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Colophospermum mopane Wood Utilisation in the Northeast of the Limpopo Province, South Africa

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Abstract

The use of *Colophospermum mopane* wood was quantified from six villages in the northeast of the Limpopo Province, South Africa. One hundred and eighty individuals were interviewed from the selected villages. Three villages were located in the depleted woodlands and the remaining three at abundant woodlands. Traditional governance structures within the selected villages and relevant conservation department officials were also interviewed. *Colophospermum mopane* is an essential source of fuelwood and provide poles used for construction of traditional structures. Each family uses 6.8 ± 0.1 kg of *Colophospermum mopane* fuelwood for cooking day^{-1} in the woodland depleted villages, while 8.2 ± 0.2 kg is used at the woodland abundant villages. *Colophospermum mopane* is preferred for construction of traditional structures because its wood is durable and is able to resists the effects of termites and wood borers.

Key words: *Colophospermum mopane*, fuelwood, poles.

Introduction

Colophospermum mopane (Benth.) J. Léonard, commonly known as mopane, is one of the most important tree species in southern Africa. It is the preferred plant species for fuelwood and poles used to construct traditional structures (Liengme, 1981; 1983; Mashabane *et al.*, 2001). *Colophospermum mopane* is also used for treatment of various animals and human diseases in southern Africa (Watt and Breyer-Brandwijk, 1962; Palmer and Pitman, 1972; Madzibane and Potgieter, 1999; Mashabane *et al.*, 2001), and hosts the mopane worms, larvae of the moth *Imbrasia belina* (Ditlhogo *et al.*, 1996). The mopane worms are widely consumed in southern Africa (Palgrave, 1983) for household nutrition (Mpuchane *et al.*, 2001) and for selling to generate incomes (Styles, 1994; Shackleton *et al.*, 2000; Kozanayi and Frost 2002). Other viable products harvested from mopane woodland by rural dwellers include stink bugs, termites, edible locust, edible mushrooms, honey, thatching grasses and wild fruits (Shackleton, 2005; Makhado *et al.*, 2009).

Colophospermum mopane dominates the hot, low-lying areas of south tropical Africa (Werger and Coetzee, 1978).

The area covered under mopane woodland in southern Africa is estimated to be about 555 000 km^2. The Limpopo and Mpumalanga Provinces of South Africa have about 23 000 km^2 (Mapaure, 1994). Mopane woodland is distributed along the Limpopo River in South Africa (Mapaure, 1994), contributing to about 50% of the vegetation in the Kruger National Park (Fenton, 1993). The controls on the growth and distribution of *Colophospermum mopane* in southern Africa are uncertain, but seem to be influenced by edaphic (Madams, 1990; O'Connor, 1992) and climatic factors (Timberlake, 1995; Okitsu, 2005).

Colophospermum mopane is a drought tolerant species confined to areas of low to moderate rainfall, dominated by alluvium and colluvium soils (Timberlake, 1995). Mapaure (1994) is of the opinion that its distribution is principally influenced by moisture availability expressed through altitude, rainfall and soil texture. In southern Africa, the mopane woodland lies in areas between 300 and 1000 m altitudes, typified by a mean maximum summer temperature of about 30ºC and a mean annual rainfall of between 400 and 700 mm (Werger and Coetzee, 1978; Timberlake, 1995). *Colophospermum mopane* occurs generally in frost-free areas. Where frost does occur, it becomes the limiting factor to its growth (Werger and Coetzee, 1978; White, 1983).

Despite the value of mopane woodland, its resource are over utilised, mis-managed and even transformed to other land-use. This has resulted in the circles of degradation surrounding the villages. The main drivers of woodland resource depletion around the villages are the result of high population pressure (Shackleton *et al.*, 2001), coupled with poverty (Shackleton *et al.*, 2000; Watson and Dlamini, 2003), lack of woodland management responsibilities and diminished power of traditional leaders (Evans *et al.*, 2000; von Maltitz and Shackleton, 2004). Lack of technical capacity to enforce conservation regulations increases the likelihood of infringement of regulations. The outcome is high pressure on local fuelwood resources (Gandar, 1983), increased distance (Mercer and Soussan, 1992) and time (Campbell *et al.*, 1993) to harvest woodland resources. The purpose of this study is to quantify the amount of fuelwood and poles harvested for rural livelihood system in the northeast of the Limpopo Province, South Africa.

