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Contribution of forest provisioning ecosystem services to rural livelihoods in Copperbelt's Miombo woodlands, Zambia

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Contents

Abstract

Global policy interest in forest ecosystem services has increased in the past two decades because of the significance of forests in mitigating climate change and providing services which are important to the livelihoods of rural people in developing countries. A better understanding of the relationship between African Miombo forest ecosystem services and livelihood strategies and outcomes, differentiated by wealth and gender, is particularly needed if the UN-REDD programme and Climate Compatible Development initiatives are to achieve their aims. In this paper, we present a case study from two Miombo woodland regions (a National Forest Reserve and a Joint Forest Management Scheme) in Copperbelt Province, Zambia. We employed focus groups, in-depth interviews, and interviewed 244 households stratified into three wealth classes and by gender of household heads, to examine the patterns of use of forest provisioning ecosystem services (FPES) in Miombo agro-ecosystems. Our results show that FPES are vitally important in providing food, medicine, fodder, and construction materials. Wealth of households significantly affected household's ranking of provisioning services, with foods ranked as the most important products by households. Wealth classes, as opposed to gender of household head, were the key determinant of the sale of FPES as a source of income. We further examined the use of PFES in coping with household shocks and stresses over a period of 12 months and found it as the most widely used coping strategy by households (33%). We conclude that FPES contribute immensely to livelihoods for consumption, as a source of income and as a coping strategy to shocks. As a result, high deforestation and forest degradation will negatively affect livelihood options. To reconcile the policy goals set by REDD+ of reducing poverty and enhancing carbon stores, it is vital that we better understand the use of PFES in livelihoods, the factors affecting their use, and households' responses to shocks and stresses through local level livelihoods analysis, engaging detailed livelihood surveys using a variety of participatory tools.

Keywords: Rural livelihoods, forest ecosystem services, deforestation, degradation, food insecurity.

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1 Introduction

Global policy interest in forest ecosystem services has increased due to their role in mitigating climate change and providing services that are important to rural livelihoods in developing countries. Donor agencies, rural development researchers and policymakers have started to focus on climate compatible development, which integrates adaptation, mitigation and development (Stringer et al., 2012). The use of forest ecosystems by people to pursue livelihoods has long been recognised (Pearson, 1937, Whitford, 1923), however, the world over, forests are disappearing at alarming rates (FAO, 2010). This has prompted policymakers, researchers and development agencies to promote the sustainable management of forests to reconcile economic development and biodiversity conservation (Paumgarten and Shackleton, 2011).

Forests provide various products that underpin many rural livelihood strategies (Shackleton and Shackleton, 2004). These are collectively referred to as 'provisioning services'. Provisioning services are, "services supplying tangible goods, finite though renewable, that can be appropriated by people, quantified and traded" (Maass et al., 2005:7). Since the value of vegetation to rural livelihoods is socially constructed and contested (Kepe, 2008), direct–use value of FPES in households' is a key determinant of their value to livelihoods. Globally, the relationship between livelihoods and forest ecosystems (as a socio-ecological system) is often not addressed in policy debates that lead to policy recommendations for forests (Carpenter et al., 2009). This has resulted in forest management strategies that are often biased towards forest conservation, at the expense of livelihoods of forest-dependent communities (Lovejoy, 2006). Rasul et al (2011) has highlighted the scarcity of empirical scientific data on economic and social benefits of ecosystem services, while Carpenter et al (2009) has called for accelerated efforts among scientists to understand the dynamics of human-natural systems to understand the use of ecosystem services within different socio-ecological systems and develop appropriate management strategies, such as the African Miombo.

The Miombo woodlands are the most extensive dry forest formation in Africa, with an estimated area of 2.7million km^2 (Frost, 1996). They hold the bulk of earth's biomass (about 43% of the world's tropical dry forests) and are one of the last remaining megafaunal assemblages (Mittermeier et al., 2003). The use of these forests has been reported in isolated case studies that have focused on specific FPES e.g. edible insects (Mbata et al., 2002), indigenous fruits (Kalaba et al., 2010, Leakey and Akinnifesi, 2008), wild vegetables, honey and oils (Shackleton and Gumbo, 2010), traditional medicine (Chirwa et al., 2008) and construction materials such as poles, fibres and (Clarke et al., 1996), though little is known on how local institutions affect the use of forests and the implications for livelihoods. Further, in the Miombo systems of Sub-Saharan Africa, there is little research that attempts to understand how socio-economic factors affect forest use. Understanding how use and sale of provisioning services is differentiated by wealth and gender is essential in understanding people's reliance on forest ecosystems and their contribution to livelihoods, because benefits derived from forest ecosystems are not uniform or equitable between and within forest dependent communities (Heubach et al., 2011, Shackleton et al., 2007), making knowledge on socio-economic differentiation important in developing

management interventions that affect rural livelihoods and sustainable forest use (Shackleton and Shackleton, 2006).

Lastly, rural households exists within a vulnerability context in which stresses and shocks affect their livelihood assets and options, over which they have very little control (Scoones, 1998). Stresses are predictable, continuous and often cumulative (e.g. seasonal food shortages), while shocks are sudden and unpredictable (e.g. droughts, floods, crop failure, illnesses and death of household members) (Chambers and Conway, 1991). Since rural communities are not homogenous, different households experience different frequencies and types of vulnerability, and respond differently (Maxwell et al., 1999, Paumgarten and Shackleton, 2011). Little is however known on the role of forests in assisting rural households to cope with shocks and stresses. Understanding people's use of provisioning services in responding to shocks and stresses is essential if the long-term goals of economic development and biodiversity conservation are to converge in regions with high poverty levels and biologically diverse ecosystems (Paumgarten and Shackleton, 2011).
This study aims to provide a more holistic understanding of forest use and its relative importance to rural livelihoods, by understanding the use of PFES in different socio-ecological systems within the Miombo; understanding how the use and sale is differentiated by wealth and gender. It further examines the use of PFES in coping with household shocks and stresses, and the ultimate implications of deforestation and forest degradation on livelihood options. It is envisaged that such understanding is important if reduced deforestation and forest degradation –plus (REDD+) and climate compatible development (CCD) are to achieve their aims.

1.1 Rural livelihoods vulnerability and forests

Vulnerability has been defined as the extent to which a system, subsystem or system component is likely to experience harm after being exposed to perturbation (Turner et al., 2003). Rural livelihoods are vulnerable to shocks (health, natural, economic), trends (economic, resource), and stresses or seasonality (seasonal food shortages, fluctuations in prices, employment opportunities) (Scoones, 1998). This is particularly true for rural communities in Sub-Saharan Africa, a region with high poverty levels (Fisher et al., 2011), and vast areas of forested land, and therefore large populations of poor people live in forested areas (Sunderlin et al., 2005). In this region, there is an intertwined challenge of poverty and forest degradation (Soltani et al., 2012). As poverty and forest degradation continue to dominate global environmental policy debates, extreme poverty and environmental sustainability, which are the first and seventh goals respectively of the millennium development goals (MDGs) remain a challenge albeit their planned achievement dates fast approaching.
Natural forests are important to rural livelihoods for household consumption, and as a source of income (Mamo et al., 2007, Shackleton and Shackleton, 2006, Sunderlin et al., 2005, Tesfaye et al., 2011) and for livelihood diversification (Barrett et al., 2001). The use of forests by rural people for both timber and non-timber products as well as to open new land for agriculture is widespread probably due to a number of reasons among them; (i) they are accessed communally on customary land, and in National Forest Reserves (due poor monitoring by government officials) (Fisher et al., 2010), (ii) they require limited skills and no capital outlay to harvest products (Neumann et al., 2000), and (iii) they provide valuable resources during the critical periods of hunger when few options are available (Byron and Arnold, 1999, Kamanga et al., 2009).

In rural livelihoods, households face various idiosyncratic shocks (such as death, sicknesses, loss of property) and covariate shocks (e.g. drought outbreaks of human and livestock diseases) (McSweeney, 2004, Paumgarten and Shackleton, 2011). Rural people us diverse strategies to cope with these set-backs (Maxwell et al., 1999, McSweeney, 2004). The coping capacity of households to shocks and stresses is determined by a number of factors such as the intensity and frequency of the shock (Pattanayak and Sills, 2001), household characteristics (such as wealth, age and gender) and asset endowment (Pattanayak and Sills, 2001, Turner et al., 2003). Households use often a variety of strategies (such as kinship, disposing of assets, forest products) to cope with idiosyncratic shocks (Heemskerk et al., 2004, Maxwell et al., 1999, Paumgarten and Shackleton, 2011). These diverse strategies are often inadequate in managing risks when facing extreme covariate shocks such as droughts (Dercon, 2002, Heemskerk et al., 2004).

The use of forests by communities is rooted in their history and is part of their culture and hence are widely used to cope with shocks and stresses (McSweeney, 2004, Paumgarten and Shackleton, 2011, Sunderlin et al., 2005). This use is differentiated by socio-economic factors such as wealth and gender. Findings on the use of forest by wealth and gender of households is mixed, some authors have reported that wealthy households as consuming more than poorer households (Cavendish, 2000, Wunder, 2001) while others report the poor as being more dependent (Shackleton and Shackleton, 2006). In Cameroon, the middle wealth groups were found to benefit more than their poor or wealthy counterparts from sale of forest products (Ambrose-Oji, 2003). In a study in South Africa, results showed that an increase in wealth status of households did not reduce the quantity of natural resources consumed (Cocks et al., 2008). Differentiating households by gender of household head has been also reported as a factor affecting forest use by households, as female headed households tend to rely more on forest products (Yemiru et al., 2010). A study in North West province of Cameroon found that women use the forests more than their male counterparts (Fonjong, 2008), while a study in South Africa found that gender only influenced the use of products which were gender specific (Cocks et al., 2008). Despite the difference in conclusions by various studies, generally, there is general agreement of the importance of forests in livelihoods despite the varying degrees of dependence, hence the need for forest management strategies that are linked to poverty alleviation (Sunderlin et al., 2005). Despite increasing understanding of the forest-poverty interaction, the links between forests and poverty reduction strategies remain poorly developed.

2 Research design and methods

The study presents empirical evidence from Copperbelt province of Zambia. This section presents the research design, and methods used to achieve the study aims.

2.1 Study Area

The Copperbelt province is located between latitudes 12^{o} 20' and 13^{o}50' south and longitudes 26^{o}40' and 29^{o}15' east and covers a total surface area of 31,014 km^2. It lies at an average altitude of 1200m above sea level, and exists under granite and granite gneiss, basement schist and lower Katanga rock systems (Syampungani et al., 2010). It is a high rainfall area, receiving average annual rainfall of 1200mm and lies on the Congo-Zambezi watershed (Chidumayo, 1987). The average temperature

ranges from 17^{o}C in the cool-dry season to 37^{o}C in the hot-dry season. Miombo woodlands represent 90% of the total vegetation, dominated by tree genera *Julbernadia*, *Brachystegia and Isoberlinia* (GRZ, 1998). Copperbelt province is an area of biological significance as it is rich in plant diversity some of which are endemic (Chirwa et al., 2008, Rodgers et al., 1996). Further, the forests are a source of livelihoods for their inhabitants in a Sub-Saharan region characterised by high poverty (73%) and deforestation levels (PRSP, 2002) , which is often referred to as the 'world's most income-poor region' (Fisher et al., 2011:161).

2.2 Site selection

Two study sites were purposefully selected on the basis of the ecological setting, evidence of use of Miombo agro-ecosystems, similarities in socio-economic activities and livelihood activities, and differences in legal status of the forests, location and local institutional contexts (Table 1). These are Mwekera Forest Reserve and Katanino Joint Forest Reserve. The villages in the two sites display the two main rural village types of Zambia's Copperbelt region, which are rural peri-industrial and rural traditional villages. The classification is based on distance from urban cities, which is over 40km and within 40km for rural traditional and urban peri-industrial respectively (Blake et al., 1997, Simon et al., 2004) and social characteristics such as socio-economic and cultural contexts, with rural traditional villages situated within customary land tenure, while rural peri-industrial are on state land (Phillips et al., 1999). The different statutory forest land classification provides different incentives for sustainable forest management, as Joint forest management (JFM) allows the use of forest by local people while National Forest Reserves entails protection of the forest by the government and local people are excluded from forest use.

