

## Full Length Research Paper

# Management of non-timber forest products harvesting: Rules and regulations governing (*Imbrasia belina*) access in South-Eastern Lowveld of Zimbabwe

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Non timber forest products such as *Imbrasia belina* (mopane worms) provide a wide range of benefits to the rural dwellers in the semi-arid areas of South East Lowveld of Zimbabwe. Rules and regulations governing mopane worm use and access in the study area that comprised of a communal area, resettlement area, small-scale farms and a national game park and the relationship of these rules to harvesting of mopane worms were analysed using questionnaire, observational studies and one way analysis of variance (ANOVA). This paper examines the extent to which access to non-timber forest products especially the harvesting of mopane worms is governed by the existence of institutional arrangements and common property management regimes. The results of the study indicated that possession of a permit is a pre-requisite requirement to harvest timber and non-timber forest products in Gonarezhou National park. Harvesters in Mwenezi resettlement areas and Chikombedzi communal area indicated that rules for mopane worm harvesting were either weak or non-existent. In Gonakudzingwa Small Scale Farms, harvesters had to seek permission from the farm owner before any harvesting of mopane worms could take place. The results from the study showed that there were significant differences in the quantity of mopane worms harvested between Gonarezhou National Park and Chikombedzi Communal Area ( $p = 0.036$ ), Gonakudzingwa Small Scale Commercial Farms and Chikombedzi Communal Area ( $p = 0.001$ ), Mwenezi Resettlement Area and Chikombedzi Communal Area ( $p = 0.001$ ). However, there were no differences between the Gonarezhou National Park, Gonakudzingwa Small Scale Commercial Farms and Mwenezi Resettlement Area. Findings of this study suggest the need for adaptive local management systems that enhance sustainable use of the resource and at the same time regulates the harvesting and the market structure of non-timber forest products.

**Key words:** *Imbrasia belina*, mopane worm, harvesting, tenure regime, access; non-timber forest products.

## INTRODUCTION

There is a growing evidence that non-timber-forest-products contribute significantly to livelihoods in rural Asia, Africa and other developing countries (Campbell and Luckert, 2002; Cavendish, 2000; Cocks et al., 2008;

Shackleton and Shackleton, 2004; Viet Quang and Nam Anh, 2006). The three main functions of non timber forest products in the rural economy is that they help to fulfill households' subsistence and consumption needs and

secondly, they serve as a safety-net in times of crises (e.g. crop failure) and thirdly to provide regular cash income (Angelsen and Wunder, 2003; Cavendish, 2002; Chileshe, 2005; Shackleton et al., 2007).

By definition non-timber-forest-products includes fruits and nuts, vegetables, fish and game, medicinal plants, resins, essences and a range of barks and fibers such as bamboo, rattans, and a host of other palms and grasses (CIFOR, 2011). This definition covers (*Imbrasia belina*) mopane worms the subject of this research where it is assumed that their harvesting is threatened by lack of rules of access in the South-East Lowveld of Zimbabwe. The mopane worms are endemic to parts of central and southern Africa and are associated with the distribution of *Colophospermum mopane* (mopane tree). *C. mopane* is confined to countries that include northern part of South Africa, northern Namibia, Botswana, Zimbabwe, Zambia, Mozambique, Malawi, and Angola (Timberlake, 1995).

Mopane worms play an important role in the nutrition of rural communities as they provide them with the vital crude proteins (61%), crude fats (17%) and carbohydrates which are more than equal amounts of beef or fish, and a higher energy value than soybeans, maize, beef, fish, lentils, or other beans that are often lacking in their diets (Hobane, 1994, 1995; Wilson, 1989; Banjo et al., 2006; Defoliart, 1995). In some African countries, children are fed with flour made from dried caterpillars to curb malnutrition, while pregnant and breast feeding women and those who are anemic are encouraged to eat caterpillars to improve their protein, calcium, and iron levels (FAO, 2004; Illgner and Nel, 2000). Toms et al. (2003) recommended that people who are HIV-positive eat the caterpillars to boost their immune system.

