POLICY BRIEF
MAY 2018

Bush Control and Biomass Utilisation Project

© Colin Lindeque – Energy for Future biomass stockpile at Ohorongo Cement

An assessment of the micro- and macroeconomic benefits of an Encroacher Bush Biomass Power Plant near Tsumeb in Namibia

KEY MESSAGES

- NamPower is assessing the feasibility of the development of a biomass power plant (between 20-Megawatt (MW) and 40-Megawatt) near Tsumeb by 2022 with an operational lifespan of 25 years. **This study aims to assess the direct, indirect and induced impacts of the project on the Namibian economy, as well as endeavour to identify the broad beneficiaries of the project.**

- Electricity generation utilising encroacher bush is in line with key national and local development priorities as outlined in key policies such as the Harambee Prosperity Plan, Vision 2030 and the Fifth National Development Plan (NDP5). **The biomass power plant will contribute towards an improved agricultural carrying capacity of the farmland where encroacher bush has been harvested, providing employment opportunities, local economic growth and skills development.**

- The encroacher bush biomass power project provides far reaching economic benefits, from biomass harvesters, to farmers, to indirect and induced employment. **Making use of an abundant resource such as encroacher bush has the potential for great employment creation in Namibia.**

- Although there are assumed biomass-based power generation costs associated with operating and maintaining a biomass power station, **there are significant economic benefits which were quantified at approximately N$ 0.40 /kWh and N$ 1.33 /kWh for the micro-economic benefits and macro-economic benefits, respectively.** These figures also vary slightly, depending on the type of harvesting arrangement (combination of fully mechanised, semi-mechanised and manual labour).

BACKGROUND

The Namibian power sector is presently facing various operational and planning challenges due to the rising demand for electricity and the need to become more independent from imports, which NamPower reported in the financial year 2016/2017 totalled 57% of meeting Namibia's power demand[1]. Despite this high proportion of energy imports, NamPower reduced imports from the previous year by 6%, a reduction attributed to the improved integration of renewable energy into Namibia's energy mix.

More so, Namibia faces the challenge that it's traditionally open savannah rangeland, characterised by a mixture of trees, thickets of bush and extensive grassland, is increasingly transforming into a dense, bush encroached landscape. Bush encroachment is defined as the densification and rapid spread of native shrub and tree species, resulting in an imbalance of grass: bush ratio. This phenomenon affects over 30 million hectares (approximately one third) of land in Namibia. This imbalance of the woody species leads to a reduced biodiversity, a decreased carrying capacity of the rangelands, and in the medium term, a reduction of available groundwater, as a result of the increased water uptake by the encroacher bushes. Due to bush encroachment's detrimental effect on the grazing capacity of agriculturally productive land, productivity has declined. Restoring bush encroached areas by the sustainable removal (harvesting/thinning) of some of the woody plants to yield a more balanced rangeland ecosystem will result in an improvement in grass production and therefore also grazing capacity.

OBJECTIVES

In support of operationalising recommendations made in a 2013 pre-feasibility study for a biomass power plant, NamPower and the Ministry of Agriculture, Water and Forestry (MAWF) and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH– Bush Control and Biomass Utilisation Project, with the support of Namibia Biomass Industry Group (N-BiG), commissioned a study in 2018 to quantify and assess the microeconomic and macroeconomic impact of:

[1] *NamPower. (2017). Annual Report 2017. Retrieved May 27, 2018: http://www.nampower.com.na/public/docs/annual-reports/Nampower%20Annual%20Report%202017%20FA%20Approved%20LR-2.pdf*

- A 20-megawatt (MW) grate-fired biomass power plant adjacent to the Otjikoto substation, near Tsumeb, Namibia, over its 25-year lifespan.
- The fuel supply and harvesting activities for a 20 MW power plant at the aforementioned site, over a 25-year period at specific feed stock price points.

The study aims were to both assess the direct, indirect and induced impacts of the project on the Namibian economy, as well as endeavour to identify the broad beneficiaries of the project in terms of the assumed power generation costs offset by the subsequent macro and microeconomic benefits generated by the project and quantify it in kWh terms.

ASSUMPTIONS

The proposed harvesting site is a radius of approximately 100 km around the proposed power plant with expansions where the biodiversity envelope is similar in nature to the area within the radius. The assumed sustainable harvesting yield of 12.65 tonnes of biomass per hectare, on a dry matter basis, means an estimated 46.7 million tonnes of biomass is available within the proposed harvesting area (Figure 1). The power plant at an export capacity of 20 MW, has an annual fuel requirement of 106,500 tonnes (t) of biomass, which equates to just 5.7% of the available encroacher bush being utilised over the full 25-year lifespan of the plant. The availability of biomass far exceeds the total anticipated demand, even at 40 MW, and means competition for the resource itself is unlikely to be sufficiently large to jeopardise the viability of the project.