Table 1: Site characteristics

Site characteristics	**Katanino Site**	**Mwekera Site**
District	**Masaiti rural**	**Kitwe City**
Location of site	13˚ 36´ S and 28˚ 42´ E; elevation 1300m above sea level	12˚ 49´ S and 28˚ 22´ E; elevation 1295m above sea level
Legal status of forest	Joint Forest Management	National Forest Reserve
Local institutions administration	Customary	State
Cultural contexts	Rural traditional	Rural peri-industrial
Distance to the nearest urban markets	75 km	20km
Forest type and quality	Miombo, intact mature forests, with regrowth sites in some areas	Miombo, intact mature forests, with regrowth sites in some areas
Ethnic groups	Lamba is the dominant ethnic group	Mixed ethnic groups ; Bemba, Luvale, Ngoni, Tumbuka, Lamba, etc.
Livelihood activities	Farming, charcoal production, livestock	Farming, charcoal production

Katanino is located 75km from the nearest urban town (Ndola). The villages are dominated by the people belonging to the Lamba tribe, who are the indigenous inhabitants of the Copperbelt province (Mitchell and Barnes, 1950). General land ownership is vested in the chief. Villages are under the authority of traditional chiefs, who are responsible for land allocation and general leadership. In rural villages such as these, people are more attached to their traditions and beliefs compared to peri-industrial villages (Simon et al., 2004). Mwekera is located about 20km from Kitwe and is comprised of mainly peri-industrial villages. Peri-industrial is defined as

villages found within approximately 40km of cities (Blake et al., 1997, Simon et al., 2004). In the villages, ethnic differences are more diverse and variable due to the mixed tribes in urban areas which feed these villages (Zimba, 2003, Kaoma, 2004). Village leadership is vested in a chairperson, who belongs to the political party in power. Previously, these villages were held under traditional authority, but due to urbanisation the traditional leaders' authority over the villages has been undermined (Zimba, 2003). Further the gazetting of the forest as a National Forest Reserve through Statutory Instrument NO. 158 of 1975 led to excluding the local people from forest use and management. The government manages forests on behalf of the citizens and therefore has decision making powers over all forest management aspects. It further excludes any stakeholder participation and does not stipulate any rights for forest dwelling communities. The ownership of all trees in Zambia (both on customary and state land) is vested in the Republican President (GRZ, 1973).

In the two sites, the livelihood activities that rural people engaged in were similar and included small-scale agriculture, charcoal production, animal husbandry, and collection of forest products (Chikonde, 2008, Kaoma, 2004). Bwengo and Kashitu villages (Katanino site), and Misaka and Twesheko villages (Mwekera site) were selected due to similarities in village sizes and accessibility.
Targeting these two case study sites with different cultural settings allowed the research to investigate how different community structures in terms of social characteristics and institutions shape the use of FPES and forest management. These study sites presented social contexts at different spatial and institutional settings within Miombo agro-ecosystems, which create factors that influence woodland use and consequent livelihood outcomes, which is critical for future management of forest ecosystems initiatives such as REDD+ as policy and management will have to develop context specific management strategies. Blom et al (2010) stress that understanding of community heterogeneity and complexity is critical for the success of REDD+, given that the initiative will be implemented in a variety of institutional and cultural settings. Lessons drawn from understanding the socio-ecological system in such an interesting case study context are therefore widely significant to southern Africa and, potentially, global woodland systems.

2.3 Methods

Primary data on PFES use and livelihood strategies of households was collected using structured household questionnaires, focus group meetings and in-depth interviews. This data collection method is widely used in collecting primary data in rural communities (Babbie, 1995). Household questionnaires provided information on the links between PFES and livelihood strategies and the impact of forest changes on livelihoods. The questionnaire had several sections covering livelihood activities and the PFES that are consumed. Data on incomes (income from sales of PFES) and household shocks and stresses were collected through recall on the previous 12 months. The reliability of forest income was further enhanced by the fact that most of the forest products are sold in the rainy season when the fieldwork was conducted.

The sampling frame was the list of all households in the villages. To capture the various categories of households in the household survey, households were stratified according to wealth (Jumbe et al., 2009, Tschakert et al., 2007). The village leaders were asked to rank the households by stratifying them by wealth categories. This is because rural people are better able to assess the relative wealth and well-being of

their communities than 'outsiders' (Hill, 1986). Earlier works have revealed that there is a higher agreement in the ranking when three informants (as a team) ranked households according to certain criterion (Silverman, 1966). The criteria for distinguishing wealth categories included livestock ownership, size and style of house including roofing material and quality of assets owned, and the ability of a household to pay for school fees. A total of 976 households were stratified in this way, and 244 households took part in the household questionnaire representing 25% sampling intensity, which is higher than the 20% recommend by similar studies (Adhikari et al., 2004, Hetherington, 1975). This number of interviewed households was large enough to be representative of the population. The sampling unit in the household survey was the household, while the unit of observation was the household head. In-depth interviews were carried out with a further 15 key informants to provide information on forest use and changes in use, and local institutions and structures that shape the use of PFES. Focus group meetings were used for triangulation and obtaining a broader understanding of forest use at the village level.

Quantitative data was analyzed using Statistical Package for the Social Sciences (SPSS) 19. The main statistical analyses applied were frequency analysis and descriptive statistics. Chi-square test for independence was used to determine associations between categorical variables. Qualitative data was analyzed using a grounded theory approach (Strauss and Corbin, 1990), where categories emerged from the interview data.

3 Results and discussion

3.1 Socio-economic summary of households

The overall average household is composed of six members (5.82±0.2). The gender distribution of household heads showed that 72.5% (n=177) were males while 27.5% (n=67) were female. The mean age of household head was significantly different ($p=0.008$) for female (53.35±1.9) and male-headed households (47.56±1.2). The sampled households consisted of 49.2% of poor households, 34% intermediate, and 16.8% wealthy households. There were no significant differences ($p=0.115$) in household sizes among wealth categories, though wealthy households had higher household sizes (7.1±0.6), than intermediate (5.96±0.3) and poor households (5.27±0.3) (Figure 1). There was no significant association between gender of the household head and wealth status of the household ($\chi^2=4.092$; $p>0.05$). The majority of the respondents in the Katanino site (75%) belong to the *Lamba* ethnic group, while in Mwekera, there were 19 ethnic groups with *Bemba* constituting the largest proportion (22%). Results on the highest educational level attained by the respondents reveal that, 23.4% have no formal education, while about half of the respondents (50.8%) have primary education. 20.9% have some secondary education while only 4.9% have completed high school.

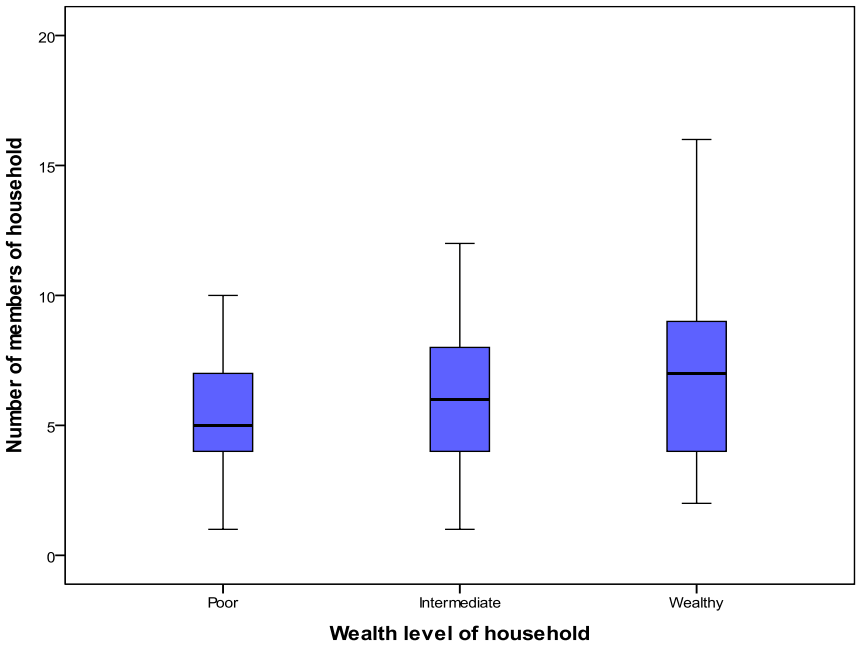

Figure 1: Household size distribution among wealth categories

3.2 Livelihoods activities

All the households interviewed were farmers (n=244) relying on rain-fed agriculture. Farming was the primary livelihood activity. Secondary activities included livestock, handicrafts, 'piecework[1], charcoal production, sale of forest products, remittances and traditional beverages (Figure 2). Other strategies included petty trading of groceries and fishing. Households in the study area combined a number of livelihood strategies which is consistent with literature on rural livelihoods which report diversification as being predominant (Ellis, 2000, Mamo et al., 2007), as no single livelihood strategy is sufficient for households (Sunderlin et al., 2005). In rural livelihoods strategies across Sub-Saharan Africa, the portfolios of activities is highly diversified across wealth classes of households to secure survival (Ellis, 2000).

[1] Casual off 'on' farm labour usually of an agriculture nature done on *ad hoc* basis, payment is either in cash or in-kind

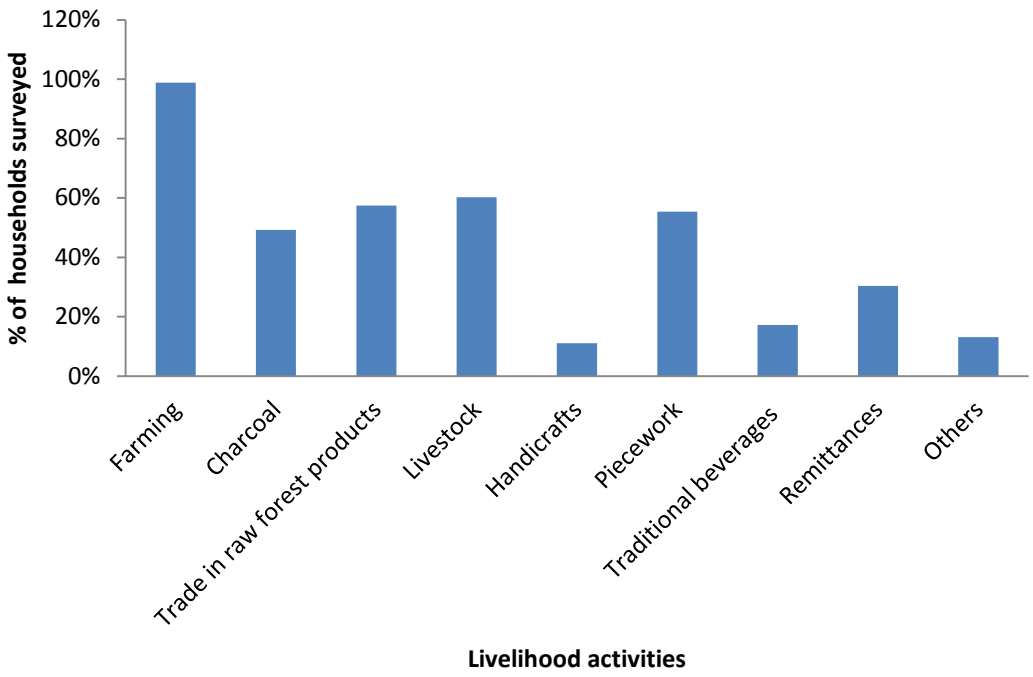

Figure 2: Main livelihood activities

Households in the survey ranked livelihood activities in the order of importance as farming (91.4%), followed by charcoal (32.9%), then '*piecework*' (29.2%), and then the sale of raw forest products (22.6%). Focus group meetings (FGs) and in-depth interviews revealed that there had been changes in people's engagement, in-terms of participation as well as intensity, in livelihood activities over the last 30 years. The Katanino FGs, revealed that in the 1980s farming and off-farm work were the main livelihood activities. The structural adjustment programme of the early 1990s led to the removal of the fertilizer support programme (FSP) consequently increasing charcoal production activities. A woman in her 70s mentioned that;

"*A long time ago during Kaunda*[2]*'s time, we used to grow crops and young men could go to the city to work and send money back to the village, now there are few jobs in the city, instead of people going to the city, it is the people from the city who are coming here. To buy farming inputs most of us do not have any options but to produce charcoal which is easily sold in the urban markets and at the roadside*"

Income from charcoal was used to buy fertilizers and other farming inputs. Despite the FSP being re-introduced in early 2003, few farmers had access to free fertilizer. Off-farm work has reduced due to lack of employment opportunities in urban areas. In Twesheko, sale of firewood has emerged over the last 10 years due to high demand in mining smelting processes and other industries. This has put pressure on the Miombo trees such as *Julbernadia paniculata*, *Isoberlinia angolensis* which are preferred due to the high calorific value, hence highly demanded for both firewood and charcoal, similar demand for these species has been reported in Tanzania (Misana et al., 2005).

[2] Kaunda was the first Republican President. He left office in 1991after losing the first democratic elections.

3.3 Households' food deficits

Almost half of the sampled households (48%) reported food shortages several months per year as maize stocks (staple food) were depleted before the next harvest season. Food shortages are mainly experienced between November and April. Food deficits differed depending on wealth status. There was a significant difference between wealth classes (χ^2 =28.7; p<0.05) with poorer households experiencing food shortages often over extended periods, while there was no difference observed as the result of gender of household head (χ^2 =2.8; p>0.05). During seasonal food shortages, 45.3% of the respondents reported charcoal sales as the main survival strategy, while 35% reported piecework, remittances (9.4%), sale of mushrooms (5%) and sale of livestock (2%). When asked about what households do during food shortages, one male local key informant in Twesheko village said

"When you run out of food in the household, the axe hits the tree".

