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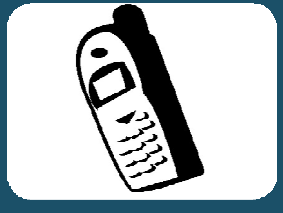
POLICY BRIEF

Bush thickening and indigenous woody plants as a source of renewable energy



INTRODUCTION

Indigenous woody plants are natural and essential components of savannah ecosystems. They benefit the ecosystem through nutrient cycling, soil enrichment and by providing food and shelter to many vertebrates and invertebrates. An increase in tree density, or bush thickening, beyond a certain threshold may be detrimental for the ecosystem and reduce the productivity of such rangeland for agriculture and conservation.

These surplus woody plants in areas where there is bush thickening present an opportunity to harvest the wood as bio-fuel. The health of the ecosystem and rangeland restoration must, however, always be prioritised during any tree harvesting for bio-fuel. The highest wood yields are in large trees, presenting a potential conflict of interest. From an ecological point of view, the larger trees should be retained during the thinning operations. It is, thus, a matter of weighing short-term benefits against long-term benefits (ecological stability and rangeland restoration).

Several recommendations can be made in the interests of ecological sustainability and for maintaining long-term stability (see box below). These are of value to landowners affected by bush thickening, as well as government decision-makers and non-governmental organisations (NGOs) involved in solving the problems associated with the bush thickening.

In South Africa, indigenous woody plants are a prominent feature of the savannah, the largest of the vegetation biomes in South Africa and the Southern African sub-continent. Woody plants are traditionally used for firewood, construction timber, the production of charcoal and wood carving. For half-a-billion people in Africa, wood is the main source of fuel

RECOMMENDATIONS

- Objectives of tree-thinning operations must be clearly identified prior to the harvesting operation.
- The threshold value in terms of tree density that can be supported in a specific rainfall region without adversely affecting the grass layer must be determined prior to the harvesting operation. Harvesting of woody plants should be done only in areas exceeding this threshold value.
- Emphasis should be on selective harvesting, during which larger trees are retained and smaller trees and shrubs are harvested, preferably of the problem tree species.
- Most woody plants will regrow again after cutting. While this may be seen as beneficial in the sense of a renewable resource, it is generally considered undesirable from a restoration point of view. It is recommended than an appropriate and ecologically safe arboricide be used to treat cut stumps after harvesting.
- As new seedlings might re-establish in thinned savannah areas, a state worse than the original thickened area may develop if left unattended. Post-treatment management such as a fire or a limited treatment with an appropriate arboricide may be required.
- The bush thickening problem cannot be solved if its causes are not addressed. The most important aspect here is stocking rates of livestock and game. Landowners must comply with prescribed stocking rates and adequate rest of the herbaceous layer.

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Bush thickening is arguably the most serious environmental problem associated with the savannah biome. Due to the water-limited nature of many savannah ecosystems, bush thickening is considered a major factor contributing towards the low occurrence or even total absence of herbaceous plants in severe cases (left). Large trees at low tree densities benefit the environment through soil enrichment under their canopies thus having positive effects on grass growth (right).

and the wood of several savannah woody species is known for their excellent fuel properties, especially species with dense heartwood. In addition, woody plants are an important source of food for browsing herbivores, which include both domestic stock and game. The recent expansion of the game ranching industry in southern Africa makes this latter aspect increasingly important to game ranchers.

An excess of woody plants, however, creates the problem of bush thickening. Many savannah ecosystems are water-limited and bush thickening negatively effects herbaceous plants, in severe cases eliminating them completely. As a result of bush thickening, the grazing capacity of large areas of the southern African savannah has declined to a level that many previously economic livestock properties are no longer economically viable. Bush thickening is a serious environmental problem in the Southern African savannah biome and an estimated 20 million hectares of the 96 million hectares is affected.

The growing energy crisis in South Africa and the world has created a growing interest in wood as an alternative energy source. The rationale is that wood is a renewable bio-fuel and it can help finance bush control measures on farmland through the selective harvesting of surplus woody plants. Although the removal of the woody plants will normally result in an increase in grass production and thus also in the grazing capacity, the results of woody plant removal may differ between vegetation types, and there are both negative and positive responses to removing trees: *There is a potential conflict of interest, depending on what is being prioritised*: the product (i.e. wood), or rangeland restoration from bush thickening. In the latter case the true advantage of tree harvesting will be increased animal production because of the increased grazing capacity, and the tree harvesting then primarily serves as a way to cover the costs of the operation. It is thus important that priorities be clearly identified *prior to the harvesting operation*.

BACKGROUND

Restoration of savannah areas with bush thickening should comply with two important requirements before it can be considered successful: it should be ecologically responsible and economically justifiable. In Southern Africa, judged on these two basic requirements, few attempts at restoring bush thickened areas can be considered successful. This is either because the costs are too high or because the wrong approach was followed. This resulted in the loss of beneficial woody plants, with the subsequent re-establishment of woody plants leaving the savannah in a worse state than before the interventions.

