POLICY BRIEF

APRIL 2020

Bush Control and Biomass Utilisation Project

Greenhouse Gas Assessment of Bush Control and Biomass Utilisation (BCBU) in Namibia

KEY MESSAGES

- **Bush vegetation currently covers more than half of Namibia's land area. Woody encroachment into grasslands has significant negative impacts on agricultural production, ecosystem services and biodiversity. At the same time, bush biomass plays an important role for Namibia's reported status as a net carbon sink.**

- **Most bush control and biomass utilisation practices that are economically viable are associated with net GHG emissions. However, these emissions can be minimised by the use of innovative technologies. Furthermore, the study found that the successful restoration of bush-encroached rangelands could in fact serve as a mechanism for carbon sequestration.**

- **If land restoration and clean technologies are mainstreamed into the bush biomass sector, GHG emissions even from large scale bush utilisation are estimated to still be significantly lower than the estimated carbon removals from ongoing additional bush growth. At the same time, scaling up the sector promises large socio-economic benefits through domestic value chains such as charcoal, energy, livestock and animal feed production.**

ACKNOWLEDGEMENTS

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The analysis, results and recommendations expressed in this brief represent the opinions of the authors and are not necessarily those of GIZ. The full report is available online at www.dasnamibia.org/download.

THE AMBIVALENT ROLE OF BUSH BIOMASS IN NAMIBIA

In Namibia, encroachment by both indigenous and alien woody species into grasslands is a major economic and ecological problem. Bush vegetation currently covers an estimated 45 million hectares of the country (SAIEA 2016) and has significant negative impacts on livestock production, ecosystem services and biodiversity (de Klerk 2004; Sirami et al. 2009; Smit and Prins 2015). The resulting economic losses call for upscaling of bush control and biomass utilisation measures to restore rangeland and diversify farm income. The Namibia Nature Foundation (NNF 2016) estimated that a total net economic benefit of N$48 billion can be generated over a 25-year period if 60% of bush encroached area was thinned.

Bush biomass and the carbon stored therein play a significant role with regards to Namibia's overall greenhouse gas (GHG) budget and the country's reported status as a net GHG sink. Namibia's Policy on Climate Change (2011), National Climate Change Strategy and Action Plan (2013), Third Communication to the United Nations Framework Convention on Climate Change (UNFCCC 2015) and Intended Nationally Determined Contributions (2015) to the Paris Agreement emphasise Namibia's commitment to further increase the national GHG sink capacity. However, these targets remain remarkably vague on the corresponding consequences for policy and practice in the Namibian bush biomass sector.

The urgent need to control bush encroachment for economic and ecological reasons on one hand and the importance of bush biomass as a terrestrial carbon stock on the other hand require a thorough understanding of the climatic impact of large-scale bush control and biomass utilisation. In a first step towards building such understanding, the Bush Control and Biomass Utilisation Project commissioned a study to analyse and quantify the impact of different large-scale bush thinning options in Namibia on the country's GHG emission budget. The study estimates the consequences of bush control in terms of carbon stock changes in the bush biomass pool and in soil organic carbon as well as potential GHG emissions after harvesting (e.g. due to increased livestock numbers). The aim is to identify those approaches and strategies to bush control and biomass utilisation which maximise economic and ecological benefits while harmonising these efforts with the (re-)formulation of national climate change mitigation targets.

KEY FINDINGS

Carbon stored in Namibia's bush systems

The study focused on Otjozondjupa Region, and extrapolated the corresponding findings to the national level. In Otjozondjupa, it was found that bush encroached areas cover about 8.6 million ha, storing an estimated 123.9 million tons of carbon (tC), corresponding to an average of 14.5 tC/ha (or 30.81 t dry matter/ha expressed in biomass).

A further estimated 146 million tC are stored as soil organic carbon (SOC), resulting in an average of 17.1 tC/ha. In total, this means that bush encroached land stores an estimated 31.6 tC/ha.

Reference savanna ecosystems (mixed woody/grass savanna) cited by the study are estimated to store slightly more carbon than bush-encroached land. While the carbon stored in their biomass is estimated to be less, they are assumed to store more soil organic carbon than bush encroached land.

Most of the bush control practices are estimated to result in net GHG emissions over a period of 20 years. The magnitude of these emissions depends on the respective management practice applied. A strong case is made for rangeland restoration at landscape level with thorough aftercare measures (management practice 2 below).

Bush Management Scenarios

The various bush management practices assessed and quantified by the study are described in Figure 1 on the right. It is estimated that the highest emissions are caused in charcoal production (management practice 4) when using a traditional Namibian steel drum kiln. Replacing these traditional kilns with stationary retort kilns is expected to have a significant emission reduction impact by up to 50% as shown in Table 1 below.

Table 1: ***Bush charcoal production – Kiln technology matters***

The GHG balance show potential mitigation options, if the charcoal industry gradually adopt retort kiln technology. Figures are referring to a 20-year period.

