SYNTHESIS PAPER

SHAPING A SECTOR

A Decade of Targeted Sector Development for Bush Control and Biomass Utilisation in Namibia

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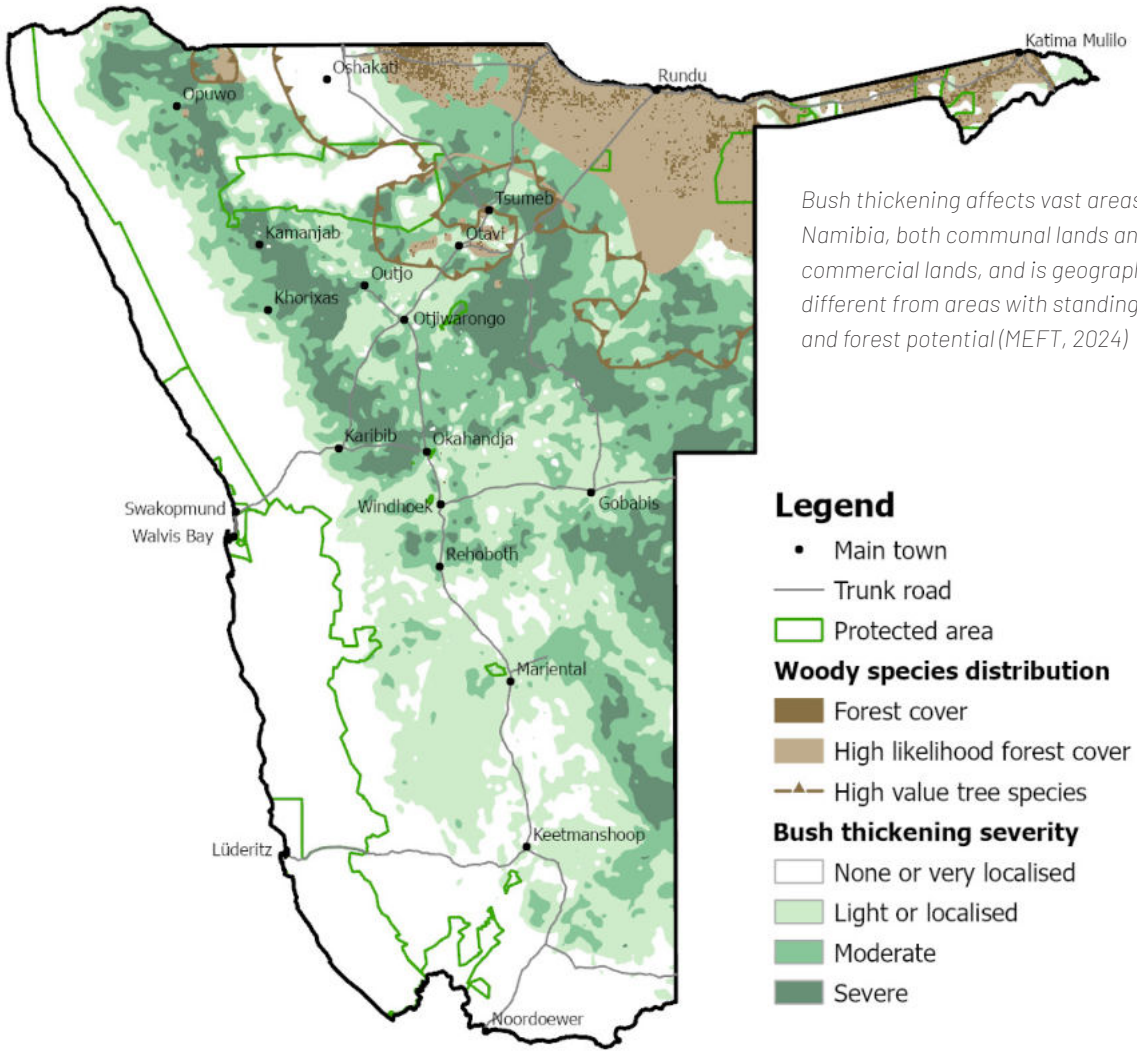
The Namibian bush-biomass sector presents a unique opportunity where ecological restoration and economic potential of natural resource utilisation intersect. By capitalising on the abundance of woody biomass, the Namibian bush-biomass sector has successfully turned what was once considered a problem, 'woody plant encroachment', into an opportunity for economic benefit and ecological restoration. Over the past decade, significant progress has been made in leveraging value chains and building institutional capacities for a self-sustained restoration economy.

This synthesis paper draws lessons from the bilateral Namibian-German development cooperation project Bush Control and Biomass Utilisation (BCBU), implemented from 2014 to 2024, and contextualises these lessons within a historical perspective. It is aimed at decision-makers in development agencies, sector support institutions and companies that are interested in furthering the sector's development or are working in similar settings in other countries.

1. Point of departure: the growing ecological and socio-economic pressures caused by woody plant encroachment

Woody plant encroachment has long been known as a global phenomenon that occurs in grassland ecosystems on different continents. Globally, a substantial portion of grassland is affected by the excessive growth of woody plants, which leads to the decline of several ecosystem services. Its causes include unsustainable land management practices, such as overgrazing and suppression of wildfires, and climate change as an accelerating factor (Stevens et al., 2017; Archer et al., 2017; Eldridge et al., 2011). However, grasslands arguably remain the Cinderella of ecosystems. They cover around 40 per cent of the global terrestrial land area and hold a third of the global above-ground vegetation biomass. Yet, their maintenance and restoration receives less attention than that of other ecosystems, especially forests. Tellingly, grasslands are frequently targeted for afforestation efforts, even in areas that have historically not featured forests and hold no such potential (Bond et al., 2019; Parr et al., 2024). Due to this imbalance in public awareness, restorative efforts that involve the systematic reduction of woody cover require significantly more narrative and justification than other measures of ecosystem restoration.



Bush thickening affects vast areas of Namibia, both communal lands and commercial lands, and is geographically different from areas with standing forest and forest potential (MEFT, 2024)

1940s to 1950s: Realisation

In Namibia, it is estimated that most grassland featured its original vegetative characteristics until the 1940s. However, early evidence of encroachment was observed and strikingly a governmental report predicted, "should this process of deterioration of the vegetation be allowed to continue the result would be devastating" (Long-Term Agricultural Policy Commission, 1949). Walter and Volk conducted their now widely cited vegetation assessments at the time and predicted woody encroachment, identifying overgrazing and the absence of wildfires as the main causes (Walter and Volk, 1954).