Materials and Methods

Study Area

Research was conducted in six rural villages in the north-eastern part of the Limpopo Province, South Africa (Figure 1). The area is demarcated under that the Greater Giyani Municipality. The Greater Giyani Municipality borders the Kruger National Park on the eastern side. Town such as Thohoyandou lies to the north and Phalaborwa to the south. The majority of the inhabitants in the Greater Giyani Municipality are Shangaan and their language is Xitsonga (Peltzer, 1998). The geographical area of the Greater Giyani Municipality is 2 967 km^2. The SigmaScan Image Analysis results of the Greater Giyani Municipality map (Figure 1) show that 59.4% of the total area of the Greater Giyani Municipality consists of cultivated areas, 30% by woodland and bushland. The town of Giyani accounts for 0.7% of the total area, while 5.4% is taken up by villages. The degraded areas account for approximately 5.0%.

The villages selected in this study are Homu 14A (23.30385º S and 30.80417º E), Homu 14C (23.31561º S and 30.740526º E), Mapayeni (23.35412º S and 30.82297º E), Makhuva (23.58236º S and 30.97446º E), Zaba (23.57581º S and 30.70878º E) and Mbaula (23.60878º S and 31.03742º E) (Figure 1). The selected villages were grouped as woodland depleted villages (Homu 14A, Homu 14C and Mapayeni) and woodland abundant villages (Makhuva, Zaba and Mbaula).

The estimated number of people at woodland depleted villages is approximately 19 500, compared to 16 000 at woodland abundant villages (Table 1). At the municipal level, the estimated population in 1996 was 217 454, which increased to 237 438 people in 2001 (Statistics S.A.: Census 2001). This implies that there is a 2% increase in human population per year. As the population increases, it consequently results in the expansion of human settlements and cultivated areas to meet human basic needs.

In 2001, 55% of the people in the Greater Giyani Municipality were unemployed and 54.3% have no electricity. Even where there is electricity, it is estimated that 80% of villagers rely on fuelwood for cooking and heating (Statistics S. A.: Census 2001). The majority of the rural inhabitants depend on old age pensions, subsistence agriculture, and on harvesting woodland resources for household nutrition and income generation. The majority of people, particularly females are unemployed, illiterate and live below the poverty line (Table 1).

The climate of the Greater Giyani Municipality is characterised by low rainfall and high temperatures. The mean annual rainfall in the Greater Giyani Municipality is 386 mm and the temperature varies from a minimum of 15 ^{o}C in winter to a maximum of 29 ^{o}C in summer (South Africa Weather Service, 1980-2003).

The vegetation in the Greater Giyani Municipality is classified under the lowveld mopaneveld savannas (Rutherford *et al*., 2006), characterised by a mixture of trees, shrubs and grasses. In this area, *Colophospermum mopane* occurs in abundance together with many other trees species such as *Combretum apiculatum, Sclerocarya birea, Dichrostachys cinerea, Terminalia sericea, Diopsyros mespiliformis, Cassine aethiopica, Dalbergia melanoxylon, Acacia species* and *Commiphora* species. The soil is loamy sands and clayey soil and is characterised by gentle undulating valleys of the Soutpansberg mountain range (Acocks, 1988). The underline geology of the area is characterised by the metasediments of the Giyani Greenstone Belt (Rutherford et al., 2006), with common rocks such as granite, sandstone, shale and basalt.

Methods

The research was carried-out from August 2004 to May 2005. Data in this study was collected through individual household surveys, participatory group interviews and by quantifying the amount of wood used daily by householders in six selected villages. A semi-structured interview was conducted with 180 villagers (30 people household^{-1} village^{-1}), 13 traditional leaders and 10 officials from conservation departments. Local nature conservation officials were asked to select three grouped woodland depleted villages (Homu 14A, Homu14C and Mapayeni) and the other three woodland abundant villages (Makhuva, Zaba and Mbaula). The selection of villages was based on the variation and abundance of woodland resources occurrence around the villages. Permission to interview villagers was obtained from the appropriate traditional authorities.

The gender split interviewed was 60% women and 40% men in the woodland depleted villages versus 59% women and 41% men in the woodland abundant villages (Table 1). The questionnaire was divided into three sections: for the villagers (randomly selecting householders); the traditional leaders; and for the relevant officials from conservation departments. Interviews were conducted in Tsonga language to avoid misunderstanding with the respondents.

