

Towards Resilient Futures Community of Practice Workshop 2

Driving Post-mining Industrial Development through Fibrous Multi-product Value Chains

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Round Table Discussion Notes: Bamboo Product Development

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Type of bamboo species

Bamboo species can be grouped as those producing runners or those that propagate by clumping. Running species typically grow in cooler temperate climates and will shoot once per year at the beginning of spring. Tropical bamboo species tend to clump. They normally shoot at the beginning of the rainy season but will do so all year provided that they are sufficiently watered. It is commonly perceived that these species are invasive, but this is believed to be false by some experts. Tropical bamboos use more water than temperate bamboos. This, however, is a rule of thumb that requires further scientific exploration.

Important factors in the cultivation and use of bamboo:

- Bamboo plantation and cultivation is labour intensive. As the culm is selectively harvested the process lends itself to the employment of unskilled manual labour.
- Uniformity is the most desirable property when cultivating bamboo for processing.
- The characteristics that are important when choosing bamboo for industrial use is the diameter of the culm; this varies from the diameter of a finger to that of the diameter of a bucket. *Dendrocalamus synicus* is one of the species with a culm of large diameter. To reach these large diameters bamboo plants need to be cultivated in optimum conditions i.e. the diameter achieved by the bamboo depends on the species and the conditions under which it grows. The greatest diameter observed in Africa is approximately 20 cm. Typically, *Bambusa balcooa* reaches about 10 to 15 cm in diameter.
- The wall thickness is another important property. The fibres reside in the wall of the bamboo. The wall thickness depends on the species of bamboo and how far above ground level the bamboo is harvested. The higher parts of the culm are more hollow and have thinner walls than the lower parts. As consequence, different products are made from different parts of the bamboo culms. The lower third of the culm has a larger diameter and wall thickness compared to the rest of the culm. Due to its larger density this part of the plant is good for growing biomass and for producing charcoal. The middle third of the culm is more uniform and may be used in flooring, manufacture of furniture and construction.

- The length of the internode is also species specific and the longer the internodes, the longer the fibre produced. For some bamboo species the nodes are straight across the cross section of the culm and they are regularly spaced from one culm to another. What is desirable is a bamboo that flowers and has more branches near the top of the plant with long straight internodes. In addition, if the internodes are long and straight the bamboo tends not to taper quickly. It may then be used for poles and building. Some bamboos produce kinked nodes. These bamboos produce branches from the nodes and these branches may in turn branch. This is not desirable.
- The top third of the plant has most of the branches. This is good for animal feed and for making various craft items. This part of the plant may be pulped and may subsequently be used for manufacturing paper. The upper branches may be compressed to create fencing or thatching.
- Bamboo may tolerate a range of soil pH conditions from 5.2 to 5.6 in order to simply survive. The question however remains whether the plant will provide a sufficient commercial yield under the cultivation conditions.
- Bamboo cannot grow in swampy land as its roots are very shallow. It may however be grown on drained ridges in swampy land.

Notes on particular bamboo species that may be considered for a trial:

- *Bambusa balcooa* may be considered to be endemic to South Africa. It is a large bamboo with short internodes and zig zagging nodes. It is a clumping species that may grow on the Highveld. It was introduced to the Western Cape by the Dutch East India Company in the middle of the 18th century. It was brought here for the purpose of manufacturing long straight ladders for use in the thatching of houses. There is a stand of balcooa growing in the Swellendam municipality from approximately 1750. This bamboo has yet to flower. Although bamboo flowers intermittently, these flowers do not produce seeds. However, when bamboo dies it flowers gregariously with seed-producing flowers.
- *Bambusa vulgaris* is also a clumping bamboo that does not grow to a great height and tapers quickly. It does not require much effort to grow.
- *Bambusa oldhamii* shows promise for commercial applications if more than simple biomass is required. It has long internodes and the nodes do not zigzag. It may grow over a large temperature range and may survive -5 °C on the Highveld. It grows to a diameter of 7.5 cm. They are good for rough work where it is desired to build rough crude constructions.
- Moso bamboo (*Phyllostachys edulis* and *Phyllostachys pubescens*) is used for bamboo strips in engineered wood. Here each culm is almost identical to each other. It is a running bamboo with straight nodes and the culm tapers very gently. It may tolerate temperatures of -17°C and may grow on the Highveld. Its size, however, would depend on the amount of water it receives.
- *Dendrocalamus asper*, a clumping bamboo, grows much straighter than balcooa and may be recommended for tropical regions.