1960s to 1970s: Counter measures

It would take until the 1970s for a notable level of response measures to be implemented by individual farmers and for the former Department of Agricultural Technical Services to issue respective recommendations. Practices included not only the removal of unwanted bush, but also its utilisation. Among the early and innovative value chains were bush-based animal feed and charcoal production. In 1979, it was estimated that around 8 million hectares of Namibian rangeland were affected by woody encroachment (Bester, 1996).

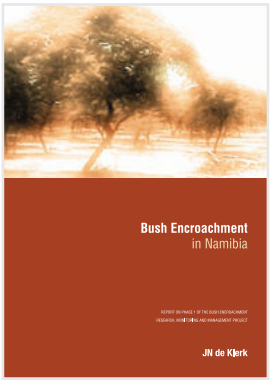
1980s to 1990s: Coordination efforts

In 1988, farmers established the Bush Utilisation Association, which was affiliated to the Namibia Agricultural Union and a response to growing charcoal production in the areas of Outjo and Grootfontein.

A National Woodland Management Council was introduced in 1997 as a mechanism to govern the utilisation of bush-wood in the country, but it was short-lived. The council was dissolved since it lacked a legal structure and was unable to enforce its own resolutions. The idea to transform it into a national board similar to the Meatboard were not realised, because it was found that **the sector lacked the required magnitude to justify such institutionalisation**. Efforts to institutionalise sector coordination subsequently lost momentum and would only be revisited two decades later.

2000s: Mechanisation and scaling

The following years paved the way for mechanisation and industrialisation in the sector. The National Development Corporation as well as different line ministries commissioned various studies on the potential of bush-biomass for value chain development during the years 2002-2003, including business plans for wood chipping and charcoal processing. It was the Cheetah Conservation Fund that pioneered the first industrial scale production facility, introducing wood briquettes in 2002. The production of the so-called Bushblok would come along with certification by the Forest Stewardship Council, constituting the first internationally recognised sustainability certification for a bush-based value chain.



During the same time period, international partnerships were formed to mobilise development support. With funding by the Government of Finland, the Bush Encroachment, Monitoring and Management Project was introduced. It produced the landmark study **"Bush Encroachment in Namibia" by J.N. de Klerk**, published in 2004. The study sparked momentum that translated into policy making, but the Draft Bush Encroachment Management Policy of 2006 was never introduced. Updated estimations now placed the land area affected by woody encroachment at 26 million hectares (Zimmermann & Joubert, 2002).

The turn of decades yet again came with a leap in development, namely the first large-scale mechanised harvesting operation. In 2011, Ohorongo Cement began sourcing 20,000 to 50,000 tonnes of wood chips annually to substitute imported coal for heat production (see photo). This development opened up an international perspective for bush-biomass utilisation in Namibia, as it constituted the first foreign direct investment into bush harvesting. It also coincided with NamPower's early investigations into the feasibility of large-scale harvesting for an on-grid biomass power plant, for which a pre-feasibility study funded by the KfW Development Bank was conducted in 2012.

Despite pioneering investment into sustainable bush utilisation, more radical approaches were still widespread, including the indiscriminate or selective application of chemicals. Without a cohesive national strategy and institutional framework, the utilisation sector remained largely fragmented.

From 2014: Sector formation and alignment

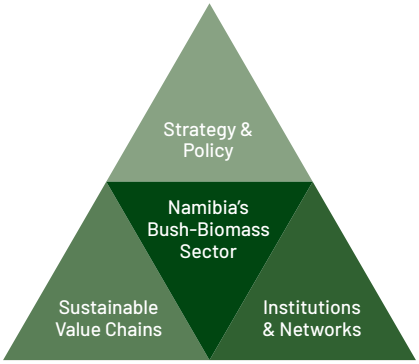
A new opportunity to further leverage the sector's potential came with the launch of the **Support to De-bushing Project** in 2014, which formed part of Namibia's bilateral development cooperation with Germany and was implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), in cooperation with the Directorate of Forestry of the then Ministry of Agriculture, Water and Forestry (now Ministry of Environment, Forestry and Tourism). The project had three consecutive phases, during which it was renamed to **Bush Control and Biomass Utilisation Project**. With a total of ten years of implementation and a broad mandate to promote sustainable solutions, the project constituted the longest and most comprehensive support measure in the field of woody encroachment to date, acting as catalyst for several developments. During the inception years of the project, the extend of woody encroachment was estimated to stand at 45 million hectares (SAEIA, 2016).

2. Ten years of Bush Control and Biomass Utilisation (BCBU): Key principles, lessons and impacts

The BCBU Project was aimed to unlock the economic, environmental and social benefits of bush biomass utilisation for the long-term benefit of Namibia's ecosystems and communities.

While the focus of the project was adjusted with each of its three phases, its mandate and activities generally spoke to the following three core pillars of the bush-biomass sector: strategy and policy, sustainable value chains, institutions and networks.

During ten years of dedicated development efforts spearheaded by the project, the following changes were arguably the most fundamental impacts:



Bush Control and Biomass Utilisation Project

Paradigm shift from "de-bushing" to "bush control and biomass utilisation"

The sustainable use of bush biomass, in large parts substituting the mere removal of excess bush, is anchored in national environmental policy and private sector activity.

Growth and diversification

The well-established charcoal value chain has increased six-fold in terms of revenue. A broad array of other value addition opportunities, from bush-based fodder to construction material, has been explored and sector actors have developed capacities to further innovate and mobilise investment.

Sector consolidation and networks

Professional institutional capacities support knowledge exchange and technology transfer. They leverage international cooperation networks and enable an efficient public private dialogue.

2.1 Strategy and policy

Responses to woody encroachment inevitably involve active alterations of vegetation compositions and therewith ecosystem functions. The complexity of this matter, especially when applied across an area of up to 45 million hectares, invites a multitude of perspectives, research and development approaches. The BCBU project has supported the sector in pursuing a strategy that is based on the following core principles.

Value-addition strategy

While value-addition approaches were among the early responses to woody encroachment in the 1970s and 1980s, control measures used to be dominated by indiscriminate arboricide application and cut-and-burn approaches. Despite the relatively low cost of these methods, they were often ineffective and thus "made the farmers fight a losing battle" (De Klerk, 2004).

BCBU aimed at changing the perspectives and strategy towards managing the bush as a valuable resource.

Putting a price tag to the bush and creating a revenue stream through value-addition proved to be a more enticing bush control option for farmers and landowners.