Non timber forest products (are the most accessible source of products and incomes for many economically marginalized people, and are consequently under considerable pressure to provide both production and environmental benefits (Dalong and Barik, 2005). Poverty, low income and survival needs often drive local people to over-harvest non timber forest products like mopane worms at the expense of environmental sustainability. Studies done by FAO (1996) indicated that there is a strong link between resource degradation and vulnerability to livelihoods.

The common-pool resources, such as forest resources and mopane worms are considered to have an inelastic supply and their sustainable utilization may be threatened by externalities associated with individual actions in the harvesting of such resources (Mutenje et al., 2010). The sustainable management of non-timber forest products is an important issue facing both development planners and policy makers (FAO, 2003). Hall and Bawa (1993) define

sustainable harvesting of natural resources as the level of harvest that does not impair the ability of the harvested population to replace itself. However, Ticktin (2004) pointed out that ignoring the potential variation in harvest strategies and their drivers can lead to spurious conclusions about resource use sustainability.

Agrawal and Gibson (1999) have shown that local people resource management is the most viable option for common pool resources like mopane worms. The premise is based on assumptions that local communities not only understand their problems but also have greater incentive to find workable solutions to problems because their livelihoods depend on these natural resources (Belcher and Schreckenberg, 2007). The incentive to conserve the natural resource base and their sustainable management thereof comes from economic opportunities which the non-timber forest products offer (FAO, 2003).

Despite the recognized importance of mopane worms to the economy and human welfare, the institutional arrangements and rules governing mopane worm use and access were found to be weak and poorly understood (Hobane, 1995). The objective of this study is therefore to investigate the extent to which mopane worm harvesting and management is driven by institutional arrangements and rules of access in the South East Lowveld, Zimbabwe. Secondly, to find out who is harvesting the mopane worms, where, how much, and for what purpose in the South East Lowveld of Zimbabwe.

## MATERIALS AND METHODS

### Study area

The study was conducted in the South-East Lowveld of Zimbabwe (Figure 1). The area occupies the region 21° 00'-22°15'S and 32° 30'-32°15'E, and covers about 300 000 ha in extent. The study was conducted in the four different property regimes: Gonarezhou National Park (state property), Gonakudzingwa Small Scale Farms (+- 700 hectares in extent), (Private Property), Chikombedzi Communal Area in (Vivinya village) (Communal Property), and Mwenezi Resettlement Farms (Edenvale, Jabula, Nardice and Ironwood) (State and Private Property).

The study area falls in the Natural Ecological Region 5 classification of Zimbabwe and rainfall ranges between 400 to 500 mm per annum with an annual temperatures of 18 to 24°C (Low and Rebelo, 1996). The study area experiences three climatic seasons: a hot dry period from August to October, a cold dry period from May to July and a hot wet period from November to April. The altitude of the study area varies between 165 and 575 m above sea level (Mlambo, 2006).

The soils are predominantly shallow sands of the siallitic group derived from sandstone (Nyamapfene, 1991). Mopane is a dominant tree found in the study area in association with *Kirkia acuminata*, *Dalbergia melanoxylon*, *Adansonia digitata*, *Combretum apiculatum*, *Camptostoma imberbe*, *Acacia nigrescens*, and *Commiphora* species.

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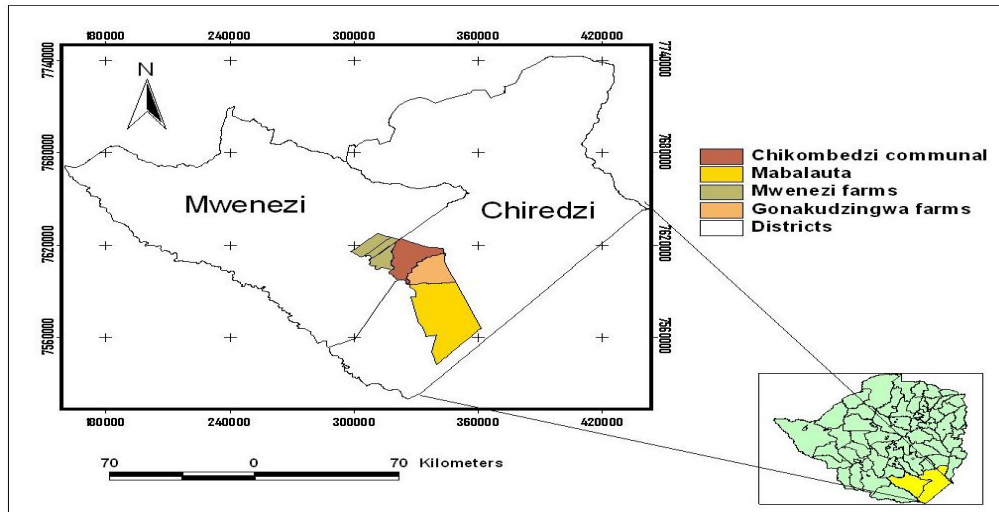


