

Short communication

The role of forest provisioning ecosystem services in coping with household stresses and shocks in Miombo woodlands, Zambia



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ABSTRACT

This paper investigates the use of forest provisioning ecosystem services (FPES) in coping with stresses and shocks in rural households of Miombo woodland systems. It assesses the influence of socio-economic factors (wealth and gender) in households' coping decisions. The study employs a mixed methods approach by combining focus groups meetings, in-depth interviews, and interviews of 244 households stratified by household wealth classes and gender of household heads in Copperbelt province, Zambia. The results show that households face multiple shocks and that FPES are the most widely used coping strategy used by households facing idiosyncratic shocks, by households, followed by kinship. A higher proportion of poor and intermediate households rely on FPES to cope with various shocks than their wealthier counterparts. When stratified by gender, more male-headed households used FPES than female headed households. With respect to coping with household food stresses, charcoal production and sale is the most widely used strategy, followed by off-farm activities and remittances. In designing forest management strategies aimed at reconciling forest conservation and rural development, such as reduction of emissions from deforestation and forest degradation (REDD+) schemes, it is vitally important that alternate coping strategies are made available to rural households to reduce pressure on forests.

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1. Introduction

Ecosystems are increasingly recognised for their contribution of services to human well-being. This has led to an interest by many researchers in understanding human–environment interactions against the backdrop of climate change and dwindling ecosystems (MA, 2005). Across the world, understanding ecosystems is an important subject for scientific enquiry (Cowie et al., 2011; Rounsevell et al., 2010), largely due to the growing costs of biodiversity loss and ecosystem degradation (TEEB, 2008). This is particularly true for developing countries whose population heavily depend on ecosystems for survival (due to high poverty levels) and have the highest rates of ecosystem degradation (MA, 2005), and is especially the case for the dryland systems of Sub-Saharan Africa (Middleton et al., 2011; Stringer et al., 2012).

1.1. Forest provisioning ecosystem services and rural livelihoods

Ecosystems services are benefits that people obtain from ecosystems (MA, 2005). Provisioning ecosystem services are those products

that can be harvested and quantified such as food, fibre and fuel (Maass et al., 2005). Miombo woodland systems are the most extensive forest formation in Africa covering an estimated 2.7 million km² (Frost, 1996) and they provide FPES, which are important for the day-to-day living of their inhabitants. They are a source of foods such as mushrooms (Syampungani et al., 2009), edible insects (Mbata et al., 2002), indigenous fruits (Kalaba et al., 2010; Leakey and Akinnifesi, 2008), seeds, wild vegetables, honey and oils (Shackleton and Gumbo, 2010). The woodlands are also a source of traditional medicine for primary health care (Chirwa et al., 2008) and poles, fibres and other materials used for constructing houses and barns (Clarke et al., 1996). Woodfuel (firewood and charcoal) from the woodlands is an important energy source, providing over 75% of the total energy needs for both urban and rural dwellers in Zambia (Malimbwi et al., 2010). To the local people, “Miombo woodlands are a pharmacy, a supermarket, a building supply store and a grazing resource” (Deweese et al., 2010, pp. 61).

1.2. Vulnerability of rural households

Rural households are vulnerable to a wide range of stresses and shocks that affect their livelihood assets and options (Debela et al., 2012). Households experience different frequencies and types of idiosyncratic shocks (such as death, sicknesses, loss of property) and covariate shocks (e.g. droughts, flooding, outbreaks of human

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and livestock diseases) (McSweeney, 2004; Paumgarten and Shackleton, 2011). Rural households seldom have access to formal insurance institutions to help them cope with stresses and shocks (Debela et al., 2012). To cope with these stresses and shocks, households use various strategies such as selling productive assets, kinship, engaging in off-farm employment, or reducing the frequency and amount of consumption (Debela et al., 2012; Dercon, 2002). Others increase extraction of forest resources for consumption as well as a source cash income (Debela et al., 2012). The coping capacity of households is determined by a number of factors such as nature and intensity of shock (Pattanayak and Sills, 2001), local environmental endowments (Takasaki et al., 2004) and household socio-economic factors (Pattanayak and Sills, 2001; Turner et al., 2003). Although households use a variety of strategies to cope with idiosyncratic shocks (Heemskerk et al., 2004; Maxwell et al., 1999; Paumgarten and Shackleton, 2011), these strategies are often inadequate to cope with extreme covariate shocks (Dercon, 2002; Heemskerk et al., 2004).

High frequency and intensity of shocks coupled with inadequate household's coping strategies is a common poverty trap for many rural households (Carter and Barrett, 2006; Zimmerman and Carter, 2003). The rising levels of human vulnerability to multiple stressors are increasing rural people's dependence on ecosystem services (Shackleton and Shackleton, 2012).