The amount of wood used by villagers for fuelwood and construction of traditional structures was quantified by measuring the length, circumference and diameter of poles, and also weighed (kg) using a potable balance. The number of samples in both woodland depleted villages and woodland abundant villages for fuelwood was 30 and 15 for construction. The volume of wood used for fuelwood and construction purposes was calculated as: $V (m^3) = l \times \pi \times (^1/_2 d)^2 \times n$. Where V = volume, l = length, π =3.1428, d = diameter and n = number of poles. The underground portions of inserted poles in the soil were included in the calculations through estimation gathered from the householders. Quantification of fuelwood used by villagers per day was based on the amount of wood used for cooking porridge once in a day. This was multiplied by total number of days per year (365) to give the annual totals. The number of adults benefiting from selling woodland resources was estimated by multiplying the fraction selling by the total population in the village. The SPSS ver. 12 statistical programme was used to analyse the socio-economic data. Data was analysed quantitatively using descriptive statistics.

Results and Discussion

Fuelwood

Fuelwood is an essential energy source to over 85% of southern Africa rural inhabitants (MacGarry, 1987; Erkkilä and Siiskonen, 1992). Eighty four percent of villagers in the woodland depleted villages and 76% in the woodland abundant villages use fuelwood as their main source of energy for cooking and heating (Table 1). Fuelwood is currently, and likely to remain the primary source of energy in rural areas in the foreseeable future.

Reliance on fuelwood

Seventy seven percent of people in the woodland depleted village and 87% in the woodland abundant villages are unemployed (Table 1) and thus heavily rely on the nearby woodland for energy supply and poles for construction of activities. Rural people live without cash and with no affordable alternative energy sources but wood (Willis, 2004), as fuelwood is the cheapest, available and most accessible source of energy (Okello *et al*., 2001; Mercer and Soussan, 1992; Liengme 1983). The wood of *Colophospermum mopane* has energy content of 21.570 kJ/kg (Tietema *et al*., 1991), making it to be preferred for cooking. Although electricity, paraffin and gas are available in the study area, villagers mostly use them for lighting. It is too expensive for villagers to use those energy sources for cooking and heating purposes, as shown by 68% of respondents in the woodland depleted villages and 71% in the woodland abundant villages (Table 1). Non-affordability of source of energy other than fuelwood has intensified woodland degradation in southern Africa (Banks *et al*., 1996; Rathogwa *et al*., 1999). More than half of the population use wood daily for cooking and heating, which is contributed by the fact that household fuelwood harvesting is a free commodity in rural areas.

The use of wood especially for cooking and heating is also influenced by culture. It is widely believed among VhaVenda and Shangaan elders that porridge cooked using fuelwood have better taste than that cooked using electricity, which makes wood to be the first choice energy source for cooking by elders in rural areas. The preference of fuelwood particularly for barbecue “*braai*” is also popular in urban areas, which is increasing the commercialisation of fuelwood. In 2005, a 10 kg pile of *Colophospermum mopane* fuelwood was sold for R8 at the Sibasa market near Thohoyandou, Limpopo Province (Makhado et al., 2009).

Colophospermum mopane is highly valued by villagers for fuelwood because its wood produces long-lasting coals, which Prior and Cutler (1992) attributed to high content of calcium crystals in its wood. The high quality of fire produced by *Colophospermum mopane* and its abundance due to its ability to coppice after harvesting makes it highly preferred by villagers as a primary source of energy. Other species used by the villagers for fuelwood were *Acacia nigrescens*, *Combretum apiculatum*, *Dalbergia melanoxylon, Dichrostachys cinerea, Diospyros mespiliformis, Euclea divinorum, Euphorbia confinalis, Gymnosporia senegalensis, Peltophorum africanum, Philnotra violecea, Terminalia sericea*, *Trichilia emetica*, *Ximenia caffra* and *Ziziphus mucronata*.

Volume of fuelwood utilised

The mean amount of fuelwood used by a family of between 5 and 8 people for cooking porridge day^{-1} is 6.8 ± 0.05 kg in the woodland depleted (Table 2a), resulting to 2 482 kg of fuelwood used year^{-1} family^{-1}. In contrast, a similar-sized family in the woodland abundant villages used 8.2 ± 0.16 kg day^{-1} (Table 2b), resulting to 2 993 kg of fuelwood used year^{-1} family^{-1}. The mean volume of fuelwood consumed day^{-1} cooking family^{-1} was 0.022 m^3 (~8.03 m^3 year^{-1}) in the woodland depleted villages and 0.032 m^3 (~11.68 m^3 year^{-1}) in the woodland abundant villages. In contrast to woodland abundant villages, villagers in the woodland depleted villages used as little fuelwood as possible to save for the next day, an indicative of fuelwood scarcity in those villages.

