by DoF should be valid for three years at a time (they are presently issued for 3 months). This will ensure that the permit and Environmental Clearance Certificate processes are aligned and provide necessary security to investors. There should still be inspections at shorter intervals, and these should have the power to revoke the permits. To enable better control over illegal cutting of trees in the charcoal industry, all wood should be brought to central points on individual farms, to allow inspection before burning. This would involve more transport of cut wood, but at the same time would bring much greater efficiency and higher production of good quality charcoal, under improved social conditions.

MET manages the **Environmental Management Act (EMA)**, and the issuing and monitoring of Environmental Clearance Certificates. There needs to be greater collaboration between the Directorate of Forestry (in MAWF) and the Directorate of Environmental Affairs (in MET) to streamline the legal process authorising people to combat bush encroachment, while ensuring that controls and monitoring are in place. The SEA suggests thresholds necessary for an EIA and Environmental Clearance under the EMA. Three categories are defined:

Environmental Clearance waived	Environmental Clearance required, with customised EMP based on the Generic EMP	Environmental Clearance required, with full independent EIA and EMP
Small bush-harvesting operations, area less than 15 ha per year.	<p>Medium-sized bush harvesting operations, 15 – 5,000 ha per year.</p> <p>The applicant (e.g. farmer) should not be in collaboration with another party that is clearing adjacent land, thereby expanding the area to be thinned beyond 5,000 ha.</p> <p>In accordance with the EMA, an Environmental Clearance is only valid for three years. At the end of three years, the project area should be inspected by DEA and DoF, the EMP updated, and application made for a new Environmental Clearance Certificate.</p>	<p>Large-scale bush harvesting operations, area greater than 5,000 ha per year (e.g. commercial bush-to-energy projects, large-scale manufacture of wood chips). This category includes projects where a number of neighbouring farms, covering more than 5,000 ha in total, contribute bush to a central processing facility.</p> <p>In accordance with the EMA, an Environmental Clearance is only valid for three years. At the end of three years, the project area should be inspected by DEA and DoF, the EMP updated, and application made for a new Environmental Clearance Certificate.</p>

The procedure for obtaining the necessary authorisations for a bush harvesting project are summarised below. It is envisaged that a small information booklet on this process will be produced, to make it simple and clear for members of the public.

Step 1	<ul style="list-style-type: none"> ○ Obtain the background information booklet from the Directorate of Forestry (DoF) in the Ministry of Agriculture, Water and Forestry (MAWF) or Department of Environmental Affairs (DEA) in the Ministry of Environment and Tourism (MET). ○ Familiarise yourself with the permitting procedure and the information required for implementing a bush thinning project.
Step 2	Complete the DoF application forms for a permit to undertake bush thinning activities:
Step 3	<p>When you have the DoF permit, approach the DEA to register your project and apply for an Environmental Clearance Certificate (ECC).</p> <ul style="list-style-type: none"> ○ Complete the ECC application forms. ○ Submit the EMP, customized from the generic template provided.



Step 4	When you have obtained the DoF permit and DEA's ECC, make sure the two have synchronized validity durations. Also make sure that the project does not require any other permit from other authorities such as Electricity Control Board etc.
Step 5	<ul style="list-style-type: none"> ○ Implement your bush thinning project. ○ Undertake the necessary monitoring as required by the DoF permit and the ECC provisions, and as detailed in the EMP.

To keep the application process smooth and efficient, and to prevent a backlog building up, DoF and DEA should aim for processing these applications within a timespan of about one month altogether.

The SEA suggests that the DEA office should establish a small core of capacity (like a specialised 'bush unit') with staff who are familiar with bush harvesting and value-adding activities. The processing of Environmental Clearance applications needs to be efficient as well as thorough. Environmental Officers in this 'unit' should be familiar with the DoF permit system and the individual projects that are running at any one time. Projects that are suspected of exceeding their permitted harvesting quotas should be closely monitored. This Directorate needs to have the teeth to be able to revoke an Environmental Clearance Certificate where necessary.

Research and monitoring is an important component of future bush harvesting activities. There should be monitoring of two main components:

- i. bush conditions and the response of rangelands to bush thinning activities, and
- ii. the level of compliance with DoF permits and Environmental Clearance Certificates.

This EMP describes the optimum density to which bush should be thinned (Appendix B Annex 2). There should be rigorous follow-up of how selected areas are responding to this and other treatments, with scientifically-based methods which control for the numerous factors affecting bush encroachment. Impacts of various arboricides, and their different methods of application, also need to be monitored. Possibly, post-graduate students could be involved in these studies, which would simultaneously build capacity in Namibia's young professionals. Other government departments, such as Research and Training (DART), and Extension Services (DAPEES) in MAWF, also have a role to play here.

Secondly, compliance of bush thinning operations with the conditions of the permits and Environmental Clearance Certificates needs to be monitored. This should be carried out by the departments which issue these authorisations, namely DoF and DEA.

There is a strong need for **training** of all people involved in thinning bush, so that labourers 'at the work-face' understand which trees to target and which to leave, and follow guidelines concerning fire safety.

Training should also be directed towards Government officials, in both the relevant ministries, MAWF and MET. There needs to be stronger inspection capacity in DoF, so that they have the ability to conduct regular inspections, and are able to detect where over-harvesting and harvesting of the wrong species occurs. Practical and standardised sampling methods to calculate bush density need to be established and learned. Tell-tale signs of cutting of large trees (thin twigs lying on the ground, large tree stumps left) need to be observed and recorded. The Forestry officers need to be stronger in their 'detective' capacities and knowledgeable in general law enforcement. This SEA sees a role for Honorary Forestry Officers, namely members of the public who are trained in enforcement of the forestry laws and can support the activities of DoF officials.

The SEA concludes that there is a crucial need for widespread selective bush thinning in Namibia, and the policy framework supports the principle of restoring the ecological integrity of rangelands. The SEA cautions that this may lead to a de-bushing boom, where thinning is wrongly interpreted as ‘clearing of bush and trees’. There is also likely to be an upsurge in activities that target the wrong trees, namely large trees, including browser and protected species, that bring the most ecological benefits to rangelands. There needs to be much stronger capacity in the government departments responsible for controlling bush harvesting operations, to minimise the negative impacts of de-bushing.

The SEA suggests that the step-by-step approach for obtaining authorisations for bush harvesting will streamline the process, and facilitate compliance with the law.

Appendix B provides the Generic EMP that every bush utilising operation will need to adapt to apply for an Environmental Clearance Certificate.

Appendix B, Annex 2 sets out the target bush density that bush thinning operations should aim for. This is defined in terms of ‘Tree Equivalents’, where one TE is a woody plant 1.5 metres high (i.e a 3 metre tree is 2 TEs, and a 0.75 metre woody bush is 0.5 TEs). The desired bush density is categorised according to the main species of encroacher bush. Every EMP needs to be customised to the specific bush conditions on the land and the specific project. This is the stage where the target density should be calculated, which then informs subsequent thinning. Inspections by DoF and DEA should then be measured against this EMP.

SEA TEAM

The SAIEA team has good knowledge of Namibia and its systems, having been involved in bush encroachment studies, ecological surveys, interactions with communities regarding natural resources management, involvement with environmental safeguards for various mining projects, studies relating to aquifer management, and interactions with livestock farmers in the context of rangeland management and beef production. The team comprises the following individuals:

Dr Peter Tarr – Namibian. PhD (Environmental Assessment, University of Aberdeen, UK, 1999). Lead Environmental Practitioner accredited with EAPAN (2012). Team Leader, directly involved in the literature review, stakeholder engagement process, team brainstorming and strategic analysis.

John Pallett – Namibian. B.Sc (Hons) (Zoology, University of the Witwatersrand, South Africa). Lead Environmental Practitioner accredited with EAPAN (2013). Responsible for project management, stakeholder engagement and the analyses of literature, current bush harvesting practices and impacts.

Nico de Klerk – Namibian. M.Sc (Agriculture, University of Pretoria, South Africa). Retired past Director in the Ministry of Agriculture, Water and Forestry. Author of the book ‘Bush encroachment in Namibia’. Responsible for analysis of current practices and impacts.

Katharina Dierkes – Namibia Permanent Resident. M.Sc (Hydrogeology, University of Frankfurt, Germany). Responsible for mapping.

Gudrun Weaver – Namibian. Responsible for administration and project management.

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1 SCOPE OF THE STRATEGIC ENVIRONMENTAL ASSESSMENT

1.1 Summary of the Terms of Reference for the SEA

The Terms of Reference for Preparation of a Strategic Environmental Assessment (SEA) for large-Scale De-Bushing and Value Addition Policy in Namibia, compiled by GIZ (April 2015), state the following:

1.1.1 Proposed SEA global objective

“Ensure that environmental concerns are appropriately integrated in all national de-bushing and value addition decision-making, implementation and monitoring processes. It is anticipated that the findings of the SEA may influence policy development for de-bushing and value addition, as well as provide guidelines for potential developers.”

1.1.2 Proposed SEA specific objectives

Describe, identify and assess the likely significant effects on the environment of implementing the national de-bushing and value addition policy (see (i) below) as well as the most important environmental and natural resource-related constraints bearing on the implementation of any related programmes.

Provide decision-makers and key stakeholders to the MAWF / GIZ De-Bushing Project with relevant information (quantitative and qualitative) to assess the adequacy of environmental considerations when supporting the implementation of the debushing and value addition Strategic Plan/Policy/Programme. This information should help ensure that environmental concerns are appropriately integrated in the decision-making processes at the stages of programming, planning and implementation. (See (ii) below.)

Recommend the degree to which the national de-bushing programme addresses the major environmental sustainability challenges of de-bushing and provide recommendations at strategic level on how potential negative effects can be minimised and how positive effects can be optimised. Particular focus must be given to the adequacy of institutional structure and capacities at the national and local level, as well as of the regulatory framework, to address key environmental concerns associated with national de-bushing and value addition policy implementation.”

Discussions with the Client raised the following points:

- (i) A de-bushing and value addition policy has not yet been developed. The SEA should therefore focus on assessing the impacts of the current de-bushing and value addition activities.
- (ii) The Scoping Phase concluded with a decision to address a few important issues needing attention (e.g. apparent contradictions in the Forestry Act, issues around arboricides) in the SEA. A Generic EMP would be produced to help streamline the permitting and Environmental Clearance process.

1.2 SEA approach and methodology

1.2.1 Literature research

To build familiarity with the subject, information was gathered from various books and reports, including:

- Colin Christian & Associates (April 2010) Energy for Future Bush-to-Fuel Project: Environmental Impact Assessment Report
- Colin Christian & Associates (July 2010) Energy for Future Bush-to-Fuel Project: Environmental Management Plan
- SEA of replication of the project 'Combating bush encroachment for Namibia's Development (CBEND) (NPC 2010)
- Book 'Bush encroachment in Namibia – Report on Phase 1 of the Bush Encroachment Research, Monitoring and Management Project' (de Klerk 2004)
- A recent assessment of the biomass resource in an area sampled near Otjiwarongo (DRFN 2015)
- Colin Christian & Associates (December 2010) Namibia Agricultural Union: The Effect of Bush Encroachment on groundwater Resources in Namibia: a Desk Top Study. Final Report. Funded by GIZ
- NamPlace project on bush encroachment and management options for the Windhoek Green Belt Landscape Area (MET 2014).

1.2.2 Field research

This project did not allow lengthy field surveys¹; rather, any field work was to be focused on gathering information on the impacts of the main de-bushing activities. It was decided to concentrate on the following six methods of de-bushing:

- Aerial spraying with arboricide
- Individual stem application of arboricide
- Mechanical clearing using bulldozers / bush rollers / chains
- Mechanical combined harvester and grinder plant (used at Ohorongo Cement)
- Manual chopping of trees
- Fire

Sites where these activities have or are taking place were identified, and field visits were undertaken to the sites to build an understanding of the local situation and impacts, and to hold discussions with the people doing the work. Each of these constituted a 'case study' for that particular de-bushing activity. A total of 12 sites were visited in the period 18-22 August 2015.

1.2.3 Expert and stakeholder engagement and input

A small workshop was held on 11 August 2015 to revise and update the information on the extent of bush encroachment in Namibia. The workshop gathered a total of nine local experts for this exercise, listed in **Appendix A**.

Further workshops were conducted in Otjiwarongo and Windhoek on 5 and 10 November 2015, to discuss the impacts (including cumulative impacts) of various methods of clearing.

¹ A 2015 GIZ call for tenders for thoroughly mapping bush encroachment in Namibia was withdrawn indefinitely.

These also addressed how the Environmental Management Plans for the different activities should be grouped into a 'generic' EMP, or categorized into separate EMPs.

1.3 Limitations of the SEA

1.3.1 Mapping exercise

Precision of our mapping is relatively low, since it was based on knowledge and experience of various bush specialists, rather than objective field surveys. To make the approach as objective as possible, we used the data from the Tree Atlas (Curtis & Mannheimer 2009) to draw the distributions of the main encroacher species, and then used the knowledge of the specialists to refine these areas. We recognize that opinions, even from experts, can differ. This limitation should caution all future users of the map, but it does not detract from the main purpose of the SEA, which is to discuss the main impacts of bush thinning and value-adding activities, so that guidelines can be included in the emerging policy for combating bush encroachment.

1.3.2 Assessment

The issue of bush encroachment is extremely complex, and it is made more so by the many opinions and anecdotes from the many farmers and stakeholders who have experiences to relate. Finding simple, generalized rules amongst all this information is very difficult. Possibly we have over-simplified issues. We have tried to show the complexity of the issues while drawing out the important lessons for minimizing environmental harm.

2 BUSH ENCROACHMENT IN NAMIBIA

2.1 Definition of bush encroachment

Bush encroachment is defined in this SEA as thickening of woody bush due to human activities, in conjunction with natural events. Areas where there is thick bush, such as some areas of mopane scrub, are not automatically labelled as ‘encroached’ because in some areas this is the natural state of the vegetation. Areas are therefore defined as bush encroached only where bush thickening has been recorded in the recent past (approximately the last 20 – 60 years) and it can obviously be ascribed to human activities such as overgrazing of livestock or manipulation of fire frequency.

Other definitions of bush encroachment include:

“the invasion and /or thickening of aggressive undesired woody species resulting in an imbalance of the grass:bush ratio, a decrease in biodiversity, and a decrease in carrying capacity and concomitant economic losses” (de Klerk 2004, p.2).

“Rangeland on which the density of bush-equivalents (a 1.5 m high bush) per hectare exceeds twice the average annual rainfall” (G.N.Smit, quoted in de Klerk 2004).

“the invasion of woody species in areas that have always had either very low density of trees and shrubs or have been devoid of them” (Mannheimer & Curtis 2009).

The primary causes of bush encroachment on savannahs include a reduction in the frequency of fires and overgrazing of livestock. When the grass layer on savannahs loses its competitive advantage and its ability to utilise nutrients and water efficiently, higher infiltration of water and nutrients into the sub-soil results; a situation that benefits bush and tree species, allowing them to predominate (de Klerk 2004). Bush encroachment is also accompanied by a change in the dominant grasses: perennial grasses are often lost, being replaced by annual species often of inferior quality for livestock (Scholes 1997, Rothauge 2007). Annual grasses are generally less productive than perennial grasses. Thus, animal production on an annual grass sward is very precarious and less sustainable.

Another important theory is the State-and-Transition Model, which says that savanna ecosystems are event-driven, where rainfall and its variability play a more important role in vegetation growth (and composition) than the intensity of grazing. This model implies that bush encroachment is not a permanent phenomenon, and that a savanna can be changed to its grass-dominated state by favourable management or environmental conditions (Doughill et al. 1999). Woody plants establish themselves after dry periods followed by a few wet years, and then maintain themselves by utilising most of the water. Rather than a gradual annual increase in numbers, the general rule is that woody plants establish in large numbers during certain years and at varying intervals (Donaldson 1969).

Thus bush encroachment can occur rapidly and may be triggered by management practices and natural events, or a combination of these factors.

Increasing level of bush thickening can cause the demise of large trees. The smaller trees ‘suffocate’ the larger ones by using up much of the shallow soil moisture, depriving the large trees of water. Trees such as *Acacia erioloba* possess a long tap root that gives them access to deep groundwater but they also depend on moisture gathered from their other superficial roots.

2.2 Namibia's main encroaching and invading plant species

In this document the term “encroacher bush” is used for indigenous species and “invader bush” for alien invasive species.

The following trees and shrubs are recognised as the main encroacher species in Namibia

- *Dichrostachys cinerea*
- *Acacia mellifera*
- *Acacia reficiens*
- *Colophospermum mopane*
- *Terminalia prunoides*
- *Terminalia sericea*
- *Acacia nebrownii*
- *Rhigozum trichotomum*
- *Catophractes alexandri*

Other species of lesser importance as encroachers, include

- *Combretum collinum* (mainly in Zambezi Region)
- *Acacia hebeclada* (in areas of eastern Omaheke)
- *Acacia erubescens*
- *Acacia fleckii* (in areas of eastern Omaheke)
- *Acacia mearnsii* (black wattle – a patch in Otavi area).
- *Acacia nilotica*

Invader species

- *Prosopis sp*
- *Leucaena leucocephala*
- *Lantana sp*

Invasion by *Prosopis* trees causes problems of a different kind from that of the other main encroacher species, because these trees are mainly confined to river beds and areas of human habitation. Their preference for drainage lines is mainly due to the seeds being dispersed by flowing water (Smit 2005), but animals also spread the seeds in dung. The few different species of *Prosopis* found in southern Africa are all exotic to the region, having been introduced in the early 1900s from South America for their shade and nutritious pods, both valuable in semi-arid areas. They produce high yields of nutritious fodder, timber and fuelwood, but tend to form thickets in river beds and adjacent areas, where they outnumber and eliminate other indigenous species, and reduce the ephemeral flow in the river beds through their own high abstraction of alluvial groundwater.

2.3 Extent of the bush encroachment problem

2.3.1 Original estimate of extent

Namibia's bush encroached areas fall mainly within the semi-arid savannas, with rainfall varying from about 300 mm in the west to over 600 mm in the north-eastern parts. It is typically reported that “26 to 30 million hectares of Namibia are encroached”. This figure is based on the map compiled by Bester in 1995, showing the main areas of encroachment (Bester 1995).

The carrying capacity of bush-encroached rangeland in Namibia has been reduced by 40 – 90%, and more than 60% of Namibia’s savanna rangeland is affected by bush encroachment (de Klerk 2004). This presently costs Namibian farmers over N\$2.7 billion annually in lost income from reduced beef production.

2.3.2 Current estimate of extent

This SEA revised the ‘Bester map’ using the field knowledge of a few recognized botanists and bush encroachment experts, to produce the maps shown in Figure 1. The individual distribution maps of the six main encroaching species were obtained from the Tree Atlas of Namibia (Curtis & Mannheimer 2005). The distributions were shown in a quarter-degree square grid, with relative abundance in each square. The team then, through discussion of their field experience and observations, removed the squares from that map where the species was identified as not encroached. Some areas where the species are dense, were not considered to be encroached if the level of encroachment was thought to be natural i.e. not caused by human interventions (such as overstocking or reduction of fires). This process eliminated the areas where the species was not encroached, to leave the quarter degree squares where the species was known to exist at a relatively high density that has come about in the past 60 years. This process yielded the six individual species maps shown as the smaller maps in Figure 1, and the areas of *Prosopis* encroachment confined to the main ephemeral rivers in southern and central Namibia. The maps were combined into the one larger central map in Figure 1, which shows only the extent of encroached bush, not densities.

This process was run for only the northern half of the country, north of 24°S. Bush encroachment in areas south of Rehoboth, where the main culprits are *Rhigozum trichotomum*, *Acacia nebrownii*, *A. mellifera*, and *Catophractes alexandrii*, is being mapped by MAWF staff (L.Lubbe pers. comm.). The recent information on *Rhigozum* density in the south-eastern part of the country (Lubbe 2013) is included in this map; the information from the west of the B1 road is drawn from the Tree Atlas.

According to this revised map, approximately 45 million hectares of Namibia are bush encroached.

The map is still ‘work in progress’. Points of contention from various stakeholders about the accuracy of the map include:

- Apparent absence of bush encroachment in north-eastern Namibia. Encroachment of *Terminalia sericea* and *Dichrostachys cinerea* is thought to be high in this area, but the map does not show it. Opinion is divided on whether the Kavango and Zambezi Regions do have a bush-thickening problem – Boys et al (2014) recognise that woody plant densities are high but do not suppress the growth and production of the herbaceous layer.
- Some areas in the north where mopane trees occur densely, usually as scrub, are not marked as encroached. Dense mopane scrub is a natural vegetation structure, and the density is not thought to have arisen from man-made interference such as overstocking or prevention of fires.
- Protected areas (notably Etosha National Park) were not considered, even though there are patches of bush encroachment in them.

Chapter 7 carries recommendations for a more thorough and scientifically accurate estimate of the extent of bush encroachment in Namibia, which would include information on dominant species, densities, and heights.

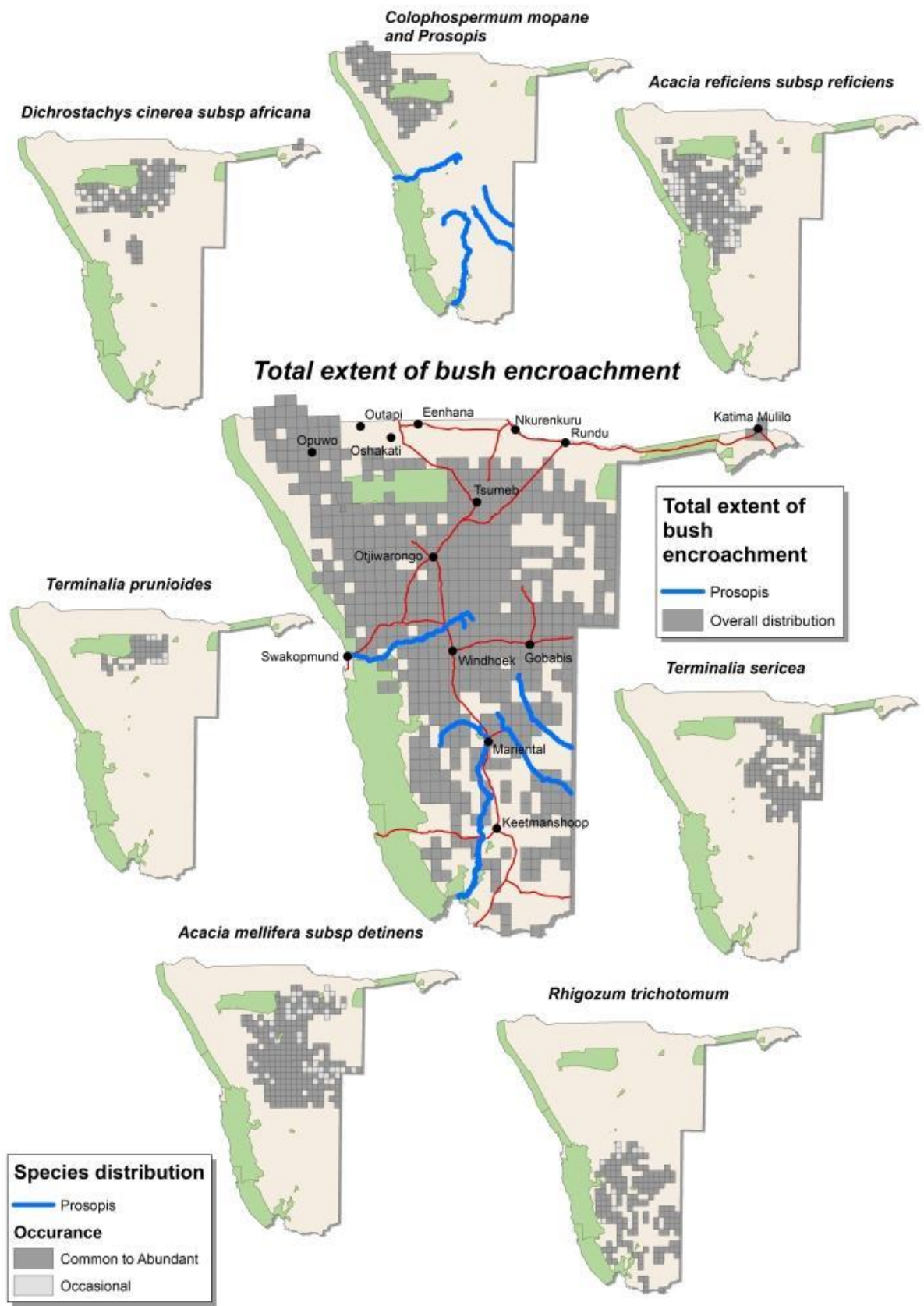


Figure 1: Revised map showing bush encroached areas

2.3.3 Prosopis species

Prosopis invasions exist along the drainage lines of the Swakop, Nossob, Auob and Fish Rivers and their tributaries (Smit 2005). Isolated stands also occur along the Oanob, Schaap, Ugab and Omaruru Rivers, and in most of the towns in Namibia south of about 19° S (roughly the southern limit of Etosha Pan). In the towns, Prosopis is used very much for firewood, and it mostly does not reach the densities where it is problematic in river beds elsewhere. In river beds, densities vary between >10,000 plants/ha, to less than 400 per hectare. Thickets along the Nossob River are about 250 m wide, while the narrower Auob valley allows an average width of 200 m. Prosopis invasions along the Nossob and Auob Rivers and their tributaries covered a total area of 8,540 ha (Smit 2005).

Prosopis is the most widespread and potentially most invasive alien plant species in the country (Smit 2005). It has a negative influence on the recharge dynamics in drainage lines. Thickets extract substantial amounts of water, making less available for other plants. During ephemeral flows, thickets may cause localized damming, which may temporarily increase infiltration to their own benefit, and reduce the volume of water that continues downstream. Smit suggests that Prosopis infestations are responsible for the diminishing recruitment of young *A. erioloba* trees along the Nossob and Auob Rivers, as the Prosopis trees have modified the frequency, volume, duration, distance and velocity of runoff detrimentally (Smit 2005).

Impacts of Prosopis invasion are:

- Displacement of local indigenous species;
- Choking of drainage lines;
- Consumption of surface water, and reduction of groundwater availability;
- Loss of biodiversity;
- Prevention of access to pasture or water;
- Decline in soil fertility;
- Degradation of landscape aesthetics.

2.4 Protected tree species

Protected species are those that have been extensively over-utilised and/or have high ecological value. A list of protected plants is presented in **Appendix B, Annex 1**. These species should not be harvested as part of bush thinning programmes. The one exception is *Colophospermum mopane* - a protected species that has become a serious encroacher in certain areas in northern Namibia. There are a few small patches where *Acacia erioloba* is tending to encroach, but they are small and do not constitute a major threat. A few other protected tree species (e.g. *Peltophorum africanum* and *Spirostachys africana*) can form thickets, but the extent of these thickets is not such that they become a threat to rangelands.

NPC 2009 reports that many protected species are commonly confused with encroacher species. Thus, strict supervision is needed to ensure that only the correct species are felled during bush thinning operations.

3 BUSH HARVESTING AND VALUE ADDING IN NAMIBIA

3.1 Namibian guidelines for combating bush encroachment

3.1.1 Ecological principles

A savanna ecosystem is complex, with close interactions between trees, grasses and soil. For instance, minerals are drawn from deeper soil levels to the surface, by the roots of trees. Leguminous trees, which include all the *Acacias*, make nitrogen available in the soil. Grasses help to retard surface flow so that water can penetrate into the soil. Soil organisms feed on organic matter and help to recycle nutrients from the surface into the root zone of trees and grasses. Large woody plants attract insects, birds and other animals which help to fertilise the soil. All of these processes depend on the status of the three main components – woody plants (trees), grasses, and soil.

There is higher grass production at low density of trees rather than at zero density (Stuart-Hill et al 1987, Teague & Smit 1992, Joubert & Zimmerman 2002). Trees provide shade and leaf litter, and leguminous trees such as the *Acacias*, *Albizias* and *Dichrostachys* fix nitrogen in the soil. A study in Omaheke found that in an area harvested for firewood two years previously, grass production was more than double that of the adjacent uncleared area (Uazukuani 2000). Also, grass production is dependent on the size of the trees rather than the total cover. Thus areas with larger single trees have higher grass production than areas with many smaller bushes. For example, the shade-loving grass *Panicum maximum*, a very good quality, high-yielding grass, is particularly associated with larger trees (Joubert & Zimmerman 2002). The larger trees therefore act as ‘fertilisers’ for the overall habitat.