It was further reported that during this period, there was a general reduction in the quality and quantity of food consumed. Seasonal food deficits are an inherent feature of rural people's livelihoods that are dependent on rain-fed agriculture, as has been reported in Malawi (Kamanga et al., 2009), Zimbabwe and Mozambique (Akinnifesi et al., 2004). Ellis (2000), reports that since crops such as maize have a single annual harvest season, the trading season is short and stocks are depleted thus making households vulnerable. Households therefore diversify their livelihoods to reduce vulnerability. This study shows that PFES are used in coping with household food stresses, which most previous studies overlooked. Despite studies such as Ellis (2000), reporting households diversifying of livelihood strategies in seasonal shortages, the role of forests have not been explicitly reported which may have an impact rural development and poverty reduction strategies. Other studies however reported forest foods as important in cushioning food crises in villages, as they prevent people from slipping into deeper poverty (Shackleton et al., 2007). Most studies have reported the consumption of harvested forest foods to meet household food deficits (Akinnifesi et al., 2004, Chirwa et al., 2008). The results of this study have however shown charcoal as the most important strategy used to meet food shortages. Although household consume forest foods during times of household food deficits, the foods only supplement charcoal production. This therefore shows that the income from charcoal is important to buy food such as maize, as this is more important than mere consumption of forest foods in times of seasonal food deficits. It is evident from this study that coping strategies during food deficits are diverse.

4 Types and extent of provisioning service use

4.1 Regular household consumption

All interviewed households used provisioning forest ecosystem services to meet various household needs. There was a high dependence on provisioning forest ecosystem services across wealth groups and different genders of household head. A range of services were used on a day-to-day basis for home consumption as part of households' livelihood portfolio (Table 2). The main categories of resources used were foods, fuelwood, medicines and construction materials. This regular consumption of provisioning services saves cash resources which can be used for other household needs (Shackleton and Shackleton, 2004).

Table 2: Proportion of households (%) using forest provisioning services per village

Forest provisioning ecosystem services	Katanino site		Mwekera site		Mean
	Bwengo (n=70)	Kashitu (n=48)	Misaka (n=72)	Twesheko (n=54)	Overall (n=244)
Indigenous fruits	97.1	83.3	83.3	90.7	88.9
Mushrooms	84.3	79.2	40.3	90.7	71.7
Vegetables	44.3	47.9	47.2	33.3	43.4
Honey	14.3	16.7	5.6	5.6	10.2
Medicinal	85.7	72.9	56.9	47.2	66.3
Fuelwood	98.6	100	93.1	66.7	90.2
Munkoyo	17.2	37.5	4.2	16.7	17.2
Handicrafts	11.4	18.8	4.2	13.0	11.1
Fodder	24.6	33.3	22.2	20.8	24.8
Construction	100	93.8	73.6	83	87.2

Overall, 90.5% households obtained various foods from the forest ecosystem. There was no significant difference between the study sites (χ^2=1.9; p>0.05). Households used more than one product with the majority of households reporting being engaged in collection of indigenous fruits (88.9%), mushrooms (71.7%), indigenous vegetables (43.4%) and honey (10.2%). Other foods collected for household consumption included caterpillars and tubers. After stratifying households by wealth and gender, the results showed no significant difference in household consumption of forest foods according to household wealth or gender of household head (Table 3). These findings coincide with studies in South Africa (Cocks et al., 2008, Shackleton and Shackleton, 2006). An increase in wealthy status of households did not lead to any changes in quantities of natural resources consumed in households (Cocks et al., 2008). According to all the FGs, within households, women and children dominated collection of mushrooms, vegetables and fruits, while men dominated honey collection and charcoal production.

A quarter of the sampled households (24.8%) used the forest as a source of fodder for mainly cattle and goats. These households were entirely dependent on the forest for animal browsing and grazing. Tree species that were most palatable for cattle were *Baphia bequaertii, Dalbergia nitudula and Parinari curatellifolia*. Other species included *Julbernardia paniculata* and *Diplorhynchus condylocarpon*. The use of trees for fodder did not show any significant difference between the study sites (χ^2=1.4; p>0.05). The results however showed a significant difference in fodder use across household wealth categories (Table 3). Wealthy households used forests for fodder more than poorer ones. This can be attributed to the fact that wealthy households owned more livestock (in terms of both proportion of households and quantity per household) than intermediate and poor households.

Table 3: Proportions of households (%) that use various forest provisioning services stratified by wealth of household and gender of household head (n=244)

Provisioning services	Wealth categories			χ^2	Gender of household head		χ^2
	Poor (n=120)	intermediate (n=83)	Wealthy (n=41)		Male-headed (n=177)	Female-headed (n=67)	
Construction	95.0	84.3	70.0	17.8**	89.2	82.1	2.2
Fodder	12.6	33.7	42.5	19.8**	26.3	20.9	0.8
Food	90.8	91.6	87.5	0.5	92.0	86.6	1.7
Medicine	66.7	68.7	60	0.9	67.6	62.7	0.5
Fuelwood	93.3	88.0	85.4	2.9	91.0	88.1	0.5

**Significant at 0.05

Forests are important for medicinal purposes. Almost two-thirds of households used forests as a source of medicine. Among the households in the study sites, use was more prevalent in Katanino (80.5%) than in Mwekera (52.8%). Statistically, there was a significant difference between the sites (χ^2=20.8; p<0.05). Within the sites, there was no difference in use between the different wealth and genders of household heads (Table 3). Households used a number of different tree species for treating various ailments. The number of those admitting the use of medicinal plants may be lower as some people belong to religious groups that do not allow the use of traditional medicine as it is linked to witchcraft. During the in-depth interviews, some respondents mentioned that people belonging to some religious groups are often not allowed to use traditional medicines and are encouraged to rely on western medicine. Some groups impose religious sanction (e.g. expulsion from group) on those who admit using traditional medicines. Imposing of religious sanctions on those using traditional medicines has also been reported in rural communities in South Africa's Savannas (Shackleton et al., 2007). The 10 most common tree species used by households in the study area is summarised in table 4.

Table 4: Ten most preferred tree species for medicinal purposes (n=161)

Tree species scientific name	Local name	Percentage of households	Tree part(s) used	Ailment(s) treated
Cassia abbeviata	Musokansoka	74.5	Bark/roots	Bilharzia, skin ailments, diarrhoea, cough, malaria
Julbernadia paniculata	Mutondo	24.2	Bark	Diarrhoea, headache
Pseudolachnostylis maprouneifolia	Musalya	18.0	Bark	Diarrhoea
Uapaca kirkiana	Musuku	17.4	Roots/bark	Cough, diarrhoea
Parinari curatellifolia	Mupundu	16.8	Bark/roots	Diarrhoea
Oldfieldia dactylophylla	Lundawampanga	13.7	Bark	Fever, diarrhoea
Syzygium guineense	Musafwa	15.5	Bark	Eye infections, cough, diarrhoea
Diplorhynchus condylocarpon	Mwenge	14.3	Bark/roots	Cough, fever
Zanthoxylum chalybeum	Pupwe	12.4	Root	Cough, diarrhoea
Piliostigma thonningii	Mufumbe	12.4	Leaves	Cough

The Miombo woodlands are relied upon as the source for domestic energy. Overall 90.2% of households used firewood from the study area for cooking and heating. Rural households lack access to alternative energy sources. In Katanino, almost all households (99.2%) relied on fuelwood; while the proportion of use in Mwekera was lower (81.7%). The proportion of people using fuelwood was not significantly different across wealth classes (χ^2=0.02; p>0.05), though the proportion of consumers decreased with increasing wealth status.

In the study area, 87.2% of households used forest provisioning services as source of construction material (i.e. poles and fibre). Trees that are used for building poles for houses and barns are *Pterocarpus angolensis*, *Pericopsis angolensis*, *Swartzia madagascariensis* because they are durable and are not easily attacked by termites, borers or wood decay fungi. Other trees such as *Anisophyllea boehmii*, *Uapaca kirkiana* and *Parinari curatellifolia* are used for roofing material, as they are also repellent and toxic to termites and other wood-eating insects. The use of trees for construction was significantly higher (χ^2=21.5; p<0.05) in Katanino than Mwekera. An inquiry into the socio-economic determinants of use revealed that within villages, the use of provisioning services for construction was significantly different between the wealth classes (Table 3). The proportion of wealthy households using construction materials from the Miombo forests was much lower than the intermediate and poor households. Houses for wealthy households were usually made from bricks, whereas poles were more often used to construct households' traditional meeting structures called *Mbalasa*.

The results show a high consumption of provisioning services in households across both wealth classes and gender of household head. Households using provisioning services for direct household consumption save cash resources which would have otherwise been used to purchase the products (Shackleton and Shackleton, 2004). There are clear gender roles in PFES extraction within households. Women dominate in the collection of mushrooms, fruits and thatching grass, while men are involved in honey collection, charcoal production and felling of trees for firewood as is widely reported (Alelign et al., 2011, Chirwa et al., 2008, Kideghesho and Msuya, 2010, Kiptot and Franzel, 2012, Shackleton and Shackleton, 2004). This study however show no significance difference in consumption of PFES between different gender of household heads, which contradicts with findings in other agro-ecosystems such as tropical rainforests in Usarambara mountains in Tanzania (Kideghesho and Msuya, 2010) , Afromontane forests in north-western Ethiopia (Alelign et al., 2011) and tropical dry forests of Nigeria (Gbadegesin, 1996). Despite the lack of significance in use of FPES between male- and female headed households, gender specific collection and use of provisioning services happens within households. In male headed households, women (either wives or adult female household members) engage in female dominated activities and vice versa for adult men in female headed households. In most literature, female headed households are associated more with women dominated activities with little consideration of households as units often comprising of different genders (Kideghesho and Msuya, 2010, Kiptot and Franzel, 2012). Further, within households, age of member of the household plays a role in defining livelihood activities that members are engaged in. Labour demanding activities such as charcoal production is more common among young men, similar observations have been made on labour intensive timber harvesting in Tanzania

(Kideghesho and Msuya, 2010). These activities are distributed within the household as a unit, whether male, or female headed.

4.1.1 Ranking of provisioning services

Household ranking of the most important forest provisioning services for their livelihoods reveals that food (58%) is the most important followed by energy (30%), construction materials (9%) and medicines (3%) (Figure 3)

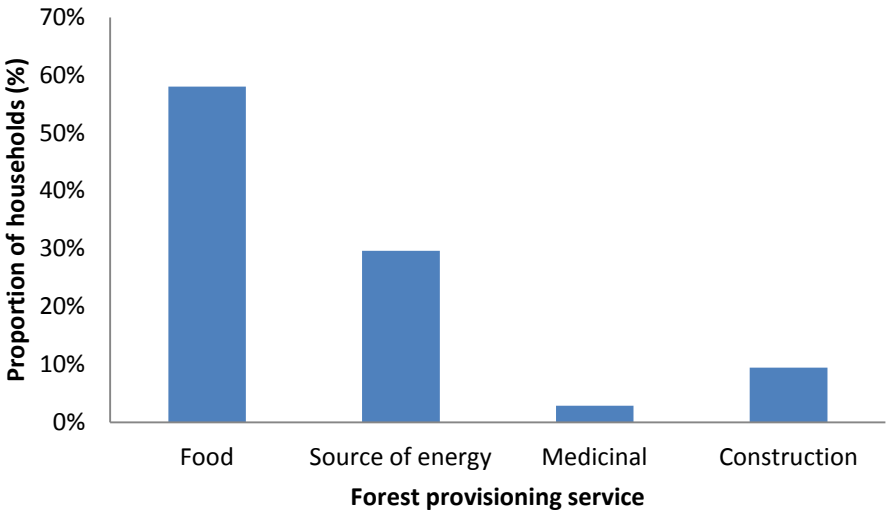

Figure 3: Household's ranking of provisioning services (n=244)

The ranking pattern of households shows that there is a significant interaction with household wealth status ($\chi 2=14.84$; $p<0.05$). Poor households ranked foods as the most important while wealthier households considered other provisioning services more important. There were no significant differences in the ranking of these services when stratified by the gender of household heads. Despite all the households consuming various provisioning services, FGs and in-depth interviews revealed that poorer households harvest more and have a higher dependence on the forests for wild food plants. The ranking of forest products is dependent on the use of forests and the forest conditions as an earlier study in *Mpunda* and *Kihamba* villages of Uganda (Banana and Turiho-Hambwe, 1997) revealed low ranking of foods due to declining forest cover which translated in few people gathering forest foods.