Figure 1. Location of the study area.

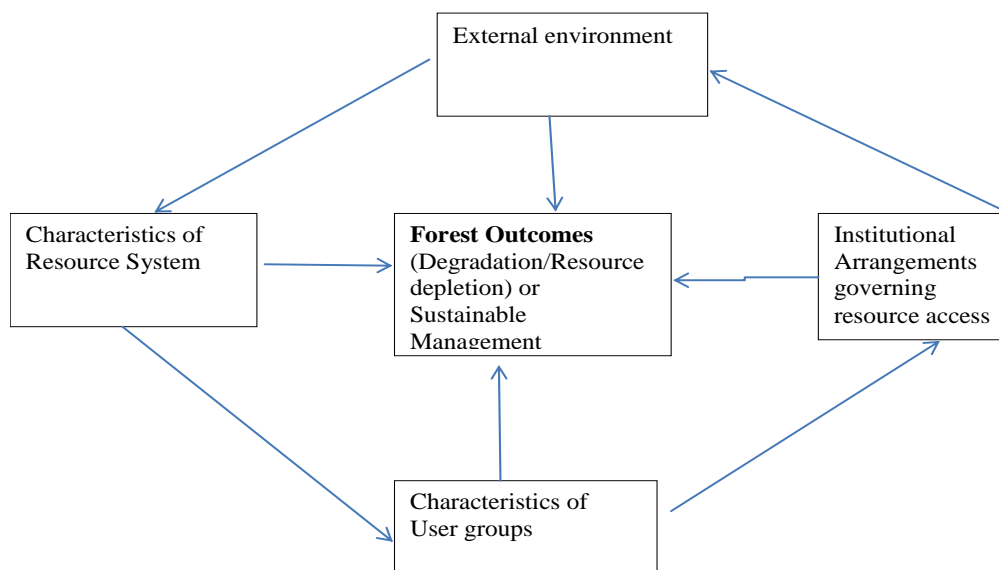


Figure 2. Conceptual framework for analysing the impact of local management institutions on Common Pool Resources management (Heltberg, 2001).

**Theoretical framework of analysis**

Wade (1988), Ostrom (1990) and Baland and Platteau (1996) suggested favorable conditions for sustainable governance of common pool resources. Agrawal (2001) summarized these factors, and identified four critical factors for sustainable governance of Common Pool Resources which are: characteristic of the resource system, user group, the institutional arrangements, and the external environment (Figure 2).

This paper draws on Agrawal's (2001) synthesis and relates to the study of mopane worms in the south east Lowveld of Zimbabwe. Institutions are important parameters for effective governance of the forest commons. Institutions are defined as a set of accepted social norms and rules for making decisions about

resource use. Institutions define who controls the resource, how conflicts are resolved, and how the resources are managed. In addition they shape the resource users' actions and expectations. For sustainable common pool resource governance rules should be easy to understand and enforce, and should hold users accountable for their actions (Agrawal, 2001). The external environment deals with demographic, cultural, technological, market related factors and their influence on resource access and use.