Although use of forests to cope with stresses and shocks has been reported in some empirical studies mostly in Latin America's tropical forests (Godoy et al., 1998; McSweeney, 2004), only a few studies have been conducted in the dry forests of southern Africa (e.g. Paumgarten and Shackleton, 2011).



Fig. 1. Location of study area.

There is a vital need for more empirical case study research to provide quantitative and qualitative data on how FPES are used as a natural insurance against stresses and shocks. Furthermore, although several studies have recently explored the influence of socio-economic factors on use and sale of forest products (Babulo et al., 2008; Heubach et al., 2011; Shackleton and Shackleton, 2006), studies on how social and economic differentiation of households' influences use of forest resources to cope with stresses and shocks are lacking.

Understanding local people's use of FPES 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), which have an intertwined challenge of poverty and addressing forest degradation (Soltani et al., 2012).

The aim of this study is to improve understanding on the role of forests as a natural insurance against stresses and shocks among rural households in Miombo woodland and to assess the influence of wealth and gender of household heads on coping decisions.

2. Study area and methodology

The Copperbelt Province of Zambia (Fig. 1) covers a total surface area of 31,014 km². It lies on the central African plateau at an average altitude of 1200 m 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 1200 mm and experiences three weather seasons that are distinguished based on rainfall and temperature, namely; hot dry (September–November), rainy season (December–March) and cold dry (April–August) (Chidumayo, 1997). The average temperature ranges from 17 °C in the cold dry season to 37 °C in the hot dry season. In terms of vegetation, Miombo woodland systems represent 90% of the Copperbelt province's total natural vegetation (GRZ, 1998). These woodlands are dominated by trees belonging to *Julbernardia*, *Isoberlinia* and *Brachystegia* genera, which are widely used for charcoal production. The Miombo is further rich in various indigenous fruit trees such as *Uapaca kirkiana*, *Anisophyllea boehmii*, and *Strychnos cocculoides* (Kalaba et al., 2013).

2.1. 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.

In the two sites, four villages were selected namely; Bwengo and Kashitu villages (Katanino site), and Misaka and Twesheko

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 1300 m above sea level	12°49' S and 28°22' E; elevation 1295 m above sea level
Legal status of forest	Joint forest management	National forest reserve
Local institutional administration	Customary	State
Cultural context	Rural traditional	Rural peri-industrial
Distance to the nearest urban markets	75 km	20 km
Forest type	Miombo woodlands	Miombo woodlands
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

Table 2

Proportion of households (%) experiencing idiosyncratic shocks stratified by household wealth and gender of household head.

Shock	Overall (n=244)	Wealth categories			X ²	Significance	Gender of head of household		X ²	Significance
		Poor (n=120)	Intermediate (n=83)	Wealthy (n=41)			Male (n=177)	Female (n=67)		
Crop failure	30.7	33.3	28.9	26.8	0.8	> 0.05	33.3	23.9	2.0	> 0.05
Serious illness	41.0	48.3	31.3	39.0	5.9	> 0.05	41.8	38.8	0.2	> 0.05
Death/funeral expenses	19.7	16.7	19.3	29.3	3.1	> 0.05	19.2	20.9	0.1	> 0.05
Major asset losses	9.8	11.7	8.4	7.3	0.9	> 0.05	11.3	6.0	1.6	> 0.05
livestock loss	8.6	10.8	4.8	9.6	2.3	> 0.05	7.9	10.4	0.4	> 0.05
Weddings and social events	2.5	0.8	3.6	4.9	2.8	> 0.05	1.7	4.5	1.6	> 0.05

villages (Mwekera site). These were selected due to similarities in village sizes and accessibility.

2.2. Methods

This study used a mixed method approach including semi-structured household questionnaires, focus group meetings and in-depth interviews. For the household survey, the sampling frame was the total number of households in the respective villages. In each village household wealth ranking exercises (see Kalaba et al., 2012) were conducted in a participatory manner with village leaders (n=3–5). The local criteria of determining household wealth included several factors such as livestock ownership, type of roofing material used by households, and quality of assets owned. A total of 244 households took part in the household questionnaire representing 25% of the sampling frame. Four focus group discussions were held (one in each village) with 10–15 discussants, which included males, females and youths belonging to different wealth classes and representing different forest users (such as charcoal producers, honey collectors, etc). 15 key informants were further interviewed. These were village residents who had lived longest in the village, to provide more detailed oral histories on past shocks and coping strategies employed.

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 an inductive grounded theory approach (Strauss and Corbin 1990).