Biological activity is important in enhancing soil fertility, often on base-poor substrates. Trees act as such biological agents, creating islands that differ from those in the open. Ample evidence in support of soil-mineral enrichment under tree canopies exists, notably with nitrogen, organic carbon and various other important elements such as calcium, potassium, magnesium and sodium. This soil enrichment under tree canopies has positive effects on grass growth. Beyond a threshold tree density, however, this positive effect may change to a negative effect as a result of competition for resources such as soil water. The effect of bush thickening on herbaceous plants differs between wet and arid savannahs. In wet savannahs herbaceous plants are able to co-exist with relatively high tree densities, while in arid savannahs the herbaceous layer mainly disappears under high tree densities, leaving bare ground.

Woody plants are an important source of food for browser herbivore species, which include both domestic stock and game. (left). For many rural communities, wood is still the only source of fuel for cooking and heating and the wood of several savannah woody species is known for its excellent fuel properties (right).

An increase in woody plant abundance is primarily brought about by two processes (vegetative growth) and the second is by an increase in tree density, mainly from the establishment of seedlings (reproduction). The reasons for an increase in the abundance of woody plants in any vegetation type are diverse and complex. In most situations the drivers of savannah systems were modified by man, either directly or indirectly. Examples are the exclusion of occasional hot fires, the replacement of most of the indigenous browsers and grazers by domestic (largely grazing) livestock often at extremely high stocking rates, the restriction of movement of herbivores by the erection of fences, poor grazing management practice, and the provision of artificial watering points.

Fire is widely used to control woody plants, although fire alone is not effective in killing woody plants in the savannahs of Southern Africa. Veld fires may, however, be used to modify the structure of the woody layer. The total exclusion of fire or, conversely, the frequent occurrence of fire under conditions of low herbaceous biomass may benefit the establishment of woody plants.

Climate change and increased atmospheric CO_2 concentrations may also have an effect on the different floristic components of savannah ecosystems. Increases in atmospheric CO_2 improve water-use efficiency and increased carbon uptake under certain circumstances.

An important determinant of woody seedling establishment is competition from other plants. Tree-on-tree competition appears to be species specific or related to the shade tolerance of the seedlings. Significant positive correlations between the size of a tree and the distance to its nearest neighbour have been reported for several woody species. The presence of large trees, representing a structured savannah, may result in a more stable ecosystem. Such a structured ecosystem can be considered the most productive since all the benefits of woody plants are represented.

The loss of large trees from savannah ecosystems through indiscriminate, non-selective bush control measures and/or tree harvesting is a major reason for sustained long-term solutions in the restoration of bush thickened areas not being achieved. Restoring savannah structure in cases where it is lost is a slow

An example of an open savannah dominated by large trees, which is considered the most productive and also less prone to bush thickening (left) Hot, brush killing fires can be used to control newly established woody plants and to assist in the prevention of bush thickening. (right)

process. This will entail a highly selective approach where woody plants are thinned in such a way that the remaining trees will benefit from the reduced competition from other woody plants, resulting in increased growth and thus an increasing sphere of influence on newly established seedlings and the wider ecosystem.

Estimations from various South African savannahs indicate that the total wood dry mass can be as high as 450 000 kg/ha, but is more often in the region of 40 000 kg/ha per harvest cycle, which could be several years.

On average the wood greater than 20 cm in diameter made up 80% of the total wood mass, while the stems greater than 0.5-20 cm and shoots less than 0.5 cm made up 13% and 7% of the total wood mass respectively. Should the trees be harvested during the summer months when the trees have their full leaf carriage the leaves would add another 2%-5 % to the total tree dry mass.

It can, however, be expected that most of the leaves will probably be lost during the harvest and chipping process as they dry and fall from the branches. It is important to note that not all this wood biomass can be used as bio-fuel and in most cases a yield of not more than 10 000 kg/ha is realistic. In general the average long-term rainfall will determine how many should be left. (A general rule of thumb stipulates that the average number of Evapotranspiration Tree Equivalents (ETTE)/ha that can be supported in a specific rainfall region without adversely affecting the grass layer, should not exceed 10 times the mean annual rainfall. An ETTE is defined as the leaf volume equivalent of a 1.5 m single-stemmed tree. Anything more that this figure presents a possible problem density and surplus trees and shrubs can be used.)

CONCLUSIONS

Research done in African savannahs has shown that the presence of woody plants in savannah ecosystems is associated with both positive and negative aspects, which are closely related to tree density. Therefore any restoration programme should focus on tree thinning rather than clearing of all woody plants to retain some of these positive influences. Each should consider the importance of a balance between the effect of surplus trees and the positive influences of trees. There is no single optimum tree density. The optimum density will fall within a range rather than being a single value.

It is important to identify priorities prior to the thinning/harvesting operation. Is it the product (wood as energy source) or rangeland restoration that is the desired outcome?

The rapid establishing of tree seedlings after the removal of some or all of the mature woody plants is likely to negate restoration measures unless post thinning/harvesting management is carried out. It is important for any land manager to realise that there is no quick solution to the problem of bush thickening, and ongoing management is essential. Sound grazing management practices, especially during wet seasons, is one way through which a landowner may ensure a vigorous and competitive herbaceous layer is established.

ABOUT THIS POLICY BRIEF

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