**Data collection**

The research was carried out from December 2009 to March

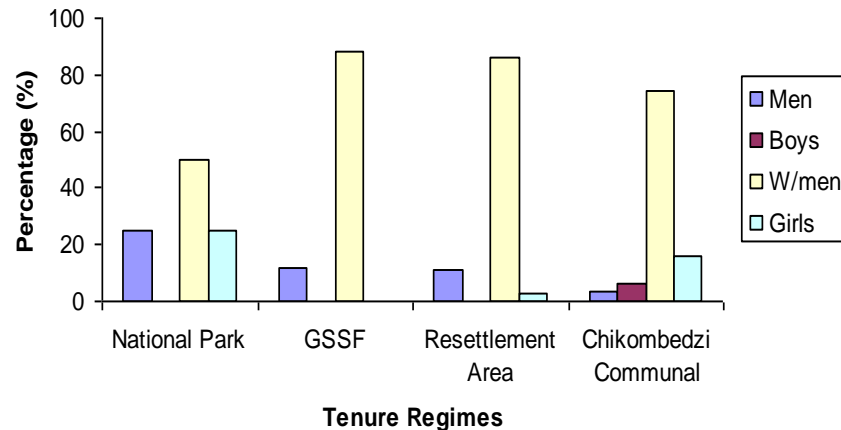


Figure 3. Gender of Harvesters found in the four tenure regimes.

2010, in Gonarezhou National Park (GNP), Gonakudzingwa Small Scale Commercial Farms (GSSCF), Chikombedzi Communal Area (CCA) and Mwenezi Resettlement Area (MRA) in the South East Lowveld, Zimbabwe. The period December 2009 to March 2010 corresponds to mopane worm eruption periods in the study area. Questionnaires were administered on 108 harvesters in all the study areas, 31 harvesters in Chikombedzi Communal Area (CCA), 37 harvesters in Mwenezi Resettlement Area (MRA), 26 harvesters in Gonakudzigwa Small Scale Commercial farms (GSSCF) and 14 harvesters in Gonarezhou National Park (GNP).

The harvesters were followed to harvesting areas and interviewed on the ground by the researcher whilst harvesting. The researcher and mopane worm harvester interaction on the ground helped to validate the correctness of information which was provided by the harvester. Data on quantities of mopane worms harvested, distances covered by harvesters from their homes, the time harvesters spend harvesting, harvesting period, rules governing access, enforcement mechanisms in place and frequency of harvesting were collected from 108 harvesters in the four tenure areas studied. Convenience sampling of harvesters was done and any harvester encountered in the study area harvesting mopane worms was interviewed. Harvesters moved in small groups of about 5 to 15 individuals and were difficult to get due to the size and remoteness of the area.

However, in very few cases harvesters moved alone and were treated as such. In all cases, information regarding where harvesters could be located was obtained through the National Parks Office in the case of Gonarezhou National Park, homestead in the case of Gonakudzingwa Small Scale farms or sabhuku (kraal head) in the case of Chikombedzi Communal and Mwenezi resettlement areas. In the field, getting information on the next group of harvesters was through asking the last group if they had seen other harvesters in the area (snow ball method). The quantity harvested (wet mass) by each harvester was weighed in kilograms (kg) using a 40 kg Dahongying scale. Quantities of mopane worm harvested were analyzed using one way analysis of variance (ANOVA).

## RESULTS

### Socio-demographic data

Mopane worm harvesting in the study area was mainly a female activity (Figure 3). In Gonarezhou National Park

about 55% of harvesters were women, 80% in Gonakudzingwa Small Scale Farms, 80% in Mwenezi Resettlement and 65% in Chikombedzi Communal. The majority of the mopane worm harvesters (27.8%) were aged between 30 to 40 years, whilst (4.6%) of the harvesters were above 70 years of age (Table 1). Results showed that 13% of the mopane worm harvesters harvested mopane worms for own use (consumption) whilst 15.7% harvest for sale and 71.3% for both consumption and for sale (Figure 4)

### Quantities of mopane worm harvested in the four tenure regimes

Table 2 shows descriptive statistics, the mean, standard deviation and 95% confidence intervals for the dependent variable (Mopane worms harvested) for each separate group (Gonarezhou National Park (GNP), Gonakudzingwa Small Scale Farms (GSSCF), Mwenezi Resettlement Area (MRA) and Chikombedzi Communal Area (CCA). There were significant differences ( $p < 0.000$ ) in the mean quantities of mopane worms harvested per day between the different tenure regimes (Table 3).