The leaves of trees are an important component of the available fodder for livestock and wild herbivores. Valuable broad-leafed trees in Namibia’s savannas include *Philenoptera nelsii*, *Boscia albitrunca* and *B. foetida*, *Combretum imberbe*, *Maerua* species and *Grewia* species (Bester & van Eck 1998). The leaves of *Acacias* are also obviously important browse, but even more valuable are their pods, which are high in protein. Thinning of trees has the additional benefit that leaves of deciduous species such as *Acacias* are shed later in winter (Cunningham 1997).

Structural diversity of a habitat determines, in part, the availability of niches and the number of species that it can support. In optimum savanna, all size classes of trees should be represented, and some patches of dense bush should remain, to increase the structural diversity both vertically (different sized trees) and horizontally (open grassy areas and patches of dense bushes).

Savanna habitat supports both grazers and browsers. The carrying capacity of a savanna area can be optimized where there is a mixture of trees, bush and grass. Mammal herbivores requiring browse or dense cover for predator evasion include kudu, giraffe, eland, dik-dik, duiker, steenbok and goats. Herbivores requiring plains and grass cover include blue wildebeest, zebra, warthog, oryx, red hartebeest, cattle, horses and sheep. This diversity of browsers and grazers (and a high carrying capacity) can be sustained in mixed savanna habitat, whereas the diversity and carrying capacity declines if there is either excess bush or complete removal of bushes and trees, especially in sandy areas.

Climax perennial grasses can go locally extinct due to bush encroachment, and these need to be re-introduced to restore productive pastures. The presence and combination of these grasses will differ in the various agro-ecological zones. Superior grasses in Namibia include:

- *Schmidtia pappophoroides*
- *Antephora pubescens*
- *Brachiaria nigropedata*
- *Digitaria seriata*
- *Panicum maximum*
- *Urochloa oligotricha*
- *Stipagrostis uniplumis*

Diversity of other animals is also relatively higher in mixed savanna than in bush-encroached areas. For instance, species needing cavities for shelter and nest sites, such as bats, hornbills, owls etc, find their requirements in relatively taller and gnarled trees such as *Boscia albitrunca* and *Acacia erioloba*. Large dead trees are particularly important in this regard. It is likely that the diversity of reptiles, small mammals and invertebrates also rises in a mixed savanna, due to the higher primary production and increased habitat diversity, compared to the levels in bush encroached or completely cleared habitats.

The density of trees and bush has a significant influence on the volume of water that penetrates to deeper levels and becomes available as groundwater. The large network of shallow lateral roots put out by encroacher species intercept water that has penetrated the surface, and return it to the atmosphere through evapo-transpiration. Once densely established, bush inhibits grass growth, and limits the recharge of groundwater. It has been estimated that water loss through evapo-transpiration is in the order of 12 Mm³ on a bush encroached farm of 5,000 ha, while it is only 6Mm³ in a balanced savanna (CCA 2010).

The following principles are summarized from guidelines for bush harvesting set out by the FSC, Piepmeyer (1996), Joubert & Zimmerman (2002), de Klerk (2004), Smit et al (2015), and others.

- As a rough guide, the 'tree-equivalents' (TEs) per hectare that remain after harvesting should be roughly 1.5 to 2 times the average annual rainfall. (A 'tree-equivalent' is a 1.5m single-stemmed tree, so a 3m tall tree would equal 2 tree-equivalents.) For example, in an area where average annual rainfall is 400 mm, there should be 600 - 800 tree-equivalents per hectare. In areas of sandy soils, such as the Kalahari sandveld, the tree-equivalents should be higher, at about three times the average annual rainfall. This 'rule of thumb' is applicable in the areas where annual average rainfall is 150 – 500 mm, and covers most of the areas in Namibia where there is severe bush encroachment.
- In areas with average rainfall greater than 450 mm, which includes most of Namibia's woodland habitat, the density should be not less than 3 times the average annual rainfall.
- Evergreen trees, protected species and riverine species should not be harvested.
- It is illegal to harvest trees in river beds and watercourses, and within 100 m of them. Riverine vegetation forms important habitat for fauna, and the roots stabilize the soil which helps to reduce erosion.
- Twigs, leaves and fines should be left where trees are felled. They create mulch which improves soil moisture, they provide soil organic matter, and increase soil nutrient levels.
- Relatively larger dead trees should not be harvested. They provide cavities for hole-nesting birds, and perches for raptors.
- Maintain spatial heterogeneity i.e. leave patches of dense bush, and retain a variety of size classes.

The overriding message is that tree thinning improves the quality of pasture, but total clearing lowers it. Bush thinning should not try to create a homogeneous environment – rather make it patchy, to create a mosaic effect.

3.2 Current bush thinning practices

Various methods for bush clearing / thinning are in practice. These include: manual cutting; mechanical clearing with heavy-duty machines such as bulldozers, bush rollers, dragged chains, or using more selective, ‘surgical’ methods that cut individual trees; the use of chemical arboricides (aerial, foliar, stem and soil applications); burning; and biological control.

The effectiveness of the various methods of bush thinning, and their impacts, are difficult to identify because there is a lack of controlled, closely monitored, scientifically principled studies. Farmers use the methods they prefer and can afford, with varying degrees of monitoring (some thorough, others only sporadic or anecdotal).

3.2.1 Manual and semi-mechanised clearing

Hand labour (using machetes, axes or chainsaws), if well supervised, is a highly effective method of bush control. It demands follow-up clearing to ensure that coppicing buds are destroyed. Chopping by hand has few negative environmental impacts, although if it is not closely supervised, the wrong trees or bushes – such as protected species or those which are valuable browser species – may be cut down. This method is practiced widely but farmers complain that it is too time-consuming and labour-intensive, both of which bring management issues (DRFN 2015). There is a general perception that there is inadequate control over what trees are cut down, and that many large trees, including non-encroacher and protected species, are being cut. The work is physically very strenuous and demanding.

If done for the sole purpose of restoring rangelands, the cost is very high and the rate of clearing very slow. Therefore it is mainly done to produce charcoal and firewood. Other products are droppers and poles, especially from trees such as *Terminalia sericea*.

3.2.2 Medium- to large-scale mechanized clearing

A wide variety of mechanical methods are employed, depending on what equipment a farmer has available or can adapt, and what is affordable. These range from heavy-duty bulldozers, bush rollers, and heavy chains that ‘sweep’ an area between two tractors. Other, more selective machinery includes machines equipped with a horizontal rotary cutter or circular sawblade, or larger excavators with a hydraulic ‘grab and cut’ apparatus. In many operations, the wood is fed into chipping machinery for later processing.

Bulldozing leads to severe soil surface disturbance, which can lead to sheet erosion and the beginning of gully formation. The disturbed topsoil serves as an ideal seed bed for weeds (e.g. *Pechuel-Loschea leubnitzii* [bitterbos] and other pioneer invaders), and also for some species of encroacher bush (in particular *D. cinerea*, *A.reficiens*, *A.mellifera*, and various *Grewia* species). The consequence of large-scale soil disturbance is very often an increase in encroacher seedling density (DRFN 2015), with re-infestation being more severe and the areas in worse condition a few years after treatment.

For least environmental harm, any mechanised clearing should create minimal disturbance to the soil, and should be able to select appropriate trees to be felled, and avoid others that are desired. The



various options and economic factors are well presented in the booklet 'Harvesting Namibian encroacher bush' (GIZ 2015).

3.2.3 Chemical clearing

The Meat Board encourages the use of arboricides by selling these chemicals at cost price to farmers (NPC 2009), and financial institutions grant loans for acquiring arboricides. Smit *et al* (2009) report that although the use of arboricides is one the more popular methods of control by farmers, new seedlings rapidly re-establish themselves in cleared areas and follow-up management is essential, such as allowing occasional fires, and manual thinning, to maintain the thinned state that arboricides can first produce.

Aerial spraying has been widely used in Namibia, with the justification by farmers that it is an 'emergency' treatment and more cost effective when bush is so dense that other methods of clearing are simply not pragmatic. However aerial spraying is now illegal² (Forestry Act Regulations, 2015), but application by hand is still allowed. This is more selective, but may also kill desirable trees that have extensive lateral root systems (Bockmuhl pers. comm. 2015, de Klerk pers. comm. 2015, Muir pers. comm. 2015).

Although chemical manufacturers may report that their herbicide products are non-toxic to cattle, wild fauna and birds, the use of some of these products poses the risk of negative environmental and human health impacts (Honsbein et al 2012). Also, less immediate and long-term effects, and how it becomes dispersed through the environment, are poorly understood. For instance, are arboricides and/or their residues being washed into ephemeral rivers and accumulating there, and possibly responsible for die-off of river-associated trees? The impact of the adjuvants in arboricides (to give them better properties for spraying, wetting etc), which make up more than half the volume of the chemicals, are also poorly understood. Long-term impacts need to be thoroughly researched.

General concerns over weed-killers are that these products and/or their break-down products have led to the proliferation of new 'super-weeds' that are extremely difficult to eradicate (Neuman & Pollack 2010, Zabalov *et al* 2011). In addition some of these products are reported to be responsible for destroying beneficial soil organisms, the promotion of fungal over-growth and a reduction in the absorption of soil nutrients by some plants (*ibid*).

In line with the precautionary principle, the use of mechanical, manual and biological control measures (such as browsing and fire) are preferable to the use of chemicals. Whilst there is no evidence of bio-accumulation from the use of arboricides (Honsbein et al 2012), our opinion is that more long-term research and monitoring is required so that this matter can be conclusively assessed.

3.2.4 Fire

Fire has evolved with savannas and the absence of fire is one of the major reasons for bush encroachment. Occasional fire (about once every 7 – 10 years) is a natural and necessary part of savanna ecosystems. Fire removes an accumulation of biomass and can stimulate grass (and seedling) growth. It can be used as an effective, albeit risky, after-care method to destroy small coppicing stumps and burn back new seedlings and saplings, as well as to destroy soft-shelled seeds themselves. In order to make this method viable there needs to be adequate grass cover available. However, many farmers are strongly against the use of fire because of the risks of it getting out of control.

² See Section 4.1.2 for clarification on this matter.



The timing, frequency, amount of rainfall and period of rest after burning influence the effect that fire has on rangeland and soil health. Despite its potential to clear the veld of unwanted biomass, repeated burning (such as occurs in north-eastern Namibia, with burns almost every year) can result in environmental degradation (NRMPS 2012).

Fire is ineffective against thickly encroached bush because there is simply inadequate fuel. However it is effective when applied to individual problematic trees: dead branches and/or dry manure are packed around the stem and burned.

3.2.5 Biological control

Browsing animals, including several game species, sheep and goats, can play a valuable role in clearing re-growth after thick bush has been removed. In the view of one rangeland specialist, Namibia would have far less of a bush problem if rangelands had more goats (Rothauge 2016, pers. comm.). After bush thinning, regrowing seedlings of the encroacher species are highly nutritious and palatable to goats, and are all within reach. Goat meat production, managed intensely, can equal or better that from cattle.

Another form of biological control is the use of biological organisms, such as the Acacia-specific fungus *Phoma glomerata*. Despite research on this fungus, methods to actively spread it as a means to combat bush encroachment have been unsuccessful.

Seed-feeding bruchid beetles introduced to southern Africa have had reasonable success against *Prosopis* infestations (Zimmerman 1991, Smit 2005). The beetles *Algorobius prosopis* and *Neltumius arizonensis* were introduced in the 1980s with the intention to reduce the annual seed crop and thereby prevent the further spread of infestations. Almost all stands of *Prosopis* in Namibia are now infected with these beetles. While they may reduce the number of seeds added to the annual seed bank, they have been ineffective in controlling the spread of the plants because such vast numbers of seeds are produced, and the seeds are long-lived.

3.2.6 After-care

The importance of after-care is emphasized in the draft Policy on Bush Encroachment and by various authors (NPC 2009; Smit *et al* 2015). When land is cleared it creates a 'vacuum' in which weeds and woody plants (sometimes more aggressive colonizers than the original encroacher species) will quickly establish themselves. Various methods are in use to manage the regrowth of bush following harvesting. These include hand application of arboricides, stem burning, and intensive browsing by goats or antelope. The judicious use of fire can also be considered as a preventative rather than a curative measure to prevent young seedlings getting established.

The intensity of regrowth varies greatly, depending on the species involved, the amount of soil disturbance created during bush clearing, and local rainfall conditions. Most farmers and bush experts agree that in areas where *Dichrostachys* occurs, re-infestation by this species is intense, usually resulting in much worse bush encroachment than before. This is due to the long survival time of its seeds in the ground, and its strong coppicing ability.

Attitudes towards after-care differ, depending on whether a farmer wants to restore the rangeland for improved livestock productivity, or whether he views the bush as a sustainable resource for continuous utilization. If it is the former, then any form of bush clearing must be linked to a sustainable rangeland management programme, because the removal of any infestation is not a once-off event. After-care is



specified as a part of the Environmental Management Plan of any bush harvesting operation (see Appendix B).

For *Prosopis* infestations, Smit (2005) suggests chemical control of isolated thickets, mechanical removal of problematic single plants, strategic use of fire, and the minimizing of seed dispersal by managing the movement of livestock when pods are being shed.

3.2.7 Affordability

Farmers complain that bush thinning methods are very expensive, even though the thinning improves the carrying capacity. For instance, a farmer in the Okahandja District reported an increase from 25 to 45 kg/ha within 4 years of chemical treatment (DRFN 2015). However, he stated that this exercise is only affordable on farms larger than 10,000 ha. The average size of commercial farms is about 5,000 ha (DRFN 2015). Over the past eight years, production costs on a cattle farm increased by 120%, while the beef price increased by only 73%. Subsequently, farmers without an additional source of income cannot afford to apply sustained bush control measures.

This is why it is so important to add value to the biomass available from bush. With this additional income the necessary bush control measures (particularly after-care) become affordable. This will enable a farmer to follow a strategy where re-harvesting can be done within 15 to 20 years. Such a model would allow a farmer to benefit from a huge increase in grass production for maybe the first 10 years after bush thinning, after which there would be a gradual decrease in grass/meat production. At a certain stage the income from re-harvesting would compensate for the loss in land productivity.

However, the idea of a bush-thinned area being allowed to re-thicken to enable a new wave of harvesting (i.e. bush farming), is contrary to the objectives of the Rangeland Management Policy since it narrows the provision of ecosystem services to only the harvesting of bush biomass. As noted earlier (Chapter 3.1), the aim of bush thinning should be to restore ecosystem health of rangelands, so that the area provides a broad range of ecosystem services on a sustained basis (i.e. groundwater recharge, soil health, habitats for biodiversity, and livestock production).

3.3 Bush value-adding practices

“Debushing in Namibia can only be economically viable if the woody biomass is recognized as a valuable resource for existing and new value chains.” (GRN 2015).

3.3.1 Realised and potential products from encroacher bush

The report *“Support to De-Bushing Project:-Value Added End-Use Opportunities for Namibian Encroacher Bush”* (GRN 2015) provides a detailed overview of potential products that are, and could be, produced from Namibian encroacher bush. Unless otherwise stated the information in the remainder of this section was summarised from this document.

Namibian encroacher bush theoretically offers 260-300 million tons of biomass, although this value is probably higher based on the revised estimate of encroachment to 45 million hectares (Section 2.3.2). However, the economically viable utilization and processing of this resource is currently hampered by:

- Changing regulations and the short validity of harvesting permits
- Limited accurate information regarding the quantities of the different encroacher species, their distribution and growth rates. This lack of knowledge - together with limited information on



the strength, grain, resin and chemical composition of the different encroacher species – remains a challenge to developing many bush encroacher industries

- The absence of harvesting rules and guidelines, which threaten the sustainability of the industry
- Limited coordination between the many different institutions that are responsible at one level or another for dealing with bush encroachment at a national level
- Many of the identified opportunities for encroacher bush depend on softwoods but seldom on mixed, heavy hardwoods which are common in Namibia.

To date the utilisation of encroacher bush has focused on firewood for local communities, charcoal for exports, and the small production of compressed firewood. Several other opportunities have been identified which could lead to value adding, the creation of SMEs and employment. These include agriculture (animal feed and organic fertiliser) and energy (industrial energy applications and power generation). However, with the exception of the bush utilisation for energy at the Ohorongo Cement factory near Otavi, these projects are not yet at a stage to be implemented and / or are not economically viable.

The end-use opportunities for encroacher bush can be grouped into the following three categories:

1. Opportunities that have already been implemented by small scale users or have a realistic chance of being implemented with limited or no additional measures needed for implementation (Table 1).
2. Opportunities that have potential for development (on a larger scale) but which require further research before implementation or improved value adding (Table 2). This category includes some current investments, which require additional measures for value adding (e.g. charcoal, wood chips, animal feed). The most promising opportunities within this group are charcoal, wood chips, and firewood as they require few skills, low investment and can utilize mixed encroacher bush.
3. Opportunities without a realistic chance to be implemented in the short to medium term. These are not described here.

Table 1: Opportunities (mostly small scale) implemented in Namibia with realistic chances for implementation by local entrepreneurs (GRN 2015).

Opportunity	Remarks
Furniture	<ul style="list-style-type: none"> ○ Only based on the invasive species <i>Prosopis</i> ○ Small diameters of other invader species not suitable/financially viable
Wooden Frames & Kitchen Boards	<ul style="list-style-type: none"> ○ Import substitution targeted ○ Entrepreneur to be identified to test feasibility
Carving	<ul style="list-style-type: none"> ○ Widespread local experience ○ Promotion of wood from encroacher bush recommended
Sticks & Handles for Tools	<ul style="list-style-type: none"> ○ Import substitution & export targeted ○ Low investment for mechanised production ○ One entrepreneur to be identified to test feasibility



Wood Glue	<ul style="list-style-type: none"> ○ Experience from other countries available ○ Foreign partners to be mobilised to investigate feasibility
Compost	<ul style="list-style-type: none"> ○ Mainly for own use by farmers ○ Small current commercial production in Namibia exceeds demand
Mulch for Gardening	<ul style="list-style-type: none"> ○ Mainly for own use by farmers ○ Small current commercial production in Namibia exceeds demand
Smoking Material	<ul style="list-style-type: none"> ○ By-product of wood processing ○ Import substitution targeted ○ Local entrepreneur to be identified



Table 2: Promising opportunities that require further investigation for improved value adding and/or viability (GRN 2015).

Opportunity	Prospects
Charcoal	<ul style="list-style-type: none"> ○ Already the most important value added product for wood from de-bushing ○ Positive image of Namibian barbeque charcoal on undersupplied world market (6th largest exporter) ○ Potential to increase exports fourfold over 10 years ○ Need to improve harvesting, production sector and regulatory framework
Wood Chips	<ul style="list-style-type: none"> ○ Increasing global market (35.1 million tons imports p.a.) ○ Short-term domestic demand by industry and power generation exceeds production capacities ○ Engineering solution to chipper technology customised to harsh Namibia conditions required ○ Tailored logistic chain solutions to access international markets to be developed
Compressed Firewood	<ul style="list-style-type: none"> ○ Existing market demand in Namibia/RSA exceeds current production capacities ○ Additional markets both locally and internationally may provide huge growth potential ○ Engineering solution to minimize sand content in resource required ○ Tailored logistic chain solutions to access international markets to be developed
Firewood	<ul style="list-style-type: none"> ○ Huge domestic demand (about 550 000t p.a.) ○ Use of invader species to be promoted in order to contribute to biodiversity conservation and environmental protection
Animal Feed	<ul style="list-style-type: none"> ○ Considerable domestic demand for complementary and emergency animal feed both in communal and commercial areas ○ Several production tests currently under way in Namibia ○ Digestion of wood controversial point of discussion ○ Suitability of species, optimal production processes and feed composition to be clarified
Wood Pellets	<ul style="list-style-type: none"> ○ Large and growing international demand (12.2 million tons imports p.a.) ○ Higher energy efficiency and bulk density as compared to wood chips ○ Engineering solutions to customized chipper technology and high sand content of resource required ○ Tailored logistic chain solutions to access international markets to be developed



Poles	<ul style="list-style-type: none"> ○ Continuous high domestic demand ○ Potential for increased local production for import substitution ○ Quality improvements required
Wood-cement Bonded Boards & Bricks	<ul style="list-style-type: none"> ○ Increasing demand in industrialised countries due to excellent properties ○ Improvement of the construction industry and import substitution of panels possible ○ Material specifications of Namibia bush and related suitability to be clarified
Medium Density Fibre Boards (MDF)	<ul style="list-style-type: none"> ○ Possibly demand for indoor construction in Namibia and other African countries, i.e. import substitution and export promotion possible ○ Overseas export hampered by quality requirements ○ No experience with Namibian hardwood species; tests required
Wood-sand Boards	<ul style="list-style-type: none"> ○ Research in Namibia ongoing; results only expected in years ○ Financial viability doubtful, therefore not commercially applied in other countries
Wood-plastic Composites (WPC)	<ul style="list-style-type: none"> ○ Niche markets of indoor construction, furniture production, agriculture (e.g. droppers) ○ Huge variety of products ○ Test results with mixed encroacher species promising ○ Market demand/opportunities in Southern Africa to be verified
Parquet	<ul style="list-style-type: none"> ○ Small (high end) local market ○ Wood of high density required; possibly available from several invader species ○ Only larger woody parts of bushes suitable ○ Sufficient quantities of attractive wood required
Shingles	<ul style="list-style-type: none"> ○ Very special traditional niche market in a few European countries ○ Invader species with relevant properties should be available ○ High prices in Europe due to manual production
Traditional Medicine	<ul style="list-style-type: none"> ○ Increasing import demand from Europe and North America ○ Highest value addition ○ Longer term research required (e.g. dosages, quantities, applications, acceptance)

3.3.2 Potential for bush-to-electricity power plants

Namibia, and southern Africa as a whole, is facing serious challenges in terms of future electricity supply (DRFN 2015, von Oertzen 2012). An additional supply of about 250MW is required in Namibia, to avert pending power shortages. The CBEND project (Combating Bush Encroachment for Namibia's Development), developed in 2009-2010, aimed to pilot a bush-to-electricity plant, with the



cooperation of NamPower and Cenored. Although it was never commissioned, there is renewed serious interest in similar projects. The DRFN study (2015) to assess the biomass resource concluded that a 5MW biomass-to-energy power station would require 36,000 tons p.a., equivalent to clearing of 3,600 ha p.a. It concluded that there would be “more than enough biomass in the country for running several biomass power stations of 20MW on a sustainable basis” (DRFN 2015).

Ohorongo Cement, through its subsidiary Energy For Future, currently uses encroacher bush to fire its kilns (CCA 2010). There are other initiatives, such as by NamPower and Namibia Breweries, investigating the viability of bush biomass power. These would mainly involve production of wood chips to substitute the burning of fossil fuels in boilers and generators. Other possibilities include wood chips in any industries which require heat, as well as wood pellets as an ingredient in animal fodder.

3.3.3 Realised and potential Prosopis products

The nature of Prosopis infestations in Namibia justify the need for improved control and management of the plants, which should be directed to limiting the spread of existing stands and improving their productivity, rather than eradicating them. Benefits derived from Prosopis trees are the high yield of nutritious pods and browse, and the shelter they offer through shade and wind breaks. The fresh green leaves emerge in late spring, often before other vegetation is available, and the pods fall before the start of the rainy season, both providing an alternative source of fodder for livestock. The wood is good for timber, firewood and charcoal. Prosopis honey is claimed to be ‘one of the best’ (Smit 2005). These offer economic opportunities for farm owners and labourers.

An important difference between Prosopis and the other encroacher species in Namibia is the value of the pods, which reinforces the argument for harvesting. Valued at a price of N\$250 per ton (Smit 2005), and up to double that if they are milled, the total annual yield of pods is worth N\$25 million to N\$50 million.

Prosopis wood for timber and furniture is worth N\$1,500 – N\$3,500 per ton. The yield of this resource is obviously dependent on trees being large enough to create planks. Prosopis charcoal is apparently superior to that from mopane, but it has a relatively low domestic market value (Smit 2005). Prosopis wood is being increasingly used for wood carvings.



4 LEGAL, POLICY AND INSTITUTIONAL OVERVIEW

Bush encroachment is widely acknowledged as a major cause of land degradation, lost agricultural potential and economic opportunity. Nevertheless Namibia has no specific policy on bush use or clearing. Such a policy needs to be multi-sectoral in nature, involving cooperation between and input from the Ministry of Environment and Tourism (MET), the Ministry of Agriculture, Water and Forestry (MAWF), the Ministry of Land Reform (MLR) and the Ministry of Industrialisation, Trade and SME Development (MITSD).

Although several MAWF policies acknowledge the threats of rangeland degradation, none, with the exception of the recently promulgated National Rangeland Management Policy and Strategy (NRMPS, 2012), provide any guidelines on bush thinning nor incentives for farmers to de-bush their land.

To date, the absence of a specific regulatory framework and coordinating body has meant that:

- There are no official guidelines or controls pertaining to bush clearing activities or for how the land is treated/maintained after clearing.
- There is no standardization of local biomass fuel products or the value-adding thereof. These issues have been documented as a major concern to many stakeholders (Honsbein 2015).

In addition, limited research has been done on the growth rates of the different bush encroachment species. Without this it is not possible to draw up plausible Forest Management Plans. This remains a further challenge to the sustainable use of encroacher bush (GRN 2015).

Von Oertzen (2014) states that policy changes that may directly affect the supply of biomass products (e.g. land reform), or those that affect the longer-term demand for biomass fuel (e.g. local content rules and regulations in regard to fuel) are always possible and should be borne in mind when considering bush clearing projects.

Regarding large scale debushing and value-adding to encroacher bush species in Namibia, the most relevant laws and policies are summarised below. These laws and policies encompass pertinent points pertaining to the:

- Conservation of soil and water resources, maintenance of biological diversity and use of wood products in a sustainable manner;
- Protection of the environment, without compromising optimum sustainable yields;
- Reducing the rates of environmental degradation caused by unsustainable deforestation, soil erosion, overgrazing and bush encroachment;
- Promoting the development and use of alternative sources of energy;
- Creating favourable conditions to attract investment in small and medium industry based on wood;
- Controlling encroacher bush (alien and indigenous) and the improvement of rangeland quality in a sustainable manner;
- Paying subsidies and grants to meet the objectives of the Soil Conservation Act.

Uncertainties in the legislation are addressed in Section 6, providing suggestions on how the policy and legal framework should be revised.

4.1 Existing legislation

4.1.1 Environmental Management Act (Act 7 of 2007)

The Act has been operational since the proclamation of the Regulations in 2012. The Act describes various rights and obligations that pertain to citizens and the Government. It sets out 13 principles, including:

- Renewable resources shall be utilized on a sustainable basis for the benefit of current and future generations of Namibians,
- Community involvement in natural resource management and sharing in the resulting benefits shall be promoted and facilitated,
- The precautionary principle and the principle of preventative action shall be applied,
- A requirement for prior environmental assessment, and
- Namibia's movable and immovable cultural and natural heritage, including its biodiversity, shall be protected and respected for the benefit of current and future generations.

This policy deals with the requirements for Environmental Impact Assessments, and the principles underpinning sound environmental management in Namibia. The policy places a high priority on, amongst others:

- Maintaining ecosystems ...in particular those important for water supply, food production, ... tourism, and sustainable development...,
- ... optimum sustainable yield...,
- ...maintaining representative examples of natural habitats...,
- ... maintaining maximum biological diversity by ensuring the survival and ... conservation in their natural habitat of all species of flora and fauna.

Under this Act, the environmental impacts of any development activity should be considered and thoroughly researched; lessening negative impacts where possible and making provision for unavoidable negative effects. Activities should be planned to address all levels of the development, from planning to decommissioning.

With respect to bush, harvesting per se is not a listed activity that requires Environmental Clearance. However, any activity which requires a permit under the Forest Act, requires Environmental Clearance. Therefore all wood harvesting activities, and any value-addition activities, require Environmental Clearance from DEA. Compliance with this law is very poor, since there are many (probably hundreds) of ongoing commercial bush harvesting and value adding activities, yet the total number of EIAs done in Namibia for these activities is very few.