"Turning a problem into an opportunity" has been fundamental for scaling up bush control measures and represents the main paradigm shift that has been achieved for the sector. Beyond the immediate benefit of additional income and employment, the value-addition strategy links bush control to export opportunities. This in many instances includes strict sustainability criteria, which would be difficult to implement without the income and price premium from international markets.

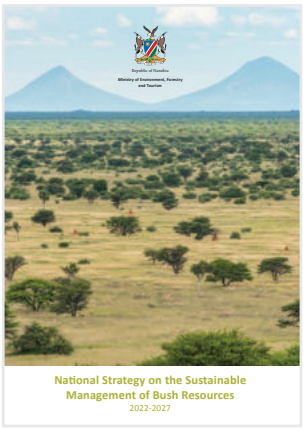
Private sector driven approach

Private actors have been the early movers and pioneers in bush control. This includes individual farmers with multiple on-farm production lines of charcoal, firewood or animal feed, the Cheetah Conservation Foundation with the bushblok production as well as Ohorongo Cement and Namibia Breweries with woodchip production for process heat generation. It remained a valuable principal of BCBU to capitalise on private sector competence and on market dynamics, rather than on public sector budget allocations and initiative.

This focus led to constructive public-private partnerships and cooperation formats, such as an inclusive representation of both government and private sector on the project steering committee, the close collaboration between law enforcement and sector associations (e.g. on matters of fire prevention or the development of biomass quantification methods) and the engagement of commercial farmers as partners in trainings and value chain development (e.g. to devise bush-based animal feed formulas).

This market-based approach contrasts government driven approaches in many countries. South Africa, for example, has since the 1990s addressed woody plant encroachment and alien species invasion through public works programmes managed by the Department of Environmental Affairs, at a cost of approximately two billion Rand annually.

National framework development



The project supported the formulation of national policy and strategy frameworks for the bush-biomass sector. This most notably includes the National Strategy on the Sustainable Management of Bush Resources 2022-2027 (MEFT 2022), as well as the amendment of the Forest Act and its Regulations, under the Ministry of Environment, Forestry and Tourism.

Linkages to relevant international conventions on climate change, land degradation neutrality and biodiversity are increasingly addressed, but are yet to be fully explored. Moreover, the approach was also mainstreamed into the strategies of other relevant sectors, for example through the Growth Strategy for the Namibian Wood Charcoal Industry, the National Bioeconomy Strategy, the Drought Strategy, the National Renewable Energy Policy, and the Nationally Determined Contributions. These strategy and policy formulations provide for a streamlined policy framework and for a political mandate of the sector at the intersection of agriculture, environment, industry and energy.

Multi-sectoral governance

BCBU aimed for a holistic understanding of the bush encroachment phenomenon and for harmonising different sectoral perspectives. In 2017, the joint publication "Forestry and Environmental Authorisations Process for Bush Harvesting Projects" for the first time combined the perspectives of the ministries responsible for agriculture and forestry on the one hand and environment on the other. The alignment of agricultural and environmental perspectives has yet to fully unfold and is hampered not only by departmental divisions in government, but also by the differing interests of private sector actors implementing bush control (e.g. for the singular purpose of higher cattle stocking rates or for the maximisation of fuelwood supply).

The project has further been instrumental in designing and providing secretarial services to an inter-ministerial Sector Steering Committee. The Steering Committee was chaired by the National Planning Commission and included a wide representation of public sector institutions (including agriculture, environment, industry, energy, labour) and private sector stakeholders (represented by the Namibian Biomass Industry Group). It thus institutionalised the multi-sectoral approach and effectively promoted policy coordination and sector consolidation. Pursuing further institutionalisation of sector governance beyond the bilateral cooperation project, the Ministry of Environment, Forestry and Tourism in 2023 conceptualised the creation of a Biomass Board. A legal mandate will be provided through the Forest Act Amendment Bill, which was yet to be submitted to Cabinet at the time of writing.

Selected activities and milestones at a glance

- Multi-sectoral Sector Steering Committee established
- Consultation process towards the introduction of the National Strategy on Sustainable Management of Bush Resources 2022-2027
- Stakeholder consultation and legal drafting of updated Forest Act and Regulations
- Publication of inter-ministerial booklet on forestry and environmental authorisation processes
- Support to the development of a governance framework for commercial bush-harvesting in communal areas, preceded by several pilot projects of bush-based animal feed and charcoal production in communal areas
- Mainstreaming of bush control and biomass utilisation into sectoral policies and strategies, including Growth at Home, Renewable Energy Policy, Drought Policy, Nationally Determined Contributions
- Technical advice on enhanced alignment with relevant international conventions, namely on land degradation, biodiversity and climate change
- Evidence-based policy advisory through the establishment of a geographic information system (i.e. the Bush Information System), bush thickening maps, economic benefit assessments, expert studies on the impact of encroachment on ecosystem services (e.g. groundwater recharge, greenhouse gas inventory, soil organic carbon), as well as a monitoring framework and baseline data collection

2.2 Institutions and networks

Institutional capacity development

As important part of shaping the sector, dedicated efforts went into the strengthening of existing institutional capacities and the creation of new institutions. The Directorate of Forestry (DoF) and its regional offices strengthened their law enforcement capacities. Leading research institutions such as the national universities NUST and UNAM substantially qualified their dedicated research capacities.

Importantly, the private sector received tailored organisational development support. The support helped to establish representative sector organisations speaking to advocacy, market development and innovation. The Charcoal Association of Namibia (CAoN) was able to establish independent and self-sufficient organisational structures. It now represents the interests of more than 1,500 charcoal producing members and drives market development, product diversification as well as the greening of the value chain. The association's evolution is reflected in its various reorganisations over the years, starting with the foundation of the Bush Utilisation Association in 1988, the subsequent rebranding to Namibia Charcoal Producers Association (NCPA) under the umbrella of the Namibia Agricultural Union, the establishment of an independent legal entity under the name Namibia Charcoal Association (NCA) in 2016 and eventually the rebranding to Charcoal Association of Namibia (CAoN) in 2023.

The Namibia Biomass Industry Group (N-BiG) was founded in 2016 in order to organise the interests of the larger biomass harvesters, but also to serve as an umbrella organisation for the overall bush-biomass sector with its diverse value chains. Although the association to this date does not have a stable income stream in the form or levies or similar arrangements, it has quickly grown into an inclusive association, representing a broad array of national and international members, effectively mobilising funding opportunities and investment, informing policy development and developing inclusive supply chains (e.g. small-scale supplier concepts for the integration of communal areas).