The uses of *Colophospermum mopane* for fuelwood in most villages of Limpopo Province mopane belt is presented in Table 3. Data from other studies on fuelwood use were compared to the current study. These studies are within the same locality, but the amount of wood used for cooking varies. Combining these results, it was estimated that a family, consisting of a mean of 7 people per household in the rural areas of Limpopo Province mopane belt, uses approximately 9.04 kg of fuelwood day^{-1} for cooking meal (Table 3). These result to an estimated 3 300 kg of fuelwood used for cooking household^{-1} year^{-1}. This estimation might have been influenced by a mean (14.9 kg) calculated by Liengme (1983). A better estimation might be obtained by using a median to avoid overestimation of the results. It is therefore estimated that approximately 7.8 kg of fuelwood is used household^{-1} for cooking day^{-1} meal or 2 847 kg year^{-1} in the Limpopo Province mopane belt.

Distance travelled and time taken to harvest fuelwood

Drastic reduction of the surrounding woodland resources in rural areas has increased the distance travelled and time taken by women and girls to harvest fuelwood. More than 1 km is travelled by women and girls to harvest fuelwood from the surrounding woodland. In the woodland depleted villages, between one and five hours are spent by females when harvesting spent by females in the woodland abundant villages.

Increased distance and time for fuelwood harvesting was also reported in most parts of southern Africa. Liengme (1983) estimated that women in Giyani, Limpopo Province, South Africa travelled between four and five kilometres, taking three to six hours to harvest fuelwood. This is close to an average of four hours spent by women in the Mametja village, Limpopo Province, South Africa (Twine *et al*., 2003). In Namibia, women travelled between eight and ten km to harvest fuelwood (Erkkilä and Siiskonen, 1992), while women in certain woodland abundant villages of Zimbabwe spent between one and seven hours (Campbell *et al*., 1993).

Social impacts of fuelwood harvesting

Long distance travelled and time spent during fuelwood harvesting limits women involvement in other socio-economic development activities. This also results in women suffering from back pains and leg pains (Madzibane and Potgieter, 1999). This could concurrently increase the use of less preferred species for fuelwood, which is species that emits high amount of carbon and smoke particulates. This might have a negative effect on the health of fuelwood users, mostly women and girls (Terblanche *et al*., 1994).

Construction of traditional structures

Seventy two percent of the respondents in the woodland depleted villages and 92% in the woodland abundant villages (Table 1), still rely on wood for the construction of traditional structures. *Colophospermum mopane* is the favoured species for the construction purposes, and accounts for more than 90% of timber used for construction of traditional structures (Liengme 1983; Van Wyk & Gericke 2000). But, scarcity of *Colophospermum mopane* poles has led to the use of other species such as *Combretum apiculatum*.

Traditional huts

Construction of huts using poles is still a major practice in the sampled villages. Huts are constructed either as round or in a rectangular shape. The mean volume of poles used as main beams of a kitchen roof in the woodland depleted villages is 0.204 m^3, 0.149 m^3 for children hut and 0.269 m^3 for adult hut (Table 2a), opposed to 0.238 m^3 for kitchen, 0.297 m^3 for children hut and 0.308 m^3 for adult hut in the woodland abundant villages (Table 2b). The brandrings of a kitchen roof in the woodland depleted villages requires a mean of 0.246 m^3, 0.154 m^3 for children hut and 0.213 m^3 for adult hut (Table 2a), opposed to 0.279 m^3 for kitchen, 0.295 m^3 for children hut and 0.343 m^3 for adult hut in the woodland abundant villages (Table 2b). A mean volume of poles utilised to construct the roof support of the kitchen is 1.332 m^3 in the woodland depleted villages (Table 2a), compared to 1.527 m^3 in the woodland abundant villages (Table 2b). The mean volume of poles used to construct the wall of a kitchen hut is 4.536 m^3 in the woodland depleted villages (Table 2a) compared to 4.811 m^3 in the woodland abundant villages (Table 2b). The mean volume of poles used to construct the wall of the roof of a kitchen in the woodland depleted villages is 0.277 m^3, 0.149 m^3 for children hut and 0.269 m^3 for adult hut (Table 2a), opposed to 0.238 m^3 for kitchen, 0.297 m^3 for children hut and 0.308 m^3 for adult hut in woodland abundant villages (Table 2b).