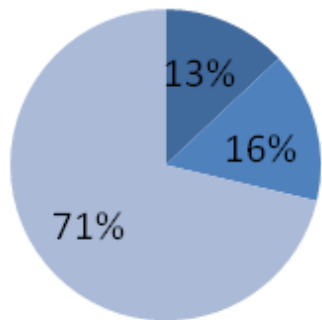
### Multiple comparisons table

Multiple comparison analysis (Table 4) showed that there were significant differences in the quantity of mopane worms harvested between Gonarezhou National Park and Chikombedzi Communal Area ( $p = 0.036$ ), Gonakudzingwa Small Scale Commercial Farms and Chikombedzi Communal Area ( $p = 0.000$ ), Mwenezi Resettlement Area and Chikombedzi Communal Area ( $p = 0.000$ ). However, there were no differences between the Gonarezhou National Park, Gonakudzingwa Small Scale Commercial Farms and Mwenezi Resettlement Area. The results showed that there were significant

**Table 1.** The percentage of mopane worms harvested by different age groups.

Age of mopane worm harvester	Percentage
Less than 30 years	13.0
30 - 40 years	27.8
41- 50 years	21.3
51 – 60 years	18.5
61 – 70 years	14.8
More than 70 years	4.6

■ own use   ■ Sale   ■ Own use and sale

**Figure 4.** Reasons for harvesting mopane worms in the four tenure regimes

difference between groups as determined by one-way ANOVA ( $F(3,104) = 13.302, p = 0.000$ ).

A Tukey post-hoc test revealed that the quantity of mopane worms harvested per day was statistically significantly lower after taking the Gonarezhou National Park ( $20.9 \pm 7.7$  min,  $p = 0.036$ ) and Gonakudzingwa Small Scale Farms ( $32.31 \pm 6.33$  min,  $p = 0.000$ ) compared to Mwenezi Resettlement Area ( $33.43 \pm 5.80$  min). Similar results were found through the Games – Howell analysis.

### The rules and regulations governing mopane worm harvesting in the four tenure regimes of South East Lowveld, Zimbabwe

In Gonarezhou National Park (state property) and Gonakudzingwa Small Scale Farms (Private Property) rules governing mopane worm harvesting and access existed. The majority of harvesters indicated that there were no rules governing the harvesting of worms in Chikombedzi Communal Area and Mwenezi Resettlement Farms.

Thirty percent of the respondents in Gonarezhou

National Park (GNP) indicated that harvesters of mopane worms should seek for permission from the parks authority prior to harvesting taking place. Whilst (70%) of the respondents said that a permit issued upon payment by the National Parks is required before harvesting of mopane worms or any other products from the park estate (Figure 5). Ten percent of mopane worm harvesters in Gonakudzingwa Small Scale Farms (GSSCF) suggested that permission to harvest the worms should be sought from the farm owner before any harvesting could be done whilst about 5% indicated that any outsider harvester is required to pay to the farm owner first before any harvesting could resume.

The majority (85%) of mopane worm harvesters in (GSSCF) said that tree cutting as a harvesting method is not allowed by the farm owners. In Mwenezi Resettlement Area (MRA), about 95% of the respondents indicated that a permit issued by the occupier of the farm is required before any harvesting whilst 5% indicated that outsiders had to pay first before they could be allowed to harvest the worms. Meanwhile thirty percent of the respondents in Chikombedzi Communal Area (CCA) confirmed that harvesters needed to seek permission from the “owner” where harvesting is taking place whilst 70% indicated that harvesters should report or seek permission from the Sabhuku (Village Headman).

However, a strong relationship existed between tenure regime and the presence of rules governing mopane worm harvesting ( $\chi^2 = 54.456; p = 0.000; DF = 3$ ). There were also significant differences ( $\chi^2 = 111.846; p = 0.000; DF = 12$ ) between rule type and tenure regime where harvesting of mopane worms is taking place. In addition, the research found out that there were strong relationship between tenure regime and the person giving the rules (be it park official, farm owner, or sabhuku in the case of Chikombedzi or Mwenezi ( $\chi^2 = 118.000; p = 0.000; DF = 9$ )). The results showed that a strong association existed between tenure regime and the propensity of rule breaking. The majority of offenders preferred to harvest in Gonarezhou National Park or Mwenezi than in Chikombedzi Communal ( $\chi^2 = 82.864; p = 0.000; DF = 9$ ). The private farms of Gonakudzigwa were the most preferred source of mopane worms compared to Mwenezi and Gonarezhou ( $\chi^2 = 38.554; p = 0.000; DF = 12$ ).