3. Results

3.1. Prevalence of seasonal household food stresses

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. When stratified by study site, the results show that the proportional of households experiencing food stress was higher in Katanino (53.4%) than Mwekera (41.6%). Food shortages were mainly experienced between November and April. Food deficits differed depending on wealth status. There was a significant difference between wealth classes ($\chi^2=28.7$; $p < 0.05$) with poorer households experiencing food shortages often over extended periods, while there was no difference observed as a result of gender of household head ($\chi^2=2.8$; $p > 0.05$). During seasonal food shortages, 45.3% of respondents reported charcoal sales as the main coping strategy, while piecework (35%), remittances (9.4%), sale of mushrooms (5%) and sale of livestock (2%) were also reported. When asked about

what households do during food shortages, one male local key informant in Misaka village said;

“When you run out of food in the household, the axe hits the tree”

3.2. Prevalence and nature of shocks

Households in the study area faced various shocks. In the 2nd 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 (19.7%), 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 2).

The proportion of households experiencing various idiosyncratic shocks was comparable between the two study sites (Fig. 2).

The focus group meetings reported various covariate shocks over the last 30 year period. These were (1) natural shocks such as severe drought in 1991/1992, and 2004/2005 farming seasons and floods 2006/2007, (2) economic shocks in urban areas leading to village in-migration and more competition for natural resources, (3) political changes in 1992, which was followed by changes in economic and agriculture policy that resulted in the abolishment of agricultural subsidies that the majority of rural people relied upon, and (4) human health shocks such as the outbreak of cholera in 1992/1993 which claimed hundreds of lives in Copperbelt province.

3.3. Coping with household income shocks

The results of this study indicate that households used diverse strategies to respond to household income shocks (Fig. 3). The coping strategies employed by the greatest proportion of households were the sale of forest products (33%), followed by piecework¹ (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 (see Fig. 3). Faith based organisations (churches) offer help especially in times of bereavement. When stratified by study site, the use of FPES was comparable between the Katanino (30.6%) and Mwekera sites (35.6%).

According to focus group meetings 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,

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

carrying out piecework and increasing charcoal production. A female interviewee in Kashitu village 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 children and adults”.

The fruits of *Parinari curatellifolia* (Mupundu) were preferred by many people as they were said to be filling.

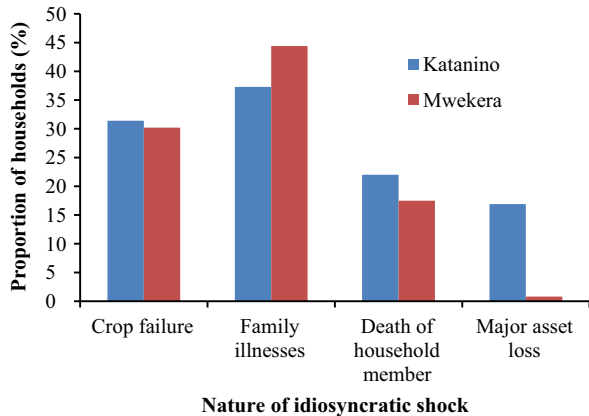


Fig. 2. Proportion of households (%) experiencing various shocks stratified by study sites.

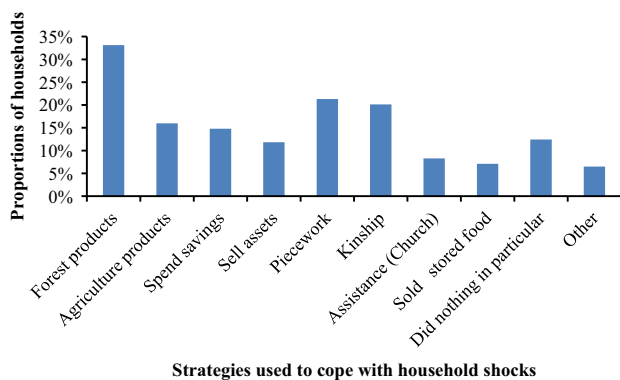


Fig. 3. Proportion of households (%) that employed coping strategies in response to income shocks (n=169).

3.4. Socio-economic determinants of coping strategies

Comparing the coping strategies across wealth classes and gender reveals that a higher proportions of poor and intermediate households used forests to cope with idiosyncratic shocks compared to wealthier households (Table 3). There were no significant differences in the use of FPES by wealth and gender when results were stratified by study site and therefore the data was pooled into one sample to analyse socio-economic determinants of coping strategies.