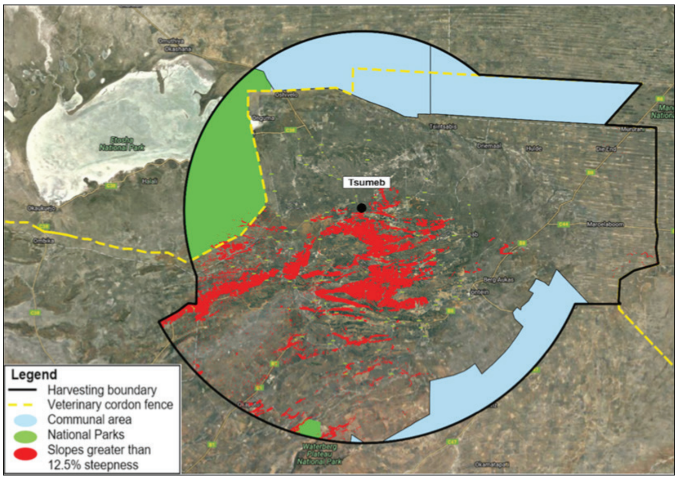

Figure 1: Proposed harvesting area for the 20 MW biomass power plant. The shaded areas are not considered suitable for harvesting.

The study modelled three harvesting methods, namely; manual, semi-mechanised and fully mechanised. The manual harvesting method is labour intensive, while the fully mechanised method is capital intensive. The semi-mechanised method is both relatively capital and labour intensive, as it makes use of more sophisticated equipment (capital) than the labour-intensive method, and also employs significantly more persons than the fully mechanised method. The price received per tonne plays a key factor in the commercial feasibility of the harvesting projects. Three price points were assessed according to two scenarios that utilise a combination of harvesting methods:

- The first scenario focused primarily on mechanised harvesting (90% fully mechanised, with the remaining 10% split evenly between manual and semi-mechanised), while
- The second was predominantly manual and semi-mechanised (55% split between these two, with the remaining 45% fully mechanised).

The three price points agreed between the parties, delivered at plant gate per tonne of chipped biomass are:

- N$450/tonne,
- N$600/tonne, and
- N$750/tonne.

KEY FINDINGS

Microeconomic benefits

The microeconomic section of the study focuses on the benefits to gross value addition (GDP) in the country, looking particularly at the impact on agricultural output, value addition from biomass harvesting, benefits accruing to the environment and ecosystem services and employment.

The overall positive microeconomic impacts of the proposed power-plant are as a result of employment creation, salaries and wages, agricultural benefits from livestock production, improved groundwater recharge, reduced CO_2 emissions and the value addition derived from biomass harvesting. At a price of N$600/tonne, the first harvesting scenario generates a total microeconomic benefit of N$1.47 billion, or N$0.40/kWh, over the project lifetime in 2018 (inflation adjusted) value terms, while Scenario 2 generates a benefit of N$1.52 billion, or N$0.41/kWh. These values represent the direct, indirect and induced additional gross value addition activity (GDP) that takes place in the country because of the proposed power plant and its up-and-downstream value chains.