4.2 Contribution of provisioning services to household income

Household economic portfolios' include agriculture, forest products, livestock, and remittances from on/off farm casual labour. Rural households use multiple sources of income as part of the land management system (Belcher et al., 2005). While all households use Miombo FPES, they are an integral source of income to 69.3% of households. Households sell various provisioning services (half of the sampled households sold more than one product) that contribute to the rural economy, therefore using different provisioning services to diversify their overall economic portfolio. Charcoal, mushrooms, and fruits were the main sources of income of households (Figure 4). Thatching grass, firewood and honey were also important sources of income, and to smaller extent handicrafts, reed mats and a traditional

non-alcoholic beverage called *Munkoyo*, which is made from roots of *Rhynchosia venulosa*.

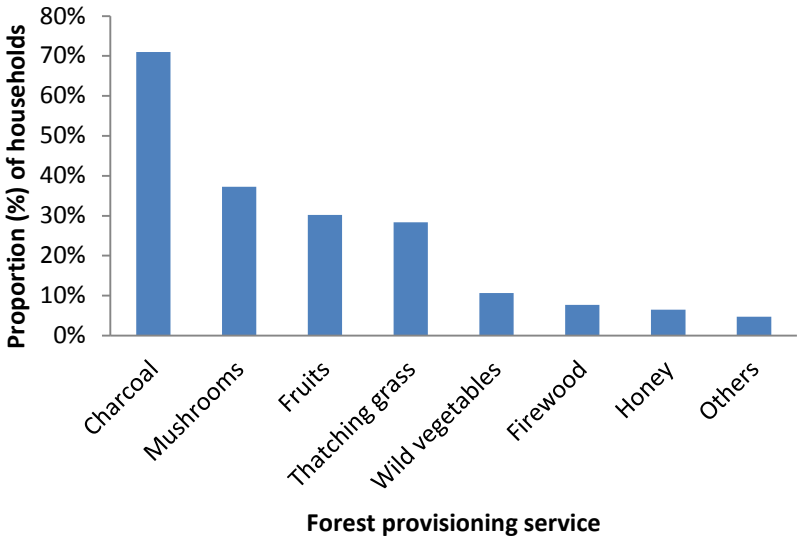

Figure 4: Household incomes derived from forest provisioning services (n=169)

Extraction of forest provisioning services requires minimum skills and technology hence making it an attractive income opportunity to rural households (Heubach et al., 2011). Mean annual income from provisioning services indicates that charcoal is the highest annual income earner for participating households (Figure 5).

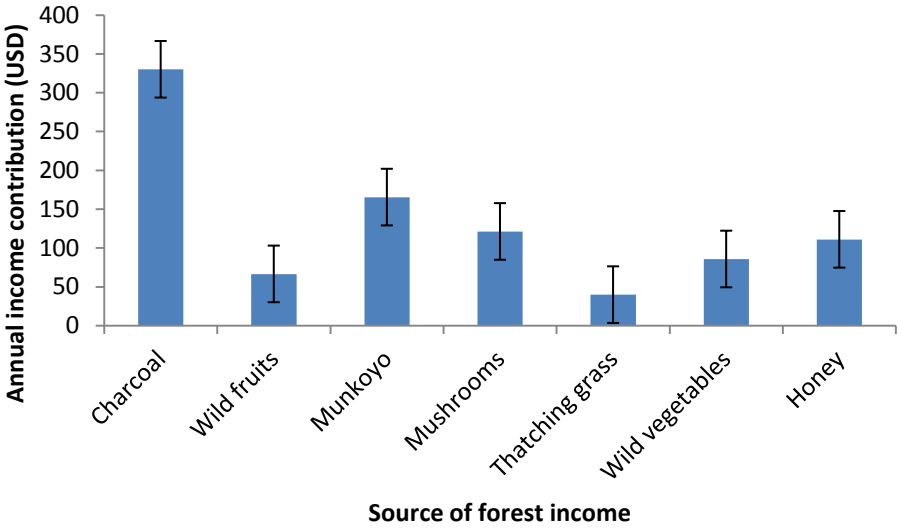

Figure 5: Annual income from provisioning services (Mean and standard errors)

Firewood, despite accounting for only 5% of household income, has high revenues (USD 1156±244.78 per annum) in Twesheko due to the high demand from the copper smelting plant in Mufulira. There was no record of selling timber or construction material in the study areas. Wild mushrooms are a delicacy usually sold

along the main roads (Figure 6), or taken to urban market markets, as far away as Lusaka (about 300km from the study area). Charcoal is produced for urban markets (Figure 7). A barter system sometimes exists where forest products are exchanged for clothes or food stuffs brought in by urban-based middlemen.

Figure 6: Wild mushrooms (*Termitomyces titanicus*) being sold at a roadside market in Katanino

Figure 7: Bags of charcoal in Katanino awaiting transportation to Lusaka

4.2.1 Inter-village comparison of households selling PFES

Comparing trading in provisioning services between the two study sites reveals that there was no significant difference in the sale of charcoal between the two study sites (Table 5). The proportions of households selling charcoal was however higher in Katanino. Similarly no significant differences were observed for thatching grass or honey. In mushroom selling, a significant difference (χ^2=7.7; p<0.05) was observed

as more households in Mwekera engaged in the sale of mushrooms than in Katanino. There was a further significant difference in the sale of wild fruits and wild vegetables between the sites (Table 5), indicating that there were more households selling these products in Mwekera. The main hindrance to marketing fresh products such as mushrooms and fruits is the short shelf-life of the products and distance to markets. This subsequently led to reduced opportunities to sell produce and high post-harvest losses, resulting in reduced income available to local people.

Table 5: Proportions of households (%) selling provisioning services, stratified by study sites

Forest product	Rural community		χ^2
	Katanino (n=118)	Mwekera (n=126)	
Charcoal	50.8	38.1	4.0
Fruits	4.6	43.0	44.2**
Honey	3.4	5.6	0.7
Mushrooms	17.8	33.3	7.7**
Thatching grass	17.8	21.4	0.5
Wild vegetables	1.7	12.7	10.8**

**Significant at 0.05

4.2.2 Intra-village comparisons for households selling PFES (wealth levels and gender)

In comparing the sale of provisioning services across wealth classes of households, this study reveals that the wealth status of households significantly affected household's involvement in mushroom selling (χ^2 =8.251; p<0.05), as poorer and intermediate households participated. When asked if any member of his household sold mushrooms, a wealthy male household head in Kashitu responded;

"Why should any member of my household wake up early at 4am in the morning to go and collect mushrooms while I have cows in my kraal that need to be milked?"

The wealth status of households further significantly influenced the sale of thatching grass and charcoal (Table 7). Poor and intermediate households participated more in the selling of certain products. The proportions of poor households were slightly higher than the intermediate households for thatching grass and mushrooms, but were lower for charcoal (though not statistically different). There was no significant difference in the sale of honey, fruits or wild vegetables among the wealth classes.

There was a significant difference in the sale of charcoal between male and female-headed households, with the former engaging more (50.3% households) than the latter (28.4%). The sale of mushrooms showed no significant differences between genders, although a slightly higher proportion of female-headed households reported selling the product. The same trend was observed for thatching grass. Other products that did not show significant differences when stratified by gender of household head included wild vegetables and honey (Table 6).

Table 6: Households (%) that generate income from the sale of PFES, stratified by wealth and gender of household head

Provisioning service	Wealth categories			χ^2	Gender of household head		χ^2
	Poor (n=120)	intermediate (n=83)	wealthy (n=41)		Male-headed (n=177)	Female-headed (n=67)	
Charcoal	45.8	51.8	24.4	8.6**	50.3	28.4	9.5**
Firewood	5.0	6.0	4.9	0.1	6.8	1.5	2.7
Wild fruits	28.6	19.7	17.1	3.0	20.3	17.9	0.01
Honey	1.7	7.2	7.3	4.4	5.6	1.5	1.9
Mushrooms	33.3	21.7	12.2	8.3**	23.2	32.8	2.4
Thatching grass	25.0	20.5	2.4	9.9**	18.1	23.9	1.0
Wild vegetables	6.7	9.6	4.9	1.1	7.9	6.0	0.3

**Significant at 0.05

The results of this study show that poor households are very dependent on income from sale of forest products as a substantial income source and sell a greater variety than their wealthy counterparts. Similar patterns have been confirmed in the Bale highlands of southern Sudan (Yemiru et al., 2010), in Malawi's (Fisher, 2004) and South Africa's savannas (Paumgarten and Shackleton, 2011). This study has further shown that gender of household head is not a significant determinant of households engaging in selling FPES. These findings contradict other studies (McSweeney, 2004, Yemiru et al., 2010) which have reported that female headed households are engaged more in selling forest products than male headed households. Despite females dominating selling as an activity, no differences occurred at household level as households have male and female members who participate in these activities. It is worth noting that the gender difference observed in charcoal production in this study may be attributable to the fact that charcoal production is physically more demanding and is usually carried out by males, as a result fewer female-headed households participate as it depends on the gender composition of their households. The wealth of households was the main determinant of engagement in the sale of PFES.

4.3 Role of provisioning ecosystem services in coping with household shocks

4.3.1 Prevalence and nature of household shocks

Households in the study area face various shocks. Although the household survey focused on the previous 12 month period (due to the short recall period of respondents) (Moshiro et al., 2005), information from the FGs covered the longer term historical shocks so as to provide the context in which the communities operated. In particular, FGs reported the following shocks (1) natural shocks such as droughts (1991/1992, and 2004/2005) and floods 2006/2007, (2) economic shocks such as high unemployment levels in urban areas leading to village in-migration and more competition for natural resources, (3) political changes in 1992 that affected access to government farming inputs, and (4) human health shocks.

In the year prior to this study, households faced a variety of shocks, with some households experiencing more than one type of shock. This led to major income shortfalls and unexpected expenditure. The largest proportion of households reported human health shocks, i.e. serious illnesses (41%), while loss of income due to weddings and other costly social events was experienced by the smallest proportion of households (2.5%). Other reported shocks were crop failure (30.7%), death of

household member (19.3%), major loss of assets through theft (9.8%), and loss of livestock (8.6%). All the identified shocks were experienced by both male- and female-headed households and across all the household wealth classes (Table 7). Despite not being significantly different, poor households had a higher proportion experiencing serious illness of household members and crop failure. It is evident from this study that household face multiple shocks within the 12 months preceding the survey. Similar findings were reported in a study in rural livelihoods in South Africa (Paumgarten and Shackleton, 2011).

Table 7: Proportions of households (%) in both sites experiencing shocks over a 12 month period, stratified by household wealth and gender of the household head

Nature of the shock	Total	Wealth categories			X^2
	(n=244)	poor (n=120)	Intermediate (n=83)	Wealthy (n=41)	
Crop failure	30.7	33.3	28.9	26.8	0.8
Serious illness	41	48.3	31.3	39.0	5.9
Death/funeral expense	19.3	16.7	18.1	29.3	3.2
Major asset loss	9.8	11.7	8.4	7.3	0.9
livestock loss	8.6	10.8	4.8	9.8	2.3

4.3.2 Coping with household income shocks

In general, rural households use a range of strategies to increase their defense against stresses and shocks, making income diversification a strategy aimed at reducing risks (Turner et al., 2003). The results of this study indicate that households use diverse strategies to respond to household income shocks (Figure 8). The coping strategies employed by the greatest proportion of households were the sale of forest products (33%), followed by *piecework* (21%) and monetary or in-kind support from kinship networks (20%). Others sold agricultural products, used their savings, sold food meant for household consumption or received assistance from churches. Faith-based organisations (church) offer help especially in times of bereavement.

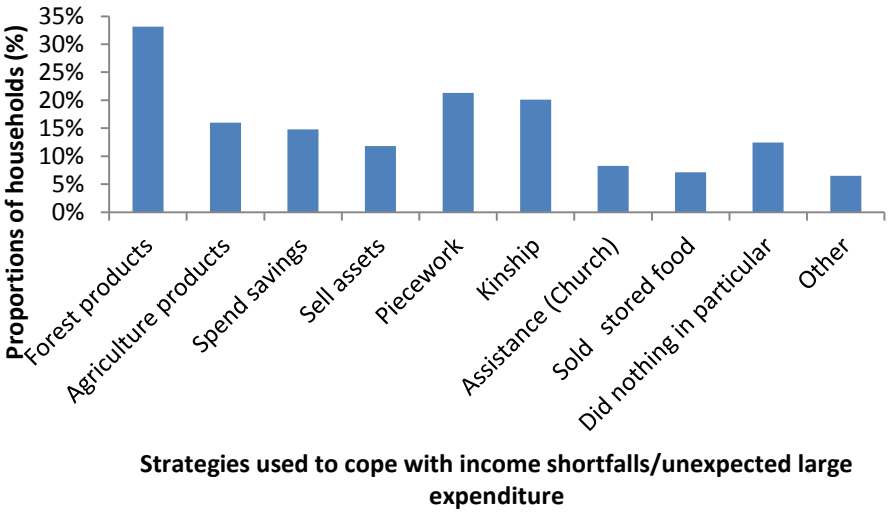

Figure 8: Proportion of households (%) that employed coping strategies in response to income shocks (n=169)

Forests are an important economic buffer in adverse times. Sale of forest products are the most important coping strategy. The results of this study differ with other case studies which reported support from kinship networks as the most important coping strategy in forest-dependent communities (Heemskerk et al., 2004, McSweeney, 2004, Paumgarten and Shackleton, 2011). The high dependency on kinship may be attributed to the fact that the above studies were conducted in more economically prosperous countries than Zambia i.e. Latin America and South Africa respectively. The high unemployment levels in Zambia compounded by lack of social support systems may have exacerbated the reliance on FPES. Further, covariate shocks make kinship support more difficult as the whole community is affected. In the study area, coping with income losses often involved the sale of charcoal or mushrooms and fruits (when they were in season). The high demand for charcoal in urban areas means that rural households produce for the urban market and use the proceeds to respond to income shocks.