Failure to comply with the recommendations of an EIA and EMP can result in an Environmental Clearance being withdrawn. The Clearance can also be withdrawn if it can be shown that the particular project is causing significant environmental degradation. Therefore this law does have considerable power over bush utilisation projects, although implementation and enforcement are currently very poor.

It is not made clear in the Act where is the cut-off in a bush-harvesting operation. For example, is the farmer who clears a few hectares of bush and makes droppers, legally required to obtain Environmental Clearance? In an area of less than 15 ha, no. The Forest Act states that any bush clearing activity on more than 15 ha, triggers the need for a permit from Directorate of Forestry, and



this in turn triggers the need for Environmental Clearance. This SEA suggests thresholds for activities that require Environmental Clearance (Section 6.2.2).

4.1.2 The Forest Act (Act 12 of 2001) and Regulations (2015)

The Forest Act (MAWF 2001) is mainly concerned with classified forests, which are not necessarily bush encroached, and which do not cover most of the encroached areas of Namibia. However it also governs and is being applied to deforesting activities that occur on any land (Section 23), which includes the bush clearing and thinning practices required to control bush encroachment. Therefore our conclusion is that the Act is applicable to bush harvesting activities anywhere in Namibia (Odendaal 2012, Hailwa pers.comm. 2015).

This is the point of departure of this SEA, but it must be emphasized that the Forest Act can be interpreted as being **only** applicable to classified forests (i.e. Forest Reserves, Community Forests and Forest Management Areas). This immediately creates ambiguity around the applicability of the Forest Act to bush encroachment practices, which needs to be resolved (see Section 6.1.4).

The Act provides for the establishment of a Forestry Council and the appointment of officials required for its implementation. It also consolidates the laws relating to the management and use of forests and forest produce, as well as providing for the protection of the environment and the control and management of forest fires. The Forest Act repeals the Preservation of Bees and Honey Proclamation, 1923 (Proclamation No.1 of 1923), Preservation of Trees and Forests Ordinance, 1952 (Ordinance No. 37 of 1952) and the Forest Act, 1968 (Act No. 72 of 1968).

This Act makes specific provision regarding permitting requirements for de-bushing. It aims to achieve the sustainable management of forests, and states: *“the purpose for which forest resources are managed and developed ... is to conserve soil and water resources, maintain biological diversity...”*

This stated aim is important, since the Act does not envisage ‘bush-farming’.

Section 16(1) provides that: *“The Director may enter into a forest management agreement with any person or institution for the creation of a forest management area on land which does not form part of a classified forest, but which land is owned by that person or institution or can be legally used by that person or institution.”*

Restrictions to harvesting

The restrictions that limit the harvesting of forest produce, include the following:

“Unless approval has been given by the Director, no person shall: -

*... clear the vegetation on more than **15 hectares** on any piece of land or several pieces of land situated in the same locality which has predominantly woody vegetation; or*
... cut or remove more than 500 cubic metres of forest produce from any piece of land in a period of one year.” Before approval the Director must consider an Environmental Assessment Report.

Section 22 is also very important in restricting harvesting:

- (1) Unless otherwise authorized by this Act, or by a licence issued under subsection (3), no person shall ... cut destroy or remove -
- (a) vegetation which is on a sand dune or drifting sand or on a gully ... or
 - (b) any living tree, bush or shrub growing within 100 metres of a river, stream or watercourse.



This applies to all vegetation, including encroacher bush species.

However, these restrictions:

- Do not apply to communal land inhabitants who may, subject to customary law, cut and remove forest produce for use as household fuel, the construction of human, livestock or crop shelter.
- Do not take into account the chemical combating of bush encroachment, with the result that large areas including those that support large and/or protected trees are cleared of woody biomass (GRN 2015).

Consequently, there remains inadequate control over woody biomass harvesting including the de-bushing of encroacher species.

Protected species

A number of plant species are protected under the Forest Act. This is in addition to species that are protected under the Nature Conservation Ordinance. A list of protected species under the Act is provided in Annexure 2 of the regulations. It includes mopane (*Colophospermum mopane*) which, although protected is also an encroacher species widely harvested for charcoal and firewood.

Permits

Permits are used by the DoF to regulate private sector forestry activities in commercial and communal areas. Permits are granted by the DoF for harvesting wood (de-bushing of more than 15 ha or removal of more than 500 m³), and/or for the transporting and exporting of wood. Permits are valid for 3 months, and are subject to inspection of the areas that have been or will be harvested. Fees for permits are only defined for saw logs, poles, rafters, droppers, wood for charcoal and commercial crafts. The other potential end-use products of encroacher bush, such as chips for energy production and animal feed, are not mentioned.

Annex 3 of the regulations stipulates the applicable fees for various types of forest produce, as well as the costs for permits. It is expected that these fees and costs will be revised in future years.

Stakeholders in this SEA expressed concern that the permit system by Forestry is not effective because there are no conditions attached to a permit (e.g. stipulation of how much bush and what species should not be felled). Furthermore, “there is no enforcement of any environmental management measures”. Although we are aware of instances where the management of permits is satisfactory, most stakeholders agreed that monitoring and inspections by DoF officials are totally inadequate to prevent illegal and/or excessive harvesting.

General harvesting regulations and guidelines

The 2015 regulations include a number of clauses pertinent to the harvesting of forest products. The most pertinent regarding bush encroachment control is that a holder of a license for the removal of forest produce must report on the species and actual quantity of the forest produce removed when submitting the next license application or at the end of the financial year (reg 9.1). Also, if the holder of a license intends clearing by burning, rehabilitating or planting, s/he must report on the area cleared by burning, rehabilitation or planted.

Regulation 10(2) requires local communities to obtain authorisation to carry out activities such as harvesting of timber, collection of firewood, honey, wild fruits and medical plants, as well as any other

activities of similar nature within and affecting a state forest.

Similarly, no-one may harvest, transport, sell, market, transit, export or import forest produce without a valid license. A person with a general dealers license is exempted from having a marketing license, however s/he must be able to prove that such forest produce was obtained legally by producing copies of the third party's harvesting license, marketing license and transport permit issued under the Act.

The regulations specify the following seven key license conditions for bush control³:

1. No aerial application of herbicides.
2. Herbicides are applied selectively on encroaching species.
3. Only prescribed herbicides for bush control may be applied.
4. Trees with stem diameter of more than 18cm at ground level may not be removed unless special approval is granted.
5. No protected species may be removed unless special permission is granted.
6. The license owner must execute proper supervision over the operations.
7. The harvesting license must be available at all times for inspection purposes.

License conditions for charcoal production include⁴:

1. Trees with stem diameter of more than 18cm at ground level may not be removed unless special approval is granted.
2. An area of at least 15m around the kiln for charcoal production must be cleared of any flammable material.
3. No protected species may be removed unless special permission is granted.
4. All employees/contractors must be treated according to all applicable laws in Namibia.
5. The permit owner must explain the permit contents and conditions to all workers and contractors.
6. Permit owner must execute proper supervision over the operations.
7. Firefighting equipment must be on site at all times.
8. All kilns must be guarded at all times.
9. Burning of charcoal may not be done within 1 km of the nearest house or dwelling.
10. The permit must be available at all times for inspection purposes.

As emphasised in NPC (2009) and GRN (2015), concise guidelines for harvesting are critical for the sustainable use of wood. The focus should be on bush thinning and not indiscriminate bush clearing. The guidelines should specify :

- The harvestable dimensions per species,
- Bush thinning of smaller specimens and never complete clearing or the removal of large trees.
- Reduced thinning in areas where mopane and silver terminalia are dominant.
- Leaving 1-4 ha bush clumps within a diversity of habitats.
- That no harvesting should occur on slopes steeper than 12% and only partially on slopes from 5-12%.
- Limit or restrict harvesting on sensitive soils, especially sodic and duplex soils as they are highly erosive.
- Leaving fine material in the veld to improve soil organic matter and moisture, and nutrient levels.

³ Sections 22, 23/Regulation 12.

⁴ Section 24/Regulations 8 and 12.

Regulations regarding fires

In addition to clauses relating to fires mentioned earlier, the Regulations emphasise the importance of preventing the outbreak of veld fires during bush thinning and charcoal production.

Regulation 8. (1) states that a person involved in fire cutline construction must (*inter alia*) prevent fires in the following ways:

- During the construction of fire cutlines, no fire is used.
- Fire cutlines have a minimum width of 15 meters.
- Fire cutlines are constructed within or surrounding a fire hazardous area.
- A fire cutline has to be connected to a natural or man-made barrier with minimum width of 15 metres.
- Fire cutlines are constructed right after the end of the rainy season.
- An area of at least 15 meters around a burning kiln should be cleared of any flammable materials with the exception of trees during the production of charcoal.

The regulations require that person in charge of a controlled burning must:

- light the fire only after a cutline of at least three metres surrounding the intended area to be burnt is constructed;
- light the fire from three sides of the area at the same time so that the fire burns to the centre, while the fourth side serves as an escape route for animals;
- make available on site sufficient fire fighting equipment and labour when the area is to be burnt; and
- ensure that no burning is done when the day temperature is exceeding 25 degrees Celsius or wind exceeding 20 kilometres per hour or in combination thereof during the months of April to July.

A person who applies for the controlled burning for the purpose of bush control or the removal of old overgrown grass must inform all neighbours in writing and obtain written approval from the neighbours 24 days before the burning is done. The regulations require a person who causes a fire to spread and cause damage to any property or forest resources, to pay compensation to a person who suffers damage as a result of that fire. The Act also provides for the declaration of fire management areas, and for establishing fire management committees. Such committees would develop fire management plans.

The SEA suggests adjustments to this Act and its Regulations in Section 6, to clarify some of the uncertainties and to make its implementation more practical. With respect to fire: the exclusion of veld fires is regarded as an important factor contributing to the problem of bush encroachment, so the policy and regulations around fire management need to be streamlined.

4.1.3 The Soil Conservation Act (Act 76 of 1969) & the Soil Conservation Amendment Act (Act 38 of 1971)

This Act makes provision for the prevention and control of soil erosion and the protection, improvement and conservation of soil, vegetation and water supply sources and resources.

The Minister of Agriculture, Water & Forestry may issue directives to land owners in respect of, amongst others:

- The prevention of erosion, the denudation, disturbance or drainage of land; and
- Any other disturbance of the soil which creates or may create conditions which cause or may cause any form of erosion or pollution of water by silt or drift sand.

Since bush encroachment contributes to reduced groundwater recharge, it follows that this Act could be used to make bush thinning compulsory.

4.1.4 Water Resources Management Act of 2014

This is important legislation in the context of bush thinning and value adding, because it requires appropriate management of water catchments and aquifers.

Article 72 (1) of the Act enables the Minister to declare a water management area (WMA) for the purpose of protecting any water resource, riverine habitat, watershed, wetland, environment or ecosystem at risk of depletion, contamination, extinction or disturbance from any source. The Act restricts a number of activities in a WMA, including water abstraction, the use of pesticides, the clearing or harvesting of vegetation, including the felling of trees and the removal of riparian growth.

If value adding activities will result in the generation of waste products that could pollute water, then Part XI of the Act (sections 56 to 71), is relevant. The opening section stipulates that a person may not discharge effluent directly or indirectly to any water resource unless such person is in compliance with a permit issued in terms of section 60. The term 'effluent' is defined to mean "...any liquid discharged as a result of domestic, commercial, industrial or agricultural activities". A water resource includes dry water courses and groundwater.

Section 33, titled "Application for licence to abstract and use water" goes on to list a number of requirements which must accompany the application to abstract water. Of particular importance is section 33 (3) which stipulates that an application for a licence to abstract and use water must be accompanied by a number of requirements including "an environmental impact analysis of the proposed abstraction of water upon the environment and existing water users and water resources" (section 33(3)(c)).

4.1.5 Labour Act (Act 11 of 2007)

Occupational Health and Safety regulations have not been promulgated under the new Act but the old regulations on Health and Safety are still in force. The following are applicable to bush clearing activities:

- Wearing canvas or other suitable clothes, gloves and suitable boots to protect against thorns,
- Wearing goggles or visors to protect eyes,
- Wearing construction helmets as protection against flying chips or wood or stone.

4.1.6 Electricity Act (Act. of 2007)

In the case of cleared bush being used for electricity generation this Act has some significance. It prohibits the generation, trading, transmitting, supplying, distributing, importing and exporting of electricity without a license, with the exception of power plants with a capacity of less than 500kVA (for non-commercial use).

4.1.7 The Import and Export Control Act

Section 2 of this Act gives the Minister of Trade and Industry the power to prohibit the export of goods (including wood products) from Namibia *in toto*, or to allow the export of goods (including wood products) only under the authority of and in accordance with the conditions stated in a permit issued by the Minister or by a person authorised by him or her (Section 2(1)(b)).

4.1.8 The Fertilisers, Farm Feeds, Agricultural Remedies and Stock Remedies Act (Act 36 of 1947)

All chemical products (including weed killers) used in Namibia are obliged to be registered with the Registrar of this Act. The Act makes it possible to prohibit the use or import of any remedy that could be an environmental risk.

Registration of agricultural chemicals in MAWF is presently dysfunctional, and there is little record of what types and volumes of chemicals are being imported into and used in Namibia. This Act is outdated and needs to be reviewed and updated to meet current needs (see Section 6.1.2). Also, research on the long-term impact of chemicals is recommended (Section 7.3).

4.2 Policies

4.2.1 The Constitution of Namibia

Article 95(1) of the Namibian Constitution commits the state to actively promote and maintain the welfare of the people by adopting policies aimed at the “...*maintenance of ecosystems, essential ecological processes and biological diversity of Namibia and utilization of living natural resources on a sustainable basis for the benefit of all Namibians, both present and future....*”

4.2.2 National Development Plan 4 and Vision 2030

Vision 2030 recognises that bush encroachment reduces land productivity, and notes that bush encroachment is complex, and expensive to reverse. Overall, as a component of land degradation, it is one of the causes of economic loss, declining food security, and escalating poverty. This leads to human migration, urbanisation and an increased need for the government to import food.

In NDP4, bush encroachment appears as one of the four top challenges in the agriculture sector. It recognises bush encroachment as a national problem and includes de-bushing as one of the activities that will contribute to growth in the agricultural sector. This aims to restore the environment, improve carrying capacity and rangeland condition, and increase land productivity. It also notes the potential to create jobs both directly, through employment for bush harvesting, and indirectly by increasing the productivity of farmland. It states “the de-bushing programme has the potenal to increase economic growth in general and rural economic development in parcular, using labour-intensive methods.”

Under economic priorities, NDP4 lists combating bush encroachment programmes as one of its key strategies. MAWF plans to intensify and scale up its de-bushing project throughout the country.

4.2.3 National Forest Policy (1992)

The Forest Policy was introduced to combat the process of desertification by promoting the sustainable and equitable development of natural forest resources. The guiding policy documents for forestry development in Namibia are the following:

- The **Namibia Forestry Strategic Plan** aims at the protection and sustainable utilization of natural forests, with the intended objectives of conservation of ecosystems, increased agricultural productivity, soil and water conservation, poverty alleviation, protection of biodiversity and preventing climate change.

The Plan proposes the following four programme areas to achieve these objectives:

1. institutional capacity-building, which will focus, among other things, on the development of institutional management systems, human resource development, and research and information management
2. the community-based management of natural forests, which will grant communities the right of ownership to forests and involve the relevant communities in managing such forests
3. a farm forestry programme, which will attempt to integrate forestry into existing farming systems and so contribute to food security and income-generation, and
4. an environmental forestry programme, which will manage designated forest areas for conservation.

Amongst other issues, the plan calls for a reduction of uncontrolled and accidental forest fires and the burning of patches of woodland to improve hunting grounds. It proposes using fire only as a controlled tool under specific circumstances.

The rehabilitation of degraded woodlands or reduction of bush densities through bush eradication does not seem to fall within the scope of the Plan (Odendaal 2012).

- The **Namibia Forest Development Policy** contains poverty alleviation measures aimed at, amongst other things, increasing livestock production, small and medium scale manufacturing enterprises based on wood – particularly non-forest wood, conservation of wildlife habitat as a basis for tourism and sustainable rural economies. It emphasizes biodiversity conservation by empowering farmers to manage forest resources sustainably, and innovative land-use strategies within multiple use conservation areas. In commercial areas the policy encourages debushing for charcoal production in order to enhance rangeland productivity. Other than that, the policy does not deal specifically with bush encroachment.

It is not clear from the Namibia Forest Development Policy what constitutes a forest, as opposed to woodland or a bush encroached area (Odendaal 2012). The Policy does address bush encroachment by stating that it supports de-bushing efforts to increase range productivity. However, no mention is made of the means to clear bush, and the possibility of using fires as a management tool for bush control is also not envisaged. Instead, the Policy regards fire as a threat that needs to be controlled. No guidelines on the use of arboricides are provided, and the Policy is silent on how bush encroachment could be prevented (Odendaal 2012).

4.2.4 National Agricultural Policy

The overall goal of the National Agricultural Policy is to increase and sustain the levels of agricultural productivity, real farm incomes and national and household food security, within the context of Namibia's fragile ecosystem. This includes the promotion of sustainable utilisation of the country's land and other natural resources.

It recognizes the problems of bush encroachment, desertification and environmental degradation caused by the destruction of forest cover, soil erosion, overgrazing and bush encroachment. The policy intends to "establish mechanisms to support farmers in combating bush encroachment effectively over the short and long term". It contains policy statements that have a bearing on options for removal and prevention of bush encroachment. However it does not provides any guidelines or incentives on how to mitigate the negative impacts of land degradation.

The Agriculture Policy is being reviewed but any revisions have not yet been formalised.

4.2.5 Draft Bush Encroachment Policy of Namibia (2004)

This policy was initiated by MET, but has been dormant for some time. It recommends that the Forest Act and the Soil Conservation Act be amended to incorporate issues pertaining to encroached savannas that fall outside the definition of forest and classified forest. In its present form, the provisions of the Forest Act apply to classified forests only (Odendaal 2012).

This policy describes the link between bush encroachment and desertification. According to Odendaal (2012) it recognises that despite the fact that existing policies and legislation regard bush encroachment as a serious problem, they do not provide any guidelines on how to deal with the problem. The policy recommends the creation of incentives for farmers to improve the productivity of their pastures by controlling encroacher bush and preventing re-infestation in an environmentally sustainable way. At the same time, improved pasture management practices need to be encouraged to minimise the risks of future bush encroachment (ibid).

The policy's call for the formulation and implementation of a policy to manage savannas on both freehold and non-freehold land has been addressed through the Rangeland Management Policy and Strategy (2012).

The roles and responsibilities of ministries that are directly involved in resolving the bush encroachment problem need to be defined in this policy as well as these two acts. This will help to make its recommendations for the management of savannas in Namibia much clearer.

The Bush Encroachment Policy should be finalised, identifying clearly the roles and responsibilities of the government (e.g. MAWF, MET, MITSD) and non-government (e.g. farmer's unions) institutions (see also Section 6.1.3). It must encourage the sustainable and cost-effective control of problem bush. It should clarify the difference between forest and bush encroachment, and make it clear what permits and regulations pertain to each. Since bush encroachment is primarily an agricultural issue, in the same way as rangeland and carrying capacity are primarily agricultural, we suggest that this policy should be led and implemented by MAWF, as part of the National Rangeland Management Policy and Strategy. After a period of trial implementation and refinement, the policy needs to be translated into legislation.

4.2.6 National Guidelines on Fires and Fire Management

The National Guidelines on Fires and Fire Management are geared towards the prevention and control of forest fires. They do not explicitly mention the use of controlled veld fires as a tool to manage bush encroachment (prevention, re-infestation, and thinning of intruder bush). However, the Guidelines provide a practical framework for the management of fires that could easily include aspects of fire as a tool in bush management.

4.2.7 National Drought Policy and Strategy

This proposes to abolish subsidies for fodder and forage during drought because these subsidies encourage farmers to retain excessive numbers of livestock. Instead incentives to encourage farmers to market animals in times of drought will be sought. Only those farmers who have implemented sustainable farm management practices are supposed to qualify for drought aid. In cases where poor pastures are the result of poor management practices such as overstocking, no drought aid will be forthcoming. In assessing management practices, the constraints imposed by insecure customary tenure systems on proper pasture management will be taken into consideration.

4.2.8 National Land Policy, the National Resettlement Policy, the Agricultural (Commercial) Land Reform Act (1995) and the Land Tax and Communal Land Reform Act (2002)

Within these policies, the relevant factors include: the efficient but sustainable use of land and natural resources; the levying of land tax on unimproved land; land size allocation and the allocation of non-freehold area rights to Traditional Authorities.

Nevertheless, few policies and guidelines have been put in place to advise how land resources should be used sustainably. This gap must carry part of the blame for poor rangeland management, which is manifested in overgrazing and bush encroachment. In addition, land tax can put extra strain on an already financially burdened industry, encouraging farmers to increase livestock numbers and exacerbating pressure on rangelands.

4.2.9 Poverty Reduction Strategy for Namibia (1998)

The PRS differentiates between a long-term goal to alleviate poverty, and a number of short-term options to generate income. In the long term the strategy aims to move away from agricultural endeavours, assuming that by 2025, the majority of Namibia's population will be urbanised. A main objective is to invest in manufacturing, education and health services as well as to develop the country as a transport hub.

The short-term strategy focuses on the promotion of agriculture, tourism and small-and-medium-scale enterprises. The agricultural sector is envisaged to increase productivity and production through agricultural extension, new crops and more efficient water use.

Combating of bush encroachment can therefore be viewed as ways to reduce poverty. For instance, labour-intensive methods of bush thinning could potentially generate employment and increase rural incomes. Secondly, improvement of groundwater recharge through bush thinning, and improving livestock productivity on rangelands, would both impact positively on rural livelihoods, and help to reduce poverty.

4.2.10 National Rangeland Management Policy and Strategy (NRMPS, 2012)

This policy provides an overview of the causes and effects (economic and environmental) of land degradation in Namibia. It analyses the impact of bush encroachment on the national economy and aquifer recharge. It advocates implementing sound rangeland management strategies through: continued research; managing for effective utilisation of plants; enhancing soil condition; practising timely drought planning; monitoring the resource base; and providing incentives for addressing bush encroachment.

The Policy aims to enable resource users (farmers and managers) to manage their rangeland resources in such a way that –

- animal production per hectare is sustainably improved,
- vulnerability of users to a highly variable resource base is decreased, and
- biodiversity is improved and maintained, so that it is able to continue to provide essential ecosystem services.

For these ends it advises that emphasis should be placed on (inter alia):

- improving the nutrient cycle through the promotion of plant diversity, healthy soil structure and functioning;
- improving the water cycle through the promotion of good soil cover and aeration; the creation of sufficient soil organic matter; reducing competition for soil moisture between undesirable

bushes and preferred grasses (bush thinning); and restoring eroded land responsible for rapid runoff during high rainfall events.

- Improving and maintaining the biodiversity of rangelands through: encouraging the correct intensity of plant utilisation; adequate recovery of utilised plants (frequency of utilisation); the reclamation of denuded rangelands; erosion control; the use of biodiversity-friendly parasite control; and managing rangelands for heterogeneity rather than for homogeneity.

Regarding institutional support for implementing sustainable rangeland management, the NRMPS suggests that, while the MAWF will take overall responsibility for implementation and reporting to Cabinet, the recently established Namibia Rangeland Forum (NRF) will be responsible for annual work planning and budgeting, monitoring and evaluation. Separate working groups for the communal areas, resettled farms, protected areas and commercial farms, will be formed under the auspices of the Namibia National Farmers' Union (NNFU), the Namibia Emerging Commercial Farmers' Union (NECFU), the MET and the Namibia Agricultural Union (NAU), respectively.

The goals of the National Rangeland Management Strategy are a) to optimize animal production per hectare without losing rangeland productivity and b) to minimize the economic losses from the resource base.

In order to achieve these goals, the Strategy identifies seven major objectives, one of which is to ensure that *“the adverse impacts of bush encroachment are reversed.”* Regarding this objective the following activities and responsible institutions are highlighted:

1. Introducing sound environmental principles and guidelines for combating bush encroachment [MAWF in collaboration with DoF, MET, DART, Polytech];
2. Recommending environmentally friendly methods of bush control with emphasis on job creation [MAWF with DART and Polytech];
3. Securing environmentally friendly after-care methods – both for bush control and wood harvesting [MAWF];
4. Improving understanding of the causes of bush encroachment [MAWF];
5. Establishing cross-sectoral capacity at national and local levels to implement, manage and monitor bush control programmes [MAWF];
6. Providing socio-economic incentives for land users to implement bush control measures [GRN, Meat Board, Agribank];
8. Training extension officers and farmers on all aspects of bush encroachment (causes, impacts, bush control measures, after-care programme, environmental implications, biodiversity and ecological/ biological functioning of savannahs) [MAWF with DART, Polytech, UNAM];
9. Establishing and maintaining an information management system on bush encroachment [MAWF, Polytech];



10. Establishing an institutional framework for implementation, which identifies the responsibilities and functions of key role players [MAWF and key stakeholders];
11. Supporting the emerging wood industry; creating a favourable investment and business climate [MAWF, MTI, MET];
12. Providing policy guidelines for invader bush harvesting as presented in the Draft Bush Management Policy [MAWF, MET];
13. Monitoring and analysing the long-term effects of selected arboricides on non-target plant species, livestock, game, birds, ground and surface water and possible toxic residues [MAWF, Meat Board, wood industry].

Another main objective of the NRMPS is to ensure that the policy environment is consistent and conducive to the implementation of the strategy. It strongly advocates that the Forest Act and the Soil Conservation Act are amended to incorporate issues (including bush thinning) related to “...encroached savannahs that fall outside the definition of forest and classified forest.”

The NRMPS identifies incentives that will encourage farmers to pursue its objectives. However, the strategy states that the development of a sound rangeland management plan and after-care of cleared land should be compulsory before the provision of incentives are considered.

The following incentives (*inter alia*) are advocated to support and encourage the implementation of the NRMS: Direct financial incentives (through subsidizing interest rates, soft-loans for small scale entrepreneurs and food-for-work programmes); the utilisation of problem bushes; ensuring property and resource rights and providing political assurance to freehold farmers regarding security of land ownership; capacity building and training; research; maintaining information management systems; and the agro-economic valuation of farmland.

4.2.11 White Paper on Energy Policy (1998)

This stipulates the following goals for the energy providers: effective governance, security and supply, social upliftment, investment and growth economic competitiveness and efficiency and sustainability. The White Paper emphasizes the development of renewable energy resources, but is silent on the potential of encroacher bush as a generation fuel.

This SEA will suggest adjustments to the Energy Policy to recognise the valuable opportunity posed by bush-to-electricity plants.

4.2.12 National Industrial Policy (2012)

The Industrial Policy outlines Namibia’s hopes for industrialization, linked closely to the aims of Vision 2030. The objective is primarily job creation, and it notes that Namibia is still beset with a high Gini Coefficient (indicating large inequalities in income distribution) and that the country is still vulnerable to outside economic shocks due to our reliance on primary industries.

The policy is not clear on how industrialization will be achieved, but the following points are relevant to value-adding from bush encroachment:



- The Government recognises its role in stimulating development of local industries with potential;
- Namibia will provide a conducive investment environment for industries;
- The SME sector must be made more robust, which can be assisted by providing training for entrepreneurs;
- The Government recognises the importance of innovation, and the need for more research and development. The fields of resource efficiency, energy and land management are noted as needing attention.

These policy directives would support the growth of value-adding industries from bush, but require targeted implementation.

Namibia's execution strategy for Industrialisation is called 'Growth at Home' (MTI 2013). There are three strategic intervention areas:

- Supporting value addition, upgrading and diversification for sustained growth.
- Securing market access at home and abroad; and
- Improving the investment climate and conditions.

4.3 International Conventions and Treaties

Namibia is a signatory to a number of international treaties and conventions.

The **Convention on Biological Diversity** (1992) has the objectives:

- The conservation of biological diversity,
- The sustainable use of biological resources, and
- The fair and equitable sharing of benefits arising from the use of genetic resources.

The object of the **United Nations Framework Convention on Climate Change (1992)** is to achieve stabilization of greenhouse gas concentrations and carbon emissions to a level that would prevent dangerous human induced climate change... to ensure that food production is not threatened... and to enable economic development to proceed in a sustainable way.