Kiln technology	Emissions tCO_2e/ha	Emissions tCO_2e / ton charcoal
Namibian traditional drum kiln	16.86	2.83
Namibian retort kiln (mobile)	16.37	1.87
Retort kiln (stationary, small scale, incl. transport)	10.14	1.06
Industrial retort kiln (incl. transport)	8.48	0.85

Emission estimates related to domestic energy production from bush biomass (management practice 6) take into account substitution of the 2010 Namibian power mix. If bush biomass energy was used to exclusively substitute electricity imports from the Southern African Power Pool (SAPP), the net emissions would be further reduced. Taking into account the sequestration effect through (re-)growth of bush biomass, the study estimated the net emissions per MWh from domestic electricity generation based on bush biomass to be 24% of those associated with the 2010 Namibian power mix and a mere 12% of those associated with the SAPP.

Bush control practices which actively increase soil fertility through soil carbon sequestration should be promoted. The study found that despite major uncertainties, rangeland restoration at landscape scale – if implemented optimally – can increase the carbon sink potential, livestock carrying capacity, adaptive capacity of the ecosystem and further benefit biodiversity and groundwater recharge.

Figure 1: ***Estimated emission factors for different bush management practices***

- All below figures are given in **tons of CO_2 equivalent per hectare** and over a 20 year period
- **Positive figures** refer to GHG emissions into the atmosphere, **negative figures** refer to sequestration of carbon from the atmosphere.
- **Percentages harvested** refer to harvestable biomass only, i.e. encroaching non-protected species with stem diameters below 18 cm

6.24

Management Practice 1: Chemical control
Chemical bush control (90% of bush biomass) for subsequent livestock farming at double stocking rate

-7.1

Management Practice 2: Rangeland restoration
Mechanised bush control (78% of bush biomass) + aftercare with arboricides. Subsequent livestock farming at triple stocking rate & bushblok, feed and/or pellet production

8.3

Management Practice 3: 'Bush farming'
'Bush farming' for energy & bushblok, feed and/or pellet production. Mechanised bush control (78% of bush biomass in year 1 and 13). No aftercare, no additional livestock

6.3 (IR)
14.4 (T)
(T) (IR)

Management Practice 4: Bush-to-charcoal
Bush control (63% of bush biomass) for medium-scale charcoal production + aftercare with arboricides. Subsequent livestock farming at double stocking rate. Total emissions depend on kiln type: Traditional (T) / Industrial retort (IR)

1.6

Management Practice 5: Firewood harvesting
Manual bush control (50% each 7 years) for use as firewood. No aftercare, no additional livestock.

12.6

Management Practice 6: Bush-to-energy
Mechanised bush control (90% of bush biomass) for large-scale electricity generation + aftercare with arboricides. Subsequent livestock farming at double stocking rate.

A restored rangeland produces a heterogeneous environment with high biodiversity and productivity.

Future National Bush Utilisation Scenarios

Three scenarios for bush utilisation at national level over the next 20 years were considered. All of these assume a continued bush growth and encroachment rate of 3%, which has a large estimated carbon sequestration impact of more than -80 $MtCO_2e$.

The baseline scenario assumes continuation of current bush control and biomass utilisation activities over the next 20 years. The major emission source in this scenario is the continued use of traditional kilns for charcoal production, which reduces the carbon sequestration potential to about -40 $MtCO_2e$.

Future scenario 1, in addition to the baseline scenario, assumes successful rangeland restoration and the establishment of a 20 MW bush biomass power plant. Successful rangeland restoration would balance some of the emissions from charcoal production, resulting in an estimated carbon sequestration potential of close to -60 $MtCO_2e$.

Future scenario 2 assumes massive upscaling of bush control activities in the form of charcoal production from currently about 120,000 ha/year to 320,000 ha/year, with 85% of charcoal production being based on industrial retort kilns and 15% on traditional kilns. It further assumes the installation of 40 MW bush biomass power and the successful rangeland restoration of 130,000 ha/year. Assuming ideal achievement of the latter, this scenario would even result in a higher overall carbon sequestration (-51 $MtCO_2e$) than the continuation of the current baseline activities over the following 20 years (-42 $MtCO_2e$).

Figure 2: ***National-level activity scenarios for different combinations of bush management practices over the next 20 years***

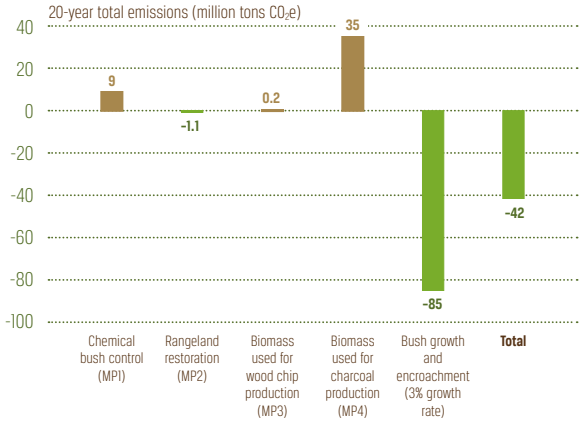
(figures in million tons of CO_2 equivalent over a 20 year period)