Income from sale of forest products helps to offset the financial costs resulting from household idiosyncratic income shocks such as livestock loss, major loss of household assets, and prolonged illness. To cover sudden expenses such as funeral or medical expenses, households do not often cope by selling forest products, but by either using other strategies (e.g. kinship) or borrowing money from neighbours and friends, and later use forest income to pay off the incurred debt. The findings here coincide with other studies in forest dependent communities (McSweeney, 2004, Pattanayak and Sills, 2001). According to Paumgarten and Shackleton (2011), poorer households have fewer options for coping with shocks and stresses and therefore increase the use and sale of forest products, as they do not require any capital outlay. This makes forests the "ultimate form of self-insurance" (McSweeney, 2004:17).

According to FGs and in-depth interviews, during severe drought periods (i.e. 1991/1992 and 2004/2005), most households survived by increasing the consumption of wild foods, carrying out piecework and increasing charcoal production. One female interviewee in Bwengo recalled the drought of 1991/1992 by saying

"That drought was terrible, we lost self-respect, what helped us survive were the Mupundu fruits, we made thick porridge which was consumed by both the children and adults".

The fruits of *Parinari curatellifolia* (Mupundu) were preferred by many people as they were said to be filling. Despite households using diverse strategies, they are deficient when covariate shocks such as droughts are extreme (Heemskerk et al., 2004). As observed in this study, diverse strategies are often used when coping with idiosyncratic shocks.

4.3.3 Socio-economic determinants of coping strategies

Comparing the coping strategies across wealth classes and gender reveal that poor and intermediate households had higher dependence on forest products compared to wealthier households, though it was not significantly different (Table 8). Among poor households, the sale of forest products acts as an economic recourse for

households experiencing income shocks (McSweeney, 2004). A greater proportion of wealthy households used kinship compared to other wealth classes. This contradicts the findings of a study in Dyala and Dixie villages in South Africa that highlighted that poorer households relied more on kinship than wealthy households (Paumgarten and Shackleton, 2011). This may be attributed to the fact that given the wealth of South Africa and robustness of mining and other industries men migrate to work in urban areas making remittances to their families in the rural areas. In this study, most wealthy households had relatives in urban areas that provided them with financial assistance during income shocks, while poor households seldom received financial assistance from urban areas. Other prevalent strategies included piecework, spending of savings, sale of assets, and harvesting more agricultural products. A higher proportion of poor households received assistance from the church (Table 8). Some households did nothing in particular in responding to income shocks such as death of livestock. The various strategies employed indicates that households use diverse ways to cope, this is because social units within communities have different coping capacities which enable them to respond differently to perturbations or shocks (Turner et al., 2003).

Table 8: Proportion of households (%) that employed coping strategies in response to shocks

Coping strategy	**Overall (n=169)**	**Wealth categories**			**χ^2**	**Gender of household head**		**χ^2**
		poor (n=85)	**Intermediate (n=53)**	**Wealthy (n=31)**		**Male- (n=126)**	**Female- (n=43)**	
Harvested more forest product	33.1	35.3	35.8	22.6	1.9	35.7	25.6	1.5
Harvested more agriculture products	16.0	20.0	9.4	16.1	2.7	19.8	6.9	5.5**
Spend savings	14.8	11.8	17.0	19.4	1.3	16.7	9.3	1.4
Piecework	21.3	22.4	24.5	12.9	1.7	20.6	23.3	0.1
Assistance from Church[2]	8.3	14.1	1.9	3.2		5.6	16.3	
Kinship	20.1	18.8	18.9	25.8	0.8	17.5	27.9	2.7
Sell assets	11.8	9.4	17.0	9.7	2.0	12.7	9.3	0.4
Sold stored food	7.1	7.1	3.8	12.9	2.5	8.7	2.3	2.0
Nothing in particular	12.4	18.8	3.8	9.7	7.1**	10.3	18.6	2.0

******Significant at 0.05

[2]Expected frequency count for the shock was less than 5 for each category; hence Chi-square test could not be applied

4.4 Perceptions regarding changes in provisioning services availability

4.4.1 Perception of deforestation and forest degradation

Despite the importance of PFES to local livelihoods, there has been a decrease in forest cover. Results from the questionnaires, in-depth interviews and FGs indicate that local people are aware of changes in forest cover, and subsequent decline of some PFES. At household level, there was a perceived decline in the availability of fruits (83.4%) and mushrooms (95.3%) but not in wild vegetables (75.9%). A female key informant from Mwekera said that

"Nowadays, you cannot find mushroom rotting in the forest, long time ago, we used to find rotten mushroom. It is now impossible because the harvesting rates are very high both males and females engage in mushroom extraction, and are sometimes hired to harvest by traders who come from urban areas".

Some households (19%) no longer easily find the tree species needed for construction materials and have to walk long distances or use less preferred species. In all FGs, participants reported the scarcity of preferred medicinal trees such as *Cassia abbreviata*. During the in-depth interview with the village headman for Bwengo he mentioned that he had domesticated *Cassia abbreviata* for easy access. In the study area, the causes of the perceived changes have been attributed to agriculture production, charcoal production, firewood, unsustainable harvesting of PFES.

4.4.1.1 Agriculture

The household survey revealed that 62% (n=150) of the respondent's cleared forest in the last five years, clearing on average 3.08±0.3 ha to increase their crop fields. Often households cut mature forests, while others reopened previous cleared land. The changing population pressure is reducing fallow time. The traditional slash and burn agriculture locally known as *Chitemene*, which relies on using ash fertilizer is practiced, as has been reported in Northern Zambia (Chidumayo, 1997). This practice is vital for soil enhancement though population increase has rendered the practice unsustainable (Lawton, 1978, Syampungani, 2009). Maize production (the main crop) has been reported to be high within the first four years of cultivation using ash fertilizer but declines later (Lungu and Chinene, 1993). This is attributed to low soil nutrients in the wetter Miombo, which according to Stromgaard (1984) is about half[3] that in drier Miombo, as nutrients are leached due to high rainfall. In the study area, some households use *Chitemene* in combination with inorganic fertilizers.

4.4.1.2 Fuelwood and charcoal

Miombo trees are important sources of energy for both domestic and industrial uses. Firewood is the main source of energy for cooking and heating for over 90% of households in the study area, with consumption being estimated at between 5-7 tonnes per household per year in Miombo eco-region (Grundy et al., 1993). Rural subsistence use of firewood often involves collection of dead wood and has therefore been reported to rarely affect the Miombo structure (Chidumayo, 1997). Live trees are usually cut for urban woodfuel markets. The cutting of trees for firewood used for mainly industrial use such as in the mining industry for smelting copper is leading to forest cover loss (Figure 9). The Miombo species are preferred due to their high calorific value. Young men are employed to cut trees for firewood. This is a fast method of getting an income for youths, as payments are completed within 7 days. According to FG in Twesheko, a key driver has been the increase in population in the villages due to in-migration prompted by high unemployment levels in the mining towns which has adversely affected the youths. A previous study estimated that per year, nearly 5000 ha of forests in the Copperbelt were lost due to fuelwood harvesting (Chidumayo, 1989).

[3] Macronutrient content in Miombo topsoil is estimated at 2.3 and 4.8 metric tonnes per hectare, in wetter and dry Miombo respectively (Stromgaard, 1984).

Figure 9: Trees cut for firewood and a truck loading for industrial use

All FGs in the study area identified charcoal production as a contributor to forest loss. Charcoal is an important source of income for rural dwellers, as it is produced for the urban markets. Charcoal production is a regular livelihood activity for some households, while for other it is temporary activity to cope with household income shocks. Charcoal and fuelwood are the main urban household fuel in Zambia for about 85% of households as only 13.8% use electricity (Central Statistics Office, 2005). Further the intermittent electricity supply in urban areas and high electricity tariffs further exacerbate the use of charcoal. In the Miombo, Chidumayo (1990) reports that 90% of the aboveground biomass is suitable for charcoal production. In Katanino study site, it was also observed that trees are felled for making fibre used in charcoal packaging (Figure 10)

Figure 10: A Tree cut for fibre used in charcoal packaging and charcoal bags with 'heads'

4.4.1.3 Wood products

In the study area, in-depth interviews revealed that wood products for construction materials (poles and timber) and carvings are selectively harvested depending on the desired specific attributes of the tree. The main timber species such as *Brachystegia floribunda*, *Isoberlinia angolensis*, *Pericopsis angolensis* and *Julbernadia paniculata* are preferred due to their durability, therefore reducing their availability as perceived by the local people. Tree such as *Julbernadia paniculata*, *Swartzia madascariensis* and *Pterocarpus angolensis* are preferred for making implements such as axes and hoe handles, cooking sticks, bowls, for household use and for sale. These species

have specific preferred attributes, e.g. *Julbernadia paniculata* is preferred due to its resistant to splitting due to its interlocked grains at the root collar as has been reported by other studies (Chidumayo, 1997, Syampungani, 2009). All FGs revealed that it is increasingly becoming difficult to find the preferred species, as they often have to walk long distances to harvest them. Scarcity of tree species such as *Pericopsis angolensis* used for carvings has also been reported in Malawi, forcing people to migrate to resource rich-areas or use less preferred species (Lowore, 2003). Selective harvesting has been reported to alter woodland structure and the genetic diversity of species due to the harvesting of the preferred species which for timber usually have straight poles (Chidumayo, 1997), though not extensively reducing the forest cover.

4.4.1.4 Increase in population

All the FGs and in-depth interviews revealed an increase in population in the study area therefore increasing the pressure on forest resources. The population is said to have increased in the early 1990s' (due to privatization of the mining industry and subsequent retrenchment of workers) and has since been increasing steadily. Household survey results showed the average number of years lived in the villages by those who have migrated to be 16.96±0.9 years. Household interviews revealed that 38.2% of households migrated to settle in the villages after losing employment in urban areas, while 26.2% migrated from other rural areas in search for land for cultivation. This has resulted in more demand for forest products and further land for cultivation, as more people are competing for declining resources. As a result there is unsustainable harvesting of forest products. The increase in harvesting intensity of forests has negative impacts on both the forest ecology and biodiversity (Belcher et al., 2005).

4.4.2 Impact of deforestation and forest degradation on livelihoods

The declining forest resource base is one of the main stresses on the livelihoods of forest dependent communities. The loss of forests diminishes household's incomes and livelihood options due to limited alternative local livelihood options. In the studied villages, households perceived a decline in the availability of FPES preferred for consumption. Households reported a decrease in forest cover which has led to decreases in the availability of mushrooms and fruits. According to a male local key informant in Mwekera, some mushroom species have become rare,

"*We no longer collect some mushroom species such as Tente (Termitomyces titanicus) due to forest clearance which has caused ecological disturbances*."

Some households have resorted to buying foods such as mushrooms which they previously used to harvest. Due to the increasingly long distances to harvest sites, some households have to walk for up to 3 hours each way to harvest mushrooms. Productive time is spent searching for tree products, which could have otherwise been used for other livelihood activities. There were also fewer livelihood options available. Previously, more people engaged in the sale of forest products (in increased quantities) which opened up more opportunities for livelihood diversification. Another local key informant in Mwekera highlighted that the loss of forest has moved the bees further away and they no longer harvest honey for sale.

"We *used to harvest large quantities of honey to sale, but we don't have enough bees anymore, they have gone far away due to the cutting down of trees. Now we only harvest small quantities of honey which is just for household consumption*".

It was further reported that deforestation has led to households losing revenue which was once realized from sale of mushrooms and fruits. According to a female key informant in Twesheko,

" in the 1980s' we used to load trucks with Musuku fruits and mushrooms to sale to Kitwe and Lusaka, now few trees have remained due to many people targeting them for charcoal and firewood."

This has mainly affected women and children, who dominated the trade. School going children used to pick the fruits for sale and used the income realized to purchase books.