**Table 2.** Tenure versus the quantities of mopane worms harvested.

Descriptive statistics								
Mopane worm harvested per day (kg)								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min	Max
					Lower Bound	Upper Bound		
GNP	14	30.0000	18.11077	4.84031	19.5432	40.4568	7.00	65.00
GSSCF	26	41.3462	28.02562	5.49628	30.0264	52.6659	10.00	87.00
MRA	37	42.4649	31.02680	5.10077	32.1200	52.8097	8.00	84.00
CCA	31	9.0323	3.63762	.65334	7.6980	10.3665	3.00	19.00
Total	108	30.9833	27.61098	2.65687	25.7164	36.2503	3.00	87.00

**Table 3.** Anova output on mean quantities of harvested mopane worms in different tenure regimes

Anova table					
Mopane worms Harvested per day (kg)					
Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	22620.513	3	7540.171	13.302	0.000
Within Groups	58952.697	104	566.853		
Total	81573.210	107			

## DISCUSSION

The findings that the majority of harvesters were women is in agreement with findings of Kozanayi and Frost (2002) who reported that more than 70% of mopane harvesting and processing has traditionally been a women and children activity. Our findings indicated that in Gonarezhou National Park about 55% of harvesters were women, 80% in Gonakudzingwa Small Scale Farms, 80% in Mwenezi Resettlement and 65% in Chikombedzi Communal.

Mopane worm play an important role in the nutrition of rural communities as they provide them with the vital crude proteins (63.5%), crude fats (18%), carbohydrates 11.4 (g/100g), minerals 3.5 (g/100g) and 543 of energy (kcal/100g), (Hobane 1994, 1995; Defoliart, 1995). Mopane worms have considerable potential for alleviating nutritional inadequacies in poor rural communities.

An important distinction must be made between the common pool resources and the management regimes under which the resources are held. Resource management regimes are often based on the basis of property rights under which the resources are held. In the study area, there are four types of property rights; which are semi-state property (with some open access rights), common property, private property and state ownership (Heltberg, 2001).

The categorization of property rights regimes into four broad categories may be misleading giving a misconception that there are clear cut divisions between the property regimes, yet there is often overlap across

regimes. Different tenure systems can apply in one locale simultaneously or at different times, for example, at one time it's a grazing area where locals harvest mopane worms, and at the other it's someone's crop field. Classification of natural resources under the broad common property regimes is therefore a theoretical ideal as this study in the South East Lowveld of Zimbabwe has shown that there are common-property-like and open-access-like scenarios in mopane worm harvesting and management.

Property rights regimes perform the function of limiting use, coordinating users and responding to changing resource condition. Thus management regimes have two main functions of flow and stock management. They define and enforce rules of resource access (flow management) and limit aggregate output from the resource to ensure continued benefits (stock management) into the future. Common pool resources are natural resources for which it is difficult to exclude potential users and which can be depleted through over-use (McKean, 2000), like in the case of mopane worms. Most of common property resources which are found in southern Africa (including Zimbabwe) are largely held under common property arrangements, (Mutenje, et al 2010), like those found in Chikombedzi. Common property resources belong to the community, and access rules are defined with respect to community membership.

In tenure regimes where there is some form of ownership of the land for example in Gonarezhou National Park (state property) and Gonakudzingwa Small Scale Farms (Private Property) rules governing mopane