Large areas of Namibian bush encroached rangeland are currently reducing the country's net carbon emissions. If industrial-scale systematic harvesting takes off, carbon sequestration will be reduced and soil emissions will likely increase. This could negatively affect the price of the biomass fuel feedstock on international markets (von Oertzen 2014).

4.4 Institutions

4.4.1 Ministry of Agriculture, Water and Forestry (MAWF)

This ministry is obviously concerned with rangelands as the resource base for the livestock industry. The main directorates involved in addressing bush encroachment are Forestry (below) and the Directorate of Agricultural Research and Development. The need for training in bush harvesting methods and bush control, as well as monitoring of bush harvesting activities, should also involve the Directorate of Agricultural Production, Extension and Engineering Services (DAPEES).

4.4.2 Directorate of Forestry (DoF)

In strict terms, this directorate is concerned with forest issues, which some stakeholders feel does not cover savanna and the issues around bush encroachment. However, DoF is directly involved in managing the utilisation of encroacher bush, through its control of permits for wood harvesting (e.g. for firewood, charcoal).

It is reported (DRFN 2015) that the Directorate of Forestry strongly supports the use of biomass for energy in future, provided that this happens in the framework of environmental principles. DoF is positioning itself by:

- Training officials within DoF and DEES in offering advisory services and exerting control over bush harvesting;
- Making budgetary provision (for vehicles, operational costs) for providing support and extension services;
- Changing the perception from bush as a forestry problem to a problem that must be addressed by the livestock sector.

4.4.3 Directorate of Environmental Affairs (DEA)

The DEA, within the Ministry of Environment and Tourism, administers the Environmental Management Act. Under this Act, an Environmental Clearance Certificate is necessary for all commercial wood-harvesting operations.

4.4.4 Ministry of Industrialisation, Trade and SME Development (MITSD)

This ministry compiled the Industrial Policy, and will be involved in supporting the emerging wood industry by creating a favourable investment and business climate.

4.4.5 Ministry of Mines and Energy (MME)

Power fuelled by encroacher bush is emerging as a likely future scenario, and has electricity generation characteristics similar to traditional coal-fired power plants. Bush-to-electricity plants could serve as base load and peak generators, with the advantage that they could be fired at times to suit demand or to complement other intermittent sources such as solar.

The MME's Directorate of Energy administers the Electricity Act, and addresses regulations and research around new and renewable sources of energy.

4.4.6 Electricity Control Board (ECB)

The ECB is the official body that grants electricity generation licences, so will be involved in administering this process. Together with MME, it will create incentives to promote renewable energy feed-in to the national grid.

4.4.7 NamPower and Regional Electricity Distributors

Although the CBEND pilot bush-to-electricity plant was never commissioned, there is renewed serious interest in similar projects. The organisations involved are NamPower, the Regional Electricity Distributor companies (e.g. Cenored), and companies that would set up as Independent Power Producers (IPPs) to them.



4.4.8 Farmers Unions

The Namibian Agricultural Union, through the Rangeland Management Policy and Strategy, is driving the establishment of the Rangeland Management Forum. Equally involved are the Namibia National Farmers Union (NNFU) and the Namibia Emerging Commercial Farmers Union (NECFU).

A sub-group of the NAU, the Charcoal Producers Association, addresses the interests of those farmers and workers involved in the charcoal industry.

4.4.9 Forestry Stewardship Council

In order to sell charcoal in Europe, certification from the Forestry Stewardship Council (FSC) is required. Requirements pertain to economic, social and environmental sustainability, and there is occasional monitoring of compliance by FSC officials.

Although some charcoal producers complain that the FSC certification conditions are difficult to meet (NPC 2009), certification is seen as very helpful by others, as it helps to secure a higher price for the charcoal in overseas markets.



5 IMPACT ASSESSMENT

5.1 Negative impacts of bush encroachment

For the following reasons, bush encroachment is one of the most serious and costly forms of habitat degradation in Namibia.

5.1.1 Socio-economic Impacts

- Heavily encroached areas are characterized by denuded, bare soils with a sparse annual grass cover and few or no perennial grasses. In heavily infested areas (4,000 bushes/ha+), livestock carrying capacity is drastically reduced and meat production losses of as much as 300% are commonly experienced. The resulting economic loss (at 2009 beef prices) was more than N\$1.2 billion (CCA 2010).
- The economic losses to farmers inevitably results in reduced labour opportunities on farms, the beef industry downstream, reduced beef exports, and reduced tax revenue to the Government (CCA 2010). In Namibia as a whole, approximately 6,283 commercial farmers with about 35,000 workers are dependent on livestock farming in the bush-affected areas. The average number of dependents per household is 4.03, so the total number of dependents on commercial farms is approximately 140,000 who are potentially affected by the bush encroachment problem (ibid).
- The knock-on effect is a lowered resilience of this sector to the myriad of external factors it constantly faces (price fluctuations, climate variability, diseases, etc.), and pressure on Government finances.

5.1.2 Water balance

- In degraded natural rangelands, three times more water is needed to produce the same amount of grass than veld in a good condition (Snyman and Van Rensburg, 1990, in CCA 2010). Moreover, undesirable bushes (e.g. *Acacia mellifera*) pump out 6 to 8 times more water through evapotranspiration compared with desired bushes and shrubs like *Boscia albitrunca* and *Grewia flava* (Donaldson 1969, in CCA 2010). Woody bush also intercepts much of the rainfall so that it does not reach the ground but evaporates from the leaves and stems again (ibid). Encroacher bush species are also able to intercept a large proportion of the moisture in the upper layers of the soil.
- Bockmühl (2006) found that in the Platveld Aquifer area, in areas with bush densities of 9,000 plants per hectare, bush could absorb all the rainfall from a daily rainfall event of 60mm. Only in daily rainfall events exceeding 60mm did some penetration to groundwater occur (in CCA 2010). However, when bush densities are less than 3,000 plants per hectare, a daily rainfall of only 30mm provides a surplus that is available for groundwater recharge (ibid).
- On certain farms, where bush clearing had been undertaken, Bockmühl found a substantial improvement in groundwater recharge following clearing of bush.

5.1.3 Soils, vegetation & biodiversity

CCA (2010) emphasises the complex interactions between trees, bush and grass in savanna ecosystems, and the importance of maintaining properly functioning rangelands in order to maintain

soil fertility and encourage plant diversity. In a diverse rangeland, grass and woody plants provide significant browse (leaves and pods) for wildlife, and livestock. Also, a mix of vegetation strata provides habitats for a great variety of wildlife, including invertebrates, browsers, grazers, scavengers and predators such as the endangered cheetah.

In nature, diversity almost always leads to greater ecological stability, and ecological stability almost always leads to the optimum delivery of ecosystem services to humankind.

5.2 Positive impacts of bush thinning

Thinning of bush encroachment is clearly needed, and is recognized as a priority in Namibia's agricultural and development policies. The benefits of bush thinning include the following:

- Employment and greater opportunities for income generation in rural areas
- Improvement of rangeland productivity
- Improvement of groundwater resources, reduction of vulnerability to climate change
- Improvement of biodiversity and ecological integrity of savannas
- Training and skills improvement
- Potential boost to the power sector, both in off-grid areas as well as in improving generation capacity over the whole grid
- Power generation from renewables – less demand on non-renewable sources, and less net CO₂ emission (NPC 2009).

5.3 Negative impacts of bush thinning

While it is obvious that bush encroachment is a problem that needs to be controlled, it needs to be recognised that thinning and clearing of bush will itself carry negative impacts. These are described below.

As discussed in Section 3, thinning/clearing of encroacher bush is done by various methods. Obviously, the types and severity of the impacts depend on how the activities are carried out: an operation that clears away all surface vegetation using bulldozers will have very different impacts from manual selective thinning. Nevertheless all potential impacts are considered, with notes on those specific activities that cause severe negative impacts, or habitats where impacts are more likely to be more severe.

5.3.1 Felling of the wrong trees

Description of impact

In any bush harvesting operation, there is a high risk that the desirable (non-encroacher) species will be removed by indiscriminate harvesting, by whatever methods are used - arboricides, mechanical or manual. Aerial application of arboricides kills all woody plants except a few species that are arboricide-tolerant (e.g. *Boscia* species, *Philenoptera nelsii*). Thus desirable trees, such as relatively larger individuals of the encroacher species, and species such as *Acacia erioloba*, get killed. The risk is also high for operations doing manual cutting, as labourers are paid on a weight basis, so they are more inclined to harvest larger and denser trees such as *Acacia erioloba* and *Combretum imberbe* (both protected species). There is already a high level of concern (personal communications from Strohbach 2009, Mannheimer 2010, 2015; Meyer 2015, Rothauge 2015) that charcoal producers are preferentially cutting large trees. Many stakeholder claim that control over bush harvesters is

completely inadequate, and that even when bad practices are reported to Forestry officials, there is very little follow up and prevention.

In some instances, bush clearing is done by simply mowing down all vegetation, with very little attention to sparing any particular trees (see Case study 1). In combination, the dust, heat and crashing vegetation can reduce visibility and/or make the operator careless. This practice goes against the principle of selective thinning, and results in the same impact, namely felling of the wrong trees.

In any harvesting operation, only the encroacher species should be targeted. Particularly large individuals of all species, and all protected species, should not be cut. Trees that are valued for their browse, such as *Boscia albitrunca*, should also not be cut. It is illegal to cut or fell protected species, and to cut trees with a base diameter greater than 18 cm.

The cumulative impact of widespread cutting of valuable and protected trees could be significant. These trees are particularly important for ecological integrity of the savanna, as they provide services such as food, shelter, nesting places for birds and animals, and are more resilient in times of drought than smaller species with less established root systems. They are also important for giving open savanna its aesthetic appeal or sense of place.

Mitigation

- All bush cutters and machine operators must be trained on which trees to target.
- In all bush harvesting operations, there should be supervision of cutters to prevent cutting or felling of non-target trees.
- There should be more frequent inspection of harvesting operations, and stronger monitoring of the permits issued by Forestry officials. This should be complemented with inspections by Environment officials, to ensure that the conditions of the EMP, as stated in the Environmental Clearance, are being met. Monitoring should include assessing the vegetation community of targeted areas before harvesting begins, and then repeating the assessment a few months later. It will become evident over time if there is a decline in the proportion of non-target species.

The de-bushing boom will place a heavy responsibility on the authorities (DoF and DEA) to ensure that cutting and harvesting procedures are carried out properly.

5.3.2 Excess killing of trees

In poorly monitored harvesting operations, it is likely that excess harvesting will occur. 'Excessive' means that the live trees left standing after a bush harvesting operation are less than the standard 'TE-rainfall formula' (see Section 3.1.1 and Appendix B Annex 2). This can occur from a range of bush thinning activities, particularly from aerial application of arboricides and mechanical clearing.

However, it must be noted that bush types are different and cannot be treated as homogeneous. An EMP should specify the guideline harvesting level for every bush-harvesting operation. For example, mopane scrub normally has very low vegetation diversity, and occurs in relatively lower rainfall areas. There is a high risk of soil erosion due to poor grass cover if excessive bush thinning is done.

Terminalia sericea, where it is dominant, is always on deep sand which has little intrinsic soil fertility. Fertility is entirely dependent on the recycling of nutrients associated with organic matter. Bush thinning in this habitat should be at a lower rate than in other less sandy habitats (Strohbach 2015, pers comm.). The bush density after thinning should be $TE / ha = 3X$ annual average rainfall. In an area

with 400 mm rainfall on sandy substrate, TEs still standing after thinning should be roughly 1200 per hectare.

These examples demonstrate that the standard ‘tree-rainfall formula’ should not be applied equally in all habitats. However, it does help to give a rough idea of when harvesting rates are excessive.

5.3.3 Disturbance to wildlife

In many bush-harvesting operations, labourers operate and camp in various places around the farm where the cutting is targeted. The presence of people spending their days and camping in the veld is likely to result in disturbance to animals such as birds, especially raptors. A number of these species, such as white-backed vulture and tawny eagle, are Red Data species. Birds with nests that are close to human activities (including chopping, operation of chain saws and other machinery, and smoke rising from charcoal kilns) are likely to abandon their nests. The nests of raptors are usually placed in large trees, hence the need to avoid cutting these trees.

There is also likely to be greater levels of poaching. Although no mammal species in the bush encroached areas likely to be affected by poaching (such as steenbok, warthog, kudu) are of high conservation priority or significantly threatened by this activity, this will lead to loss of wildlife that many farmers are trying to build up for hunting and/or ecotourism purposes. Other species, such as tortoises and leguaans, are conservation priorities.

Accidental fires are another consequence of bush harvesting activities. These not only interfere with a farmer’s rangeland management practices, they also disturb wildlife and kill animals such as tortoises.

The impacts of disturbance, multiplied many times through widespread de-bushing operations, could cause the decline of wildlife populations and loss of revenue from conservancies and game and hunting farms.

Mitigation

- The Environmental Management Plan should identify and define sensitive areas in the harvesting area, and exclude them from the harvesting plan. Localized areas with relatively dense concentrations of birds nests – such as along an ephemeral river with larger trees containing nests of vultures – should be excluded from harvesting activities. An attentive farmer should be aware of these things on his or her land and take care to cause as little disturbance as possible.
- Vigilance by the farmer and/or the person in charge of the harvesting teams is necessary to prevent contraventions of the law. Teams that are left on their own for extended periods are likely to get away with poaching and felling of the wrong trees, while those that are visited and checked frequently will be more readily apprehended and the wrong activities penalized and stopped. It all depends on active, involved management.

5.3.4 Smoke and emissions from charcoal kilns

Charcoal kilns produce smoke, although if they are operated efficiently, this should be very little. The smoke usually disperses quickly in the open air and this is helped by any small breeze. Nevertheless, such incremental amounts all contribute to global climate change. More significant at the local scale, however, is the situation in cold conditions, such as winter nights when the air is still and there is a temperature inversion close to the ground, smoke accumulates close to ground level. This can reach the proportion where it reduces visibility and becomes a health hazard for local people.

Bush value-adding activities, such as energy generation or manufacture of products from wood chips, might also produce significant air emissions.

Mitigation

- Kilns should be operated efficiently, so that there is very little smoke. Kiln operators should be trained in correct packing of the kilns.
- Retort kilns are known to be more efficient in that they produce less smoke. This alternative charcoal-making apparatus should be considered for charcoaling operations.
- Scrubbers should be installed in factory chimneys to minimize air emissions.

5.3.5 Loss of soil fertility

Mechanical clearing with bulldozers and large earth-moving machinery can clear ground cover from the soil and expose the soil to direct sun and wind. Depending on the soil type this can ‘bake’ the surface into a hard crust, and removal of plants and leaf detritus takes away the shade and the source of organic matter. Methods that remove the grass layer are also problematic as the exposure of the soil to harsh sun reduces cyanobacteria, which are important in nutrient cycling in the soil. All of these conditions lose fertility from the soil.



Picture 1: Clearing of bush by bulldozer has left the soil badly disturbed and barren.

Mitigation

There is little that can be done to prevent soil fertility loss, after excessive bush clearing or complete clearing by bulldozers has been done. Rather, these practices should not be carried out in the first place.

5.3.6 Increased encroachment after bush thinning

De-bushing activities often lead to coppicing of trees and subsequent thickening of the bush worse than before i.e. re-infestation. Areas with *Dichrostachys* are particularly badly affected – this species regrows vigorously, because its seeds stay viable for a few years, and regrowth occurs from both stumps and newly germinated seeds. The density of bushes increases hugely. Another risk is the possibility that one encroacher species could become dominant at the expense of another that is thinned out.

If the approach is for bush farming, then regrowth is not seen as a negative impact. It is viewed positively, because the biomass resource is being replaced.

However, a farmer trying to achieve a mixed savanna that will optimise livestock production, groundwater recharge and local biodiversity, will see regrowth as a nuisance that must be kept under control. In this case, follow-up treatment is required.

Mitigation

The approach to after-care needs to be considered for particular species and planned accordingly. For *A.mellifera* it may be sufficient to apply methods such as hand application of herbicides or stem burning. A more aggressive after-care strategy, and perhaps a wider range of methods, will be needed for *Dichrostachys cinerea*. The high concentration of young plants may demand that less labour intensive strategies be used, such as intensive grazing by goats, use of fire after a year or two to kill young seedlings, and other methods to follow. A shorter rotation time for bush harvesting may also be necessary.

Monitoring of bush density in previously harvested areas should form part of the inspection routine of Forestry officials.

5.3.7 Killing of non-target trees and other effects of arboricides

Arboricides are considered to be safe as long as they are applied accurately, according to the label instructions (Honsbein et al 2012). However, discussions with stakeholders showed that “sometimes it is necessary to dose areas higher” (especially for *Dichrostachys* infestations). Also, many farmers have puzzling cases where large trees have died unexpectedly, possibly from receiving a higher dose, or the dose becoming concentrated by processes underground that can’t be explained (2015 personal communications from N. de Klerk, C.Muir).

An additional concern is that the long-term residual effect of arboricides has not been well studied. The adjuvants in the chemical mixture possibly have side effects that we are not yet aware of. Arboricides may differ in the amount of impurities they carry, and it is possible that cheaper brands (which would get used more than other more expensive brands) are more likely to contain impurities that might be harmful. These are some of the potential hazards that underlie arboricide use.

Aerial spraying of arboricides is now a prohibited activity (Forest Act Regulations 2015). Many stakeholder agree that aerial spraying is “too drastic” as it can kill desirable species such as *Boscia* and *Philenoptera*. However some stakeholders were adamant that the prohibition should be relaxed as there are certain situations where only aerial application is possible to clear very dense thickets.

Arboricides applied to stems/leaves by hand have a number of advantages and may provide safer treatment of bush than unselective harvesting methods that are sometimes used.

- Dead bush remains in place until the grass has grown, providing protection from grazing, a bit of shade and wind protection,
- Soil is not disturbed,
- There is little opportunity for other problem bushes (e.g. Vaalbos [*Pechuel-Loeschea leubnitziae*]) to replace the target species,
- The manual work is much easier on the human body than hand cutting, and may be more sustainable for this reason,
- Nutrients and organic matter are returned to the soil as the dead bush decomposes or may be burned during natural fires or managed fires.



Arbicide pellets remain effective for a few years (depending on soil type and probably rainfall), and stay on the surface so are liable to being moved away from where they are placed, mainly by water. This opens the possibility that they kill non-target trees. Pellets are therefore the least desirable mode for applying arbicide.

Mitigation

- Proper calibration of any application equipment, so that dosages are accurately applied.
- Must have strict monitoring and management during application, so that the chemicals are not just ‘thrown down an aardvark hole’ or sold.
- Further research is necessary to calculate minimum dosages that achieve the desired effect.

5.3.8 Safety and health hazards for workers

There are a number of occupational hazards associated with harvesting bush, such as snake bite, accidents with machinery, and after-hour social issues such as risky sexual behavior associated with temporary workers in camps.

Mitigation

There are standard occupational safety measures and practices to reduce the risks to health from the conditions that workers experience. These include training, protective clothing, availability of first aid facilities, and HIV/AIDS awareness-raising. They are described in the generic EMP, Appendix B.

5.3.9 Pollution of soil and water from bush-utilising factories

There are possible negative impacts from processing of wood, such as generation of tars as a waste product of wood gasification for bush-to-energy, and production of brines as an effluent. These have the potential to cause local pollution of soil and water resources. Their severity depends on the details of the processing, which are project-specific.

Mitigation

The design of any bush processing plants must obviously minimize the risks of causing pollution.

5.3.10 Negative impacts of bush farming

There is a fundamental conflict between a bush farming objective (on one hand) and restoring rangelands (on the other hand). Following bush thinning there is a process of ecological succession whereby the composition of the veld gradually changes (e.g. from annual species to perennial grazing grasses). If a site is repeatedly harvested (say every 10 – 15 years) the process of ecological succession will not be able to proceed to a climax state.

The perennial grasses which are the end point of this succession process are essential to optimise grazing, they are generally more nutritious, they protect the soil even in the non-growing season because their roots remain alive, and they create spongy topsoil conditions that allow rainfall to penetrate - thus increasing soil moisture and groundwater recharge while reducing surface runoff. Perennial grasses, because they also provide permanent cover (though partial) even when grazed or burned, they protect the soil thus reducing soil temperature and moisture loss, allowing soil microbes to operate etc.



Moreover, as noted in Section 3.2.7, bush farming is contrary to the objectives of the Forest Act and the Rangeland Management Policy and Strategy. It narrows the provision of ecosystem services to only the harvesting of bush biomass. Most importantly, bush farming will probably not lead to recovery of groundwater levels in rangelands. The aim of bush thinning should be to restore ecosystem health of rangelands, so that the area provides a broad range of ecosystem services on a sustained basis (i.e. groundwater recharge, soil health, habitats for biodiversity, and livestock production).

5.4 Case studies of experiences from bush-harvesting operations

Case study 1: Unselective mechanised clearing, with no after-care.

Farm Sargberg 549 (Ohorongo). S1931127; E1727761

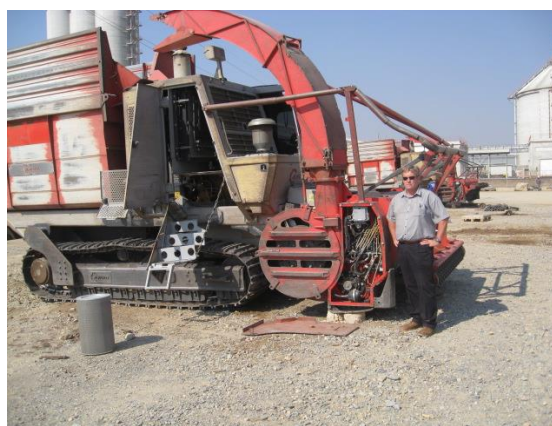
Soil: Loamy turf soils with high clay content (25%).

Topography: Flat

All bushes and trees were mechanically removed in 2012 except for a few *Lonchocarpus nelsii*. Biomass was harvested, chipped and removed to the cement factory. No after-care took place.

This area was heavily re-encroached with mainly *D. cinerea*. Presently there are more than 4,000 stems with an average height of 1,5m. *Catophractus alexandrii* and *A. mellifera* seedlings are also present.

Ohorongo Cement admitted that the non-selective harvesting was wrong. They have switched over to a process where a more balanced ratio of trees and other plants is pursued.



Case study 2: Selective mechanised thinning.

Farm: Sargberg 549 (Ohorongo site 4) S19313245; E17275413

Soils: Loamy soils, 20% clay

In 2014 encroacher species were selectively removed with large machinery. A sound variation of large trees (*Spirostachys Africana*, *Tarconanthus camproratus*, *Combretum imberbe*, *A. reficiens*) were left. Grass cover now good with desired grass species like *Urochloa bolbodes* and *Cenchrus ciliaris* coming back.



Case study 3: Mechanical clearing and arboricides

Farm Phantom 490 (Tinus Pretorius). S2040017; E1635773

Soil: 10 to 15% clay.

Topography: 2% gradient in this camp. Rest of the farm is hilly.

Mechanically de-bushed with front end loader in 2000.

This was followed up with chemical manual treatment (Ustilan – 3 cc per plant) in 2005 and again in 2008 with Meat Board chemical – also 3 cc per plant.

Re-infestation by mainly *D. cinerea* and *A. mellifera* have already been observed. *A. erubescens* also a major problem on this farm.



This farmer's view it that a combination of 'bush farming' and cattle farming is necessary. After clearing, it takes about 10 years before re-growth has reached the same biomass yield of bush per hectare. During this time, excellent grazing is available for roughly the first 7 years.

Alternatively, the treated veld could be used by goats as a form of after-care, to slow down or control re-growth.

5.5 Impacts of value-adding activities

5.5.1 Charcoal production

Charcoal production is being done in the name of thinning encroacher bush, but very often it targets large trees, since this requires less effort per kilogram of wood. A recent trend is that farmers are now using chain-saws to fell trees. This will possibly lead to even more of the large trees being targeted. The DoF regulation states that trees thicker than 18 cm in diameter must not be cut, but enforcement and inspections are so poor that this is widely ignored. Therefore charcoal production is mostly not achieving a bush-thinning purpose, because the dense encroacher bushes are mostly the relatively smaller trees. Furthermore, this is damaging to the ecosystem – large trees are the ones that must preferentially be retained (shade, moisture, nutrient cycling, bird nests and shelter).

Smoke from the kilns/ drums can, under certain conditions such as cold mornings in hilly terrain, become a significant negative factor. This is addressed in Section 5.3.4. Production using the conventional kilns is relatively inefficient, with much of the smaller twigs burning to ash before the larger branches have properly carbonised. This is also a cause of smoke, supports the suggestion in Section 5.3.4 to switch to more efficient kilns, such as retort kilns.

Problems associated with labour on farms, whether thinning for charcoal or large-scale mechanical-harvested products, e.g. poaching, are addressed under disturbance to wildlife, Section 5.3.3

The charcoal industry would benefit from greater adherence to the FSC principles, as this would ensure greater profits for the farmers. The increased income could pay for some of the more thorough management that is required to prevent environmentally harmful practices.

Positive socio-economic impact:

No-one can afford to thin bush without earning some income from the bush (Honsbein & Joubert 2009). Charcoaling offers an easy way to do this – it can be viewed as ‘startup income’ in the first steps of recovery from bush encroachment. Charcoal can be an income, but it is not the solution. It can be supportive in that it makes funds available for after-care.

There are significant positive impacts arising from the income which charcoal workers make. Their income is usually higher than that received by normal farm labourers. Ultimately, bush-thinned farms can be more productive in livestock production, which itself brings wider socio-economic benefits.

5.5.2 Impacts of large-scale mechanised clearing (e.g. for wood chips or electricity)

Most of the products suggested as value-additions from encroacher bush entail mechanized chopping and chipping of the trees. Therefore the different processes for manufacturing, for instance, compressed firewood or animal feed, have a ‘common denominator’ in the first step of wood harvesting. Various impacts can potentially arise from this process, namely:

- Possibility of soil erosion due to machines working on slopes,
- Disturbance to wildlife, especially killing of small slow-moving species such as tortoises, pythons. Also possible disturbance to nesting birds, raptors most vulnerable,
- Possibility of cutting non-target trees where they are mixed up in dense stands of bush and there is dust and noise around the machine,
- Disturbance to the surface soil, with the consequence that regrowth will be vigorous and after-care will be necessary,

- Pollution of soil and water,
- Truck traffic on local, farm roads,
- Construction camp impacts on local communities.

5.6 Cumulative impacts

Ongoing removal of wood results in a long-term overall **loss of nutrients** from the soil, since the nutrients locked up in wood are removed along with the wood (Joubert & Zimmerman 2002). Loss of nitrogen-fixing trees such as the Acacias and Dichrostachys may result in reduction of soil nitrogen levels (Joubert & Zimmerman 2002). It is important to leave the leaves to decompose – this is where the main nutrients are stored in the trees.

Excessive clearing of trees in sandveld areas carries stronger negative impacts than on other soils because the soil, consisting mainly of quartz grains, is naturally relatively less fertile. Much of the organic matter in the soil comes from the trees, and the shade and moisture they provide helps to cycle the nutrients through the ecosystem. Excessive clearing of trees over an extended period would gradually impoverish the soil.

Groundwater recharge will not recover if trees are farmed for their regrowth.



6 CONSIDERATION OF ALTERNATIVES: policies, laws and management

Bush encroachment has been declared a national problem and provision must be made for farmers to do something amidst all the laws, regulations and powers given to government officials. In the preface of the Rangeland Management Policy and Strategy (2012), the Honourable Minister has pointed out that the lives and livelihoods of many people throughout Namibia are threatened by land degradation. In addition to his plea for all stakeholders to rededicate their efforts to implement the Policy and Strategy, there is also a need to align the overall GRN policy environment in order to reverse land degradation and achieve optimum productivity. In the following sub-sections, the SEA provides suggestions on adjustments to policies and legislation for this purpose.

6.1 Policy and law

6.1.1 Long term vision

The over-riding principle in combating bush encroachment, provided by the Forest Act and the NRMPS, and fully supported by this SEA, is the ecological restoration of rangelands. This will lead to enhanced livestock production and the provision of the full range of ecosystem services.