Central entry point to the sector

From its initial mandate, to establish the De-bushing Advisory Service for the provision of information days and trainings, the BCBU Project evolved into a central entry point to the sector and a docking station for other support initiatives. Although this is not typically the role of a technical cooperation project, the project office and staff became a natural contact point both for local famers and entrepreneurs seeking advice on bush control methods and related opportunities and for international technology providers and potential investors.

The project regularly hosted delegations from development agencies, consultants involved in feasibility assessments and consortiums from neighbouring countries seeking inspiration for their own support programmes. BCBU served as the seed crystal for players to cooperate and to contribute to the sector. Throughout the years of implementation, and with increasing maturity and independence of the sector associations, this function of an entry point and knowledge broker transitioned to CAoN and N-BiG. Given their experience and standing in the sector, these institutions understand both the local and the international perspectives and are able to effectively broker cooperation opportunities and market access.

International cooperation networks

National bush-biomass stakeholders have been encouraged to enter into international cooperation arrangements and to open up to innovative international perspectives on technologies, concepts and markets. This included the facilitation of business delegations, participation in international trade fairs and sector information events. Tailored business matchmaking programmes allowed international companies to familiarise themselves with the conditions for doing business in Namibia and the exposed national stakeholders to international business models as well as harvesting and processing technologies. The resulting cooperation networks created considerable new sector dynamics in Namibia. The international perspective is crucial, given the that local market dynamics alone will not spur the investment into diverse value chains and modern technologies, due to the small population size and low level of industrialisation of Namibia.

Selected activities and milestones at a glance

- Inception of the De-bushing Advisory Service (DAS) in 2014, which was later integrated into the Namibia Biomass Industry Group
- Conceptualisation of the Namibia Biomass Industry Group (N-BiG) and support to its founding in 2015
- Support to the establishment of the Namibia Charcoal Association (NCA) as stand-alone legal entity, out of the semi-formalised Namibia Charcoal Producers Association (NCPA) in 2016; renaming to Charcoal Association of Namibia (CAoN) in 2023
- Organisational development support through grant agreements with both N-BiG and CAoN
- Strengthening of research capacities through cooperation with both Namibia University of Science and Technology (NUST) and University of Namibia (UNAM)
- Funding of partnership with an international academic institution, including several exchange visits between Germany and Namibia and the conceptualisation of a Biomass Industrial Park
- Long-term support to enhance capacities of the Directorate of Forestry (DoF), through training measures and procurement of equipment for field inspections
- First national conference on bush encroachment in 2015, support to the annual Biomass Fair, and inception of the National Dialogue Platform

2.3 Sustainable value chains

As highlighted, the Namibian bush-biomass sector is built on the premise that the commercial utilisation of natural resources can incentivise and trigger environmental restoration. It is essential that value chain activities actually speak to this premise and deliver respective evidence.

Scalable and replicable solutions

The sheer scope of the bush encroachment problem on 45 million hectares of rangeland is calling for large scale solutions in bush harvesting and processing. Even the combined biomass consumption of the charcoal value chain, amounting to one million tonnes per year, or the potential off-take of the future 40 MW Otjikoto Biomass Power Plant of 200,000 tonnes per year, are far from reducing the extend of woody encroachment at the national level.

Current efforts are estimated to consume less than 20 per cent of the annually available bush biomass, not considering expansion of encroachment and re-growth. The BCBU project has pursued a combination of large-scale opportunities and those that are implementable in a decentralised and partially small-scale fashion.

Building on the initial study "Adding Value to Namibian Encroacher Bush" in 2015 and continuous market research, a number of promising value chains have been supported, including sustainable charcoal, carbon credit eligible biochar, supplementary bush-based animal feed, sustainable building materials, as well as woodchips and pellet production as substitute of fossil fuels in industrial heat and energy generation.

Further to such value chains, large scale biomass projects have been supported, most prominently the Otjikoto Biomass Power Station Project (OBPS) of NamPower. The integration of climate and biodiversity targets into the core business model allowed for project funding through the Mitigation Action Facility. The implementation of the Otjikoto project and its successful operation will be a litmus test for marrying economy and environment in a restoration economy. In addition, a number of international expressions of interest for bush-biomass products have been received and followed up, such as proposed investments into pellet production.

Finally, some innovative and far-reaching approaches have been pursued, such as the substitution of fossil carbon in product groups such as plastics or textiles within a bioeconomy environment, or use of bush-biomass as a carbon carrier for the production of sustainable aviation fuels within the green hydrogen context.

Promoting these different scales will ensure that the sector moves closer to actually tipping the scale, at some point holding further encroachment at bay or even reducing it, while at the same time providing small-scale solutions with low-entry barriers that are replicable across the country and outside the feedstock sourcing areas of large-scale projects.

Voluntary sustainability safeguards

A restoration economy requires integrated environmental and economic perspectives. For this reason, the BCBU Project not only promoted the development of value chains, but concurrently fostered the streamlining of policy and regulatory frameworks, as well as international sustainability certification. Among others, accessing international markets very effectively promotes the introduction of international sustainability criteria for the supply chain.

The sustainability requirements of the European barbecue market led to the development of a localised FSC standard and the subsequent certification of 1.6 million hectares of encroached land. Through direct cooperation with FSC, Namibian charcoal has established a strong branding as the "greenest charcoal" globally (FSC, 2020). While external certification at times is perceived as imposed and as introducing unnecessary trade barriers, it is essential in leveraging the pricing premium for bush-based products that is needed to implement sustainable and restorative practices. Voluntary certification was also a successful mechanism for the organised private sector to meet government half-way, i.e. reducing the pressure on the Directorate of Forestry to ascertain compliance through regular field inspections.