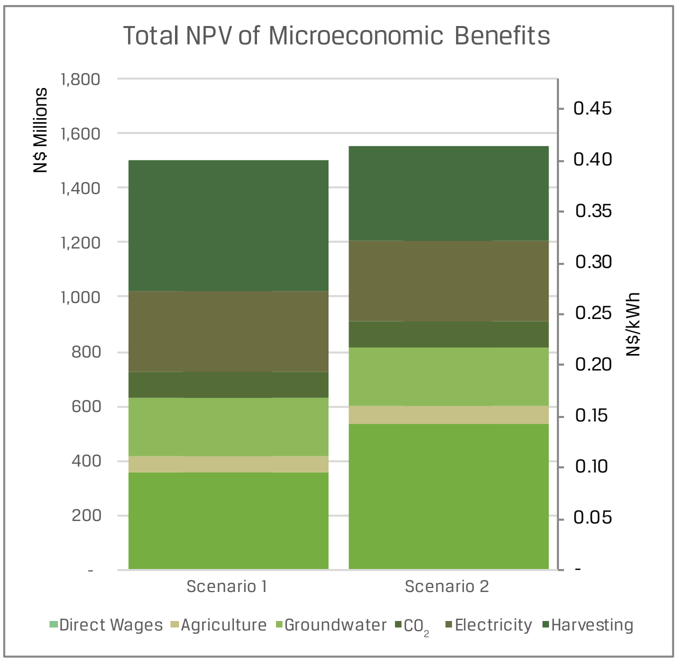

Figure 2: Net Present Value (NPV) of microeconomic benefits

Macroeconomic benefits

On the macroeconomic impact, it was noted that while the majority of the employment is generated at the micro level, the contribution to GDP by both personal and corporate income tax is heavily dependent on the price point and harvesting method. As the mechanised harvesters are slightly more profitable, the first scenario contributes more to income tax (at N$600/tonne, this is N$92 million as opposed to N$76 million, in net-present-value terms over 25 years). The large import factor of the power plant construction sees an initial negative impact on GDP. However, the operational phase of the power plant has a smaller, but longer-lived contribution to GDP over its 25-year lifespan, between -0.004% and 0.019% (dependent on the biomass price). The impact on inflation is expected to be negligible, as the 20 MW power plant produces less than 4% of hourly power requirements of Namibia, and electricity (and other fuels) make up less than 4% of the inflation basket. The balance of payment sees net positive effects, largely due to the import-substitution of electricity (N$134 million/year in 2018 value terms) as well as contributions from cattle and beef exports.

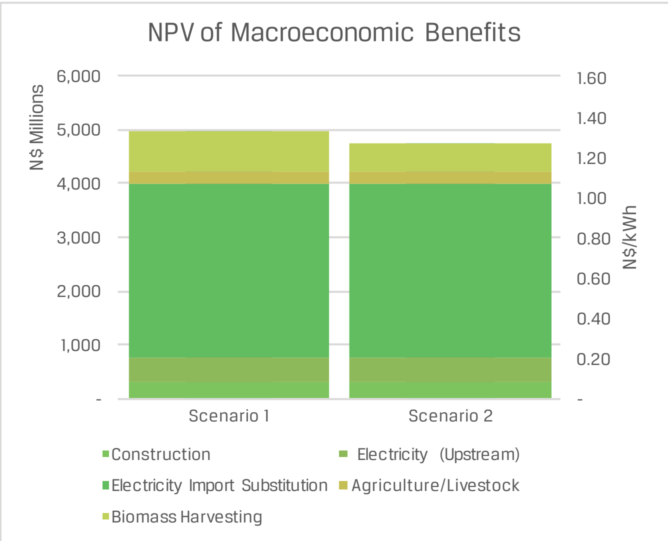

Figure 3: Net Present Value of Macroeconomic Benefits, inclusive of the microeconomic benefits in Figure 2.

The infographic on the back illustrates the comparison of estimated economic return on investment from the biomass power plant in both scenarios of harvesting methods.

POLICY RECOMMENDATIONS

From the National Integrated Resource Plan (2016) the Unit Cost of Energy (N$/kWh) for a biomass-based dispatchable renewable plant is listed as N$2.25/kWh and N$2.07/kWh for a 5 MW and 10 MW capacity, respectively. The assumptions used in the Macroeconomic study, considering a 20 MW capacity plant operated at 85% capacity factor, uses a Unit Cost of Energy (N$/kWh) which is lower than these quoted for the 5 MW and 10 MW plants. In addition, the Unit Cost of Energy is also expected to be less for a larger 40 MW option.

Taking this into account, the quantified economic benefits on a micro and macro scale are significant when compared to the expected Unit Cost of Energy and should play a vital role in decision making. Therefore, policy recommendations include:

- The national policies that promote bush control/thinning towards rangeland restoration, such as the National Rangeland Strategy (2012), the Harambee Prosperity Plan (2016) and the Fifth National Development Plan (NDP5, 2017), should be operationalised through the utilisation of Namibia's encroacher bush resources as a viable and rewarding alternative for electricity generation.
- The key considerations to optimise the micro- and macroeconomic benefits from the 20 MW biomass power plant include the harvesting methods utilised and the price paid for biomass. While mechanised harvesters are marginally more profitable, the manual and semi- mechanised methods employ more people (albeit with lower wages). Ultimately, the harvesting method decision will come down to harvesters themselves, who are likely to favour the slightly higher returns under mechanised harvesting. From the study, the significant micro and macro benefits are clearly articulated and the sensitivity towards the biomass price points for both the harvesters and the power plant is clear. However, this project provides far reaching economic benefits for Namibia, and its successful implementation would likely facilitate similar projects which could provide for greater efficiency gains.

ABOUT THIS POLICY BRIEF

This brief is based on the extensive report **An assessment of the micro- and macroeconomic benefits of an Encroacher Bush Biomass Power Plant near Tsumeb in Namibia** prepared by Cirrus Capital for NamPower and the MAWF/GIZ – Bush Control and Biomass Utilisation Project, with the support of Namibia Biomass Industry Group (N-BiG).