6.1.2 Registration and control over agricultural chemicals

Registration of agricultural chemicals in MAWF is presently dysfunctional, and there is little record of what types and volumes of chemicals are being imported into and used in Namibia. The Fertilisers, Farm Feeds, Agricultural Remedies and Stock Remedies Act of 1947 is outdated and needs to be reviewed and updated to meet current needs.

6.1.3 Finalisation of the Bush Encroachment Policy

Section 4.2.5 of this report calls for finalization of the 2004 Draft Bush Encroachment Policy. This SEA suggests that this should be coupled with the National Rangeland Management Policy and Strategy (NRMPS), since bush encroachment is an integral part of rangeland management.

A holistic management package should be applied to the complete rangeland landscape in a comprehensive manner that considers the interests of the full range of stakeholders and recognises both formal and informal practices, the rule of law and cultural norms. The problem with the NRMPS is that it is advisory in nature and not legally binding. In practice that means compliance is low. For this reason, a statutory body is recommended, to take care of livestock production based on extensive rangeland management, i.e. livestock and game ranching, pastoralism in all its multiple forms, and sustainable rangeland management as expounded under the NRMPS and including comprehensive bush control and wood processing (Rothauge 2016 pers. comm.).

After a period of trial implementation and refinement, the policy needs to be translated into legislation.



6.2 Institutional arrangements

6.2.1 Forestry permitting procedures

DoF exercises control over harvesting of wood for charcoal through its permit system, but it is widely observed that there is inadequate control of wood-cutting activities on the ground. For instance, much of the harvesting for bush actually targets large trees and ignores most of the smaller problem bushes, because large trees provide more wood per effort. There is much illegal cutting of protected species such as *Combretum imberbe* and *Acacia erioloba*, in areas where harvesting occurs.

Harvesting permits are currently issued for 3 months at a time. This needs to be much longer – at least 12 months – so that potential investors feel secure that they will not be jeopardized by the possible withdrawal of a permit. The Environmental Clearances issued under the Environmental Management Act are valid for 3 years, and for the sake of consistency, it would be better to make the DoF permits the same. Inspections by DoF would still need to be done regularly, at least every 3 months.

The Forest Act is unclear about what constitutes ‘forest’ and whether bush encroached land falls under its regulations for harvesting. The situation with regard to aerial spraying of arboricide is also unclear, as it is prohibited in the 2015 Regulations, but it has been publicly announced that exceptions to this law can be made. Thirdly, licence conditions for charcoal producers should be made more practical (w.r.t. the firebreak distance around kilns, and improving the conditions for wood to be identified before it is burned to charcoal). Regulations pertaining to controlled fires should be more practical. Overall, greater clarity and more practical regulations are required in the Act.

Recommendations:

- There is an urgent need for improved law enforcement and policing of wood cutting activities.
- The Directorate of Forestry (in MAWF) and the Directorate of Environmental Affairs (in MET) should align their internal procedures, in particular the validity period of the Forestry Harvesting Permit and the Environmental Clearance Certificate (ECC). It is recommended that the validity period of both the Harvesting Permit and the ECC be validity for three years.
- Procedures should make provision for issuing DoF permits that are subject to the approval and issuing of an ECC (see EMA procedures below). If the Clearance Certificate is obtained, the provisional DoF permit should be aligned to the validity period of the ECC.
- The Forest Act and its Regulations should be revised.
- Supervising wood harvesting would be improved if:
 - all wood harvesting operations were structured so that the harvested wood is delivered to a central receiving station (the “wood market”) before being processed. It would only take one inspector to inspect the central wood market at any time, making the whole operation supervisable and therefore more likely to be within the law and sustainable; or
 - DoF increases the number of GRN or Honorary Forestry officers to inspect bush thinning activities in situ.

Both of these suggestions have management and financial implications, but this SEA strongly recommends that they be considered in order to bring about much needed improvements in monitoring and enforcement of bush thinning and value-adding activities.

6.2.2 Environmental Management Act procedures

Section 4.1.1 stated that it is not clear in the Environmental Management Act where is the cut-off in a bush-harvesting operation, where Environmental Clearance is required. The Forest Act states that any

harvesting in an area greater than 15 hectares requires a permit. The Environmental Management Act, in turn, states that any forestry activity that requires a DoF permit, needs to have Environmental Clearance. This SEA suggests that bush harvesting operations on an area 15-150 ha in size should be governed by a Forestry permit only, and that the Environmental Clearance procedure should be triggered for wood-harvesting activities above 150 ha as recommended below.

Recommendation:

- This SEA recommends that the following thresholds for Environmental Clearance be considered.

Table 3: Categories defined

Environmental Clearance waived	Environmental Clearance required, with customised EMP based on the Generic EMP	Environmental Clearance required, with full independent EIA and EMP
Small bush-harvesting operations, area less than 15 ha per year.	<p>Medium-sized bush harvesting operations, 15 – 5,000 ha per year.</p> <p>The applicant (e.g. farmer) should not be in collaboration with another party that is clearing adjacent land, thereby expanding the area to be thinned beyond 5,000 ha.</p> <p>In accordance with the EMA, an Environmental Clearance is only valid for three years. At the end of three years, the project area should be inspected by DEA and DoF, the EMP updated, and application made for a new Environmental Clearance Certificate.</p>	<p>Large-scale bush harvesting operations, area greater than 5,000 ha per year (e.g. commercial bush-to-energy projects, large-scale manufacture of wood chips).</p> <p>This category includes projects where a number of neighbouring farms, covering more than 5,000 ha in total, contribute bush to a central processing facility.</p> <p>In accordance with the EMA, an Environmental Clearance is only valid for three years. At the end of three years, the project area should be inspected by DEA and DoF, the EMP updated, and application made for a new Environmental Clearance Certificate.</p>

- It is suggested that applicants for Environmental Clearance use the generic EMP (Appendix B) as a template. It needs to be modified by a proponent for the specific details of the site and the operations. With sufficient detail, the EMP would then be used as the basis for issuing of the Environmental Clearance certificate.

The procedure for obtaining the necessary authorisations for a bush harvesting project are summarised below. It is envisaged that a small information booklet on this process will be produced, to make it simple and clear for members of the public.

Table 4: Authorised procedure necessary for bush harvesting project

Step 1	<ul style="list-style-type: none"> ○ Obtain the background information booklet from the Directorate of Forestry (DoF) in the Ministry of Agriculture, Water and Forestry (MAWF) or Department of Environmental Affairs (DEA) in the Ministry of Environment and Tourism (MET). ○ Familiarise yourself with the permitting procedure and the information required for implementing a bush thinning project.
Step 2	<ul style="list-style-type: none"> ○ Complete the DoF application forms for a permit to undertake bush thinning activities:
Step 3	<ul style="list-style-type: none"> ○ When you have the DoF permit, approach the DEA to register your project and apply for an Environmental Clearance Certificate (ECC). <ul style="list-style-type: none"> ➔ Complete the ECC application forms; ➔ Submit the EMP, customized from the generic template provided.
Step 4	<ul style="list-style-type: none"> ○ When you have obtained the DoF permit and DEA ECC, make sure that the project does not require any other permit from other authorities such as Electricity Control Board etc.
Step 5	<ul style="list-style-type: none"> ○ Implement your bush thinning project. ○ Undertake the necessary monitoring as required by the DoF permit and the ECC provisions, and as detailed in the EMP.

To keep the application process smooth and efficient, and to prevent a backlog building up, DoF and DEA should ensure that processing of these applications does not take longer than one month altogether.

6.2.3 FSC guidelines

Forestry Stewardship Council guidelines (Appendix D) should be more vigorously applied. The FSC principles are beneficial to the resource, and FSC accreditation is economically much more profitable, as products can achieve higher prices on the export market.

6.3 Refinement of the occurrence and density of bush encroachment

The national map showing the extent of bush encroachment, and the extent of bush-thinning operations, needs to be refined and updated over time, to keep track of the cumulative impact of the 'de-bushing boom'. We suggest this is done in two stages.

- To provide an accurate assessment of the baseline situation, there should be a survey that includes the tree species, densities and heights of bush, to give a measure of biomass available now. This could be done following a relatively simple and inexpensive method of aerial surveying, and some ground truthing, that has been trialled in small parts of Namibia for applications such as vegetation monitoring and even wildlife censuses (Mendelsohn 2015, pers. comm.). High resolution photographs and modern software allow recognition of individual trees and bushes that can be identified to species and measured, to create an accurate record of the extent, species, density and biomass of bush across the encroached areas of Namibia. Relatively small surveys of this kind have been done for about N\$ 0.5 million, covering about 400,000 ha (Mendelsohn 2015, pers. comm.). Careful sampling and extrapolation could probably cover the whole extent of the bush problem, at least in the northern part of the country, at a price that would be small compared to the large amounts of funding that combating bush has used over the years.



- The second stage could involve ongoing monitoring with various lower-resolution remote-sensing methods to track changes from the baseline. Modern methods of remote sensing, using hyper-spectral imaging and other improvements, could possibly be used but are likely to be very costly. There are cheaper, practical alternatives (Verlinden 2015, pers. comm.). This could possibly be undertaken by MAWF's National Remote Sensing Centre, or non-government bodies such as SASSCAL or private contractors. The information, linked to ground-truthing carried out as part of the Forestry permitting procedures, could help to track the overall extent and status of bush encroachment over time.

6.4 Assessment of the carbon impact of a 'de-bushing boom'

Large-scale wood harvesting to reduce bush encroachment will release a lot of wood-bound carbon back into the atmosphere, affecting Namibia's status as a global carbon sink.

Recommendation:

- An expert calculation should be made of the change in sequestered and atmospheric carbon due to wood harvesting and processing, and of the possible increased carbon sequestration by improved rangelands and increased livestock production.

6.5 Long-term research and monitoring

There is no evidence in the literature that arboricides cause negative impacts on the environment, but the precautionary principle suggests that chemical methods of control should be used with caution. There are examples of other chemicals that were first thought to be harmless, that are now banned in many countries (e.g. glyphosphates in Roundup).

The bush sector would benefit from much more robust, scientifically based research, covering not only arboricides, but also topics such as the effects of levels of bush thinning, fire, livestock pressure, and the influence of substrate and weather on bush thinning practices. These factors are intertwined and difficult to elucidate, therefore long-term, controlled studies are necessary.

Recommendations:

- Long-term research and monitoring of arboricide use should be undertaken. In the immediate term, this should aim for stronger control over the application of arboricides (e.g. quantities, distribution, methods). In the long term, it should seek to clarify the issue of hidden impacts that at this stage are presumed to be absent.
- Research and monitoring should address two different components:
 - i) bush conditions and the response of rangelands to bush thinning activities, and
 - ii) the level of compliance with DoF permits and Environmental Clearance Certificates.
- i) During and after bush harvesting operations, there should be rigorous studies focussing on bush thinning methods and how selected areas are responding to the treatments. It is important that scientifically-based methods are used, which control for the numerous factors affecting bush encroachment. Possibly, post-graduate students could be involved in these studies, which would simultaneously build capacity in Namibia's young professionals. There is also a role here in MAWF's agriculture departments such as Research and Training (DART), and Extension Services (DAPEES).



ii) Secondly, compliance of bush thinning operations with the conditions of the permits and Environmental Clearance certificates needs to be monitored. This should be carried out by the departments which issue these authorisations, namely DoF and DEA.

6.6 Training

There is a strong need for training of all people involved in thinning bush, so that labourers 'at the work-face' understand which trees to target and which to leave, and follow guidelines concerning fire safety.

Training should also be directed towards Government officials, in both the relevant ministries, MAWF and MET. There needs to be stronger inspection capacity in DoF, so that they have the ability to conduct regular inspections, and are able to detect where over-harvesting and harvesting of the wrong species occurs. Practical sampling methods to calculate bush density need to be established and learned. Tell-tale signs of cutting of large trees (thin twigs lying on the ground, large tree stumps left) need to be observed and recorded. The Forestry officers need to be stronger in their 'detective' capacities. This SEA sees a role for Honorary Forestry Officers, namely members of the public who are trained in enforcement of the forestry laws and can support the activities of DoF officials.

MET manages the issuing and monitoring of Environmental Clearance certificates. The DEA office should establish a small core of capacity (like a specialised 'bush unit') with staff who are familiar with bush harvesting and value-adding activities. The processing of Environmental Clearance applications needs to be efficient as well as thorough. Environmental Officers in this 'unit' should be familiar with the DoF permit system and the individual projects that are running at any one time. Projects that are suspected of exceeding their permitted harvesting quotas, should be closely monitored. This Directorate needs to have the teeth to be able to revoke an Environmental Clearance certificate where necessary.



7 CONCLUSIONS

It is obvious that there is a crucial need for widespread selective bush thinning in Namibia. This is publicly and politically recognised, and the policy framework supports the principle of restoring the ecological integrity of rangelands.

The SEA cautions that this may lead to the wrong kind of de-bushing boom, where thinning is interpreted as 'clearing of all bush and trees'. There is also likely to be an upsurge in activities that target the wrong trees, namely large trees, including browser and protected species, that bring the most ecological benefits to rangelands. There is evidence that this is already the case in the charcoal industry. There needs to be much stronger capacity in the government departments responsible for controlling bush harvesting operations, to minimise the negative impacts of de-bushing.

The SEA suggests that a clear step-by-step approach for obtaining authorisations for bush harvesting will streamline the process, and facilitate compliance with the law. Some stakeholders warned against the desirability of compiling a generic EMP, on the basis that bush dynamics are complicated and over-generalising could give the wrong advice. This SEA is aware of that risk, but still recognises enough common ground to guide environmentally sound harvesting, and limit negative impacts from poor practices.

Therefore the most important output of this SEA is the generic EMP, and the process involving the Directorates of Forestry and Environmental Affairs to obtain the necessary authorisations for bush harvesting.

The intention of the generic EMP is to save time and money for farmers and proponents of bush harvesting projects, by avoiding the need for lengthy environmental assessment. But it must still be recognized that the generic EMP will not be able to cover each and every activity and detail for the great array of bush thinning / harvesting operations that are expected to grow in future. Therefore each specific operation will still need to be assessed for the specific bush conditions on site, and for the kind of harvesting and value-adding that will be done.

We trust that the process for obtaining authorisations will be straightforward in the government departments. This will help to clear the path for large-scale selective bush thinning and value-adding projects in Namibia.



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9 APPENDICES

APPENDIX A: STAKEHOLDERS CONSULTED DURING BUSH THINNING SEA

Person		Organisation / Affiliation	Participation / Interest	Contact details
Baggot-Smith	Arthur	Farmer	Interviewee for bush clearing case study	
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Kashandula	Progress	GIZ bush advisor	Windhoek SEA workshop	progress.kashandula@giz.de
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Pretorius	Tinus	Farmer	Interviewee for bush clearing case study	
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Schneider	Mecki	Farmer, NAU rangeland expert	Interviewee for bush clearing case study	



Schrader	Pieter	Farmer	Interviewee for bush clearing case study	
Sikabongo	Freddy	DEA, MET	Environmental clearance procedures	freddy_sikabongo@yahoo.co.uk
Smit	Paul	Farmer	Interviewee for bush clearing case study	
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Van Eck		Farmer	Interviewee for bush clearing case study	
Van Zyl	N	Farm Magdalena, farmer	Otjiwarongo SEA workshop	nicolaashunter@hotmail.com
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Venter	Willem	Namwater	Windhoek SEA workshop	venterw@namwater.com.na
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von Bach	Helmke	Kamanjab Boerevereniging	Otjiwarongo SEA workshop	svonbach@iway.na
Zenzi	Peter	Farmer	Interviewee for bush clearing case study	
Zimmerman	Ibo	Polytechnic lecturer, bush expert	Windhoek SEA workshop	izimmermann@polytechnic.edu.na



APPENDIX B: GENERIC ENVIRONMENTAL MANAGEMENT PLAN FOR BUSH THINNING PROJECTS

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PROJECT AND PROPONENT PARTICULARS

1. NAME OF FARM(S) / LAND WHERE PROJECT IS LOCATED

.....

2. LEGAL STATUS OF THE LAND:

3. DESCRIPTION OF CURRENT USE OF THE FARM, INCLUDING LIVESTOCK NUMBERS, WATERS, CAMPS, ETC.

.....

.....

4. NAME AND CONTACT DETAILS OF FARMER / LAND CUSTODIAN / MANAGER

.....

5. NAME AND CONTACT DETAILS OF IMMEDIATE NEIGHBOURING FARMERS / LAND CUSTODIANS / MANAGERS

.....

6. DESCRIPTION OF THE GENERAL ECOLOGY OF THE FARM / LAND (topography, soil type, flora, fauna)

.....

.....

.....

7. DESCRIPTION OF THE BUSH ENCROACHMENT PROBLEM ON THE FARM / LAND (tree species, densities)

a) List the tree species that are causing the problem:

.....

.....

b) Provide at least three density counts/estimates for the area to be thinned. The sample areas for which counts/estimates are provided, should be representative of the overall problem, and if possible,



they should be the same places that are depicted in photo's 2, 3 and 4 (see photo requirements later on in this form)

- Area 1 density count: trees per hectare
- Area 2 density count: trees per hectare
- Area 3 density count: trees per hectare

8. DESCRIPTION OF PAST EFFORTS TO MANAGE THE BUSH ENCROACHMENT PROBLEM ON THE FARM / LAND

.....

.....

.....

.....

9. DESCRIPTION OF THE PROPOSED BUSH THINNING PROJECT

.....

.....

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9.1. EXPECTED DURATION OF THE PROJECT (years)

9.2. SPECIES TO BE THINNED

9.3. ROUGH DENSITY OF TREES TO REMAIN AFTER THINNING

.....

9.4. SIZE OF AREA TO BE THINNED (hectares)

.....

9.5. METHODS OF BUSH THINNING TO BE USED

.....

.....
9.6. EQUIPMENT / MACHINERY / CHEMICALS TO BE USED.....

.....
9.7. NUMBER OF STAFF TO BE EMPLOYED

9.8. HOW STAFF WILL BE RECRUITED

9.9. WHERE STAFF WILL LIVE

9.10. WHAT CONTRACTUAL ARRANGEMENTS WILL BE MADE WITH STAFF

10. DESCRIPTION OF THE BUSH VALUE-ADDING PROJECT

10.1. EXPECTED DURATION OF THE PROJECT (years).....

10.2. PRODUCTS TO BE PRODUCED (description, quantity, etc.)

.....
10.3. SIZE OF AREA WHERE VALUE ADDING PROJECT WILL BE LOCATED ..

10.4. METHODS OF PRODUCTION TO BE USED

.....
10.5. EQUIPMENT TO BE USED



.....
.....

10.6. NUMBER OF STAFF TO BE EMPLOYED

10.7. HOW WILL STAFF BE RECRUITED

.....
.....

10.8. WHERE WILL STAFF LIVE

.....

10.9. WHAT CONTRACTUAL ARRANGEMENTS WILL BE MADE WITH STAFF

.....
.....

10.10. WHAT LIQUID OR SOLID WASTE WILL BE GENERATED (QUANTITY AND TYPE)

.....
.....

10.11. WHERE WILL THE WASTE BE DISPOSED

.....

10.12. HOW MUCH WATER WILL BE USED

10.13. WHERE WILL THE WATER COME FROM

.....

10.14. WHAT AIR EMISSIONS WILL BE GENERATED

.....
.....



10.15. *HOW WILL THE PRODUCT BE TAKEN TO MARKET*

10.16. *WHO AND WHERE IS THE MARKET*

.....
.....

ANY OTHER INFORMATION THAT FURTHER DESCRIBES THE PROJECT(S)

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IMAGES AND MAPS (proponent must provide these)

PHOTO 1: FARM MAP (can be GoogleEarth image showing farm boundaries)

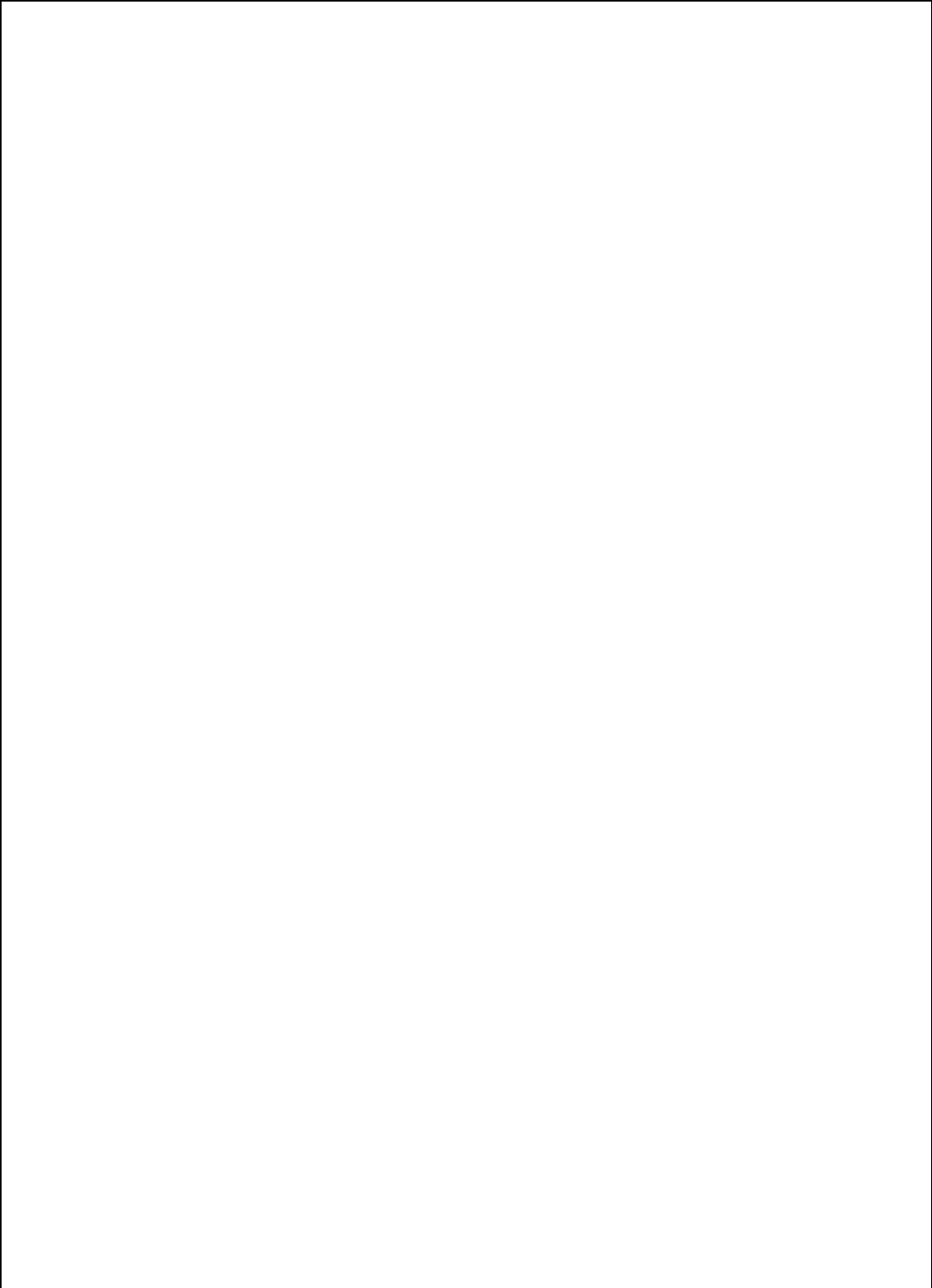


PHOTO 2: BUSH ENCROACHED AREAS⁵

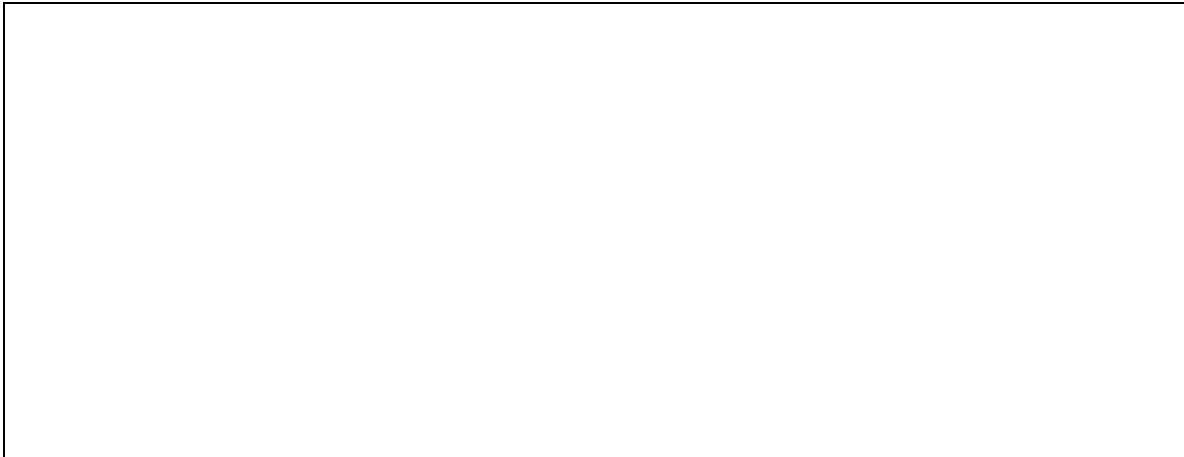


PHOTO 3: BUSH ENCROACHED AREAS

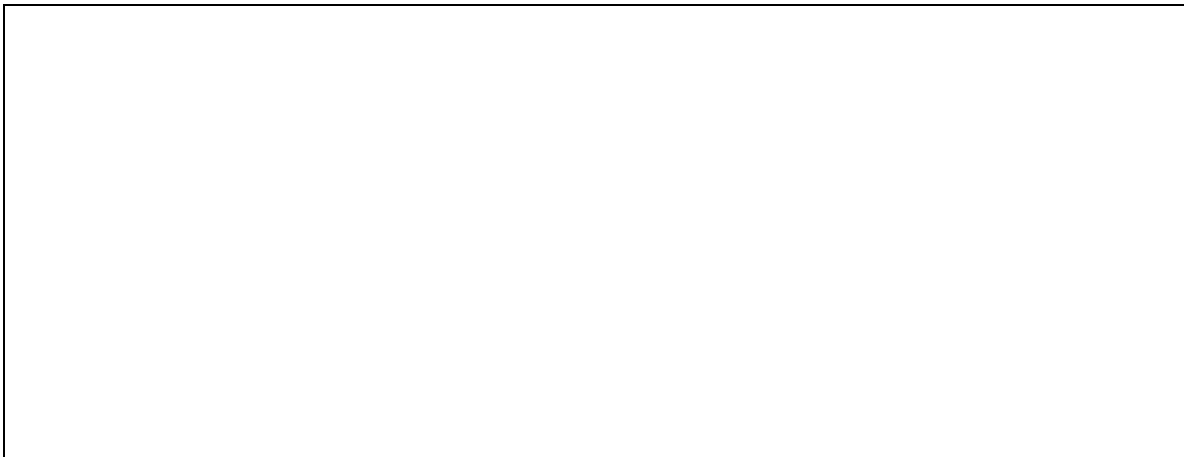


PHOTO 4: BUSH ENCROACHED AREAS



⁵ Please ensure that the place where you take these photos, corresponds with the place where the 3 tree density estimates were made (see section 7 of this form)



THE PURPOSE OF A GENERIC EMP

According to the Environmental Management Act and the Forestry Act, an Environmental Clearance Certificate is needed by a person wishing to undertake a bush clearing and/or a commercial bush value-addition project.

Normally, an Environmental Impact Assessment (EIA) has to be completed, together with an Environmental Management Plan (EMP). The EMP is a plan of how the proponent (the project implementer) will reduce or avoid the negative impacts identified in the EIA. The Environmental Commissioner in the Ministry of Environment and Tourism (MET) will assess the EIA report and EMP to make sure that the negative impacts are minimised. If s/he is satisfied, an Environmental Clearance Certificate is issued. The certificate usually requires the project proponent to diligently implement the EMP. For large projects that are likely to have extensive, complex and/or long-term environmental impacts, it will be unwise to 'short cut' the EIA process. But for smaller projects (e.g. a farm or cluster of farms in the same area, running a medium-sized bush thinning project), the proponent(s) only needs to modify the attached Generic EMP, and submit that to the DEA with the application for Environmental Clearance.