Degradation is reducing household forest income therefore weakening economic safety nets. Other studies have reported that deforestation causes nutritional deficiencies in forest dependent communities due to scarcity of forest foods, or obtaining of less preferred foods (Bandyopadhyay et al., 2011), and loss of household income (Kamanga et al., 2009). This reduces both household income and food security. Deforestation and degradation further reduces the availability of medicinal trees, making it difficult to find some tree species such as *Cassia abbreviata* whose roots and barks are used for treating a plethora of diseases. These findings coincide with earlier studies by Shanley and Luz (2003) in eastern Amazonia where highly sought after medicinal trees have become scarce; many of which did not have botanical substitutes. Forest degradation is further increasing people's vulnerability to stresses and shocks. Since forests offer an important coping strategy to household income shocks especially among poorer households, deforestation is hampering the coping strategies of households. Loss of forests requires significant changes to livelihoods in order to cope and adapt (Shackleton et al., 2007), therefore deforestation is a threat to rural livelihoods that have limited alternative livelihood options.

4.5 Local institutional structure and impact on use of PFES

The management of Mwekera National Forest Reserve follows a conventional conservation approach which excludes communities from managing the forests. There are no local institutions that engage communities in active forest management or customary rules regulating forest use. This is because the forests are managed centrally by the State; through the District Forest Department. The centralized system with its weak institutional capacity has led to defacto open access. Household surveys, FGs and in-depth interviews revealed the absence of forest extension services in the communities. The forest department lacks financial and personnel limitations to license and monitor forest operations to ensure sustainable utilization, and provide extension services to rural communities. According to an expert interview with a government official in the forest department

"we are under-funded, we don't have motorbikes or vehicles to carry out operations and neither do we have protective clothing, going to communities is like a war and those people can attack you as they think you are going to evict them from their land as some have encroached the forest reserve."

The current institutional framework within the forest department has structural weaknesses such as lack of forest guards within the institutional structure. At the village scale in Mwekera, rules regulating forest use and management do not exist. Further, no protecting of trees for a particular environmental or cultural service exists. An in-depth with a male respondent revealed that;

"When I first migrated to this village, I was observing the customary rules on harvesting of forest products such as fruit trees which I used to practice where I came from. I stopped when I realised the other people here were not following any rules, we have difference beliefs and taboos in our ethnic groups which makes it difficult to observe them in these mixed ethnic communities"

Posner (1997) suggests that adherence to norms is affected by external (e.g. peer-pressure) and internal (e.g. feeling of guilt) factors. Since norms on use of forests prescribe behaviour, enforcements and sanctions elicit compliance (Hønneland, 1999, Sutinen and Kuperan, 1999), but norms easily erode in the absence of reciprocal behaviour and cooperation within communities (Ramcilovic-Suominen and Hansen, 2012). The absence of local rules in forest management in Mwekera may be attributed to the weakened traditional institutions due to the migration of people from different cultural and institutional backgrounds due to mining activities, compounded by lack of formal recognition of traditional institutions in forest management, as has been reported that customary rights are often considered inferior to statutory ones (Quinn et al., 2007).

Despite the statutory regulations which assume to protect the forest as pristine, human activities were observed in the forest. Illegal collection of forest products was rampant; extensive areas of the forest are depleted. The forest has been diminished to fragments. These observation are consistent with previous studies that report centralized forest management as lamentably failed to sustainably manage forest resource (Agrawal and Gibson, 1999, Holling, 2000). Local people obtain products from the forests without any consent from the forest department despite the law demanding permits and licences to harvest forest products. Some people from urban areas also harvest forest products, including cutting down trees in order to sell firewood to urban industries. Since forest use is statutorily illegal, local people have not engaged in institutionalised (customary institutions) use of forest resources. Legally, local people are illegal settlers and do not have title to their land. The uncertainty of land tenure has made local people lose the ability to enforce exclusion rights (e.g. encroachment from outsiders). In Katanino JFM, exclusion rights are enforced through customary institutions, while local people are involved in forest management through local forest user groups. A male in-depth respondent in Mwekera highlighted that;

"We live around the Forest Reserve and we know the people who cut trees but we however do not have the authority to stop them."

Protection of Mwekera as a National Forest Reserve has not stopped people from using the forests, as there are many illegal activities. During the study, charcoal kilns were found within the forest reserves (Figure 11).

Figure 11: Charcoal kiln in Mwekera National Forest Reserve

Local people around the reserves do not have any incentives for protecting the forest, or for sustainable utilization of PFES. This curtails the development of local rules and norms regarding forest use as forests are seen as the governments 'property.' The current centralized forest management system aims at limiting the livelihood activities of local people, but practically the forests were heavily encroached and forest products are being harvested unsustainably.

In Katanino Joint Forest Management Area, community rules existed on forest use and management. The formal institution under JFM was established with the consent of traditional institutions. In a FG it was highlighted that customary rules were used to manage the forest way before the implementation of the JFM.

"Our forefathers instructed us to protect the forest; we had rules regarding forest use even before JFM was implemented"

These rules prevented the cutting of trees on any land except for agricultural expansion. Customary rules existed for protecting water catchment areas as no cutting was allowed near streams and burial sites, and no cutting of fruit trees. Sanctions were imposed on those found breaking the community rules following the village conflict resolution structure (Figure 12). Offenders are first reported by the complainant (any member of the community) to village headmen who often consults a group of village elders, if not resolved, the case is then taken to the traditional councillor who then refers the case to the chief for punishment; persistence in breaking the rules could result in being banished from the chiefdom.

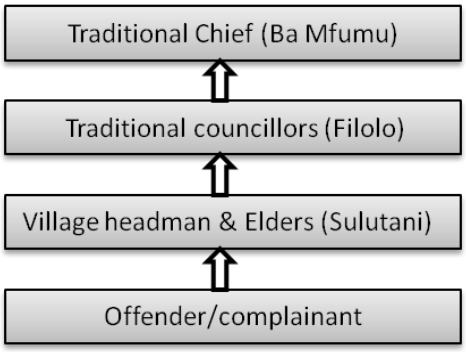

Figure 12: Traditional leadership structure

Studies (Keleman et al., 2010, Wunder, 2001) have reported strong social ties in native communities as promoting checks and balances on behaviour, the connections within the community restrain bad behaviour and hence it is less likely that people will break the rules, norms and regulations on forest protection. Beliefs and social ties under the traditional administration system help to enforce local rules. This is because norms exist in specific social settings, compelling individuals to act in a certain way and often punishing non-compliance (Krasner, 1983). This creates a standard of appropriate behaviour which gives rise to reciprocal expectation about social behaviour in a community which determines people's interests and conduct (Dimitrov, 2005). During the fieldwork in Katanino, it was observed that due to the rule that allows cutting of trees for agricultural purposes, some households cut trees and produced charcoal under the pretext that they will grow agricultural crops.

The introduction of JFM in an already established customary system in Katanino brought a different formal institutional structure which contradicts the local leadership establishment (Figure 13). This structure consists of the village resource management committees (VRMC) comprising of representation from village headmen, forest resource guards and a representative of each forest user group (such as charcoal producer, honey collectors, mushrooms, etc.). The VRMC reports to the forest management committee (FMC), which consists of representatives of the local chief, forest department, each VRMC and the district council. FMC further reports to the district development coordinating committee (DDCC) which is a technical advisory committee comprising of heads of various government units in the district and NGOs. The DDCC is mandated to coordinate all programmes in the district and has several sub-committees among them environment and natural resources sub-committee. In this structure, decision making is retained by the government. Under JFM, the local chief(s) lack direct legal recognised role in forest management, though they send a representative to the forest management committee. Customary rules regulating forest use (e.g. No cutting of fruit trees, conserving of trees along streams) have been integrated in statutory rules under JFM. There are however conflicts between customary and JFM rules, firstly JFM developed artificial forest user groups to regulate, monitor and issue permits for the use of specific forest product such as mushroom, honey, fruits. Customarily, people harvest multiple products and are not defined by user groups. Further since collection times are determined by household needs, compliance with the issuing of permits may be a challenge. Permits have a further possibility of elites capturing most of the benefits while less powerful people are excluded from using resources. There is a conflict in resource ownership after the introduction of JFM. Customarily, trees are

owned by the tribal chief while under JFM, trees are owned by the Republican President. Conflicts further exist in enforcement of rules; customary system channels are faster than State legal procedures, while there seem to be flexibility in enforcing customary rules. The identified conflicts between JFM and customary management seem to have been reduced by the absence of regular forest monitoring by government officials leaving the forest de facto under customary management.

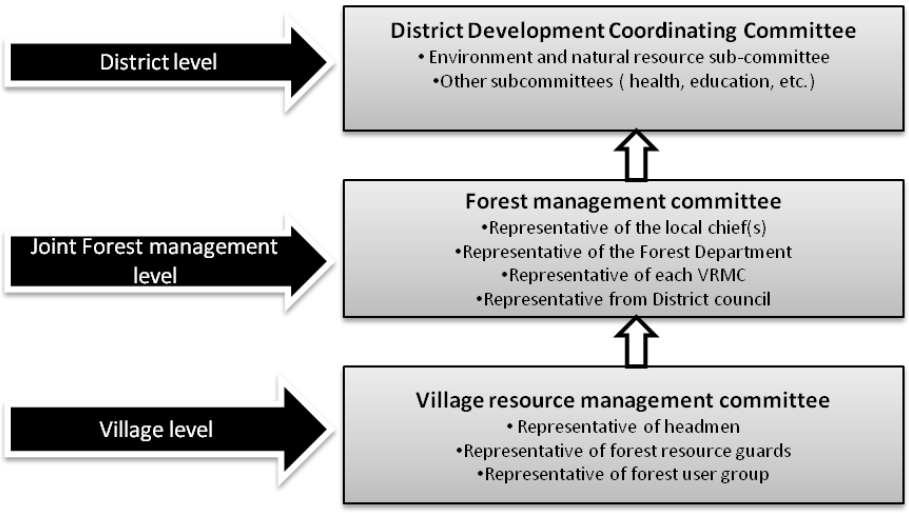

Figure 13 : Structure of Joint Forest Management

JFM seems to have slowed deforestation by incorporating traditional management but hasn't prevented degradation. In Katanino, the forest guards were still active in forest protection (though reported reductions in the frequency forest patrols) and reporting those found cutting trees to the traditional leadership. A male forest guard highlighted that

"We are not motivated to protect the forest. We don't receive any money for the work we do, in the forest we risk our lives from snakes, as well as those who come to harvest trees illegally have axes and chain saws which they threaten us with."

Local communities do not receive any financial benefits for managing the forest (due to legislative barriers). All taxes, levies, and licences are collected by the Forest Department and accrue entirely to the government. Despite communities receiving indirect benefits in terms of forest products, households do not perceive the connection between the forest products and forest management, as benefits are framed around receiving financial incentives from the government, this has made the local people less enthusiastic in forest conservation. Studies have shown that clear guidelines on payments for ecosystem services are cardinal in sustaining sound use and management (Pagiola et al., 2007). Though participation seem to be the core fabric of JFM, our findings show the shortcomings in participation resulting in inequalities in benefit sharing and participation in decision making. This seems to suggest that governments are more focused on sharing the cost of managing resources compared to the benefits. These findings provide additional insights into earlier studies that revealed community based natural resources management (CBNRM) implementations are often top-down, with little participation by local people (Quinn et al., 2007, Stringer et al., 2007). In their review of the global CBNRM narratives, Dressler et al (2010) highlighted that in many CBNRM schemes, the state has no capacity or legitimacy to implement decisions due to legal impediments.

5 Conclusions

This study has provided insights on the relative importance of FPES to rural livelihoods in the Miombo in different local institutional contexts, and the differentiation in use and sale of forest products in relation to household wealth and gender of household head. The findings of this study present further evidence that FPES contribute substantially to rural livelihood portfolios irrespective of household wealth and gender of household head particularly with regard to proportion of households' use of PFES. According to Shackleton and Shackleton (2006), households rely on forests through direct-use value, strongly associated with cost saving. The results however suggest that poor households depended more on the forest as a source of construction materials than wealthy households (as they could not afford other construction materials), but considerably used the forest less as a source of fodder compared to their intermediate and wealthy counterparts. In a study in India, fodder use was related to livestock ownership and therefore wealthy households used the forest considerably more as a source of fodder (Davidar et al., 2008). Further, food provisioning services are important as their availability corresponds with food lean periods, helping food insecure poor households avoid starvation and thereby increasing livelihood security. This study has thus contributed to the growing research on forest use in livelihoods from socio-economic dimension in southern Africa, much of which has been conducted in the dry sub-humid woodlands (Campbell et al., 1996, Campbell et al., 1997, Shackleton and Shackleton, 2004, Shackleton and Shackleton, 2006) which are in a different agro-ecological with the wet Miombo of Zambia's Copperbelt.

Furthermore, PFES are an important source of income for poorer households. Wealth of households significantly influenced households' involvements in the sale of forest products. Income derived from provisioning services makes an important contribution to the livelihoods of poor households who have limited income streams. With respect to gender, despite females dominating the selling activity, there was no difference between male and female-headed households in the sale of provisioning services, except for charcoal sale which was dominant among male headed households. These findings contrast other studies (Babulo et al., 2008, McSweeney, 2004) which report female headed households as engaging more in sale of forest products. The study further shows that the sale of forest products is determined by contextual factors such as proximity to markets and the nature of the products (e.g. shelf-life), as it was observed that, apart from selling of charcoal, fewer households sold PFES in Katanino due to weak demand; especially for products with a short shelf-life such as fresh mushrooms and fruits. The lack of improved technology for the processing of products has implications on post-harvest losses (in cases for foods), and reduces the amount of revenue that households obtain from the sale of forest products.