The success of any bamboo growing project would largely be determined by the appropriate choice of bamboo species. It was recommended that 5 to 6 bamboo species be chosen for trial. The most promising species may then be further tested. A challenge would be that each cycle of testing takes 5 to 6 years. After trials, one species should be selected for an industrial scale operation. Trials will not provide sufficient feedstock for tests on further processing. In this time the surrounding communities may use the bamboo for craft products i.e. the size and nature of the product streams may be scaled to the amount of feedstock available. Crafting may consume various sizes of bamboo.

Harvesting of Bamboo

All bamboo shoots typically take three to four months to grow to their full height and girth. This is a water shoot containing no lignin and therefore may not be used in the manufacture of products. The plant then takes approximately two years to lignify. At year four it does not grow at all. In year five it starts to deteriorate and die. Consequently, year three is the quickest time where it is viable to commercially harvest. In a three-year-old stand, the three-year-old culms may be harvested; this would imply that 30% of the stand could annually and sustainably be harvested after three years of growth. However, it is best to harvest the five year olds after seven years. Two-year-old shoots will be large enough to harvest after five years. However, the danger is that the leaves that the plant requires for growth will also be cut down.

The typical heights of the shoots at the various stages of growth are given in the following table:

Year	1	2	3	4	5
Shoot height	1 m	2 m	4 m	8 m	maximum height

Bamboo processing

As bamboo culms are hollow, the cost of transport is relatively high. Consequently, processing should take place near the site of bamboo production. The skills to cultivate and process bamboo certainly exists in South Africa. Also, labour costs here are becoming more competitive with Asian countries.

The barrier to entry to a bamboo industry is very low in terms of its processing and machinery required. Because it is hollow, it is light to work with and even hand saws may be used for processing.

Bamboo when heated may be bent and when it cools it holds its form i.e. if straight bamboo is required, it may be heated and straightened.

Fibre and vinegar may be extracted from bamboo. These industrial or chemical process may be capital intensive. Bamboo grows more easily than cotton. However, the extraction of its fibre is a chemical process and these chemicals may not be environmentally friendly.

Potential markets for bamboo in South Africa

There is no consumer resistance to developing a market for bamboo in South Africa. In addition, there is definite demand as South Africa imports significant quantities of bamboo in the form wooden flooring and laminated boards. Bamboo socks and planter boxes may readily be found in the shopping malls of South Africa.

There are businesses in South Africa that import raw hollow tubes of the *Phyllostachys* variety and then manufacture screens. There is a large market for bamboo stakes for plants e.g. approximately 1 million stakes are sold to just the citrus industry annually. Some of the market demands are met by wild stands of bamboo in KZN.

China overwhelmingly dominates the market for bamboo products. They also lead the world in R&D of bamboo products. The positive aspect of this is that all the required machinery for bamboo processing has already been developed and may readily be purchased.

Barriers to a bamboo industry in South Africa

One of the reasons that the bamboo industry has not grown in South Africa is that a water permit is required for its commercial plantation. The Department of Water Affairs is engaged in research involving evaporation rates and water usage of bamboo plantations. Until the research is completed they will not issue permits. The five-year study has three years to go. They may grant water permits to growers provided that data may be gathered for their own research projects. It is rumoured that stands of less than 5 ha in size may not require a water permit.

Commercial farmers are concerned as to who will buy their bamboo as there is no processing or well developed market for it in South Africa.

In the light of the above, the development of a bamboo industry in South Africa will be a time consuming process. Mines have the capacity and the long term vision to facilitate this process. During this development, degraded land may be rehabilitated and the associated communities may be empowered through the provision of work and the development of new industries.