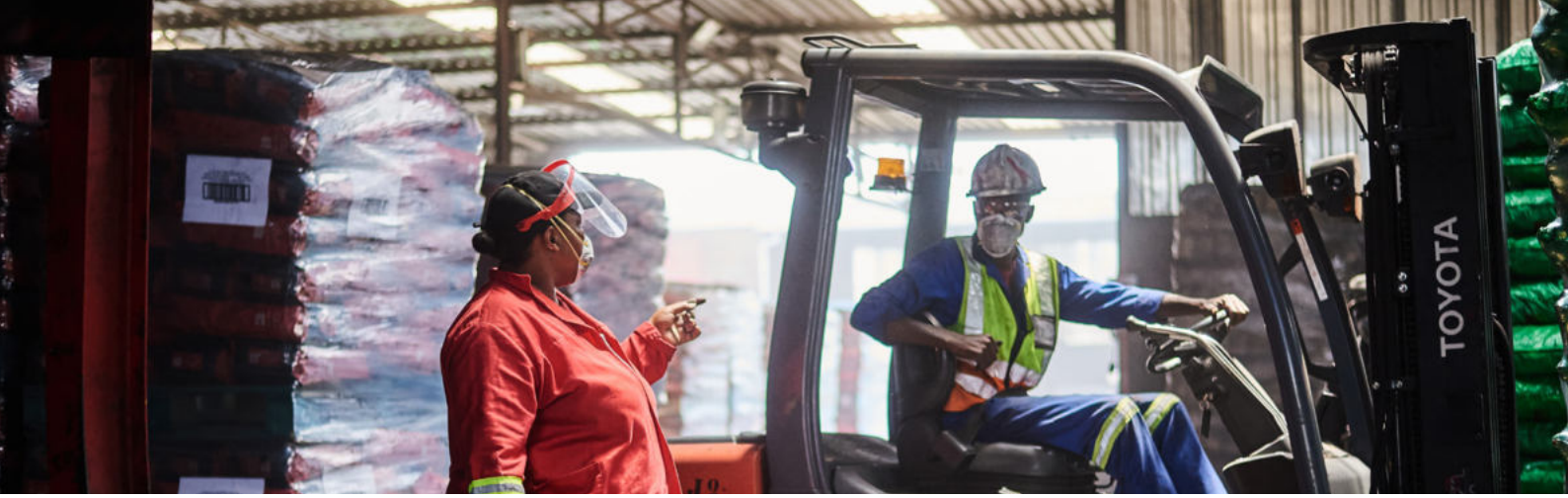
Focus on communication and knowledge transfer

The lack of knowledge transfer and documentation of good practices was identified early on as an impediment to sector development. Beyond producing technical studies, the project put processes in place that ensured that each one of them would translate into summarised information products, including brochures, posters, videos, decision support tools and similar formats. The unified branding of these publications under the slogan "Beyond Bush" allowed for an easy integration into the outreach activities of the De-bushing Advisory Service, which acted under the umbrella of the project at first, but later migrated

into the independent Namibia Biomass Industry Group. All knowledge products are referenced as project outputs, but are at the same time fully owned and utilised by the sector association. The BCBU project pursued communication and outreach not as an add-on activity, but streamlined it into all its project outputs with a respective significant budget allocation.

Selected activities and milestones at a glance

- Various studies, brochures, videos, manuals and decision support tools on bush-based biomass value chains, harvesting methods, biomass quantification and financing
- Development of the charcoal value chain, incl. extensive piloting of improved technology and pyrolysis processes, exploration of by-products (in cooperation with Charcoal Association of Namibia) and a public private partnership project on the establishment of a training centre (with DHG Vertriebs- & Consultinggesellschaft mbH)
- Investigations into the optimisation of harvesting, incl. publication of harvesting manuals featuring manual and (semi-) mechanised harvesting methods suitable for differing socio-economic settings. Funding of technology demonstrations in harvesting and chipping.
- Extensive piloting of bush-based animal feed production in a communal setting (in collaboration with the United Nations Development Programme), a commercial setting and at an agricultural government research station. This included the formulation of feed mixtures, the veterinary assessment of the health impact as well as the development of a business plan tool
- Support to the NamPower Otjikoto Biomass Power Station project, among others through macro-economic benefit assessment studies
- Grant agreement with the Forest Stewardship Council (FSC) towards the drafting of the localised FSC National Forest Stewardship Standard for the Republic of Namibia
- Mobilisation of complementary funding lines and support programmes for different value chains, including bio-ethanol and fibreboards
- Capacitation of the NUST chemical laboratory for enhanced biomass material testing and product research and development
- Development of formal qualifications in bush harvesting and processing through the Namibia Training Authority (NTA)
- Funding of applied research on the production of biochar in different farming settings, including soil application trials, in collaboration with NUST
- In-depth investigation of relevant payment for ecosystem services schemes, especially carbon credits



2.4 Further lessons and insights

Beyond the described project concept and approach, the following aspects were additional enabling factors for positive impact.

Continuity

The project duration of ten years sets the BCBU project apart from previous and parallel interventions, which tended to be more short-lived and limited in terms of mandate and budget. The long duration allowed the project to build close partnerships, gain the trust of stakeholders and implementation partners, and build up institutional memory and a high degree of in-house technical expertise. BCBU defied typical personnel cycles of project-based assignments and maintained a core staff composition with some advisors being on board for almost the entire ten years.

Leveraging of existing dynamics

The project strongly leveraged existing economic dynamics, namely the charcoal sector and activities in commercial agricultural areas. Despite the inherent risk that this would manifest existing inequalities, such as the exclusion of communal areas from economic opportunities, it in fact facilitated positive impact in a relatively short time span, such as the doubling of employment, the scaling of sustainability certification and product innovation. Proven and matured value chains are now ready for replication in the more sensitive communal areas, as the project manifested through various pilot projects and the development of a dedicated governance framework for communal areas.

Timing

The timing of development programmes is determined by various factors, not all of which are related to the dynamics on the ground. Such factors include sectoral priorities of donor countries and the competition among sectors for budget allocations and external support. As the inception of the BCBU project was among others sparked by the innovative approach of Ohorongo Cement to harvest bush-biomass as a source of thermal energy, the project was implemented during a time period with pre-existing economic dynamics and available mature technologies.

Further coincidental timing factors also played a role, most notably the severe drought leading up to the year 2019, which served as a major push-factor for bush-based value chains, such as charcoal and animal feed. Overall, these positive timing factors outweighed the negative effects of certain delays, such as the final investment decision by NamPower for its 40 MW Otjikoto Biomass Power Station, which was announced in 2024 and will thus only unfold its impact on the sector after the project period.

3. The road ahead: considerations for further sector development

In the long run, bush-biomass utilisation has the potential to firmly establish itself as an economic sector at the interface of agriculture, industry and environment. However, this will require continuous efforts to monitor, promote and govern the sector, ensuring that the best possible balance between economic interests and ecological considerations is maintained. The sector must remain responsive to evolving scientific evidence, as well as changing international sustainability requirements.