Our findings show that FPES are important for coping with household shocks. Households use diverse strategies to respond to household income shocks, with use of PFES being the most dominant, in contrast to kinship which many studies (Heemskerk et al., 2004, McSweeney, 2004, Paumgarten and Shackleton, 2011) report as dominant. A third of households sold PFES to offset costs resulting from household income shocks. There was a higher dependence on forests for coping with income shocks among poor and intermediate households due to their limited coping strategies. Rural households in developing countries rarely have enough resources available to cope with shocks, and lack access to social-support systems

or public safety-nets, which even when present are often weak (Heemskerk et al., 2004).

Deforestation and forest degradation is reducing the livelihood options as well as weakening rural people's coping strategies in the event of shocks. Presently, people have observed declining forest cover as their own livelihood activities are contributing to resource depletion, which has reduced income realized from the sale of PFES. An analysis of the local institutions regulating forest management reveals that there are no local institutions engaged in forest management in Mwekera National Forest. The exclusion of local communities in management and the non-functioning of government monitoring has increased illegal cutting of trees in the forests by both people living in the surrounding communities and those coming from other villages. We therefore show that restricting legislation does not stop people from harvesting forest products as weak state institutions lead to de facto open access. In Katanino, local people were involved in Joint Forest Management, and community laws on forest management existed, though many people were withdrawing from managing the forest due to a lack of financial benefits.

This study has presented further evidence of the high dependence of rural livelihoods on PFES, which highlights the vulnerability of rural communities to changes in the forest ecosystem. To reconcile forest conservation and livelihood improvement under the emerging global strategies such as REDD+, we recommend (1) Understanding people's use of PFES and the socio-economic factors affecting use to inform management practices, (2) Improved marketing of PFES and reduction of losses through improved processing of product and enhance market infrastructure to increase revenue accrued to rural households (3) Policies and actions to provide households with insurance mechanisms to meet household income shocks to reduce dependence on forests which to most poorer households is the only available option, (4) Policies and legislation that strengthening local institutions capacities in forest management through narrowing the government local people divides in forest management, offering greater participation of local people in forest governance. There is a need to involve local people in resource management, as any conservation strategies that exclude rural communities from forests will negatively affect rural livelihoods and the ecosystem.

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7 References

ADHIKARI, B., DI FALCO, S. & LOVETT, J. C. 2004. Household characteristics and forest dependency: evidence from common property forest management in Nepal. *Ecological Economics,* 48**,** 245-257.

AGRAWAL, A. & GIBSON, C. C. 1999. Enchantment and Disenchantment: The Role of Community in Natural Resource Conservation. *World Development,* 27**,** 629-649.

AKINNIFESI, F. K., KWESIGA, F. R., MHANGO, J., MKONDA, A., CHILANGA, T. & SWAI, R. 2004. Domesticating priority miombo indigenous fruit trees as a promising livelihood option for smallholder farmers in southern Africa. *Acta Horticulturae,* 632**,** 15-30.

ALELIGN, A., YEMSHAW, Y., TEKETAY, D. & EDWARDS, S. 2011. Socio-economic factors affecting sustainable utilization of woody species in Zegie Peninsula, northwestern Ethiopia. *Tropical Ecology,* 52**,** 13-24.

AMBROSE-OJI, B. 2003. The contribution of NTFPs to the livelihoods of the 'forest poor': evidence from the tropical forest zone of south-west Cameroon. *International Forestry Review,* 5**,** 106-117.

BABBIE, E. 1995. *The practice of social research,* California, Wadsworth Publishing Company.

BABULO, B., MUYS, B., NEGA, F., TOLLENS, E., NYSSEN, J., DECKERS, J. & MATHIJS, E. 2008. Household livelihood strategies and forest dependence in the highlands of Tigray, Northern Ethiopia. *Agricultural Systems,* 98**,** 147-155.

BANANA, A. Y. & TURIHO-HAMBWE, G. P. A socio-economic analysis of forest foods consumption in Hoima and Masindi Districts of Uganda. African crop science conference, 1997. African Crop Science, 1435-1442.

BANDYOPADHYAY, S., SHYAMSUNDAR, P. & BACCINI, A. 2011. Forests, biomass use and poverty in Malawi. *Ecological Economics,* 70**,** 2461-2471.

BARRETT, C. B., REARDON, T. & WEBB, P. 2001. Nonfarm income diversification and household livelihood strategies in rural Africa: concepts, dynamics, and policy implications. *Food Policy,* 26**,** 315-331.

BELCHER, B., RUÍZ-PÉREZ, M. & ACHDIAWAN, R. 2005. Global patterns and trends in the use and management of commercial NTFPs: Implications for livelihoods and conservation. *World Development,* 33**,** 1435-1452.

BLAKE, B., KASANGA, K., ADAM, M., NSIAH-GYABAAH, K., PENDER, J., QUASHIE-SAM, S. J., WARBURTON, K. & WILLIAMS, K. 1997. Kumasi Natural Research Management Research Project Inception Report. The University of Greenwich.

BLOM, B., SUNDERLAND, T. & MURDIYARSO, D. 2010. Getting REDD to work locally: lessons learned from integrated conservation and development projects. *Environmental Science & Policy,* 13**,** 164-172.

BYRON, N. & ARNOLD, M. 1999. What futures for the people of the tropical forests? *World Development,* 27**,** 789-805.

CAMPBELL, B., FROST, P. & BYRON, N. 1996. Miombo woodland and their use: overview and key issues. *In:* CAMPBELL, B. (ed.) *The miombo in transition: woodlands and welfare.* Bogor: Center for international forestry research (CIFOR).

CAMPBELL, B. M., LUCKERT, M. & SCOONES, I. 1997. Local-level valuation of Savanna resources: A case study from Zimbabwe. *Economic Botany,* 51**,** 59-77.

CARPENTER, S. R., MOONEY, H. A., AGARD, J., CAPISTRANO, D., DEFRIES, R. S., DIAZ, S., DIETZ, T., DURAIAPPAH, A. K., OTENG-YEBOAH, A., PEREIRA, H. M., PERRINGS, C., REID, W. V., SARUKHAN, J., SCHOLES, R. J. & WHYTE, A. 2009. Science for managing ecosystem services: Beyond the Millennium Ecosystem Assessment. *Proceedings of the National Academy of Sciences of the United States of America,* 106**,** 1305-1312.

CAVENDISH, W. 2000. Empirical regularities in the poverty-environment relationship of rural households: Evidence from Zimbabwe. *World Development,* 28**,** 1979-2003.

CENTRAL STATISTICS OFFICE 2005. Living conditions monitoring survey report 2004. Lusaka: Central Statistics Office.

CHAMBERS, R. & CONWAY, G. R. 1991. Sustainable rural livelihoods: practical concepts for the 21st century. *IDS discussion paper 296.*

CHIDUMAYO, E. N. 1987. Woodland structure, destruction and conservation in the Copperbelt area of Zambia. *Biological Conservation,* 40**,** 89-100.

CHIDUMAYO, E. N. 1989. Land use, deforestation and reforestation in the Zambian Copperbelt. *Land Degradation & Development,* 1**,** 209-216.

CHIDUMAYO, E. N. 1990. Above-ground woody biomass structure and productivity in a Zambezian woodland. *Forest Ecology and Management,* 36**,** 33-46.

CHIDUMAYO, E. N. 1997. *Miombo ecology and management: an introduction,* London, IT Publications in association with the Stockholm Environment Institute.

CHIKONDE, J. 2008. Management plan for Katanino forest reserve. Kitwe: Copperbelt University.

CHIRWA, P. W., SYAMPUNGANI, S. & GELDENHUYS, C. J. 2008. The ecology and management of the Miombo woodlands for sustainable livelihoods in southern Africa: the case for non-timber forest products. *Southern Forests,* 70**,** 237-245.

CLARKE, J., CAVENDISH, W. & COOTE, C. 1996. Rural households and miombo woodlands:use, value and management. *In:* CAMPBELL, B. (ed.) *Miombo in transition:woodlands and welfare in Africa.* Bogor: Center for International Forestry Research (CIFOR).

COCKS, M. L., BANGAY, L., SHACKLETON, C. M. & WIERSUM, K. F. 2008. 'Rich man poor man' - inter-household and community factors influencing the use of wild plant resources amongst rural households in South Africa. *International Journal of Sustainable Development and World Ecology,* 15**,** 198-210.

DAVIDAR, P., ARJUNAN, M. & PUYRAVAUD, J.-P. 2008. Why do local households harvest forest products? A case study from the southern Western Ghats, India. *Biological Conservation,* 141**,** 1876-1884.

DERCON, S. 2002. Income risk, coping strategies, and safety nets. *World Bank Research Observer,* 17**,** 141-166.

DIMITROV, R. S. 2005. Hostage to norms : institutions and global forest politics. *Global Environmental policy* 5**,** 1-24.

DRESSLER, W., BUESCHER, B., SCHOON, M., BROCKINGTON, D., HAYES, T., KULL, C. A., MCCARTHY, J. & SHRESTHA, K. 2010. From hope to crisis and back again? A critical history of the global CBNRM narrative. *Environmental Conservation,* 37**,** 5-15.

ELLIS, F. 2000. The Determinants of Rural Livelihood Diversification in Developing Countries. *Journal of Agricultural Economics,* 51**,** 289-302.

FAO 2010. Global forest resource assessment. Rome: FAO.

FISHER, B., LEWIS, S. L., BURGESS, N. D., MALIMBWI, R. E., MUNISHI, P. K., SWETNAM, R. D., KERRY TURNER, R., WILLCOCK, S. & BALMFORD, A. 2011. Implementation and opportunity costs of reducing deforestation and forest degradation in Tanzania. *Nature Clim. Change,* 1**,** 161-164.

FISHER, M. 2004. Household welfare and forest dependence in Southern Malawi. *Environment and Development Economics,* 9**,** 135-154.

FISHER, M., CHAUDHURY, M. & MCCUSKER, B. 2010. Do Forests Help Rural Households Adapt to Climate Variability? Evidence from Southern Malawi. *World Development,* 38**,** 1241-1250.

FONJONG, L. 2008. Gender roles and practices in natural resources management in the North West Province of Cameroon. *Local Environment,* 13**,** 461- 475.

FROST, P. 1996. *The ecology of miombo woodlands,* Bogor, Center for international forestry research (CIFOR)

GBADEGESIN, A. 1996. Management of forest resources by women: A case study from the Olokemeji forest reserve area, southwestern Nigeria. *Environmental Conservation,* 23**,** 115-119.

GRUNDY, I. M., CAMPBELL, B. M., BALEBEREHO, S., CUNLIFFE, R., TAFANGENYASHA, C., FERGUSSON, R. & PARRY, D. 1993. Availability and use of trees in Mutanda Resettlement Area, Zimbabwe. *Forest Ecology and Management,* 56**,** 243-266.

GRZ 1973. The Forests Act. Lusaka: Government printers.

GRZ 1998. An overview of Copperbelt Forestry Action Plan. Ndola: PFAP.

HEEMSKERK, M., NORTON, A. & DE DEHN, L. 2004. Does public welfare crowd out informal safety nets? Ethnographic evidence from rural Latin America. *World Development,* 32**,** 941-955.

HETHERINGTON, J. C. 1975. Samples? What shape? How large? How many? *Scottish Forestry,* 29**,** 260-267.

HEUBACH, K., WITTIG, R., NUPPENAU, E.-A. & HAHN, K. 2011. The economic importance of non-timber forest products (NTFPs) for livelihood maintenance of rural west African communities: A case study from northern Benin. *Ecological Economics,* 70**,** 1991-2001.

HILL, P. 1986. *Development Economics on Trial: The Anthropological Case for a Prosecution,* Cambridge, Cambridge University Press.

HOLLING, C. S. 2000. Theories for sustainable futures. *Conservation Ecology,* 4**,** 7.

HØNNELAND, G. 1999. A model of compliance in fisheries: Theoretical foundations and practical application. *Ocean and Coastal Management,* 42**,** 699-716.

JUMBE, C. B. L., BWALYA, S. M. & HUSSELMAN, M. 2009. Contribution of dry forests to rural livelihoods and the national economy in Zambia. *XIII World Forestry Congress.* Buenos Aires, Argentina, 18 – 23 October 2009.

KALABA, K. F., CHIRWA, P., SYAMPUNGANI, S. & AJAYI, C. O. 2010. Contribution of agroforestry to biodiversity and livelihoods improvement in rural communities of Southern African regions. *Tropical Rainforests and Agroforests under Global Change: Ecological and Socio-economic Valuations***,** 461-476.