The amount of poles used in the woodland depleted villages is about 1.315 m^3, which is relatively similar to 1.405 m^3 used in the woodland abundant villages. However, this is less than the 3.02 m^3 of poles used to construct a hut in Zimbabwe, but close to the 1.22 m^3 poles used by Tsonga's in the Limpopo Province (Liegme 1983; Cunningham and Davis, 1997). The number of huts per household in the Greater Giyani Municipality is between three and four (Statistics S.A.: Census, 2001), which can be estimated that three huts per household in the woodland depleted villages require about 3.95 m^3 of poles and 5.26 m^3 for four huts. By comparison, three huts per household in the woodland abundant villages require about 4.22 m^3 of poles and 5.62 m^3 for four huts.

Maize granaries

Villagers still construct maize granaries stores to preserve harvested crop such as maize. The granary can either be constructed in the roof of a kitchen or alongside the hut. The smoke produced by the kitchen fire limits insect infestations to the preserved crops at the roof of a kitchen granary (Mashabane *et al.*, 2001). A mean wood of 0.273 m^3 is utilised when building the wall of alongside hut granary and 0.361 m^3 for the granary in the roof of a kitchen in the woodland depleted villages (Table 2a), compared to 1.596 m^3 utilised for building the wall for alongside hut granary and 0.363 m^3 for a granary in the roof of a kitchen in the woodland abundant villages (Table 2b). The estimated mean amount of poles used to construct a medium sized outside hut granary in the woodland depleted villages is 0.563 m^3 and 0.309 m^3 in woodland abundant villages (P =0.140), while a granary in the roof of a kitchen use 0.537 m^3 poles in the woodland depleted villages and 0.873 m^3 in the woodland abundant villages.

The lifespan of granary store constructed at the top of a kitchen roof was estimated to be between 10 and15 years, which is the same as a hut. Conversely, a granary store built separately from the kitchen hut lasts for little more than five years, which is similar to the findings of Mashabane *et al*. (2001). The construction of a granary store on the roof of a hut is difficult and often requires traditional skills, which are now lacking mostly to the youth. Consequently, regular construction of outside granaries will be common, increasing the probability of large volume of wood consumption.

Fencing

Mashabane et al. (2001) stated that not all poles used for fencing are from *Colophospermum mopane* tree. This study found that villagers also use *Acacia nigrescens*, *Combretum apiculatum*, *Dalbergia melanoxylon*, *Terminalia sericea*, *Dichrostachys cinerea* and *Combretum hereroense* poles for fencing. The supporting poles tend to be spaced further apart to about 1m when fencing a household stand. Villagers indicated that the fence should last for more than 10 years, if there is regular replacement of old and rotten poles every year, especially when species other than *Colophospermum mopane* are used. Construction of a fence in the woodland depleted villages required a mean of 11.433 m^3 for the main poles and 1.243 m^3 for the supporting poles (Table 2a), as opposed to 14.883 m^3 used to construct the main poles and 1.324 m^3 for supporting poles in the woodland abundant villages (Table 2b). The estimated mean amount of poles required for construction of fence in a family is 6.338 m^3 in the woodland depleted villages and 8.104 m^3 in the woodland abundant villages.

Animal kraals

Kraals are constructed either square or rectangular shape. It requires more poles to construct cattle kraal than goat and pig kraals. A mean volume of 17.183 m^3 is used to construct a cattle kraal, 1.947 m^3 for a goat kraal and 0.457 m^3 for pig kraal in the woodland depleted villages (Table 2a), compared to 38.170 m^3 used to construct a cattle kraal, 4.826 m^3 for a goat kraal and 0.932 m^3 for a pig kraal in the woodland abundant villages (Table 2b). The choice of species to use when constructing a kraal is less important as these structures are annually moved to avoid animals being trapped by mud during the rainy season, and to limit foot diseases in animals (Lowore *et al*., 1995). This means that every year, new poles are harvested to renovate or construct new kraals. During the renovation of the kraals, old and rotten poles are utilised for fuelwood purposes.

Utensils

Colophospermum mopane wood is used to a less extent for making tools such as mortar, pestle, spoon, walking sticks for elders and hand hoes used for ploughing. Villagers cut down the whole tree to construct a mortar. Mean volume used to construct a mortar in the woodland depleted villages is 0.085 m^3 and 0.002 m^3 for a pestle (Table 2a), while in the woodland abundant villages is 0.096 m^3 to construct a mortar and 0.004 m^3 for a pestle (Table 2b). Mortar and pestle are used traditional for grinding maize, peanuts and in preparation of traditional medicine. The uses of *Colophospermum mopane* wood for crafting utensil was also mentioned in the Giyani, Limpopo Province by Liengme (1981) and Mashabane *et al*. (2001).