Table 4. Multiple Comparisons Analysis

<b>Multiple comparisons</b>							
<b>Dependent variable: Mopane worms harvested per day (kg)</b>							
	(I) Tenure	(J) Tenure	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
<b>Tukey HSD</b>	GNP	GNP					
		GSSCF	-11.34615	7.89250	0.479	-31.9539	9.2616
		MRA	-12.46486	7.47060	0.346	-31.9710	7.0413
	GSSCF	CCA	20.96774*	7.66649	0.036	.9501	40.9854
		GNP	11.34615	7.89250	0.479	-9.2616	31.9539
		GSSCF					
	MRA	MRA	-1.11871	6.09281	0.998	-17.0274	14.7900
		CCA	32.31390*	6.33148	0.000	15.7820	48.8458
		GNP	12.46486	7.47060	0.346	-7.0413	31.9710
	CCA	GSSCF	1.11871	6.09281	0.998	-14.7900	17.0274
		MRA	33.43261*	5.79706	0.000	18.2961	48.5691
		CCA					
<b>Games-Howell</b>	GNP	GNP	-20.96774*	7.66649	0.036	-40.9854	-.9501
		GSSCF	-32.31390*	6.33148	0.000	-48.8458	-15.7820
		MRA	-33.43261*	5.79706	0.000	-48.5691	-18.2961
	GSSCF	CCA					
		GNP	-11.34615	7.32377	0.420	-31.0567	8.3644
		MRA	-12.46486	7.03182	0.301	-31.3118	6.3821
	MRA	CCA	20.96774*	4.88420	0.004	6.7013	35.2342
		GNP	11.34615	7.32377	0.420	-8.3644	31.0567
		GSSCF					
	CCA	MRA	-1.11871	7.49846	0.999	-20.9615	18.7241
		CCA	32.31390*	5.53497	0.000	17.1182	47.5096
		GNP	12.46486	7.03182	0.301	-6.3821	31.3118
GNP	GSSCF	1.11871	7.49846	0.999	-18.7241	20.9615	
	MRA	33.43261*	5.14245	0.000	19.6038	47.2614	
	CCA						
GSSCF	GNP	-20.96774*	4.88420	0.004	-35.2342	-6.7013	
	GSSCF	-32.31390*	5.53497	0.000	-47.5096	-17.1182	
	MRA	-33.43261*	5.14245	0.000	-47.2614	-19.6038	
MRA	CCA						
	GNP						
	GSSCF						
CCA	CCA						
	GNP						
	GSSCF						

\*. The mean difference is significant at the 0.05 level.

worm harvesting and access existed. In tenure regimes where there was no real ownership of the land, the majority of harvesters indicated that there were no rules governing the harvesting of worms that is, in Chikombedzi Communal Area and Mwenezi Resettlement

Farms.

In Gonarezhou National Park, the Parks and Wildlife Act of 1975 entrusts the management of the park to the National Parks and Wildlife Authority. Access to mopane worm harvesting in the park is made possible through the

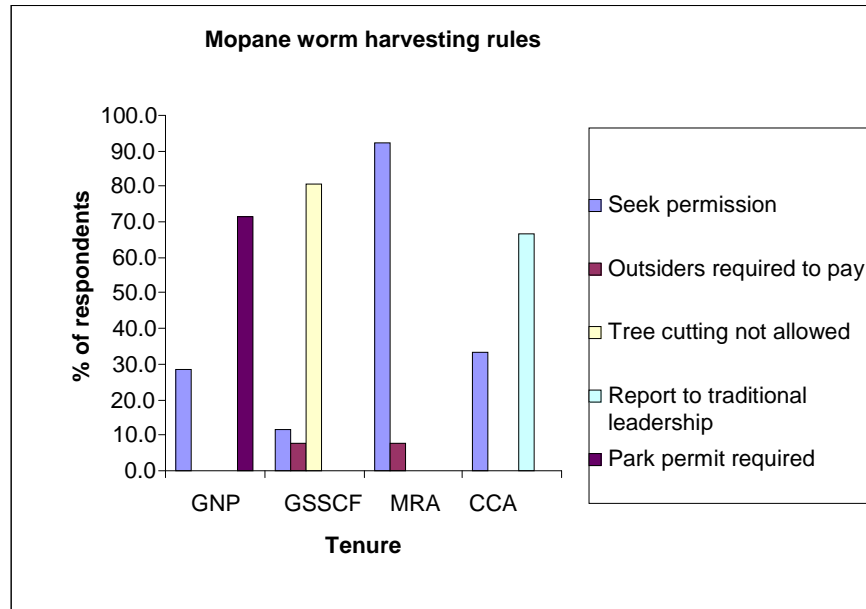


Figure 5. Rules governing mopane worm harvesting in the South East Lowveld.