3.1. Ecological considerations: achieving restoration

Global meta-studies on the restoration of affected ecosystems find that the reversal of woody encroachment is difficult to achieve, regardless of the methods applied (Ding et al., 2023). Moreover, restoration as a concept is contested due to an inability to determine to which state an ecosystem is to be restored to, especially when there is limited evidence of the historical state of the given ecosystem. As a result, the definition and target indicators tend to be vague, which negatively impacts the standardisation of the approach and the evaluation of success. In Namibia, experience shows that there is neither a specific approach, nor guaranteed success for bush control interventions. Successes are localised, speak to specific environmental context factors and are interconnected with land use. This observation leads to several important considerations.

No one-size-fits-all solution

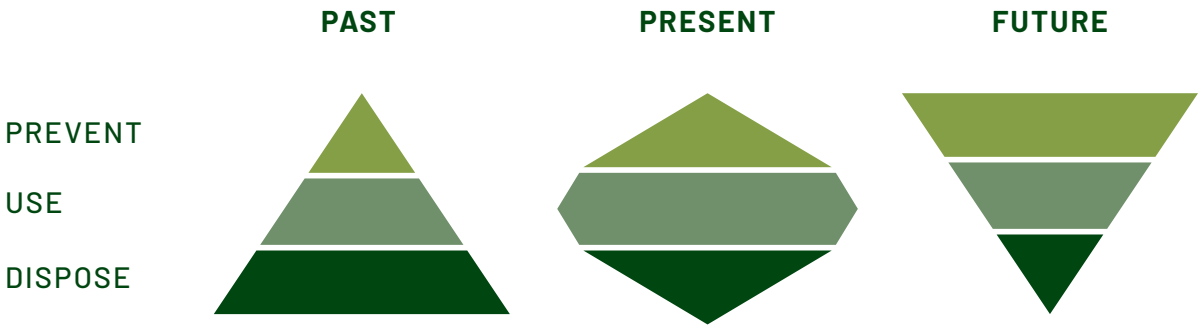
Ecological zones present a high degree of variability and thus require tailored solutions. Single treatment solutions and narrow targets for restoration should be avoided.

Restoration cannot be rushed

A century of degradation will not be reversed in a decade. Implementing bush control in smaller camps at a time and refining the approach over several years will be more successful than an once-off treatment. 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. Continuous follow-up activities, so-called aftercare, are essential to achieve restoration success and stabilise ecosystems. Further policy reform and innovative financing models are required to enable systematic aftercare.

Prevention must be strengthened

Restoration efforts will always be costlier than prevention. Although bush-based value chains can render bush thinning economically viable and even create additional income streams for farmers, they form part of a reactive measure and do not address the root cause of woody encroachment. The graph below illustrates in a simplified way, how the response to woody plant encroachment has developed during the past decade, not least through the efforts of the BCBU project. In the past, the disposal of bush-biomass was predominant (including cut-and-burn approaches as well as unselective arboricide application). Today, the emphasis has noticeably shifted to sustainable use. Going forward, Namibian land-use sectors will be well-advised to continue shifting their focus, investing significantly more resources in the prevention of land degradation through woody plant encroachment. Due to the large scope of already existing encroachment in Namibia, this will not be a contradiction to the existence of the bush utilisation sector. Bush-biomass use will also in future function as an important strategy to adapt to existing woody encroachment and to mitigate and delay its negative consequences.



Abstract depiction of the desired trajectory of bush control from disposal to prevention. Sustainable utilisation functions as the enabler and is a long-term adaptation mechanism.

Adapt to encroachment rather than fight it

In future, woody plant encroachment can be partially avoided and its negative consequences can be mitigated by continuous thinning. However, given the magnitude of the land cover changes and the impact of global drivers, such as climate change, the trend will most likely not be reversed. It is thus imperative to transform land-use systems and adapt them to the existence of woody encroachment. In future, targeted measures to reduce woody encroachment and enhance ecosystem services in selected areas will co-exist with land-use concepts that embrace the existence of high bush densities. The provision of woody biomass as well as enhanced above-ground carbon sequestration can in their own right be regarded as ecosystem services. The determining factor between these two models will be a good understanding of natural tipping points and thresholds, beyond which an ecosystem will plunge into rapid decline.

Localised and replicable solutions within a landscape approach

The focus must shift away from solving the problem of woody encroachment on 45 million hectares, to designing solutions that are available for application on a local scale and easily replicable. This involves small-scale solutions, such as on-farm animal feed production, as well as large-scale approaches, such as feedstock sourcing for a biomass power plant. Land-users will benefit more from an array of diverse value chain opportunities than from a complex national agenda designed to reverse woody encroachment altogether. Nevertheless, coordination on a landscape level is desirable. As long as interventions end at fence lines, their success rates will be hampered, as ecological dynamics and ecosystem services can only be influenced on a landscape level.

Creating circular approaches

Repeated off-take of biomass without compensation can in the long-run negatively affect ecosystems, e.g. by limiting their nutrient cycle and further reducing soil quality. Leaving residual biomass on the ground, distributing process ash(e.g. from combustion processes)and notably the application of biochar are options to be explored to counter this effect.

3.2 Social considerations: inclusive impact and adequate capacities

Inclusivity remains a cornerstone of sustainable development and is crucial to ensure that social considerations are integrated into all aspects of development initiatives. Social inclusivity is needed to leave no one behind and entails addressing the needs and concerns of all members of society. This requires a concerted effort to promote equity and social justice in decision-making processes, policies and actions. Some important social considerations include:

Communal land

Woody encroachment is prevalent in communal areas just as much as in commercial areas. Land in communal areas is a common pool resource. Regulatory authorities are cautious about possible overexploitation and illegal forestry activities in this context. This is further exacerbated by limited capacities to effectively monitor and enforce the law in communal areas and by the lack of proven business models for bush control and related benefit sharing in communal areas. A dedicated governance framework for commercial utilisation of bush-biomass in communal areas has been developed in 2024 and holds the potential to enable rural communities to partake in the opportunities. The development of inclusive supply chains and joint venture business models will strengthen equity in the sector and is a vital part of its further development. It will, however, require further development interventions and support programmes to carefully guide this development, capacitating both the communities and relevant support organisations. These efforts can build on extensive capacity development measures and pilot projects implemented during the past decade.

Labour standards and working conditions

The high employment potential of the bush-biomass sector is based on its decentralised nature and the partially low skills requirements. This however also renders the sector susceptible to sub-standard labour conditions. Both the sector associations and international sustainability certification have contributed to the establishment of good practice in this regard, which is widely applied. As the sector expands and economic activities take place also beyond the reach of membership-based organisations and voluntary certification, compliance with labour standards will require continued attention.