Preference of Colophospermum mopane for construction of traditional structures

The pole of *Colophospermum mopane* is mostly preferred to use in construction because it has a high durability of between 10 and 15 years, but Mashabane *et al.* (2001) report a lifespan of about 25 years. *Colophospermum mopane* has the ability to re-grow after harvesting and able to resist the effects of wood borers increasing its preference in construction purposes. The poles are slightly scorched by fire and then debarked to enhance their resistance to the effects of termites. The inner barks are used for making ropes, while the outer barks are used for fuel.

The durability of *Colophospermum mopane* wood is due to the fact that it has a high wood density of around 1200 kg/m^3 (Goldsmith and Carter, 1981). It contains chemicals that resist the effects of termites and wood borers. The wood cell of *Colophospermum mopane* and *Combretum apiculatum* are packed with crystals of calcium oxalate, which results in a dense wood, as opposed to *Acacia* species (Prior and Cutler, 1992). Also, the secondary metabolites collectively known as extractives, contributes to the final density of wood. *Colophospermum mopane* occurs in relatively harsh, dry growing environments, those harsh conditions increases the content of extractives in the plant (Wesley-Smith *pers. comm*. 2005).

Scarcity of *Colophospermum mopane* poles has led villagers to use *Combretum apiculatum* and *Acacia nigrescens* poles during construction of structures. Poles from species other than *Colophospermum mopane* do not last long due to the effects of termites and wood borers, which implies a shorter lifespan of structures leading to a much faster replacement rate of structures and thus a higher demand. The non-wood product examined in this study is the mopane worms, larvae of the moth *Imbrasia belina*.

Conclusion

This study has provided some basic estimates of wood products used in rural livelihood. *Colophospermum mopane* is the ideal species for fuelwood supply and poles used for construction of traditional structures. Circles of degradation are common around the villages, indicating unsustainable resource use practices. Uncertain in the management of natural resources in rural areas as a result of high rate of unemployment coupled with poverty and population growth, which has increased the demand. Land use conversion and unclear responsibility in the management of woodland has also exacerbated the situation. In the light of this study, the followings options are proposed:

a) Implementation of means that would ensure efficient use of woodland resources.

b) Initiation of community projects that aims at conservation of natural resources and eradication of poverty in rural areas.

c) Initiation of conservation education programmes to educate local people (young and old) about the need for conservation and its subsequent benefits. Such programmes need to target females as they constitute the majority of the illiterate people in the studied villages.

d) Application of coppice woodland management, method and season of woodland resource harvesting in rural areas.

e) Greater cooperation between villagers, traditional leaders and conservation departments in an attempt to conserve woodland resources.

f) Setting up of a committee comprised of the above-mentioned people to take the responsibility in the management of woodland and for amendment of permits, which are in line with villagers' needs and resource availability.

g) Sourcing of funds to raise conservation awareness at village level and for capacity development. The awareness campaign needs to include coppice management, fire management and project management.