Baseline Scenario: Continuation of current activities

Total area under bush control: 198,510 ha/year

MP1: 68,000 ha/year
MP2: 7,500 ha/year
MP3: 1,200 ha/year
MP4: 121,810 ha/year

Estimated net emissions over 20 years: - 42 $MtCO_2e$

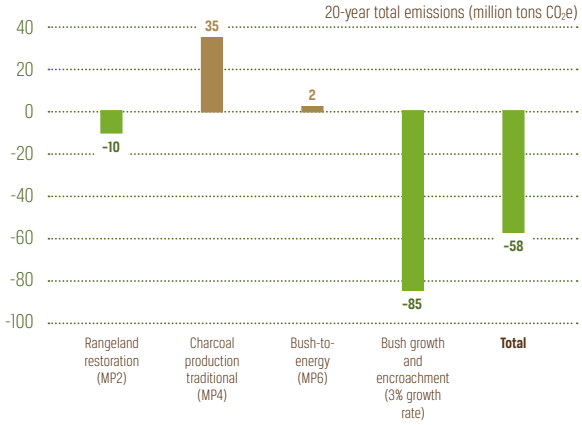


Future Scenario 1: Rangeland restoration and 20 MW bush-to-energy

Total area under bush control: 196,742 ha/year

MP2: 68,000 ha/year
MP4: 121,810 ha/year
MP6: 6,932 ha/year

Estimated net emissions over 20 years: - 58 $MtCO_2e$

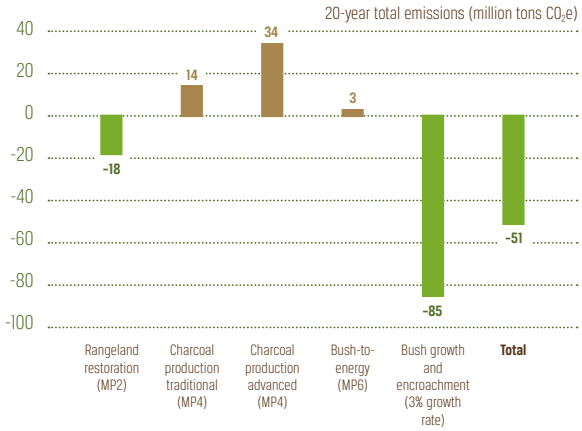


Future Scenario 2: Rangeland restoration, large-scale charcoal, 40 MW bush-to-energy

Total area under bush control: 463,864 ha/year

MP2: 130,000 ha/year
MP4 (T): 50,000 ha/year
MP4 (IR): 270,000 ha/year
MP6: 13,864 ha/year

Estimated net emissions over 20 years: - 51 $MtCO_2e$



POLICY CONSIDERATIONS

- Scaling up bush control and biomass utilisation has significant potential economic and ecological benefits but will likely reduce the estimated carbon sequestration potential associated with bush biomass unless sustainable rangeland restoration is achieved. The latter requires appropriate aftercare of bush-thinned areas. Maximum carbon sequestration is expected under moderate harvesting of 50% bush biomass.

- Legislative issues needing clarity and enforcement must include:
  - Bush control activities main objective should be to restore habitats at landscape level.
  - Bush harvesting intensity should not exceed 80% of standing harvestable biomass. Accordingly, non-selective harvesting approaches should only be allowed in justified cases.
  - The GHG emissions of bush-based charcoal production can be reduced significantly through the widespread introduction of stationary retort kiln technology.

- Given the multi-dimensional aspects of BCBU, a multi-sectoral approach is required in which the different national ministries and interest groups align their BCBU-related policies and activities under a coordinating body to minimise the trade-off between climate-related and economic benefits.

- The exact impact of bush encroachment and removal on soil carbon stocks is still uncertain and requires further research. The MEFT could consider integrating the carbon model application developed in line with this study into future national GHG inventories and mitigation target setting in the Namibian AFOLU sector. Such considerations may also include the potential of biochar as a means of both mitigation and soil improvement.

- Climate change mitigation of the bush biomass sector should not be considered in isolation, but together with the climate change adaptation potential, of bush-based value chains, such as charcoal and animal fodder production, that can contribute to diversification of livelihoods and farming income as well as biodiversity conservation and increased ecosystem services.

Bush encroached stands produce a homogeneous environment with low biodiversity and productivity.

Redressing bush encroachment impacts have been prioritised at national and international level through the Namibian Government ratification of the 3 Rio Conventions. Hence rangeland restoration is key in:

- Achieving mitigation and adaptation targets within the UNFCCC, through the new Partnership Plan under the NDC Partnership
- Promoting conservation and sustainable development objectives within the Convention on Biological Diversity
- Combating desertification and mitigating the effects of drought within the United Nations Convention to Combat Desertification.

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