This report is available online at **http://www.dasnamibia.org/download**

FOR MORE INFORMATION ABOUT THE ASSESSMENT AND THE FINDINGS, PLEASE CONTACT:

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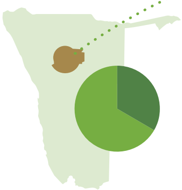
N-BiG Namibia Biomass industry Group

Electricity generation utilising encroacher bush in Namibia

Although there are assumed biomass-based power generation costs associated with operating and maintaining a biomass power station, there are also significant economic benefits which were quantified at approximately N$ 0.40/kWh for the microeconomic benefits and N$ 1.33/kWh for the macroeconomic benefits. Some economic factors considered for this quantification are highlighted below.

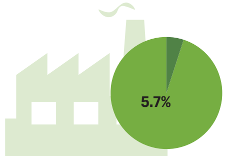


Bush encroachment is defined as the densification and rapid spread of native shrub and tree species, resulting in an imbalance of biodiversity. It is estimated that in Namibia bush encroachment affects over one third of all land, that is over 30 mil hectares (ha) of land of the approximate 82 mil ha of total land surface.

The proposed harvesting site is a radius of **approximately 100 km with more than 46 million tonnes of biomass** available for harvest.

BEFORE BUSH THINNING	17 ha
AFTER BUSH THINNING	10 ha

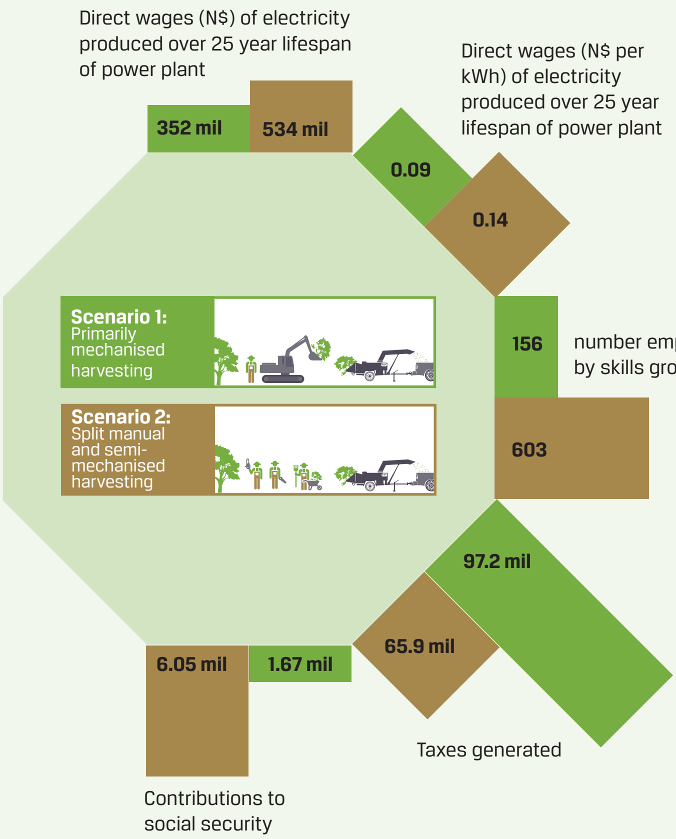
It is estimated that the carrying capacity of encroached land is 17 ha per head of cattle and that carrying capacity will increase to 10 ha per head of cattle four years after bush thinning.

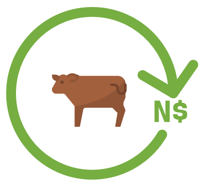


A 20 MW power plant has an annual fuel requirement of **106,500 tonnes of biomass**, only **5.7%** of the available encroacher bush being utilised over the full 25-year lifespan of the plant.

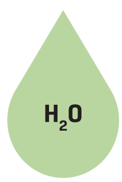
Supplying biomass for electricity generation:

Two scenarios for shared benefits





The livestock industry has an extensive upstream value chain and well-developed downstream value chain, **implying that for every N$1 of output generated by this industry, N$3.63 of output is generated in the economy as a whole**, across various different up-and-downstream activities.



Using a conservative estimate and after all offset costs are accounted for, **the extractable groundwater resource is expected to increase by 11.7 million m^3 over the 25-year project lifespan.** The real net value of groundwater recharge in 2018 terms is N$244 million, or N$0.07/kWh, over the 25-year lifespan.

The biomass **power plant more than doubles the local market for wood chips** in Namibia.