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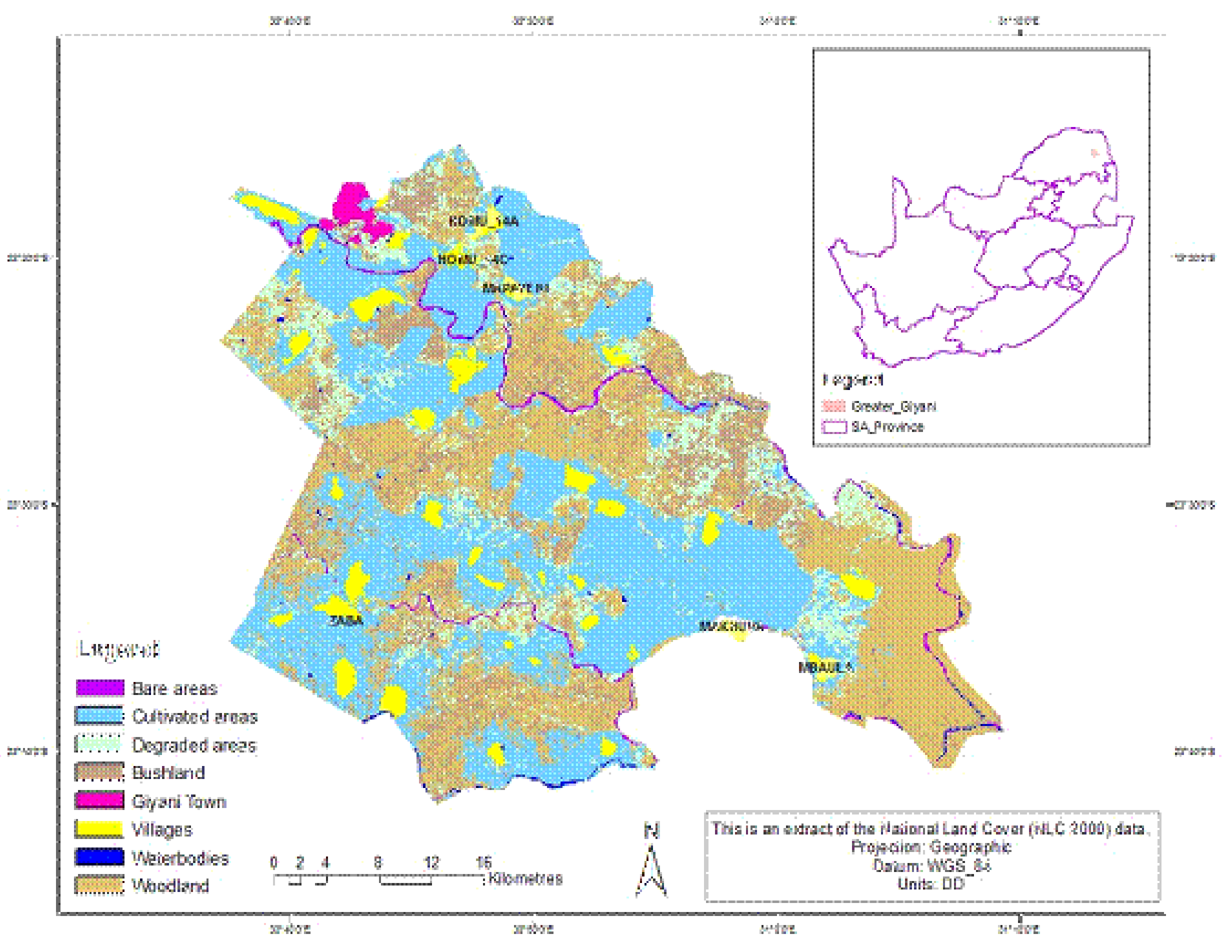

Figure 1. The six selected rural villages in the Greater Giyani Municipality. These villages are located in the northeastern part of the Lowveld, Limpopo Province, South Africa. Data source: National Land

Cover 2000.

Table 1. Socio-economic characteristics of the selected villages in the Greater Giyani Municipality.

Socio-economic characteristic	**% of respondents in woodland depleted villages (n=90)**			**% of respondents in woodland abundant villages (n=90)**		
Gender						
Females	60			59		
Males	40			41		
Human population[a]	19500			16000		
Monthly household income[b]						
<R1000	66			91		
R1001 - R2000	17			6.4		
R2001 - R5000	4			26		
>R50001	2			0		
Employment types[b]	Males	Females	Total	Males	Females	Total
Unemployed	25	52	77	15	72	87
Self employed	8	6	14	1	3	4
Government employed	2	1	3	3	5	8
Private employed	1	2	3	0	1	1
Level of education[b]	Males	Females	Total	Males	Females	Total
Illiterate	12	32	44	4	26	30
Primary	11	10	21	6	9	15
Secondary	11	19	30	21	31	52

Tertiary	1	1	2	1	3	4
Use of fuelwood						
Yes	84			76		
No	16			24		
Affordability to use other fuel than fuelwood						
Yes	32			29		
No	68			71		
Use of wood for construction						
Yes	72			92		
No	28			8		

n = number of people interviewed

[a] = estimated by the community leaders

[b] = percentages do not always add up to 100 due to rounding off and lack of answers by some of the participants

Table 2a. Mean measurement of the uses of *Colophospermum mopane* for fuelwood and poles used in construction by villagers in woodland depleted villages of the Greater Giyani, Limpopo Province, South Africa.

Uses		**Length (m)**	**Circumference (m)**	**Diameter (m)**	**Mass (kg)**	**No. of poles**	**Volume (m^3)**
Fuelwood		1.1	0.18	0.05	6.8	10	0.022
Types of traditional huts							
Kitchen							
Roofing:	Main beams	4.0	0.18	0.06	5.7	18	0.204
	Brandering	3.5	0.1	0.04	1.7	56	0.246