use of the permit. The park authority has got the power and authority to exclude those people who do not follow their management rules. The major problems faced by harvesters in Gonarezhou are the high fees charged by the park authority to the harvesters about \$2 per day. Even people, who live adjacent to the park, have to pay the same fees as people from other areas far from the park. Due to the fee structure, other harvesters sneak into the park to harvest without making a payment. On the other hand the park authority is not able to efficiently patrol the park because of the area it had to cover and secondly because of insufficient financial and material resources. A user friendly and sustainable policy framework should be put in place to enable free access of the local people into the park. Local people feel that they should have a stake in the management of natural resources in the park rather than the current menial benefits, for example, thatch grass and meat from problem animal control operations, which are far from meeting their needs.

In Gonakudzingwa Small Scale Commercial Farms, the farm owner is the sole rule giver with access, withdrawal, management, exclusion and alienation rights. Upon granting of harvesting permission by the farm owner, the mopane harvesters are informed accordingly and tree cutting as a method to harvest worms is not permitted across all the tenure regimes. Any offenders caught would be expelled from the farm or the axe confiscated. In practice it's difficult for farm owners to properly enforce the rules because of many resource constraints which militate against them. In extreme cases farm owners report the violations to the police.

Mwenezi is a resettlement area (semi-state regime)

with both elements of state and private property. The majority of mopane worm harvesters in Mwenezi indicated that there were no mopane worm harvesting rules. The new farmers in Mwenezi had the access and withdrawal rights to mopane worms found in their area but do not have full management and exclusion rights to outsiders. The locals and the local leadership in Mwenezi had little or no power to exclude outsiders to harvest mopane worms, the same situation is prevailing in Chikombedzi communal area. The locals could neither sell, transfer or mortgage state property. In addition farmers in Mwenezi got their farms through the land reform program of 2002. The major point therefore, relates to security of tenure. In addition the natural resource governance in Mwenezi is affected by the wrangles between two traditional chiefs in the area, Chiefs Mpapa and Chitanga, over the control of the resettlement area. Mopane worms in Chikombedzi are treated as an open-access resource (no controls over access or use). Open access property regime implies different property-rights governing access to and use of the resources.

In Chikombedzi, villagers had usufruct rights of access and withdrawal to mopane worms found in the village. These villagers had management rights to mopane worms around their immediate homesteads and graveyard areas. However, the rights of Chikombedzi villagers to exclude others are weak and in most cases non-existent. People from other villages had to seek for permission from the local headman (Sabhuku) to harvest mopane worms as a matter of formality. Due to the nature of the statutes that govern access to land and natural resources, the headmen had no full powers to



deny people access to the mopane worms. Our findings are consistent with other studies that some Non Timber Forest Products were being depleted rapidly than others for various reasons (De Beer and McDermott, 1996); Chaudary (1998); Olson (1998) and IFAD (1999). Natural resources with high economic value are depleted more rapidly than resources with low economic value (Schlager and Ostrom, 1992). Hardin's (1968) view that resources being freely accessible to all leads to competition between users in the pursuit of maximizing their personal benefits is related to our findings in the South East Lowveld of Zimbabwe.

## Conclusions

The objective of this paper was to examine the rules and regulations governing mopane worm (mw) access in South-Eastern Lowveld of Zimbabwe and their effect on sustainable management. The study results show that there is a correlation between the quantities harvested to protection of the property regimes from wantom harvests especially in Gonarezhou National Park and Mwenezi Resettlement Area.

In general common property resources belong to the community as in the case of Chikombedzi where rules of access are defined with respect to community membership. In Chikombedzi, rules of conservation are difficult to regulate and access is limited to community membership where rules are unenforceable. Such property regimes form good candidates for resource degradation. In this study we managed to show that the rules governing the harvesting and access to mopane worm management are in place in the Gonarezhou National Park and Gonakudzigwa private farms. But such rules do not exist in Chikombedzi communal and Mwenezi resettlement area where mopane worm is treated as open access resource. Further work is needed to establish how the rules could be used to reduce conflict on natural resources in the south east lowveld so that there are "win win" outcomes between state, private, resettlement and the communal people.

## Conflict of Interest

The authors declare that they have no conflict of interest.

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