KAMANGA, P., VEDELD, P. & SJAASTAD, E. 2009. Forest incomes and rural livelihoods in Chiradzulu District, Malawi. *Ecological Economics,* 68**,** 613-624.

KAOMA, P. 2004. Management Plan for Mwekera Forest. Kitwe Zambia: Copperbelt University.

KELEMAN, A., MANAGE, U. G. & DOOLEY, K. 2010. Conservation and the agricultural frontier: collapsing conceptual boundaries. *Journal of Sustainable Forestry,* 29**,** 539 — 559.

KEPE, T. 2008. Beyond the numbers: Understanding the value of vegetation to rural livelihoods in Africa. *Geoforum,* 39**,** 958-968.

KIDEGHESHO, J. R. & MSUYA, T. S. 2010. Gender and socio-economic factors influencing domestication of indigenous medicinal plants in the West Usambara Mountains, northern Tanzania. *International Journal of Biodiversity Science Ecosystem Services & Management,* 6**,** 3-12.

KIPTOT, E. & FRANZEL, S. 2012. Gender and agroforestry in Africa: a review of women's participation. *Agroforestry Systems,* 84**,** 35-58.
KRASNER, S. D. 1983. *International regimes* Ithaca NY, Cornell University Press.
LAWTON, R. M. 1978. STUDY OF DYNAMIC ECOLOGY OF ZAMBIAN VEGETATION. *Journal of Ecology,* 66**,** 175-&.
LEAKEY, R. R. B. & AKINNIFESI, F. K. 2008. Towards a domestication strategy for indigenous fruit trees in the tropics. *Indigenous Fruit Trees in the Tropics: Domestication, Utilization and Commercialization***,** 28-49.
LOVEJOY, T. E. 2006. Protected areas: a prism for a changing world. *Trends in ecology & evolution (Personal edition),* 21**,** 329-333.
LOWORE, J. 2003. Miombo woodlands and rural livelihoods in Malawi: An in-depth analysis and critical review based on literature research. Bogor, Indonesia: Center for International Forest Research, CIFOR Report.
LUNGU, O. I. & CHINENE, V. R. N. 1993. Cropping and Management Systems and their Effect on Soil Productivity in Zambia. A Review. *Ecology and Development Paper No.5.* The Agricultural University of Norway.
MAASS, J. M., BALVANERA, P., CASTILLO, A., DAILY, G. C., MOONEY, H. A., EHRLICH, P., QUESADA, M., MIRANDA, A., JARAMILLO, V. J., GARCIA-OLIVA, F., MARTINEZ-YRIZAR, A., COTLER, H., LOPEZ-BLANCO, J., PEREZ-JIMENEZ, A., BURQUEZ, A., TINOCO, C., CEBALLOS, G., BARRAZA, L., AYALA, R. & SARUKHAN, J. 2005. Ecosystem services of tropical dry forests: Insights from long-term ecological and social research on the Pacific Coast of Mexico. *Ecology and Society,* 10**,** Article No.: 17.
MAMO, G., SJAASTAD, E. & VEDELD, P. 2007. Economic dependence on forest resources: A case from Dendi district, Ethiopia. *Forest Policy and Economics,* 9**,** 916-927.
MAXWELL, D., AHIADEKE, C., LEVIN, C., ARMAR-KLEMESU, M., ZAKARIAH, S. & LAMPTEY, G. M. 1999. Alternative food-security indicators: revisiting the frequency and severity of 'coping strategies'. *Food Policy,* 24**,** 411-429.
MBATA, K. J., CHIDUMAYO, E. N. & LWATULA, C. M. 2002. Traditional regulation of edible caterpillar exploitation in the Kopa area of Mpika district in northern Zambia. *Journal of Insect Conservation,* 6**,** 115-130.
MCSWEENEY, K. 2004. Forest Product Sale as Natural Insurance: The Effects of Household Characteristics and the Nature of Shock in Eastern Honduras. *Society & Natural Resources,* 17**,** 39-56.
MISANA, S., JAMBIYA, G. C. & MCHOME, B. 2005. Charcoal potential of Miombo woodlands at Kitulangalo, Tanzania. *Journal of Tropical Forest Science,* 17**,** 197-210.
MITCHELL, J. C. & BARNES, J. A. 1950. *The Lamba village: report of a social survey* University of Cape Town.
MITTERMEIER, R. A., MITTERMEIER, C. G., BROOKS, T. M., PILGRIM, J. D., KONSTANT, W. R., DA FONSECA, G. A. B. & KORMOS, C. 2003. Wilderness and biodiversity conservation. *Proceedings of the National Academy of Sciences of the United States of America,* 100**,** 10309-10313.
MOSHIRO, C., HEUCH, I., ASTROM, A. N., SETEL, P. & KVALE, G. 2005. Effect of recall on estimation of non-fatal injury rates: a community based study in Tanzania. *Injury Prevention,* 11**,** 48-52.
NEUMANN, P., MORITZ, R. F. A. & MAUTZ, D. 2000. Colony evaluation is not affected by drifting of drone and worker honeybees (Apis mellifera L.) at a performance testing apiary. *Apidologie,* 31**,** 67-79.

PAGIOLA, S., RAMÍREZ, E., GOBBI, J., DE HAAN, C., IBRAHIM, M., MURGUEITIO, E. & RUÍZ, J. P. 2007. Paying for the environmental services of silvopastoral practices in Nicaragua. *Ecological Economics,* 64**,** 374-385.

PATTANAYAK, S. K. & SILLS, E. O. 2001. Do tropical forests provide natural insurance? The microeconomics of non-timber forest product collection in the Brazilian Amazon. *Land Economics,* 77**,** 595-613.

PAUMGARTEN, F. & SHACKLETON, C. M. 2011. The role of non-timber forest products in household coping strategies in South Africa: the influence of household wealth and gender. *Population and Environment,* 33**,** 108-131.

PEARSON, G. A. 1937. CONSERVATION AND USE OF FORESTS IN THE SOUTHWEST. *Scientific Monthly,* 45**,** 150-157.

PHILLIPS, D., WILLIAMS, K., ANDREWS, G., CLARKE, J., CARTER, M., KINSMAN, P., SMITH, D., WILLIS, K., BRADBURY, I., WU, K. & HILLYER, A. 1999. Literature review on peri urban natural resource conceptualisation and management approaches. Final Technical Report. DFID Natural Resources Systems Programme, University of Nottingham and University of Liverpool.

POSNER, R. A. 1997. Social Norms and the Law: An Economic Approach. *American Economic Review,* 87**,** 365-369.

PRSP 2002. Poverty Reduction Strategic Paper. Lusaka: Government of the Republic of Zambia.

QUINN, C. H., HUBY, M., KIWASILA, H. & LOVETT, J. C. 2007. Design principles and common pool resource management: An institutional approach to evaluating community management in semi-arid Tanzania. *Journal of Environmental Management,* 84**,** 100-113.

RAMCILOVIC-SUOMINEN, S. & HANSEN, C. P. 2012. Why some forest rules are obeyed and others violated by farmers in Ghana: Instrumental and normative perspective of forest law compliance. *Forest Policy and Economics,* 23**,** 46-54.

RASUL, G., CHETTRI, N. & SHARMA, E. 2011. Framework for valuing ecosystem services in the Himalayas. Kathmandu: ICIMOD.

RODGERS, A., SALEHE, J. & HOWARD, G. 1996. The biodiversity of miombo woodlands. *In:* CAMPBELL, B. (ed.) *The miombo in transition: woodlands and welfare in Africa.* Bogor: Center for international forestry research (CIFOR).

SCOONES, I. 1998. Sustainable rural livelihoods: a framework for analysis. Brighton: Institute of Development Studies.

SHACKLETON, C. & SHACKLETON, S. 2004. The importance of non-timber forest products in rural livelihood security and as safety nets: a review of evidence from South Africa. *South African Journal of Science,* 100**,** 658-664.

SHACKLETON, C. M. & SHACKLETON, S. E. 2006. Household wealth status and natural resource use in the Kat River valley, South Africa. *Ecological Economics,* 57**,** 306-317.

SHACKLETON, C. M., SHACKLETON, S. E., BUITEN, E. & BIRD, N. 2007. The importance of dry woodlands and forests in rural livelihoods and poverty alleviation in South Africa. *Forest Policy and Economics,* 9**,** 558-577.

SHACKLETON, S. & GUMBO, D. 2010. Contribution of non-wood forest products to livelihoods and poverty alleviation. *In:* CHIDUMAYO, E. N. & GUMBO, D. J. (eds.) *The dry forests and woodlands of Africa: managing for products and services.* London: Earthscan.

SHANLEY, P. & LUZ, L. 2003. The Impacts of Forest Degradation on Medicinal Plant Use and Implications for Health Care in Eastern Amazonia. *BioScience,* 53**,** 573-584.

SILVERMAN, S. F. 1966. ETHNOGRAPHIC APPROACH TO SOCIAL STRATIFICATION - PRESTIGE IN A CENTRAL ITALIAN COMMUNITY. *American Anthropologist,* 68**,** 899-921.

SIMON, D., MCGREGOR, D. & NSIAH-GYABAAH, K. 2004. The changing urban–rural interface of African cities:definitional issues and an application to Kumasi, Ghana. *Environment & Urbanization,* 16**,** 235-248.

SOLTANI, A., ANGELSEN, A., EID, T., NAIENI, M. S. N. & SHAMEKHI, T. 2012. Poverty, sustainability, and household livelihood strategies in Zagros, Iran. *Ecological Economics,* 79**,** 60-70.

STRAUSS, A. & CORBIN, J. 1990. *Basics of qualitative research: Grounded theory procedures and techniques.,* Newbury Park, Sage Publications.

STRINGER, L. C., DOUGILL, A. J., MKWAMBISI, D. D., DYER, J. C., KALABA, F. K. & MNGOLI, M. 2012. Challenges and opportunities for carbon management in Malawi and Zambia. *Carbon Management,* 3**,** 159-173.

STRINGER, L. C., REED, M. S., DOUGILL, A. J., SEELY, M. K. & ROKITZKI, M. 2007. Implementing the UNCCD: Participatory challenges. *Natural Resources Forum,* 31**,** 198-211.

STROMGAARD, P. 1984. The immediate effect of burning and ash-fertilization. *Plant and Soil,* 80**,** 307-320.

SUNDERLIN, W. D., ANGELSEN, A., BELCHER, B., BURGERS, P., NASI, R., SANTOSO, L. & WUNDER, S. 2005. Livelihoods, forests, and conservation in developing countries: An Overview. *World Development,* 33**,** 1383-1402.

SUTINEN, J. G. & KUPERAN, K. 1999. A socio-economic theory of regulatory compliance. *International Journal of Social Economics,* 26**,** 174-193.

SYAMPUNGANI, S. 2009. *Vegetation change analysis and ecological recovery of the Copperbelt Miombo woodland of Zambia.* PhD, University of Stellenbosch.

SYAMPUNGANI, S., GELDENHUYS, C. J. & CHIRWA, P. W. 2010. The use of species-stem curves in sampling the development of the Zambian miombo woodland species in charcoal production and slash-and-burn regrowth stands. *Southern Forests,* 72**,** 83-89.

TESFAYE, Y., ROOS, A., CAMPBELL, B. M. & BOHLIN, F. 2011. Livelihood strategies and the role of forest income in participatory-managed forests of Dodola area in the bale highlands, southern Ethiopia. *Forest Policy and Economics,* 13**,** 258-265.

TSCHAKERT, P., COOMES, O. T. & POTVIN, C. 2007. Indigenous livelihoods, slash-and-burn agriculture, and carbon stocks in Eastern Panama. *Ecological Economics,* 60**,** 807-820.

TURNER, B. L., KASPERSON, R. E., MATSON, P. A., MCCARTHY, J. J., CORELL, R. W., CHRISTENSEN, L., ECKLEY, N., KASPERSON, J. X., LUERS, A., MARTELLO, M. L., POLSKY, C., PULSIPHER, A. & SCHILLER, A. 2003. A framework for vulnerability analysis in sustainability science. *Proceedings of the National Academy of Sciences of the United States of America,* 100**,** 8074-8079.

WHITFORD, H. N. 1923. THE USE OF TROPICAL LAND AND TROPICAL FORESTS. *Scientific Monthly,* 17**,** 135-145.

WUNDER, S. 2001. Poverty alleviation and tropical forests - What scope for synergies? *World Development,* 29**,** 1817-1833.

YEMIRU, T., ROOS, A., CAMPBELL, B. M. & BOHLIN, F. 2010. Forest Incomes and Poverty Alleviation Under Participatory Forest Management in the Bale Highlands, Southern Ethiopia. *International Forestry Review,* 12**,** 66-77.

ZIMBA, S. C. 2003. Sustainable forest resource management through indegenous people's tenure and participatory approach: a case of the Copperbelt province of Zambia. Kitwe: Copperbelt University.