	Roof support	2.65	0.55	0.20	10	16	1.332
Wall (plastered with mud)*		2.7	0.5	0.18	9.5	66	4.536
Children							
Roofing:	Main beams	4.0	0.19	0.05	6.0	19	0.149
	Brandering	3.2	0.12	0.03	1.8	68	0.154
Adults							
Roofing:	Main beams	3.5	0.25	0.07	8.9	20	0.269
	Brandering	4.3	0.09	0.03	1.9	70	0.213
Fencing							
	Main poles	1.72	0.8	0.3	12.5	94	11.433
	Supporting poles	1.32	0.11	0.04	5.9	749	1.243
Types of maize grain stores							
Outside hut granary							
Foundation		1.05	0.55	0.18	2.2	10	0.267
Floor		2.65	0.2	0.06	3.0	35	0.262
Wall		2.2	0.11	0.06	2.40	138	0.273
Roofing:	Main beams	2.8	0.16	0.05	2.30	22	0.121
	Brandering	2.47	0.09	0.03	2.4	27	0.047
Granary in the roof of a kitchen							
Foundation		2.6	0.42	0.15	12.2	12	0.552
Floor		2.7	0.23	0.1	5.3	33	0.700
Wall		1.5	0.2	0.06	2.0	85	0.361
Animal kraals (Main poles)**							
Cattle		2.4	0.6	0.27	13.9	125	17.183
Goat		2.1	0.55	0.15	6.2	130	4.826

Pigsty		1.8	0.45	0.13	6.0	39	0.932
Others:	Mortar	0.99	0.74	0.33	30	1	0.085
	Pestle	1.25	0.20	0.05	6.8	1	0.002

* = estimated as the poles were plastered with mud soil

Table 2b. Mean measurement of the uses of *Colophospermum mopane* for fuelwood and poles used in construction by villagers in woodland abundant villages of the Greater Giyani, Limpopo Province, South Africa.

Uses		**Length (m)**	**Circumference (m)**	**Diameter (m)**	**Mass (kg)**	**No. of poles**	**Volume (m^3)**
Fuelwood		1.6	0.20	0.06	8.2	05	0.032
Types of traditional huts							
Kitchen							
Roofing:	Main beams	4.2	0.20	0.06	6.2	20	0.238
	Brandering	3.7	0.09	0.04	1.8	60	0.279
	Roof support	2.70	0.55	0.20	10	18	1.527
Wall (plastered with mud)*		2.7	0.5	0.18	9.2	70	4.811
Children							
Roofing:	Main beams	4.2	0.22	0.06	10	25	0.297
	Brandering	3.5	0.1	0.04	1.7	56	0.246
Adults							
Roofing:	Main beams	4.0	0.24	0.07	9.5	20	0.308
	Brandering	3.9	0.12	0.04	2.2	70	0.343
Fencing							

	Main poles	1.74	0.84	0.36	12.5	84	14.883
	Supporting poles	1.34	0.11	0.04	5.4	786	1.324
Types of maize grain stores							
Outside hut granary							
Foundation		1.0	0.50	0.17	2.0	12	0.272
Floor		2.78	0.35	0.1	3.4	38	0.830
Wall		1.9	0.1	0.09	2.25	132	1.596
Roofing:	Main beams	2.5	0.15	0.05	2.6	28	0.137
	Brandering	2.6	0.42	0.15	12.2	12	0.552
Granary in the roof of a kitchen							
Foundation		3.0	0.37	0.14	12.0	12	0.554
Floor		2.6	0.55	0.15	5.4	37	1.701
Wall		1.85	0.19	0.04	2.3	156	0.363
Animal kraals (Main poles)**							
Cattle		2.45	0.55	0.27	14.2	272	38.170
Goat		2.1	0.29	0.10	6.7	118	1.947
Pigsty		1.9	0.23	0.06	5.2	85	0.457
Others:	Mortar	1.0	0.79	0.35	34	1	0.096
	Pestle	1.26	0.22	0.06	7.2	1	0.004

* = estimated as the poles were plastered with mud soil

Table 3. Estimated mean amount of fuelwood used for cooking by rural inhabitants in the Limpopo Province. Data derived from previous studies and current study on fuelwood use along the Limpopo Province mopane belt.

Date	Study area	No. of people $family^{-1}$	Amount of wood used for cooking day^{-1} (kg)	Median rank (kg)
This study	Giyani^{+}	5-8 (6.5)	6.8	6.8
This study	Giyani^{++}	5-8 (6.5)	8.2	7.5
2001*	Giyani	7	7.5	7.8
1999**	Venda	8	7.8	8.2
1983***	Giyani	7	14.9	14.9
Estimated mean		7	9.04	Median = 7.8

*Mashabane et al. (2001)
**Madzibane and Potgieter (1999)
***Liengme (1983)

$^{+}$Woodland depleted villages
$^{++}$Woodland abundant villages