Technical and Vocational Education and Training (TVET)

Vocational education plays a crucial role in promoting employment as well as entrepreneurial and economic opportunities in the bush biomass sector. The effectiveness and sustainability of bush thinning hinges on the presence of a skilled workforce. Technologies are only sufficiently selective, if workers are knowledgeable on adequate off-take rates, sensitive ecological areas and protected species. In the same vein, harvesting operations will only be economically viable, if equipment is handled appropriately and wear and tear is minimised. Namibia Training Authority, in close coordination with bush-biomass sector stakeholders, has developed relevant unit standards for the management of undesirable plant encroachment in rangeland as well as for an understanding of basic environmental principles in agriculture. The sector will benefit from further promotion and implementation of these standards.

3.3 Economic considerations: scale and sector maturity

There is frequent debate about the best possible uses and business models for bush-biomass. The following considerations will guide further scaling:

Scaling both local solutions and international opportunities

A popular topic of discussion is an assumed competition between local utilisation and export opportunities. As in other economic sectors of Namibia, the solution lies in ensuring that local demand is catered for, while international markets serve as catalysts to achieve scale and innovation. It will not be feasible to use bush-biomass for the production of construction material locally, for example, without attracting investment in modern technology through international markets first. The other way around, it also seems unlikely that wood chips can be exported as long as no large-scale local supply is pursued, e.g. no biomass power plant exists in Namibia.

In a vibrant bush-biomass sector, local utilisation and export opportunities will be implemented in synergy. Finding the first large volume off-taker of wood chips or pellets on international markets will spur much needed sector growth and stability. On the other hand, bush-based animal fodder production presents a unique opportunity. It provides a link between ecosystem restoration, climate change adaptation and food security by making fodder available locally and enabling individual farmers to sustain their herds also during environmental extremes like droughts.

Tapping into innovative finance models

Namibia has great potential to benefit from carbon credits and, in future, biodiversity credits. Biochar Carbon Removal (BCR) is increasingly seen as the readiest form of carbon dioxide removal and attracts investment of larger corporations. Moreover, carbon credits will in future converge with biodiversity credits and so-called "biodiversity positive carbon projects" are likely to be preferred on international offset markets.

The Namibian bush-biomass sector already pioneers these concepts on the African continent, with over 70,000 hectares currently certified for ecosystem service claims by the Forest Stewardship Council (FSC, 2022). In addition, first Biochar Carbon Removal credits have been generated (PyroCCS, 2023). Compensation and offset revenue models can finance the establishment of new value chains, but must be complemented with additional income streams that carry these value chains once the external funding phases out.

3.4 Political considerations: sector mainstreaming

To fully realise the potential of bush-biomass utilisation as the cornerstone of a restoration economy, the following considerations are relevant on the policy level:

Incentive mechanisms

Restoration often does not provide the same incentives as destruction. While there are inherent economic benefits attached to the (over-) use of ecosystem services, there are limited immediate incentives attached to the restoration of these. Both environmental and agricultural policy can be adjusted to change this, by introducing the obligation of active biodiversity conservation and related tax-based relief and penalties, for example.

Streamlining

Bush-biomass utilisation constitutes a significant contribution to the national bioeconomy and speaks to various international conventions that Namibia reports to, including climate change, land degradation neutrality and biodiversity. However, these concepts and conventions remain underutilised for the mobilisation of development funds and investment.

Fostering spill-over effects

The dynamics of the bush-biomass sector can have positive spill-over effects for other sectors in Namibia, especially forestry. For example, the experience with FSC certification in encroached areas could inform respective certification of timber harvesting areas.