The Generic EMP deals with most of the impacts that need to be managed, irrespective of where the project is located. However, no two farms or projects are identical, so this Generic EMP must be customised for each and every project. The proponent must study the generic EMP, delete those actions that are not relevant to his/her project/site, modify those actions that need fine-tuning, or even add new actions that are relevant. It is not acceptable to just adopt this Generic EMP as it stands.

This EMP considers a range of issues, clustered under suitable headings for ease of reference. The issues are not listed in order of priority – they are all important.



HEALTH AND SAFETY				
Impact description	Generic mitigation measure	Project specific additional measures	Responsibility	Indicators
HIV/AIDS infection due to risky sexual behaviour	<ul style="list-style-type: none"> • Provide awareness information to workers • Do not allow visitors to the project area • Provide free condoms • Provide recreation facilities (games/TV etc.) 	None obvious, but the proponent must consider modifications to the generic mitigation measures	The person/company that has the permit from DoF is responsible for implementing. S/he must ensure that all sub-contractors implement the EMP. VERY IMPORTANT – the proponent must provide the names and contact numbers of the persons responsible	<ul style="list-style-type: none"> • Evidence of a training event, • written instructions regarding visitors, • facilities visible
Bites / stings from snakes, scorpions and insects	<ul style="list-style-type: none"> • Staff may not to catch or kill snakes or scorpions – back away. • Staff must wear protective glasses, gloves, closed shoes, hard hat and overalls while working. • A first aid kit, which includes an aspivenom pump, must be accessible for all staff. • Accommodation / eating areas kept clean at all times, garbage placed in closed containers to avoid attracting vermin, insects. • All staff must be informed in writing about the consequences of breaking these rules, and it must be clear that the rules are understood. 	As above	The person/company that has the permit from DoF is responsible for implementing. S/he must ensure that all sub-contractors implement the EMP.	<ul style="list-style-type: none"> • Evidence of a first aid training event, • written instructions regarding non-handling of wildlife, • First aid kits accessible • facilities clean • protective gear being worn.
Harm to face, eyes, skin and other parts of the body from thorns, dust, etc	<ul style="list-style-type: none"> • Staff must wear protective glasses, gloves, closed shoes, hard hat and overalls while working. 	As above	The person/company that has the permit from DoF is responsible for implementing. S/he must ensure that all sub-contractors implement the EMP.	<ul style="list-style-type: none"> • Protective gear being worn.
Loss of life/injury from traffic accidents	<ul style="list-style-type: none"> • Vehicles roadworthy and properly maintained. • Drivers comply with all Roads Ordinances, including avoiding overloading, speeding, safety belts, yellow line driving. • Vehicles travel with lights on whether using tar or gravel roads. • No driving at night. • No conveying of hitch-hikers or non-project staff • Instruction in road safety must be given and repeated periodically amongst all drivers. 	As above	The person/company that has the permit from DoF is responsible for implementing. S/he must ensure that all sub-contractors implement the EMP.	<ul style="list-style-type: none"> • Vehicles roadworthy • Zero traffic fines or accidents • Evidence of drivers receiving instruction/ training in road safety. • All drivers licensed

	<ul style="list-style-type: none"> All staff must be informed in writing about the consequences of breaking these rules, and it must be clear that the rules are understood. 			
Loss of life/injury from machinery accidents	<ul style="list-style-type: none"> Machines properly maintained. Operators know and comply with machine instruction manuals. Instruction in machine operating safety must be given periodically to operators. 	As above	The person/company that has the permit from DoF is responsible for implementing. S/he must ensure that all sub-contractors implement the EMP.	<ul style="list-style-type: none"> Machines well maintained Zero machine-related accidents Evidence of operators receiving instruction/training in operating safety.
Loss of life/injury from fire accidents	<ul style="list-style-type: none"> Fire-fighting equipment (rubber beaters and/or backpack spray) must be accessible at key points during controlled burning. Deploy beaters/backpack spray immediately when a fire starts A fire cart must be available at each work station with water supply and pumps to deal with fire. Regular training for site staff on fire prevention and control, especially in the dry season. If a fire starts, notify the farm owner/ manager immediately. Open fires only permitted in a designated facility at the site camp. Campfire must be extinguished when staff go to bed, or leave the camp. No cigarette butts, matches or any other burning object may be thrown into the veld. An area of at least 3 metres must be cleared of grass around active charcoal kilns. Combustible refuse must be burnt in a drum. An area of 3 metres must be cleared of grass around such a drum. The drum may not be left unattended until the fire is extinguished and a lid has been placed on the drum. 	As above	The person/company that has the permit from DoF is responsible for implementing. S/he must ensure that all sub-contractors implement the EMP.	<ul style="list-style-type: none"> No fire incidents Evidence of a fire-fighting training event, Written instructions regarding fire prevention, Fire-fighting equipment available at base camp, on vehicles and at charcoal kilns. Suitable drum available for combustible refuse, and located in cleared area. Suitable cleared area designated for campfire at base camp.



	<ul style="list-style-type: none">• All staff must be informed in writing about the consequences of breaking these rules, and it must be clear that the rules are understood.			
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DISTURBANCE OF WILDLIFE AND LIVESTOCK

Impact description	Generic mitigation measure	Area specific additional/ alternative measures	Responsibility	Indicators
Loss of wildlife and livestock from poaching	<ul style="list-style-type: none"> • Killing of wildlife and setting of snares is prohibited. Anyone caught involved in such activities will be fired immediately. • Possession of a firearm or snare is prohibited. Such items will be confiscated if detected, and the offender issued a warning. • All staff must be informed in writing about the consequences of breaking these rules, and it must be clear that the rules are understood. 	As above	The person/company that has the permit from DoF is responsible for implementing. S/he must ensure that all sub-contractors implement the EMP.	<ul style="list-style-type: none"> • No snares present in the camp or veld • No firearms on site • No incidences of poaching
Escape of wildlife and livestock due to fences damages/ gates left open	<ul style="list-style-type: none"> • Fences may not be damaged and gates may not be left open. • All staff must be informed in writing about the consequences of breaking these rules, and it must be clear that the rules are understood. 	As above	The person/company that has the permit from DoF is responsible for implementing. S/he must ensure that all sub-contractors implement the EMP.	No wildlife or livestock escape from the property due to fences damages/ gates left open by project staff.
Loss of wildlife/ livestock because of fires	<ul style="list-style-type: none"> • See section on fires in “Health and Safety”. 	As above	The person/company that has the permit from DoF is responsible for implementing. S/he must ensure that all sub-contractors implement the EMP	See section on fires in “Health and Safety”
Disturbance of sensitive animal species	<ul style="list-style-type: none"> • Permanent nests of large raptors such as eagles or vultures, must be avoided by at least 100m. • Some reptiles such as tortoises and pythons move very slowly when cold. Site staff, drivers, and the machine guide in particular, shall look out for any slow moving animals and avoid causing any harm to such animals. 	As above		



DAMAGE TO PLANTS AND RANGELANDS⁶ (other than those being legally harvested)				
Impact description	Generic mitigation measure	Area specific additional/ alternative measures	Responsibility	Indicators
Loss of protected tree species	<ul style="list-style-type: none"> • Avoid cutting protected trees, whether large or small ones. Many of the protected species are frequently found amongst dense encroacher bush, so they are at risk of being destroyed by bush management practices e.g. harvesting machines, arboricides, and even hand labour, if not adequately supervised. • Protected trees must be marked (e.g. with hazard tape) and all staff must know that marked trees are out of bounds. • Trees protected under the Forest Act are listed in Annex 1. • All staff must be informed in writing about the consequences of breaking this rule, and it must be clear that the rule is understood. 	As above	The person/company that has the permit from DoF is responsible for implementing. S/he must ensure that all sub-contractors implement the EMP.	<ul style="list-style-type: none"> • No protected trees are cut •
Disturbance of sensitive plant habitats	<p>With the exception of prosopis and black wattle, there must be no bush/tree cutting in broadleaved woodlands and other sensitive habitats including:</p> <ul style="list-style-type: none"> • <i>Kirkia acuminata</i> – <i>Danthoniopsis dinteri</i> woodlands in the Otavi Mountains. • <i>Spirostachys africana</i> - <i>Terminalia prunioides</i> thickets/woodlands occurring often on footslopes or plains. • <i>Olea europea</i> subsp. <i>africana</i> – <i>Euclea undulata</i> thickets. • <i>Terminalia sericea</i> – <i>Acacia fleckii</i> thickets occurring on remnants of sand dunes within the karstveld. • All plant communities within 100m of a fountain or spring. These habitats often include uncommon wetland trees. • <i>Acacia erioloba</i> – <i>Tylosema esculentum</i> habitats, and all stands of <i>Acacia erioloba</i> trees. • Palmveld (<i>Hyphaene petersiana</i>). 	As above	The person/company that has the permit from DoF is responsible for implementing. S/he must ensure that all sub-contractors implement the EMP.	No bush/tree cutting in such areas, with the exception of black wattle and prosopis
Ecological imbalance due to over-harvesting	<ul style="list-style-type: none"> • In order to maintain soil fertility and provide habitat and browse for wildlife and birds, the following measures shall be carried out within each and every target area: <ul style="list-style-type: none"> ○ Leave bush clumps (or 'islands') totalling 	Modify this component of the EMP considerably for the specific habitat in the	The person/company that has the permit from DoF is responsible for	Correct level of harvesting, adequate numbers of trees, and islands, remain.

⁶ With acknowledgments to Colin Christian and Associates 2010



	<p>at least 10% of the target area.</p> <ul style="list-style-type: none"> ○ If any slopes with gradients of 5 – 12.5% are included in the target area, then the islands must be increased to 20% on those slopes. ● Within areas that are cut, all large trees (over 4m tall), including dead trees, shall be retained. The only exception is if the vegetation consists entirely of encroachers that are all over 4m. In that case, leave 300 - 500 per hectare in any case. ● The TE – rainfall formula includes all sizes and species, including Protected species. The result a year after cutting should be grasslands with many large trees providing shade in a park-like landscape, with some islands of bush as mentioned above. ● In addition to small bush islands, also leave at least one large area exceeding 1 ha as a representative sample of the original habitat. ● All ‘islands’ envisaged above should include browser species of bush, Protected species of trees, and even encroacher species as they also have benefits for soil fertility. Browser species are listed in Annex 3. ● Seek to create an environment with a matrix of grass, large trees and bush. 	project area.	implementing. S/he must ensure that all sub-contractors implement the EMP	Area has a “park-land” appearance after bush thinning.
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SOIL EROSION				
Impact description	Generic mitigation measure	Area specific additional/ alternative measures	Responsibility	Indicators
Loss of topsoil as a result of bush thinning.	<ul style="list-style-type: none"> No bush cutting permitted on slopes steeper than 12.5% gradient (i.e. 1 in 8). Bush cutting is also not recommended on slopes of 5 - 12.5% (i.e. between 1 in 20 and 1 in 8). On all slopes of 5 – 12.5 %, machinery should move approximately along the contours (not up and down slopes). If such slopes are significantly bush encroached it is recommended that they be set aside as part of the 50% of bush encroached areas per farm that will not be cut even in the medium to long term. Sandy and silty soils are prone to erosion and loss of soil fertility following bush cutting. Where <i>Terminalia sericea</i> is dominant it is an indicator of deep sand. All sites where this species is dominant should be harvested at the TE – rainfall formula for woodland i.e. TE per hectare = 3 x rainfall. 	Modify this component of the EMP for the specific conditions on the site.	The person/company that has the permit from DoF is responsible for implementing. S/he must ensure that all sub-contractors implement the EMP.	<ul style="list-style-type: none"> No bush thinning in steep areas Bush cutting by machines must be done along the contour.
Erosion or destabilisation of river banks as a result of bush thinning	<ul style="list-style-type: none"> No bush cutting permitted within 100 metres of a watercourse (see Forest Act). This includes small watercourses and ‘blind valleys’ found in karst areas, and also springs. Two exceptions only are permissible <ul style="list-style-type: none"> where bush has encroached into ephemeral (seasonal) pans – it is acceptable to clear the bush within the floor of the pan but not around the outside margins. Prosopis and black wattle may be removed from within a watercourse and from the riverbank. 	<p>Modify this component of the EMP considerably if the project envisages removing prosopis or black wattle.</p> <p>Also modify the EMP if the land has no watercourses, or if they are significantly different to those described in column 2.</p>	As above	Apart for the exceptions of black wattle and prosopis, no tree cutting in riverbeds, riverbanks or within 100 metres thereof.

POLLUTION OF GROUNDWATER				
Impact description	Generic mitigation measure	Area specific additional/ alternative measures	Responsibility	Indicators
<p>Pollution of soil and water from waste products (e.g. tars, ash, brine) generated in bush-to-energy plants or factories for wood products</p>	<p>Where appropriate, the waste should be re-used. E.g. i) ash should be redistributed in the harvested areas, so that nutrients are returned to the soil. ii) Some of the tars produced in a wood gasifier, might be re-useable as fuel in the plant.</p> <p>Where re-use is not feasible, appropriate disposal must be considered e.g. in a site equipped for hazardous waste disposal, with measures to prevent seepage into soil and groundwater.</p> <p>Brine and contaminated water should be collected and stored in sealed evaporation ponds. The residue should be regularly scraped up and disposed of in an appropriate site.</p>	<p>Modify this component of the EMP for the specific conditions and wastes generated on site.</p>	<p>The person/company that has the Environmental Clearance is responsible for implementing.</p> <p>Composition of effluents should be specified by the proponent, and measures for safe disposal put in place.</p> <p>Water quality inspectors from MAWF and/or MoHSS need to exercise control over disposal of effluents.</p>	<ul style="list-style-type: none"> • Sporadic sampling of local soil and water, to test for contaminants. •
<p>Small-scale, local pollution patches caused by spillages and servicing of machinery used in bush harvesting operations. (e.g. fuels, oils, greases)</p>	<p>Regular maintenance and servicing of vehicles and machinery, to prevent breakdowns and the need for on-site repairs.</p>	<p>Modify this component of the EMP for the specific conditions and wastes generated on site.</p>	<p>The person/company that has the Environmental Clearance is responsible for implementing.</p>	<ul style="list-style-type: none"> • Sporadic sampling of local soil and water, to test for contaminants.

POLLUTION OF AIR				
Impact description	Generic mitigation measure	Area specific additional/ alternative measures	Responsibility	Indicators
Smoke given off from charcoal kilns can, under certain conditions, accumulate to harmful levels.	Training and supervision of charcoal producers can improve the efficiency of the process, so less smoke is produced. Retort kilns, operated efficiently, produce almost no smoke.	Modify / adapt where appropriate.	Charcoal producer.	Complaints from neighbours / local people.
Wood utilisation factories may generate air pollution e.g. smoke, soot.	Air emission control measures e.g. scrubbers installed in chimneys	Modify / adapt where appropriate.	Proponent is responsible for minimising air emissions.	Complaints from neighbours / local people.



PREVENTION OF REGROWTH THROUGH AFTERCARE				
Impact description	Generic mitigation measure	Area specific additional/ alternative measures	Responsibility	Indicators
The original encroacher species, or more aggressive colonizers, will quickly establish themselves in the thinned-out areas.	Preventing bush regrowth following harvesting can be achieved through: <ul style="list-style-type: none"> • Hand application of arboricides, • mechanical removal of problematic single plants • stem burning, • judicious use of fire, and • intensive browsing by goats or antelope, especially when regrown plants are still small. 	There are no formulas or recipes for ideal aftercare – trial and error learning from neighbours, is essential, as is regular and meticulous monitoring.	Farmer/land owner/land custodian	Thinned areas remain at the required tree density, or within defined limits of acceptable change (see appendix 2).
Aftercare burning and/or stem burning generates air pollution e.g. smoke, soot, and fires may “get away”, threatening other rangeland and neighbours.	<ul style="list-style-type: none"> • No burning when the day temperature exceeds 25°C or wind exceeds 20 kph or in combination thereof during the months of April to July. • Notify neighbours a day or two before the controlled burning. • Remove livestock from the area prior to burning. • Ensure there are escape routes for larger forms of wildlife so that they do not succumb to the fire. • Avoid burning in areas where there are active nests of endangered bird species (e.g. vultures, eagles) – wait until chicks have fledged. • Fire-fighting equipment (fire-cart, rubber beaters and/or backpack spray) must be accessible and in working condition. • Prepare firebreaks that are at least 3 metres wide, around the area on 3 sides, prior to the controlled burn, or define an area bordered by roads which are wide enough to prevent a fire “jumping”. • Monitor the area after the burn is over, in case a smouldering coal or dung is blown into an unburnt area. 	Fires need careful planning. Each burn must take into account the weather, available fuel, the purpose of the fire (hot or cool fire?), neighbour rights and needs.	Farmer/land owner/land custodian	Fire is fit for purpose and it is contained as planned.



<p>Illness to workers through exposure to chemicals</p>	<ul style="list-style-type: none"> • Staff must wear the necessary protective gear while working with chemicals. • Staff must know and comply with instruction manuals for the particular chemical. • Instruction in chemical application must be given periodically to staff. 	<p>None obvious</p>	<p>Farmer/land owner/land custodian</p>	<p>No injury to workers.</p>
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MONITORING

Monitoring after bush-thinning is essential, and is the responsibility of the landowner/custodian.

Since bush thinning is expected to improve the ecological integrity of rangelands, there should be indicators to monitor this. However, it is difficult to specify indicators that can be directly linked to rangeland improvement through bush thinning in a particular area. Other more general indicators of ecosystem health, such as population status of predators (e.g. birds of prey) are more easily achieved and are also more useful for land managers who are concerned with the overall health of the ecosystem.

From a farmers perspective, a sustainable increase in the amount of livestock and game utilising in the camp/area would be a useful indicator.

For example:

	When area was encroached	Year 1 after bush thinning	Year 2	Etc....
Cattle				
Goats				
Kudu				
Etc....				

Also, the actual density of bush in a camp/area needs to be monitored, so that the farmer/land custodian can track the effectiveness of the operation. A simple template for this is as follows:

	When area was encroached	Year 1 after bush thinning	Year 2	Etc....
Invader species 1	X no. per ha	X no. per ha	X no. per ha	X no. per ha
Invader species 2	X no. per ha	X no. per ha	X no. per ha	X no. per ha
Etc....	X no. per ha	X no. per ha	X no. per ha	X no. per ha

Another good indicator could be borehole yields – see below:

	When area was encroached	Year 1 after bush thinning	Year 2	Etc....
Borehole 1	Litres per hour	Litres per hour	Litres per hour	Litres per hour
Borehole 2	Litres per hour	Litres per hour	Litres per hour	Litres per hour
Etc....	Litres per hour	Litres per hour	Litres per hour	Litres per hour

Other indicators would be grass species in the area, and how veld dynamics change over time. Rule of thumb is that a desired outcome is an ever increasing ratio of perennial grasses compared to annual species, and the extent of grass cover. In time, the area should progress from being dominated by pioneer species, to being dominated by climax species.

As with all monitoring, one cannot measure only one indicator or parameter, as there are always many different factors at play. At a minimum, a farmer needs to record and monitor other factors, such as rainfall during the season/year (not just the total, but also when the rain occurred), frost, unusual



temperatures, etc. Farmers/land custodians need to get into the habit of monitoring, keeping records, and reporting as required by legislation.

REPORTING

Section 9 of the Forestry Regulations require a person who has harvested forests and forest produce, to report on and actual quantity of the forest produce removed when submitting the next licence or at the end of the financial year.

Therefore, the completion of this form is the responsibility of the proponent, and its completion forms part of the EMP.

REPORT BACK ON SUMMARY OF FOREST PRODUCE USED

Date	Permit number	Quantity permitted (ton) Har./Mar.Trans.Exp.	Product	Amount (N\$) Har./Mar.Trans.Exp.	Receipt number	Actual quantity harvested	Date report back	Remarks



ANNEX 1: PROTECTED PLANT SPECIES

as listed in the Forest Act, 2001 (Act no. 12 of 2001) Regulations (2015)

Species name	Common names (English)	Reasons to be protected (ES = Ecosystem Services; EU = Extent of use)
<i>Acacia erioloba</i> E. Mey.	Camel-thorn	EU (Heavily utilized by humans and animals - medicinal, cash crop, unsustainable harvesting of fuel wood for export, slow growth rate, cultural value, economic value, ES (keystone species))
<i>Acacia nigrescens</i> Oliv	Knob-thorn	EU (Used by humans and animals - wood used for construction, utensils, fuel, tanning, browsed by game), ES (retains river banks)
<i>Acanthosicyos horridus</i> Welw. Ex Hook.f.	Nara	Cultural and economic value, ES (Dune stabiliser)
<i>Adansonia digitata</i> L.	Baobab	ES2 (Keystone species) EU (heavily utilised by humans and animals)
<i>Adenia pechuelii</i> (Engl.)	Harms Elephants-foot	EU (unsustainable harvesting for horticultural trade), slow growth rate, Slow and/or episodic recruitment
<i>Adenium boehmanium</i> Schinz	Bushman poison	EU (unsustainable harvesting for horticultural trade)
<i>Afzelia quanzensis</i> Welw.	Pod mahogany	EU (Extensively used by humans and animals- curios, medicinal, timber, potential as ornamental trees, browsed by animals), slow growth rate, Restricted range.
<i>Albizia anthelmintica</i> (A.Rich.) Brongn.	Worm-cure albizia	EU (Utilized by humans and animals - medicinal, utensils, browsed by livestock and game)
<i>Aloe dichotoma</i> Masson	Quiver tree	EU (unsustainable harvesting for horticultural trade), Slow growth rate, Cultural value, Slow and/or episodic recruitment
<i>Aloe pillansii</i> L. Guthrie	Giant quiver tree	Slow growth rate, Restricted range, Slow and/or episodic recruitment
<i>Aloe ramosissima</i> Pillans	Maiden's quiver tree	Slow growth rate, Restricted range, Slow and/or episodic recruitment
<i>Baikiaea plurijuga</i> Harms	Zambezi teak or Rhodesian teak	EU (heavily utilised for timber, implements, utensils, wood carvings)
<i>Berchemia discolor</i> (Klotzsch) Hemsl.	Bird-plum	EU (heavily utilised by humans and animals)
<i>Boscia albitrunca</i> (Burch.) Gilg & Gilg-Ben.	Shepherd's tree	EU (heavily utilised by humans and animals)
<i>Burkea africana</i> Hook.	Burkea	EU (heavily utilised by humans - timber, firewood, implements)
<i>Caesalpinia merxmeullerana</i> A.Schreib.	Orange-river caesalpinia	Restricted range

<i>Citropsis daweanana</i> Swingle & M.Kellerm.		EU (Wild crop relative - genetic resource), Restricted range
<i>Colophospermum mopane</i> (J. Kirk ex Benth.) J. Kirk ex J. Léonard	Mopane	EU (heavily utilised by humans and animals (browse and forage) - charcoal, timber, fuel wood, construction, medicine, host to important edible caterpillar), slow growth rate, cultural value.
<i>Combretum imberbe</i> Wawra	Leadwood	EU (heavily utilised by humans and animals - fuel wood, construction material, implements, illegally harvested for charcoal, other purposes, browse, shade) Cultural value, Extremely slow growth rate.
<i>Commiphora capensis</i> (Sond.) Engl.	Namaqua corkwood	EU (illegally harvested for horticultural trade), Restricted range
<i>Commiphora cervifolia</i> J.J.A.van der Walt	Antler-leaved corkwood	EU (illegally harvested for horticultural trade), Restricted range
<i>Commiphora dinteri</i> Engl.	Namib corkwood	EU (illegally harvested for horticultural trade)
<i>Commiphora gariensis</i> Swanepoel	Orange River corkwood	Restricted range
<i>Commiphora giessii</i> J. J. A. van der Walt	Brown-stemmed corkwood	Restricted range
<i>Commiphora gracilifrons</i> Dinter ex J. J. A. van der Walt	Karee corkwood	Restricted range, EU (illegally harvested for horticultural trade), Restricted range
<i>Commiphora krauseliana</i> Heine	Feather-leafed corkwood	EU (illegally harvested for horticultural trade), Restricted range
<i>Commiphora namaensis</i> Schinz	Nama corkwood	EU (illegally harvested for horticultural trade)
<i>Commiphora oblanceolata</i> Schinz	Swakopmund corkwood	Very small, widely scattered populations, Restricted range
<i>Commiphora saxicola</i> Engl.	Rock corkwood	EU (illegally harvested for horticultural trade)
<i>Commiphora virgata</i> Engl.	Slender corkwood	Value (cultural - host to edible caterpillar)
<i>Commiphora wildii</i> Merxm.	Oak-leaved corkwood	EU (resin for perfume), Value (cultural - perfume)
<i>Cyphostemma bainesii</i> (Hook. F.) Desc.	Gouty vine	EU (illegally harvested for horticultural trade), Restricted range
<i>Cyphostemma currorii</i> (Hook. F.) Desc.	Kobas	EU (illegally harvested for horticultural trade)
<i>Cyphostemma juttae</i> (Dinter & Gilg) Desc.	Blue kobas	EU (illegally harvested for horticultural trade), Restricted range



<i>Cyphostemma uter</i> (Exell & Mendonça) Desc.	Kaoko kobas	Restricted range
<i>Dialium engleranum</i> Henriq.	Kalahari podberry	EU (Extensively used by humans – fruit an important part of diet of San and Kavango peoples, medicinal, timber, implements)
<i>Diospyros mespiliformis</i> Hochst. Ex A.DC.	Jackal-berry	EU (Heavily utilised by humans and animals - important fruit tree, timber, cash crop, utensils, watos, fuel wood, medicinal, fruit eaten by animals and frugivorous birds), slow growth rate.
<i>Elephantorrhiza rangei</i> Harms	Karas elephant-root	Restricted range and habitat
<i>Entandrophragma spicatum</i> (C.DC) Sprague	Owambo wooden-banana	Cultural value, slow growth rate, Restricted range
<i>Erythrina decora</i> Harms	Namib coral-tree	Small populations scattered over wide area, Cultural value, potential horticultural value
<i>Euclea asperrima</i> Friedr.-Holzh.	Mountain guarri	Restricted range
<i>Euclea pseudebenus</i> E. Mey. Ex A. Dc.	Wild ebony	ES (Keystone species, prevent erosion of water courses), Slow growth rate
<i>Faidherbia albida</i> (Delile) A.Chev.	Ana tree	ES (Important component of riparian fringe, prevents erosion of river beds, Keystone species), EU (heavily utilised by stock and game, important shade tree in arid west).
<i>Ficus burkei</i> (Miq.) Miq.	Strangler fig	EU (fruit for humans and animals), Restricted range
<i>Ficus cordata</i> Thunb.	Namaqua rock-fig	EU (fruit for humans and animals)
<i>Ficus sycomorus</i> L.	Sycamore fig	EU (fruit for humans and animals)
<i>Guibourtia coleosperma</i> (Benth.) J. Léonard	False mopane	EU (Heavily utilised by humans and animals - food, cash crops, very important shade tree, timber, watos, utensils)
<i>Hyphaene petersiana</i> Klotzsch ex Mart.	Makalani palm	EU (heavily utilised by humans and animals - utensils, basketry, thatching, fuel, ropes, palm wine, food)
<i>Kirkia dewinteri</i> Merxm. & Heine	Kaoko kirkia	Restricted range
<i>Lannea discolor</i> (Sond.) Engl.	Live-long	EU (used by humans and animals), Restricted range
<i>Maerua schinzii</i> Pax	Ringwood tree	EU (heavily used by humans and animals), slow growth rate
<i>Moringa ovalifolia</i> Dinter & A. Berger	Phantom tree	EU (heavily used by humans and animals - horticultural value, browse, tourism)
<i>Neoluederitzia sericeocarpa</i> Schinz	Silk-seed bush	Restricted range
<i>Ozoroa concolor</i> (C. Presl. Ex Sond.) De Winter	Green resin-bush	Restricted range, scattered distribution
<i>Ozoroa namaquensis</i> (Sprague) Von Teichman & A. E. vanWyk	Gariiep resin-tree	Restricted range



<i>Pachypodium lealii</i> Welw.	Bottle tree	Slow growth rate, EU (unsustainable harvesting for horticulture trade)
<i>Pachypodium namaquanum</i> (Wyley ex Harv.) Welw.	Elephant-trunk	Slow growth rate, EU (unsustainable harvesting for horticulture trade), Restricted range
<i>Pappea capensis</i> Eckl. & Zeyh.	Jacket-plum	ES (Keystone species, prevents erosion in rivers), EU (utilised by humans and animals - important shade tree, edible fruit, browsed)
<i>Philenoptera violacea</i> (Klotzsch) Schrire.	Apple-leaf, rain tree	ES (important component of riparian and floodplain canopy) EU (utilised by humans and animals - fences, watos, medicines, browse, fodder)
<i>Protea gaguedi</i> J. F. Gmel.	African white protea	Restricted range, EU (heavily utilised by humans – medicinal overharvesting of roots)
<i>Pterocarpus angolensis</i> DC.	African teak, kiaat	Value (economic), EU (heavily utilised for timber, implements, utensils, wood carvings)
<i>Salix mucronata</i> subsp. <i>Capensis</i> (Thunb.) Immelman	Small-leaved willow, river willow	ES (stabilisation of river banks, shade), EU (Heavily utilised by humans – overharvesting for fuel wood, potentially threatened), Restricted range
<i>Schinziophyton rautanenii</i> (Schinz) Radcl.-Sm.	Manketti	EU (heavily utilised by humans and animals - utensils, curios, musical instruments, timber, shade, fruit a very important food and cash crop)
<i>Schotia afra</i> (L.) Thunb. var. <i>angustifolia</i> (E. Mey.) Harv.	Karoo schotia	EU (Utilised by humans for wood), Restricted range
<i>Sclerocarya birrea</i> (A. Rich.) Hochst.	Marula	EU (Heavily utilised by humans and animals for fruit, shade, browse, medicines, wood).
<i>Searsia lancea</i> (L. F.) F. A. Barkley	Karee	ES (Prevent erosion of river banks)
<i>Sesamothamnus benguellensis</i> Welw.	Kaoko sesame-bush	EU (Illegally harvested for the horticultural trade), slow growth rate, Restricted range
<i>Sesamothamnus guerichii</i> (Engl.) E. A. Bruce	Herero sesame-bush	EU (Illegally harvested for the horticultural trade), slow growth rate
<i>Sesamothamnus leistneri</i> Giess ex Ihlenf., ined.	Large-leaved sesame-bush	EU (Illegally harvested for the horticultural trade), slow growth rate, Restricted range
<i>Spirostachys africana</i> Sond.	Tamboti	EU (Heavily utilised by humans - timber)
<i>Sterculia africana</i> (Lour.) Fiori	African star-chestnut	Economic value (tourism and horticulture) EU (utilised by humans – medicinal and food)
<i>Sterculia quinqueloba</i> (Garcke) K. Schum.	Large-leaved sterculia	Economic value (tourism and horticulture), restricted habitat
<i>Strychnos cocculoides</i> Baker	Corky monkey-orange	Economic value (cash crop), EU (heavily utilised by humans and animals - fruit)



<i>Strychnos potatorum</i> L. F.	Black bitterberry	ES (Important component of river and flood plain vegetation) EU (utilised by humans (fish poison, shade) and animals (food and shade), Restricted range.
<i>Strychnos pungens</i> Soler.	Spine-leaved monkey-orange	Economic value (cash crop), EU (heavily utilised by humans and animals - fruit, medicinal)
<i>Strychnos spinosa</i> Lam.	Spiny monkey-orange	Economic value (cash crop), EU (heavily utilised by humans and animals - fruit and furniture), Restricted range
<i>Tamarix usneoides</i> E. Mey. Ex Bunge	Wild tamarisk	ES (prevents erosion of river beds and river banks, important component of riparian vegetation), EU (browsed by game)
<i>Tylecodon paniculatus</i> (L. F.) Toelken	Southern botterboom	EU (unsustainable harvesting – horticultural trade), Restricted range
<i>Welwitschia mirabilis</i> Hook f.	Welwitschia	Cultural value, scientific value, economic value (tourism)
<i>Ziziphus mucronata</i> Willd.	Buffalo-thorn	ES (prevents erosion of river beds and river banks, important component of riparian vegetation) EU (Utilized by humans and animals - medicinal, construction, implements, fuel wood, browsed by livestock and game.