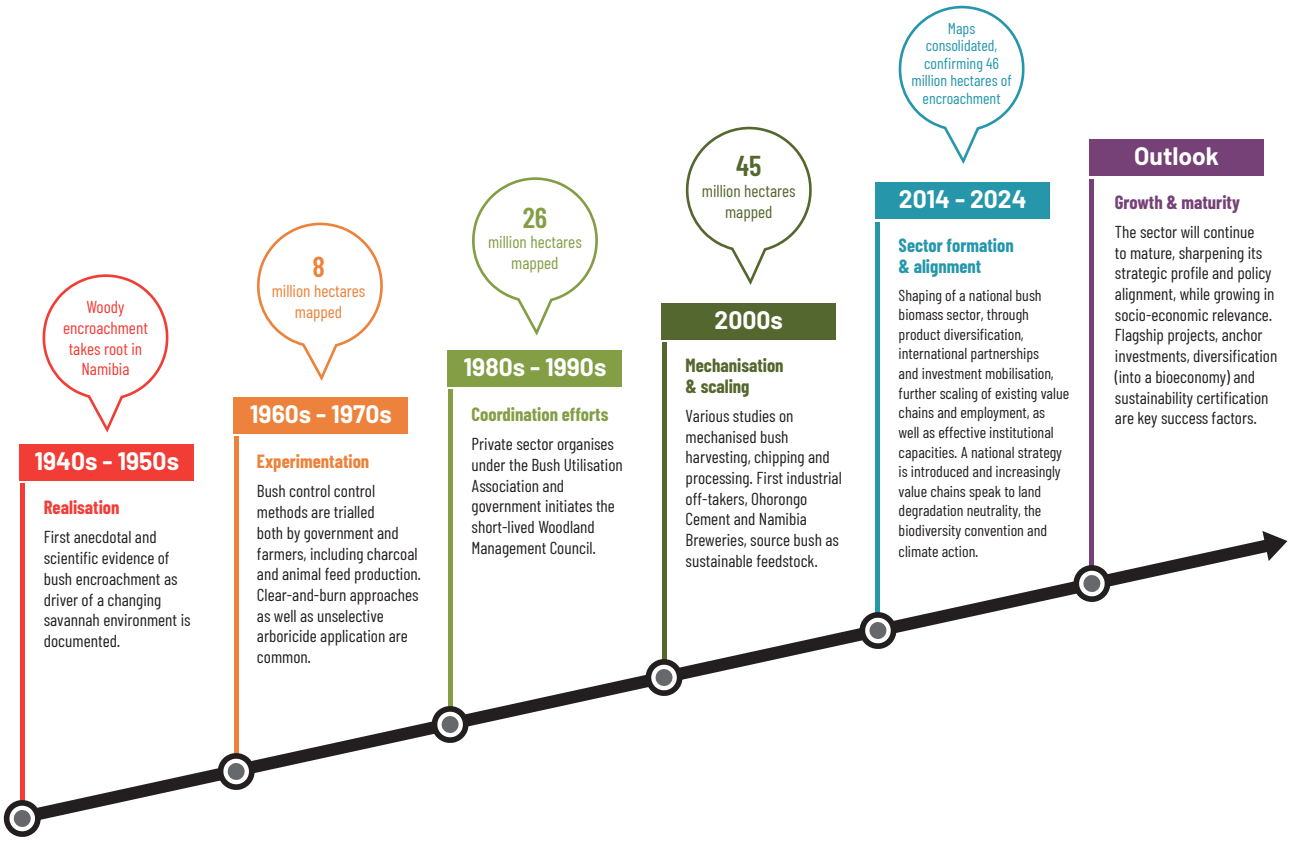
4. Outlook

Bush-based value addition has emerged as a coordinated and thriving economic sector in Namibia, making substantial contributions to the national economy. While not as deeply rooted as traditional industries like agriculture and conventional forestry, this sector holds immense promise across various dimensions of national development. It speaks to rangeland management and related land-use, industrialisation and investment promotion, biodiversity conservation, climate action and, ultimately, to land restoration. A particular benefit of the sector is its decentralised nature and the partially low entry barriers for producers. The existing value chain solutions can be implemented on a small-scale and are yet scalable to industrial levels. This contributes to socio-economic development and secures livelihoods in rural areas.

Professionally represented by membership-based associations and characterised by close collaboration between industry and government, the sector demonstrates important prerequisites for further development and the deliberate balance of seemingly contradictory trajectories. This includes balancing large-scale industrial solutions with small-scale community-centric approaches, promoting a climate-positive path while optimising economic benefits, and fostering a balance between global export orientation and local utilisation. In a matured biomass sector, these trajectories will eventually not compete, but enable each other.

Flagship projects, such as the Otjikoto Biomass Power Station, will play a central role in further enhancing the evidence base of the sector and serve as a proof of concept. As the sector continues to grow and diversify, there will be an increasing level of positive spill-over effects and synergies with other environmental and economic development efforts in the country, ultimately consolidating into a Namibian restoration and bioeconomy.

Ten years of a dedicated development interventions have profoundly shaped the sector. The Bush Control and Biomass Utilisation Project was deliberately responsive to existing socio-economic dynamics and sought to foster the collaboration between government and private sector. Sector stakeholders have benefited from the project's effort to establish professional institutional capacities. They are now prepared to continue their growth path beyond external support.



The evolution of Namibia's response to woody plant encroachment during the decades leading up to the BCBU project. The quantification of the affected area stems from national overview maps published at different points in time. The absolute figures are not directly comparable due to evolving methods and data availability, but a consolidation of existing maps confirmed the overall scope of encroachment and its regional distribution (MEFT, 2024).

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Overview of the main project publications

Strategies and Frameworks

National Strategy on the Sustainable Management of Bush Resources (2022)

Governance Framework and Management System for Sustainable Bush Control in Selected Communal Areas of Namibia (2023)

Studies, Brochures and Policy Briefs

Adding Value to Namibian Encroacher Bush: Turning the Challenge of Bush Encroachment into an Opportunity (2015)

Quantifying Harvestable Encroacher Bush: Determining the Balance between Environmental Sustainability and Economic Feasibility of Bush Utilisation (2015)

Financing Bush Control: An Overview of Current and Proposed Financing Programmes for Bush Harvesting and Value Addition (2016)

Assessment of the Macroeconomic Benefits of De-bushing in Namibia (2016)

Strategic Environmental Assessment of Large-Scale Bush Thinning and Value-Addition Activities in Namibia (2016)

The Economics of Land Degradation. Namibia Case Study: Bush Control Generates Economic and Environmental Benefits (2017)

Animal Feed from Namibian Encroacher Bush. The Production of Animal Feed from Encroacher Bush has Transformational Potential for Agriculture in Namibia (2017)

Impact of Bush Encroachment on Groundwater Recharge: Evidence from 9 Years of Soil Hydrological Monitoring in the Namibian Thornbush Savanna (2018)

Namibian Wood Charcoal: A Triple Win for the Namibian Environment, the Country's Economy and International Consumers (2018)

Biochar from Namibian Encroacher Bush. Practical Guidelines for Producers (2020)

Namibia's Economic Opportunities. Biomass Value Addition: Charcoal and Animal Feed (2020)

Greenhouse Gas Assessment of Bush Control and Biomass Utilisation in Namibia (2020)

Labour-based Encroacher Bush Harvesting Guidelines (2020)

State and Trends of the Namibian Bush Biomass Sector (2020)

Road Map to a Biomass Industrial Park. Biomass Partnership with Namibia (2021)

Success Stories from the Field: Bush Control and Biomass Utilisation in Namibia (2021)

An Assessment of the Micro- and Macroeconomic Benefits of an Encroacher Bush Biomass Power Plant near Tsumeb in Namibia, First Edition (2018) and Second Edition (2021)

Introducing the Acacia Fibreboard (2022)

Harvesting and Processing of Namibian Encroacher Bush. Compendium of Harvesting and Processing Technologies, First Edition (2015) and Second Edition (2023)

Mobilising Climate Finance Through Carbon Removal: The Case of Namibian Bush Biomass and Biochar (2023)

Assessment of the Impact of Bush Encroachment and Bush Control on Soil Organic Carbon in Namibia (2024)

Forestry and Environmental Authorisations Process for Bush Harvesting Projects, First Addition (2017) and Second Edition (2024)

Manuals and Tools

Decision support system on how to control bush thickening by Acacia mellifera in Namibian Savanna rangelands (2017)

Cost Calculation Tool for Bush Feed Production (2017)

Bush Control Manual (2017)

Bush Information System (2018)

Biomass Quantification Tool (2021)

Biochar Carbon Removal Business Case Tool (2023)

Bush Thickening Maps of Namibia (2024)

Selected Videos

De-bushing Namibia: Vision of an Emerging Sector (2015)

The Value of Land – Generating Benefits for Biodiversity, Agriculture and Social Welfare in Namibia (2017)

Transforming Namibia: Turning Bush into Fodder (2018)

Gondwana Collection – Namibia and the Bush Encroachment Phenomenon (2019)

Biomass Industrial Parks for Namibia (2020)

Potential of Labour-based Bush Harvesting for Rangeland Restoration (2020)

Biochar - Investing in the Future (2020)

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