ANNEX 2: RECOMMENDED DENSITY OF TREES AFTER BUSH THINNING

The SEA has emphasized the importance of selective bush thinning, to achieve the goal of ecological restoration of rangelands. This annex defines what level of bush thinning is most appropriate, categorized according to the main encroacher species. The information is based on de Klerk (2004), the draft policy on bush encroachment (2004), and the opinion of six bush experts (Dave Joubert, Nico de Klerk, Axel Rothauge, Ben Strohbach, Cornelis van der Waal, Roelie Venter).

The recommendations use a formula based on tree equivalents (TEs) and average annual rainfall. A TE is defined as a woody tree/bush of 1.5 metres height. Thus a 3 m tree represents 2TE. A 0.75 m tree/bush represents half a TE.

Main principles

- All bush thinning should aim to leave a heterogeneous mix of trees and bush. The veld that remains should have a variety of tree species (including some of the encroacher species), of different size classes, and spaced so that there are some open patches and some dense patches, to provide a variety of habitats for animals.
- Bush thinning should be carried out in a phased approach so that the system is not shocked by an abrupt change from dense bush to open veld.
- If arboricides are going to be used, only foliar (leaf spray) and stem-applied arboricides are recommended. Pellets should not be used, as they tend to get washed along the surface by rain, and end up in non-target areas.
- Dry river beds tend to carry more trees, and larger trees. Forestry regulations state that trees should not be killed within 100 m of a river course. Thinning is required in densely encroached river margins, but one should leave a higher density of trees than on the adjacent habitat. It is especially important to leave the large trees and protected species along a river course. The exception to this is *Prosopis*, which invades river beds, but should be eradicated.
- Judicious thinning should leave behind a sufficient number of trees (following the formulas provided below) to create a more stable savanna that does not need major intervention at short intervals after the initial thinning.
- Training of the work force is necessary before harvesting starts, so that workers know which trees to target and which to avoid. Work teams need to be managed so that any excessive harvesting or killing of the wrong species is noticed and corrected.



a. Dominant encroacher species = *Acacia (mellifera, reficiens, luderitzii, erubescens, fleckii, nebrownii)*

- Leave all trees greater than 18 cm diameter (measured at ground level).
- Leave all protected species.
- Leave enough *Acacias* so that the total density of TEs per hectare = 1.5 times the average rainfall. i.e. in an area with ~400 mm rain, the total density of all trees should be ~600 TEs / ha.
- In sandy substrates, leave enough *Acacias* so that the total density of TEs per hectare = 2 times the average rainfall. i.e. in an area with ~400 mm rain and sandy soil, the total density of all trees should be ~800 TEs / ha.

b. Dominant encroacher species = *Dichrostachys cinerea*

- Leave all trees greater than 18 cm diameter (measured at ground level). Any *Dichrostachys* greater than 10 cm diameter (these are the taller individuals) should also be left.
- Leave all protected species.
- Leave enough *Dichrostachys* so that the total density of TEs per hectare = 1.5 times the average rainfall. i.e. in an area with ~400 mm rain, the total density of all trees should be ~600 TEs / ha.
- Protect the soil surface by packing brush.
- Aftercare is essential to prevent re-infestation.

c. Dominant encroacher species = *Terminalia sericea*

- Leave all trees greater than 18 cm diameter (measured at ground level).
- Leave all protected species.
- Leave enough *Terminalias* so that the total density of TEs per hectare = 3 times the average rainfall. i.e. in an area with ~400 mm rain, the total density of all trees should be ~1,200 TEs / ha. This recognizes the extra importance of the trees in supplying nutrients to the sandy soil.

(Remember that a large *Terminalia sericea*, approx. 6 m high, is 4 TEs!)

d. Dominant encroacher species = Mopane

- Leave all trees greater than 18 cm diameter (measured at ground level).
- Leave all protected species.
- Leave enough mopanes so that the total density of TEs per hectare = 2 times the average rainfall. i.e. in an area with ~400 mm rain, the total density of all trees (all species) should be ~800 TEs / ha. This recognizes the importance of mopanes as fodder.
- All cases where thinning is planned in mopane-dominated veld, especially where the veld is degraded (e.g. lack of grass, soil erosion) should first be inspected by Forestry officials or a bush expert, to assess the level of harvesting that should be done. It might be advisable in such conditions to leave more trees than the 2x rainfall amount specified above.

e. Dominant encroacher species = *Rhigozum trichotomum*

- Leave all other tree and bush species, including all protected species.
- Leave enough *Rhigozum* so that the total density of TEs per hectare = 2 times the average rainfall. i.e. in an area with ~200 mm rain, the total density of all trees and bushes should be ~400 TEs / ha.



- Remember that a Rhigozum bush is usually ~0.75 m tall, i.e. 0.5 TEs. If there are no other trees or bushes, the density of Rhigozum should be ~800 bushes / ha

f. Dominant invasive species = *Prosopis*

- Take out all *Prosopis* trees.
- Use only approved methods, such as manual chopping or responsible use of arboricide. Do not use polluting methods such as applying engine oil to cut stems.

ANNEX 3: IMPORTANT FODDER / BROWSE SPECIES

(Limit cutting and leave substantial clumps of these)

References are made in the table to two useful texts (and page numbers) for identification and information:				
TAN = The Namibian Tree Atlas (Curtis & Mannheimer, 2005)				
vW&vW = Field Guide to Trees of Southern Africa (van Wyk and van Wyk, 1997)				
Scientific Name	English Name	Afrikaans Name	Oshwambo Otjiherero	Comment
<i>Bauhinia petersiana</i>	Coffee neat's foot	Koffiebos	Omutwanghuta / Omukatjipera	Associated with deep sands. Can get dense TAN 212, vW&vW 372/3
<i>Combretum apiculatum</i>	Kudu bush, red bushwillow	Koedoebos	Omumbuti / Omunaluko	Can get dense TAN 468, vW&vW 328/1
<i>Combretum hereroense</i>	Mouse-eared combretum	Kierieklapper		TAN 478, vW&vW 332/1
<i>Croton gratissimus</i>	Lavender croton	Laventelbos	Mbango / Omumbango	TAN 326, vW&vW 86/3
<i>Dombeya rotundifolia</i>	Wild pear	Drolpeer	Omuryahere	TAN 452, vW&vW 234/3
<i>Ehretia alba</i> (= <i>Ehretia rigida</i>)	White puzzle-bush	Deurmekaarbos	Omusepa	TAN 565, vW&vW 162/4
<i>Euclea undulata</i>	Common guarri	Gewone ghwarrie / besembos	Omukarambandje	TAN 514, vW&vW 340/3
<i>Grewia bicolor</i>	Two-coloured raisin bush	basterrosyntjie	Omuhonga / Omundjembere	TAN 428, vW&vW 236/4

<i>Grewia flava</i>	Velvet Raisin	Rosyntjebos	Omuvapu	TAN 432, vW&vW 238/2
<i>Grewia flavescens</i>	Sandpaper raisin	Skurweblaar rosyntjie	Omuhe	TAN 434, vW&vW 238/3
<i>Tarchonanthus camphorates</i>	Wild camphor	Vaalbos	Omuteatupa	TAN 628, vW&vW 112/2
<i>Terminalia sericea</i> *	Silver cluster-leaf	Geelhout	Omuseasetu	Associated with deep sands TAN 498, vW&vW 174/2
<i>Ziziphus mucronata</i>	Buffalo thorn	Blinkblaar wag-'n-bietjie	Omukaru /Omukekete	TAN 412, vW&vW 232/2



APPENDIX C: ISSUES AND RESPONSES IN THE SEA

IAP 1: Colin Christian

25 Nov 2015

In response to your request to review the DRAFT SEA Scoping Document, I have put together the following document for your consideration.

I would like to preface this document as follows:-

There is no doubt that certain species of encroacher bush need to be managed in Namibia's Savannah ecosystems in order to restore productive rangelands and economically productive farms. Certain bush types need to be thinned, but it must be recognised that such activities can be either ecologically beneficial or harmful, depending on the methods used and the quality of environmental management applied, including aftercare. **Restoration of rangelands (and other potential benefits) are not automatic following bush removal.** For example, the experience of many farmers and researches has shown that the density of encroacher bushes often gets worse, with further decline in grazing potential.

Namibia's bush encroached savannas are not ecologically uniform. Several different types of bush occur and soil types differ substantially. These different types of habitat cannot be treated uniformly and **a generic approach to management** without detailed understanding of the local affected environments **will lead to degradation** in some habitats, including loss of biodiversity and potential long term damage to soils. **Appropriate management measures need to be developed for specific habitats at a project level for specific localities.**

SEA Response: Agree that it is dangerous to over-simplify. But at the same time there are common issues, and overall guidelines to best practice need to be provided.

First hand experience with bush management over the past 5 years has given rise to a number of concerns about European commercial interests in bush for energy, and concerns about the companies and agencies involved. SAIEA should be aware of these concerns and the experiences that gave rise to them in order to make informed decisions about the SEA. To date we have seen commercial interests selectively presenting the assumed benefits of bush thinning (or even "debushing") while playing down or ignoring the potentially serious adverse impacts of poor management of bush harvesting.

Furthermore, **a Bush Farming ("Energy Farming") approach** that has been a stated part of both Energy for Future and the GIZ's strategy for the future **is misguided. It is a very high risk approach that is very unlikely to achieve rangeland restoration.** An "Aftercare" approach to restore rangelands is needed - as recommended by De Klerk (2004) based on extensive research and review (also Strohbach, Rothhauge, and others). This is necessary to facilitate the process of ecological succession of savannah grasslands towards a "climax" state - i.e. dominated by the perennial grazing grass species, and balanced by sufficient trees and bush.

SEA Response: The SEA cautions about bush farming. See 5.3.10

The headings in the following sections refer to headings used in the Draft SEA Scoping Report.

SCOPE of THE SEA

Terms of Reference by GIZ

- A “**De-bushing**” approach is ecologically totally unsound. The available literature / research shows clearly that Savannah ecosystems need both the grassy and woody components in an appropriate ratio (see summaries in De Klerk, 2004). Woody species must be maintained throughout the grassland / tree matrix for a wide variety of reasons. The term “debushing” cannot be used to represent an ecologically sound objective – that term should be used only when referring to harmful clearing of all woody material. The objective of ecologically sound bush management should be referred to as “**selective bush thinning**”. Please remove the word “de-bushing” from the report except where it is intended to refer to the bad practice of complete clearing.

SEA Response: Where appropriate, the SEA uses the term ‘bush thinning’, and urges that the approach should be thinning, not clearing of bush.

- “Significant effects / environmental impacts” depends on the type of habitat and the type of soils. Generalisation across all of Namibia’s savannahs would be misguided and would lead to mismanagement. The quality of management will also have a major influence on the environmental impacts that result – either for better or for worse. Environmental Management Plans to guide that management need to be specific to local areas and particular habitats.

SEA Response: Partly disagree. There are impacts that are common to all bush thinning activities, and it is useful to provide management guidelines to mitigate these. However, the SEA does recognise that individual site-specific conditions are important, and these are addressed in the EMP.

- Decision-makers include MET (Environmental Commissioner) – In terms of the Environmental Management Act (2007) and Regulations (2012) Environmental Clearances are needed on a project-specific basis. MAWF (e.g. Directorate of Forestry) is not authorized in law to override or waive the requirements of the Environmental Management Act.

SEA Response: Agree.

- Regarding assessing the “adequacy of institutional structures” – that should include not only Namibian institutions but also the competence of European organisations, which are trying to establish themselves at the centre of bush utilization projects in Namibia, should be scrutinized. To date experience with European organisations / companies has shown very little evidence of adequate ecological understanding of these sensitive savannas. The expertise of organisations like Energy for Future and the GIZ is purely technical and economic and is almost devoid of any ecological competence with Namibian savannah ecosystems.

SEA Response: All institutions are required to follow the law. The SEA tries to find ways to streamline the process for bush thinning activities to comply with the law.

- Regarding “assessing the impacts of the current de-bushing... activities” – only one Environmental Compliance Report on the activities of Energy for Future was submitted to MET before this company suspended compliance monitoring due to their own failure to comply with the EMP. Comprehensive compliance auditing is a requirement under the Environmental Management Act but it has not happened and neither MET nor the Directorate of Forestry has enforced this important task.

SEA Response: This shortcoming is recognised, and emphasises the need to support and streamline the relevant legal safeguards.

- Generic EMPs are not possible in such diverse habitats, bush types and soils. EMPs need to be done according to specific limited areas that are relatively homogeneous. The savannah ecosystems in Namibia are NOT homogeneous and practices that are appropriate in one area will be damaging in another area. In terms of responsibilities, much of this is defined in legislation and current practice, but there are major differences between commercial and communal areas. It should be emphasized that the major means of control should be through the Environmental Management Act and Environmental Clearance system – which is probably the strongest instrument for control that is available.

SEA Response: The generic EMP provided in this SEA needs to be customised to each individual site. Agree that the EMA is an important instrument.

- Guidance on bush thinning needs to be specifically tailored to local conditions:
 - Specifically defined areas, and
 - Specifically defined habitats, and
 - Specific methods of harvesting or bush management; all the above acting together, and
 - Requirements for aftercare to ensure restoration of rangelands.

SEA Response: The generic EMP provided in this SEA needs to be customised to each individual site and the project activities.

- Section 1.2.1 Additional & corrected References: -

- Colin Christian & Associates (April 2010) Energy for Future Bush-to-Fuel Project: Environmental Impact Assessment Report (Not “Ohorongo EIA Report” – that was for the Cement Plant)
- Colin Christian & Associates (July 2010) Energy for Future Bush-to-Fuel Project: Environmental Management Plan
- Colin Christian & Associates (May 2012) Energy for Future Bush-to-Fuel Project: Environmental Compliance Audit for Bush Harvesting
- Colin Christian & Associates (December 2010) Namibia Agricultural Union: The Effect of Bush Encroachment on groundwater Resources in Namibia: a Desk Top Study. Final Report. Funded by GIZ.
- Add the assessment Report on the use of arboricides by Honsbein – I think it was for the Meat Board – not sure of the reference.

Section 1.2.2 Field research: -

- There is definitely a need for the SEA team to visit significant examples where compliance was not achieved, and those where compliance was achieved (if any) in order to gain an understanding of the practical difficulties of implementing bush management safely. Moreover, farmers should be consulted during these visits for the same reasons.

SEA Response: This was done (5.4).

- Regarding aerial spraying (add distribution of any arboricide pellets too) – aerial application of arboricides in any form cannot be selective, it cannot protect trees and should simply be banned in my opinion.

SEA Response: Agree that aerial spraying cannot be selective enough. It is now prohibited (4.1.2)

- Individual stem application (add arboricides that are applied to the soil) – certainly needs guidelines and minimum distances from special or protected trees. This may be a better solution for aftercare than for initial bush thinning.

SEA Response: Cautions on the use of arboricides are given (5.3.7)

- Mechanical clearing using bulldozers/ bush rollers / chains can be very damaging to the soils and should not be used.

SEA Response: Agree. (5.3.5)

- “Tree shredder” machinery has had significant adverse impacts, not so much because of the machine but because it is not used selectively enough. See all reports by Colin Christian & Associates, above.

SEA Response: Agree. (5.3.1 and 5.3.2)

- Manual chopping – needs a very high commitment to training and supervision. A big question is whether people can do this work sustainably.

SEA Response: Agree. The need for training is emphasised (6.6)

- Fire is not effective for killing bush, but it can be effective as part of an aftercare strategy (de Klerk, 2004). Occasional fire is a natural and necessary part of savanna ecosystems. The active policy of exclusion of fire in the past is misguided. Occasional controlled burning may have a place, but it does have obvious risks in the event of loss of control.

SEA Response: Agree. (3.2.4)

It is of considerable concern that by now, after working with the bush issue for years, the GIZ still does not appear to understand that creating generic EMPs – ignoring the high diversity of habitats, soils types etc., and ignoring the extensive available literature and reviews of past research on savannahs. The differences in habitat types and species also has implications for aftercare – a subject which GIZ generally ignores but which is essential to the effective restoration of rangelands, including the all-important perennial grass species or “climax” species.

Bush farming (repeated disturbance) will not allow the process of ecological succession to proceed to its: “climax state”. The perennial grasses are essential for soil protection, grazing, and infiltration of rainfall to groundwater.

LEGAL POLICY & INSTITUTIONAL OVERVIEW

The **Principles of Environmental Management** that are contained in the Environmental Management Act (2007) should be included in the Scoping & SEA Report. These are intended to guide all environmental management in Namibia – they are good principles and they are internationally recognized. Several of them are directly applicable to bush management: -

Principles of Environmental Management (EMA, No.7 of 2007)
No. 3966 Government Gazette 27 December 2007

PART II

PRINCIPLES OF ENVIRONMENTAL MANAGEMENT

Principles of environmental management

3. (1) The principles set out in subsection (2) –

- (a) guide the implementation of this Act and any other law relating to the protection of the environment;
- (b) serve as the general framework within which environmental plans must be formulated; and
- (c) serve as guidelines for any organ of state when making any decision in terms of this Act or any other law relating to the protection of the environment.

(2) The following are the principles of environmental management: -

- (a) renewable resources must be used on a sustainable basis for the benefit of present and future generations;
- (b) community involvement in natural resources management and the sharing of benefits arising from the use of the resources, must be promoted and facilitated;
- (c) the participation of all interested and affected parties must be promoted and decisions must take into account the interest, needs and values of interested and affected parties;
- (d) equitable access to environmental resources must be promoted and the functional integrity of ecological systems must be taken into account to ensure the sustainability of the systems and to prevent harmful effects;
- (e) assessments must be undertaken for activities which may have a significant effects on the environment or the use of natural resources;
- (f) sustainable development must be promoted in all aspects relating to the environment;
- (g) Namibia's cultural and natural heritage including, its biological diversity, must be protected and respected for the benefit of present and future generations;

(h) the option that provides the most benefit or causes the least damage to the environment as a whole, at a cost acceptable to society, in the long term as well as in the short term must be adopted to reduce the generation of waste and polluting substances at source;

(i) the reduction, re-use and recycling of waste must be promoted;

(j) a person who causes damage to the environment must pay the costs associated with rehabilitation of damage to the environment and to human health caused by pollution, including costs for measures as are reasonably required to be implemented to prevent further environmental damage;

(k) where there is sufficient evidence which establishes that there are threats of serious or irreversible damage to the environment, lack of full scientific certainty may not be used as a reason for postponing cost-effective measures to prevent environmental degradation; and

(l) damage to the environment must be prevented and activities which cause such damage must be reduced, limited or controlled.

The main mechanism for control of the exploitation of natural resources by MET is explained as follows.

In response to an EIA for a specific project in a specific area, MET can issue an Environmental Clearance certificate. The issuing of this certificate is subject to the project Proponent's compliance with the recommendations in the EIA and EMP. Failure to comply with those recommendations can result in an Environmental Clearance being withdrawn, without which the project cannot operate. Therefore MET does actually have considerable powers in law. An Environmental Clearance can also be withdrawn if it can be shown that the particular project is causing significant environmental degradation.

It is of concern that MAWF (Directorate of Forestry) has taken a very soft approach with regard to enforcement and even compliance monitoring, which has actually undermined the requirements of Environmental Management Act, without being legally authorized to do so.

SEA Response: The generic EMP and streamlining the legal process of permits and Environmental Clearance is an attempt to strengthen this weakness.

Permits by Forestry: The permit system by Forestry is not effective because there are no conditions attached (e.g. conditions to comply with an EMP) and there is no enforcement of any environmental management measures.

There is a recent report on regrowth involving Dr Smit from Bloemfontein but I have not yet seen it. Ask Nico de Klerk. Regrowth will be highly variable depending on the highly variable rainfall (typically +100% to – 50% of the annual average).

BUSH ENCROACHMENT IN NAMIBIA

Section 3.3 Protected Tree Species

One needs to be very careful about bush thinning in Mopane areas – that could just create a desert. These are low diversity ecosystems, with low and very unreliable rainfall. Not enough is known to make any ‘safe’ predictions.

SEA Response: The bush thinning recommendation for mopane-encroached areas is conservative. (Appendix B Annex 2d)

Similarly, areas dominated by *Terminalia sericea* are always on deep sand. This Kalahari sand (wind blown sand) is quartzitic and has no intrinsic fertility. As soon as it is cleared it loses the nutrients that were previously kept in the system by recycling organic matter. The result is desertification. The Forest Act recognizes this and protects areas of wind blown sand from clearing of natural vegetation.

SEA Response: The bush thinning recommendation for T.sericea-encroached areas is also conservative. (Appendix B Annex 2b)

Experience from the charcoaling industry needs to be heeded – where many large trees of protected species are being exploited. Protected tree species, and large trees, have also been taken by Energy for Future during their bush harvesting by machine.

BUSH HARVESTING AND VALUE ADDING IN NAMIBIA

I suggest that attention needs to be drawn afresh to De Klerk (2004) for both its summaries of extensive literature on savannah ecosystems and bush management.

Section 4.1.1. Ecological principles

This section of the Draft SEA Scoping Report is very thin and inadequate. In order for people to develop management recommendations they need to first understand the ecosystems. The report should summarise a lot more of the available information – For example, **fundamental to Savannah ecosystems is the way in which woody species interact with grassy species for their mutual benefit, and for the benefit of soils.** For example: - water and minerals are drawn from different depths, microclimates, grasses retarding surface flow to allow it to sink in, soil organisms, decline in soils nutrients with distance from trees and bush, woody plants attract insects, birds, animals – all of which fertilise the soil, the needs of fauna for shade (including domestic livestock), diversity of grasses is related to diversity of habitat, often the best grazing grasses are adjacent to bush or under trees, etc etc. The implications for management of these systems of the extensive research that has been summarised by de Klerk should be elucidated in the SEA.

SEA Response: Section 3.1.1 outlines these principles.

Section 4.3.1 Table 2

Several of the uses in Table 2 do not use bush at all, so they offer no solution. As you rightly say, only the alien *Prosopis* can be used for furniture. None of the encroacher species have much use except in chipped form for energy.

Table 3

Charcoal may have a place as a business in its own right but it is NOT a solution to the bush problem. This is because most of the encroacher bushes are very small diameter, while charcoal needs stems of at least 2cm diameter. These are ignored by the charcoalers in favour of large trees because large trees yield greater mass of charcoal for a given amount of effort. Therefore, a tremendous amount of damage is being done by charcoalers under the pretence of managing bush. This industry needs to be far more strictly controlled because taking big trees is not sustainable, and is ecologically harmful in many ways, and may be harmful to grazing resources and to soils in many cases.

SEA Response: Section 5.4.1 addresses the issues in the charcoal sector.

Regarding *Prosopis* sp. or any other alien invasive species. The aim should be to eradicate these species because they are a significant threat to water resources and biodiversity. So to build an industry on alien species is not sustainable in the long run. Of course the material can be used in the process of eradication. Where a species like *Prosopis* is used for wood carvings – that’s a good way to use existing stocks but there is a risk that people may plant it for this purpose and spread it.

SEA Response: The recommendation for thinning of Prosopis-encroached areas is complete removal of all trees (Appendix B Annex 2f).

IMPACT ASSESSMENT

The issue of generalisation in highly diverse environments

I have a serious concern about this section and the GIZ’s attempts to reduce everything to a simplistic level and to generalise impacts and mitigation measures to all situations. We know that GIZ has been influenced by Energy for Future who tried to claim that the EIA & EMP done for bush to supply the cement factory was applicable to all bush harvesting operations. EFF persisted with this despite the consultant’s clear statements - in meetings and in writing - that the EIA was applicable only to a 75 km radius of the cement plant and 85,000 tonnes of bush chips per year. That the GIZ is persisting with such misguided thinking is evident in the Terms of Reference for this SEA. They ask for assessments for various kinds of bush management activity as if the whole of Namibian Savannas were homogeneous and could be treated the same way. They then want to use this SEA as a basis for generalised management measures. That will not work ecologically.

There is no substitute for compliance with the Environmental Management Act (EMA), which requires site-specific EIAs for all projects involving the use of natural resources. In your summary of GIZ’s Terms of Reference there is no mention of MET and the EMA. Was MET or the EMA mentioned in the TOR?

It is also a concern that the GIZ, which represents German technical commercial interests, not environmental and farming interests in Namibia, wishes to establish advisory services and influence legislation, especially the Directorate of Forestry. As I will show in another section below, neither the competence of GIZ to understand and manage Namibian Savannah ecosystems nor their objectivity to influence Namibian legislation for the benefit of Namibia’s environments and farmers have been demonstrated to date.

Furthermore we know that the Forest Act is a weak piece of legislation for managing bush, but the Environmental Management Act is a strong piece of legislation because it results in an Environmental

Clearance as a pre-condition for operation, that can be withdrawn if a project is shown to be environmentally harmful or compliance with the EMP is inadequate.

The Regulations (2012) under the Environmental Management Act (2007) clearly state that their regulations apply whether there is other legislation or not!

Regarding the content of the Assessment section of this SEA: -

- It is not possible to generalise regarding impacts in different habits and it would be environmentally damaging to do so. For example, in sandy soils (the habitat where *Terminalia sericea* often / usually dominates) soil fertility is known to decline very rapidly if woody plants are removed (De Klerk, 2004), (experimental work by Strohbach, pers comm), and it is also recognised / implied in the Forest Act 2001 – re clearing on sandy.

SEA Response: The SEA recognises habitat variations, but still finds it useful to generalise the impacts.

- There are many respects in which the use of arboricides (pellets), applied selectively and at safe distances from non-target trees may be far more environmentally friendly than bush harvesting. (e.g. no disturbance of the soil, no removal of the grass layer, reduced risk of one problem species being replaced by another (e.g. Vaalbos), and reduced need for aftercare because the pellets are effective in the soil for a few years (depending on soil type). The Report by Honsbein did not find a problem with this (provided that the chemicals are supplied by reliable countries / sources with strict environmental controls).

SEA Response: Partly agree (5.3.7). The SEA cautions against the use of pellets which can get washed away from where they are applied, into non-target areas.

- All methods that remove the grass layer are inherently problematic, exposing the soil to harsh sun affecting cyanobacteria, drying out the soil and also exposing it to erosion.

SEA Response: Agree (5.3.5)

- Aftercare & Bush farming / “energy farming”: Aftercare is as important as the original bush thinning, for all methods used. There is a fundamental conflict between a bush farming approach (on one hand) and restoring rangelands (on the other hand). Let me explain. Following disturbance such as bush thinning there is a process of ecological succession whereby the composition gradually changes (e.g. from annual species to perennial grazing grasses). If a site is repeatedly harvested (say every 10 – 15 years) the process of ecological succession will not be able to proceed to a climax state. The perennial grasses which are the end point of this succession process are essential to optimise grazing, they are generally more nutritious, they protect the soil even in the non-growing season because their roots remain alive, and they create spongy topsoil conditions that allow rainfall to penetrate - thus increasing soil moisture and groundwater recharge while reducing surface runoff that causes erosion. Perennial grasses, because they also provide permanent cover (though partial) even when grazed or burned, they protect the soil thus reducing soil temperature and moisture loss, allowing soil microbes to operate etc.

SEA Response: Agree (5.3.6 and 5.3.10)

- Bush types are very different and cannot be treated as homogeneous. For example; Mopane is of very low diversity and often in lower rainfall areas. There is very little known about these ecosystems, but it is clear that there is a high risk of soil erosion due to poor grass cover if bush thinning is done. Another example; *Terminalia sericea*, where it is dominant, is always on deep sand which has no intrinsic soil fertility. Fertility is entirely dependent on the recycling of nutrients



associated with organic matter. Bush thinning here would have to be a very low percentage of the bushes/trees – otherwise a desert will be created (Strohbach, pers comm, has done experimental research). *Dichrostachys cinerea* / *Terminalia prunioides* habitats often include many broadleaved trees (high diversity) except where it is on old cultivated lands. Selectivity in harvesting is extremely important because of this. These habitats also include many protected species. *D.cinerea* leaves a seed bank in the soil so that regrowth is from seed as well as from stumps. This has implications for aftercare. By contrast *Acacia mellifera* seeds do not remain viable in the soil if they don't grow in the first year. This has different implications for aftercare.

SEA Response: Recommendations on the desired bush density after thinning recognise the differences between bush types (Appendix B Annex 2)

- De Klerk (2004) provides an excellent summary of extensive research findings on African sanannas. Impacts can be inferred to some extent if the assessment is done by somebody with thorough understanding of the implications of the ecological research. For example, at least one study found that soil fertility tends to decline with distance from bush or trees. Therefore all harvesting must leave all big trees (say 4m high) as well as many bush clumps in every hectare. The amount of bush and trees to be left depends on the habitat and soil type.

SEA Response: Catered for in the recommendations on desired bush density after thinning

- Grass species are different depending on their relationship to trees /bush or in the open patches of the veld.
- Slope gradients are a very important factor affecting the risk of soil erosion following harvesting.
- Certain entire habitats should simply be excluded from harvesting (e.g. *Spirostachys* / tamboti and others identified by Strohbach (specialist botanical report) for Colin Christian & Associates – EFF EIA study (2010).
- Trees of diameter 18cm+ are very large trees in the context of most bush-encroached areas. This is far too big – the limit for harvesting should be far less. One specialist on birds recommended that trees larger than 4m high should not be removed (Rob Simmons – in Colin Christian & Associates (April 2010) Energy for Future EIA. Strohbach, pers comm, suggested 15 cm maximum diameter, but this will be too large for certain habitats where small species of protected trees are common e.g. Commiphora species. This again draws attention to the difficulty of generalising for all habitats.

SEA Response: The 18cm diameter threshold conforms with the Forest Act Regulations, so is used to define 'large' trees to keep consistency in the sector. All protected species should not be killed or damaged. (Appendix B Annex 2)

Overall, the impacts of bush harvesting depend on the quality of effective implementation of the recommendations of good, locally specific EMPs. **The quality of management and compliance is one of the biggest variables in determining the environmental impacts.** Good management based on sound ecological understanding has the potential to improve rangelands (subject to restoring the all-important perennial grasses), groundwater recharge, and maintain biodiversity. Poor management, which will inevitable if local habitats are not sufficiently understood or there is insufficient commitment to close supervision, will usually result in reduced biodiversity, failure to restore perennial grasses, reduced grazing capacity, and loss of soil fertility over a few years or more (depending on the soil type). The risks of losing soil fertility are lower with clayey soils and higher with sandy soils (all other things being equal – which they are not!)



These benefits will not be automatic and the environmental risks of poor implementation need always to be stated as well. This must be done in a transparent manner in the interests of good decision-making by the authorities and by affected parties. Commercial interests should not “sell” bush harvesting projects on the basis of the assumed benefits while ignoring (or worse, trying to hide the environmental risks and adverse impacts as we have seen in this industry so far).

While full scientific certainty is often not possible in detail (as it will vary from site to site) it can be said that certain activities will present a high risk of ecological damage, loss of biodiversity, loss of soil fertility etc. e.g. Bush farming is a high risk approach anywhere in Namibia’s savannas. Likewise, bulldozing is an unacceptably very high risk approach.

Because of the vast scope and complexity of the subject matter for this SEA, a **multi-disciplinary team** is needed to present an adequate summary of the ecological functioning of the various savanna types / bush habitats, and identify the environmental impacts and risks.

EIAs are needed for project-specific proposals in particular localities. Broad generalisations in an SEA will not serve the needs of environmental management in these highly diverse, and sensitive environments.

SEA Response: The problem of bush encroachment will grow, and put Namibia’s rangelands in worse condition, if it is not actively combated. Demanding a complicated, expensive, long approach to allow any bush harvesting operation to proceed, will make the problem worse. The SEA recognises the dangers of over-generalising, but suggests that most of the negative impacts of debushing can be addressed without requiring project-specific EIAs. A generic EMP, with some local, site-specific tuning, can help to streamline the legal process to allow bush thinning to proceed on a large scale.

Public Participation / Consultation with all Interested & Affected Parties

One of the key requirements of the EMA (2007) and its Regulations (2012) is comprehensive consultation with the people affected. This needs to be done for this SEA.

Furthermore, public meetings need to be held throughout the areas where bush harvesting is intended – not just in Windhoek and Otjiwarongo. Since 2010, many farmers have now had an opportunity to see the benefits and adverse impacts of bush harvesting, and have valuable experience to offer regarding the impacts thereof.

Previous meetings convened by the GIZ have been by invitation only, without advertisement in public invitations.

For example, at one of those meetings (in March 2015) – attendees were selectively invited, there was no public invitation in the press for example, the meeting was held in Windhoek only, and few or no farmers were present.

A further example, the Outcome Report of a meeting with GRN and NamPower (April 2014) also states GIZ’s intentions (under Road Shows ...) where GIZ’s understanding of meetings consists of telling people what should be done rather than asking the affected parties what their views are. GIZ’s approach and stated intentions shows no understanding of the Principle of thorough public consultation to determine their needs and interests – as required under the 12 principles in the EMA (2012).



The few case studies in your Draft report fall far short of the **public (I&AP) consultations** that are envisaged in the EMA (2007) and Regulations (2012).

SEA Response: The public participation process was admittedly short and not widespread, but this did not jeopardise the process of sampling farmers concerns. Little further value would have been added by undertaking a longer and more thorough public consultation process.

Bush thinning practices:

All methods of bush thinning require a very high level of training and full-time supervision by a competent person on site. Experience has shown that this is true whether the methods are predominantly labour intensive or mechanical.

SEA Response: Training is emphasised (6.6)

Manual bush thinning

- This work is extremely hard on the human body in Namibia's heat, dust and dryness.
- Will the work force stay? (Charcoalers report a very high staff turnover.)
- Can the necessary volumes be harvested manually?
- Vulnerability to labour unrest.
- Difficult to train and supervise a large workforce.

Mechanical ~~Clearing~~ Bush thinning

- The high tech approach of Energy for Future failed because even these purpose-made heavy duty harvesters broke (Schuette and Konzmann, EFF, pers comm),
- These big machines, although very manoeuvrable (on tracks) were not operated selectively enough, so many non-target species were destroyed, including protected species,
- Large expanses of bush and trees were cleared with no bush or trees left,
- Machines need to be on tracks to minimise the compaction of the soil / spread the load per cm², and to avoid punctures!
- A system in which encroacher bush species are selected and cut one-by-one, then put through a separate shredder, would make it easier to be more selective,
- EFF harvested many large trees despite the fact that the EMP required no cutting of trees taller than 4m. If machines were developed that make it physically impossible to cut trees bigger than a certain diameter that would help to minimise the needless destruction of large trees. Perhaps a hoseshoe-shaped "yoke" of a certain diameter could be incorporated in the design of cutter heads so that only trees that are smaller than the 'yoke' can be cut. It is the smaller bushes that are causing the loss of grazing capacity. (Strohbach, pers comm, suggested 15 cm maximum diameter, but this will be too large in my opinion for certain habitats where small species of protected trees are common e.g. Commiphora species.),
- Non-problem bush species need to be left because they provide browsing for cattle, goats and wildlife such as kudu. These browser bush species include genera such as *Rhus* (now named *Searsia*).

Chemical ~~Clearing~~ bush thinning (by aerial means or hand applied to soil)

- Aerial application (by spraying or pellets) cannot be selective and should therefore be banned.
- Hand application to soils is potentially more selective in the hands of people who are well trained and well supervised. However it poses a risk to desirable species. E.g. a farmer



reported killing a big Marula tree that was 50m away from where the pellets were placed. Later root extension is often far in these arid areas.

- Arboricides (pellets applied to stems/soil by hand) have a number of advantages and I am beginning to think that they may provide much safer treatment of bush than the unselective harvesting that we have seen to date, because
 - Dead bush remains in place until the grass has grown, providing protection from grazing, a bit of shade and wind protection,
 - Soil is not disturbed,
 - There is little opportunity for other problem bushes (e.g. Vaalbos) to replace the target species,
 - Pellets remain effective for a few years (depending on soil type and probably rainfall) so that woody seedlings are suppressed giving the grass a better chance to outcompete woody seedlings,
 - The manual work is much easier on the human body than hand cutting, and may be more sustainable for this reason.
 - Nutrients and organic matter are returned to the soil as the dead bush decomposes or may be burned during natural fires or managed fires.
- The points above about larger trees and browser bushes are also applicable to all other methods.

Fire

- The total exclusion of natural fires is one of a suite of factors, all acting in concert, which has caused bush encroachment.
- Fire is not effective in killing mature bushes of some species (e.g. *Dichrostachys* and *A.mellifera*) but it does kill young seedlings. It is therefore more effective as an aftercare tool than for primary treatment of bush.

CONSIDERATION OF ALTERNATIVES: POLICIES, LAWS AND MANAGEMENT

Section 6.1.1 As explained above, I believe that **there is a fundamental conflict between “bush farming” and restoration of rangelands.**

SEA Response: This SEA explains the negative impacts of bush farming (5.3.10).

During the public participation by Colin Christian & Associates (2010) for the EFF EIA, farmers stated that after about 4 years the regrowth of species like *Dichrostachys* was so dense that cattle could not get in to graze. The number of woody plants per square metre was much greater than before. This has been confirmed by De Klerk and Strohbach.

Now, the proponents of “bush farming” like Energy for Future have argued that, despite the above problem, there would be plenty of grazing available. But that view was expressed by engineers having no understanding of the complex ecosystems that are African savannas, and no ecological training. Furthermore people from northern Europe, (post-glacial environments that are very simple and resilient) do not understand the following:



- the difference between perennial and annual grasses – there are differences in nutritional quality as well for livestock,
- the process of ecological succession from annuals to perennials that is necessary to restore the rangelands, protect the soil and provide other ecosystem services,
- The complex interactions between trees and grassy components that have evolved over hundreds of millions of years,
- The fragility of savanna ecosystems, especially in arid areas where annual variability is extreme (e.g. rainfall).

The above raises concerns about the competence of agencies like the GIZ and commercial companies like Energy for Future, through the GIZ, to be influencing policy or law making on environmental matters. Their expertise is technical and commercial, not ecological or Namibian. The major concern is therefore that European commercial interests may be allowed to override ecological and farming concerns. This risk is high because of the low capacity and limited experience of MET and the Directorate of Forestry – the latter has shown themselves to be soft of law enforcement, even waving the requirements for compliance monitoring in one instance that is known to me.

SEA Response: This SEA cannot comment on these opinions and allegations. The purpose of the generic EMP and streamlining the legal process is to facilitate environmentally safe bush thinning.

BEST PRACTISE OF GUIDANCE & MONITORING

There are two types of monitoring necessary here:

Firstly: Monitoring of Compliance with Environmental Management Plans

- The first is monitoring the compliance with an area-specific EMP during implementation. This has practical difficulties. In dense bush it is often impossible to see what trees are there before harvesting because the bush is too thick and thorny to get in. This makes it relatively easy for operators to conceal their malpractice / non-compliance.

In the case of charcoaling, operators have been reported to cover the stumps of large trees to conceal their illegal / unauthorised cutting of those trees.

- Limited surveillance (before-and after) is possible after the fact e.g. by Google Earth, but that is too late – the damage is done. Real time surveillance by cameras set up on tethered balloons at harvesting sites could theoretically be used to monitor some aspects of compliance (e.g. removal of large trees) but cannot be used to identify species. However this requires a high level of technical expertise just to get the cameras to operate and transmit georeferenced images to a monitoring point. So this would probably not work. Who would fund this and take responsibility?
- As we have already seen, self monitoring by bush companies like EFF does not work because they have neither the necessary knowledge to identify plants or the commitment to do the job selectively, and they are not willing to commit the necessary human resources and money to supervision and compliance monitoring.
- EFF tried to suppress some items of non-compliance in a report that had to be submitted to MET & Forestry. Furthermore, after the first environmental audit they ceased to commission audit reports. Clearly the authorities will have to exercise much stronger will to enforce compliance if bush harvesting / management is to be carried out in compliance.
- The scale of the bush harvesting envisaged by German commercial interests and the GIZ is so large that compliance monitoring presents a vast challenge, but without that many thousands of



hectares of rangelands could be significantly degraded. Effective compliance monitoring will require a large body of suitably qualified and trained Environmental Scientists. At present there are probably not sufficient or sufficiently qualified and experienced people in the private sector or government to cover this function adequately.

- All compliance monitoring needs to be independent of the operating commercial companies.
- In Namibia, despite efforts to increase the capacity of MET by setting up inspectors, the level of capacity to enforce environmental laws is still very low. It will apparently not be ready to handle the scale of operations envisaged by the GIZ and European commercial interests for many years to come. The result of inadequate government capacity could be detrimental to productive rangelands. As I have stated before, bush harvesting will not automatically improve rangelands – that depends on the quality of environmental management during both harvesting and aftercare operations.

SEA Response: The SEA recognises the lack of capacity to monitor and control bush harvesting activities, and urges the authorities to increase staff numbers and skills to keep up with the de-bushing boom (6.2.1 and 6.2.2). Honorary Forest Officers are also suggested.

Secondly: Monitoring of Environmental Impacts

The second type of monitoring that is necessary is to determine the actual impacts of project implementation, both positive and negative impacts.

In 2010, in relation to the EFF bush project, the Directorate of Forestry undertook to initiate a programme of impact monitoring and research. No funds were available at the time, and this has not yet happened.

- A systematic programme of monitoring is needed. Measurable parameters need to be developed that can be repeatable and comparable from site to site.
- Impact monitoring suffers from some of the same difficulties that were experienced and noted above for compliance monitoring.
- The cost of such research will be enormous and it is hard to imagine the GRN committing sufficient financial resources or qualified human resources to this task.

SEA Response: The SEA urges improved monitoring and research, to better inform future bush thinning activities.



REFERENCES

I suggest adding the references to the reports by Colin Christian & Associates which include the one that was funded by the GIZ (Colin Christian & Associates, 2010 on bush and groundwater). It did mention specific environmental concerns and risks. As the sponsors of that study GIZ is in possession of that information.

SEA Response: Included.

This ends my comments on SAIEA's Draft Report.



ISSUE	RESPONSE IN SEA
<p>“The SEA suggests thresholds for the necessity for an EIA and Environmental Clearance under the Environmental Management Act.”</p> <p>I assume this covers a year. Maybe safer to add the time frame</p>	<p>Environmental Clearance is granted for 3 years. This is now stated</p>
<p>“The suggested process for getting permits from DoF (MAWF) and getting Environmental Clearance from DEA (MET) ...”</p> <p>we definitely need a time line here. As it is proposed, DoF or the Commissioner may take years to react to the submission.</p>	<p>The SEA suggests that this process should not take longer than one month.</p>
<p>“The following trees and shrubs are recognised as the main encroacher species in Namibia: ...”</p> <p>Maybe this generalization requires reference to certain areas</p>	<p>The maps in Figure 1 show the main areas of occurrence of the species</p>
<p>2.3.2 If you don't mention the new estimated surface, you agree with Bester's 30mil ha. Please for the sake of detail, this 2.3.2 requires your new estimate.</p>	<p>The new estimate of 45 million hectares is now stated in 2.3.2</p>
<p>3.2.3 “The Meat Board encourages the use of arboricides by selling these chemicals at cost price to farmers”</p> <p>not only them. Farmers receive a subsidized loan from Agribank, thus by implication some financial institutions support this too.</p>	<p>Now stated.</p>
<p>3.2.3 “... aerial spraying is now illegal ...”</p> <p>I understood it is still doable with special permission from DoF???</p>	<p>The Director of DoF has publicly stated that he is willing to consider exceptions to this regulation. It is not clear whether he is legally authorized to do so.</p>
<p>4.1.2 Unless otherwise authorized by this Act, or by a licence issued under subsection (3), no person shall ... cut destroy or remove -</p> <p>(b) any living tree, bush or shrub growing within 100 metres of a river, stream or watercourse.</p> <p>this is very interesting that the river connecting the Hardap dam and Mariental in future may not be cleared anymore to reduce the likelihood of flooding the town.</p>	<p>Presumably the regulation would be waived in this instance</p>
<p>4.1.2 The regulations require that person in charge of a controlled burning must: ...</p>	<p>Agreed. The DoF regulations regarding fire are not very practical.</p>



<ul style="list-style-type: none"> ensure that no burning is done when the day temperature is exceeding 25 degrees Celsius or wind exceeding 20 kilometres per hour or in combination thereof during the months of April to July. <p>A person who applies for the controlled burning for the purpose of bush control or the removal of old overgrown grass must inform all neighbours in writing and obtain written approval from the neighbours 24 days before the burning is done.</p> <p>the months April to July are questionable. Furthermore, nobody will know the temp and wind 24 days prior to set the fire.</p>	
<p>5.3.4 Charcoal kilns produce smoke, although if they are operated efficiently, this should be very little. The smoke usually disperses quickly in the open air and this is helped by any small breeze. ...</p> <p>please provide the expert view prior to make such a generalization. This smoke is a cause of reducing the condensation factor so that rainfall pattern has changed.</p>	<p>Smoke from kilns is very little relative to what is produced from veld fires and vehicle fumes. But yes, every small amount of ash and CO2 into the atmosphere contributes to global climate change. This is now stated in the SEA.</p>

IAP 3: Peter Cunningham 8 Feb 2016

ISSUE	RESPONSE IN SEA
1. All maps currently in use are coarse and would need refinement & fieldwork to verify.	Agreed, see 1.3 and 2.3.2
2. Using 1.5 or 2 TE could also be too coarse - much more complicated than that & farmers might abuse.	Agreed. The complexity of the bush encroachment issue is realized (1.3) but at the same time some simple guidelines are necessary.
3. No mention of the fact that bush thickening could be natural and/or cyclic - See my paper on 150 yrs ago, etc.	See 2.1. The definition of bush encroachment includes natural causes.
4. No simple solution - system much more complex than we think - requires dense patches even, especially with a mosaic approach, etc.	The EMP (App B) emphasizes that veld after thinning should be heterogeneous.
5. More emphasis should be given to FSC certification for charcoal industry - only sanity in the industry at present.	See FSC guidelines
6. Also see: Cunningham, P.L. & Joubert, D.F. 2003. An environmental impact assessment on bush control methods proposed under the bush	



<p>encroachment research monitoring & management project. IDC, 9 July 2003.</p> <p>Cunningham, P.L.1997. Pilot Study to Determine Densities of Certain Species and the Potential Wood Biomass Suitable for Charcoal Production. Internal report, Polytechnic of Namibia, Department of Natural Resource Management and Tourism, Windhoek.</p> <p>Cunningham, P.L.1997. Ecological Consequences of Bush Thickening with Special Reference to Namibia. Internal report, Polytechnic of Namibia, Department of Natural Resource Management and Tourism, Windhoek.</p>	
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APPENDIX D: FORESTRY STEWARDSHIP COUNCIL GUIDELINES

The Forestry Stewardship Council provides guidelines on sustainable use of forestry resources. It is an international body, so the guidelines are directed to genuine forests, not the woodlands and bush encroached savannas that typify Namibia. Nevertheless, the guidelines include important principles of sustainability, and addresses issues around charcoal manufacture that are relevant here. The process of obtaining FSC accreditation has been described by one stakeholder as ‘the only sanity in the industry at present’.

FSC accreditation is done through an organisation called Soil Association Woodmark. A Woodmark generic standard and checklist, adapted for Namibia, is used by certified Namibian inspectors to verify whether an operation complies with FSC principles.

The standard is divided into 10 sections, each corresponding to one of the FSC principles. Within each principle, there are criteria which must be met.

Principle 1: Compliance with laws and FSC principles

These criteria ensure that all national and local laws and administrative requirements are met and legally prescribed fees paid. Also there must be compliance with international treaties and agreements to which the country is a signatory. Forest management areas should be protected from illegal harvesting, settlement and other unauthorised activities. There must be a long-term commitment to adhere to the FSC principles and criteria.

Principle 2: Tenure and use rights and responsibilities

There must be evidence that the harvester has a legal right (e.g. land title, customary right or lease agreement) to the land on which s/he operates. Local communities with customary tenure shall maintain control to protect their rights or resources.

Principle 3: Indigenous peoples’ rights

The legal and customary rights of indigenous peoples to own, use and manage their lands, territories, and resources shall be recognised and respected. Sites of special cultural, ecological, economic or religious significance to indigenous peoples (such as rock art, burial grounds) should be protected by forest managers. Traditional knowledge about resources in forest areas (e.g. devil’s claw plants, fruits of indigenous trees) should be compensated if these species are used.

Principle 4: Community relations and worker’s rights

Forest management operations shall maintain or enhance the long-term social and economic well-being of forest workers and local communities. For e.g., communities within or adjacent to the forest management area should be given opportunities for employment, training and other services. Health and safety aspects should be adequately covered, workers should be able to register with unions (e.g. Namibia Farm Workers Union), and a grievance procedure should be in place and known.

Principle 5: Benefits from the forest

Forest management operations shall encourage the efficient use of the forest’s multiple products and services to ensure economic viability and a wide range of environmental and social benefits. The economics of the operation should be demonstrated e.g. annual budget and product values. Local processing should be encouraged. Wasting of resources, and damage to other forest resources, should be minimised. Local economies should be strengthened and diversified. Harvesting should be done to



enhance ecosystem services and resources. Rates of harvesting must be done within sustainable limits.

Principle 6: Environmental impact

Forest management shall conserve biological diversity and its associated values, water resources, soils, and unique and fragile ecosystems and landscapes, and, by so doing, maintain the ecological functions and the integrity of the forest. These aspects should be investigated in an EIA, before harvesting activities start. The EIA should identify Red Data species and sensitive habitats that might be affected, as well as conservation zones (e.g. conservancies, community forests). Any illegal or inappropriate offtake of plants or animals must be controlled. There should be written guidelines for harvesters about minimising damage and mechanical disturbances, and protecting water resources. Pesticides and herbicides should not be used; if they are, they must be strongly justified and reasons given why non-chemical alternatives are not used, and proper equipment and training must be provided. All hazardous chemicals are prohibited. Use of biological control agents must be strictly controlled, and use of GMOs is prohibited. The use of exotic species must be strictly controlled. Conversion of forest to plantations or non-forest land uses should not occur; it must be fully justified if intended.

Principle 7: Management plan

A management plan – appropriate to the scale and intensity of the operations – shall be written, implemented, and kept up to date. The long term objectives of management, and the means of achieving them, shall be clearly stated. It should specify harvesting rates and species targeted, and monitor forest growth and dynamics. It should document the environmental safeguards identified in the EIA. It must specify how species at risk are identified and protected, and show maps with locally relevant features. Workers must be trained and there should be supervision to ensure the management plan is implemented.

Principle 8: Monitoring and assessment

Monitoring shall be conducted – appropriate to the scale and intensity of forest management – to assess the condition of the forest, yields of forest products, chain of custody, management activity and the social and environmental impacts. Monitoring procedures should be consistent and replicable over time. It should keep track of yields, growth and regeneration rates, changes in flora and fauna, environmental and social impacts, economics of the operation, and documentation for following a ‘chain of custody’ for any products. Results from monitoring must be included in the management plan. Monitoring results should be publicly accessible.

Principle 9: Maintenance of high conservation value forests

Management activities in high conservation value forests shall maintain or enhance the attributes that define such forests. Decisions regarding high conservation value forests shall always be considered in the context of a precautionary approach.

Principle 10: Plantations

Plantations shall be planned and managed in accordance with principles 1-9, and Principle 10 and its criteria. While plantations can provide an array of social and economic benefits, and can contribute to satisfying the world’s needs for forest products, they should complement the management of, reduce pressure on, and promote the restoration and conservation of natural forests.



Strategic Environmental Assessment of Large-Scale Bush Thinning and Value-Addition Activities in Namibia

Harvesting of encroacher bush is expected to increase dramatically in Namibia, with support for bush thinning and value-adding coming from government, donors and commercial institutions.

The Strategic Environmental Assessment study addresses the environmental impacts of de-bushing activities, and helps to ensure that environmental concerns are integrated in the decision-making process. A specific output of this report is the Generic Environmental Management Plan to facilitate the process of permitting and environmental clearances for all bush utilisation projects.

The study cautions a “de-bushing boom” might target the wrong trees, namely large trees, including browser and protected species that bring the most ecological benefits. An emphasis is placed on selective bush thinning rather than bush clearing. It calls for strong capacity in the government departments responsible for controlling bush harvesting operations, to minimise the negative impacts of de-bushing.