A significantly higher proportion of poor households ‘did nothing in particular’ in responding to income shocks such as death of livestock. A higher proportion of poor households received assistance from the church. With respect to gender, a larger proportion of male-headed households used forests as a coping strategy. Furthermore, more male-headed households spent their savings. Female head households received more assistance from faith based organisations and through kingship. A significantly higher proportion of male-headed households harvested agricultural produce to cope with shocks.

4. Discussion

4.1. Household food stresses

Rural households in these dryland Miombo woodland regions experience food shortages between November and April. Seasonal food deficits are an inherent feature of rural people’s livelihoods that are dependent on rain-fed agriculture, as reported in Malawi (Kamanga et al., 2009), Zimbabwe and Mozambique (Akinnifesi et al., 2004). In the study area, crop farming is predominately rain-fed and harvested food stocks are usually depleted before the next harvest season, making households vulnerable to food deficits. Households therefore diversify their livelihoods by producing charcoal and undertaking off-farm activities to reduce their vulnerability. Despite studies, reporting households diversifying livelihood strategies in response to seasonal shortages, the role of forests have not been explicitly reported, which may impact rural development and poverty reduction strategies. The results of this study show that charcoal production is the most important strategy used to meet food shortages. Although households consume forest foods during times of household food deficit as reported by earlier studies (Akinnifesi et al., 2004; Chirwa et al., 2008), the foods only supplement income from charcoal production. This therefore shows that the income from charcoal is important to buy food such as maize and that this is more

Table 3
Proportion of households (%) that employed coping strategies in response to shocks.

Coping strategy	Overall (n=169)	Wealth categories			X ²	Significance	Gender of household head		X ²	Significance
		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	> 0.05	35.7	25.6	1.5	> 0.05
Harvested agriculture products	16.0	20.0	9.4	16.1	2.7	> 0.05	19.8	6.9	5.5	< 0.05
Spend savings	14.8	11.8	17.0	19.4	1.3	> 0.05	16.7	9.3	1.4	> 0.05
Piecework	21.3	22.4	24.5	12.9	1.7	> 0.05	20.6	23.3	0.1	> 0.05
Assistance from church	8.3	14.1	1.9	3.2	0.4	> 0.05	5.6	16.3	2.1	> 0.05
Kinship	20.1	18.8	18.9	25.8	0.8	> 0.05	17.5	27.9	2.7	> 0.05
Sell assets	11.8	9.4	17.0	9.7	2.0	> 0.05	12.7	9.3	0.4	> 0.05
Sold stored food	7.1	7.1	3.8	12.9	2.5	> 0.05	8.7	2.3	2.0	> 0.05
Nothing in particular	12.4	18.8	3.8	9.7	7.1	< 0.05	10.3	18.6	2.0	> 0.05

important than consumption of forest foods in times of seasonal food deficits.

4.2. Coping with shocks

Our findings show that FPES are also important for coping with household shocks. A third of households sold FPES to offset costs resulting from household income shocks. Households use diverse strategies to respond to household income shocks, with use of FPES being the most dominant, in contrast to kinship previous studies (e.g. Heemskerk et al., 2004; McSweeney, 2004; Paumgarten and Shackleton, 2011) have reported as dominant. 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. In our study regions there was a higher dependence on forests for coping with income shocks among poor and intermediate households due to their limited financial capacity, making forests an important economic buffer in adverse times and a source of household income diversification (Debela et al., 2012; Pattanayak and Sills, 2001; Vedeld et al., 2007). This matches the findings of a recent study in Uganda that observed that though use of forest products may sometimes be labour intensive (e.g. charcoal production), they provide the only opportunity for poorer households to generate income to cope with shocks (Debela et al., 2012). 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).

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 such as borrowing money from neighbours and friends, and later use forest income to pay off the incurred debt (McSweeney, 2004; Pattanayak and Sills, 2001). According to Paumgarten and Shackleton (2011), poorer households have fewer options for coping with shocks and stresses, and have low agricultural capacity (Debela et al., 2012), and therefore increase the use and sale of forest products, which do not require any capital outlay. This makes forests the “ultimate form of self-insurance” (McSweeney, 2004, p. 17).

4.3. Socio-economic (wealth and gender) determinants of coping strategies

Among poor households, the sale of forest products acts as an economic option 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 South Africa that highlighted that poorer households relied more on kinship than wealthy households (Paumgarten and Shackleton, 2011). This is probably due to the comparatively stronger economy of South Africa and robustness of mining and other industries that allow men from across wealth classes to migrate to work in urban areas and send remittances to their families in 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. Poor households seemed to have low social capital. With respect to gender, the higher proportion of male-headed households engaging in

forest use may be attributed to the fact that charcoal is the most common forest product produced and sold to cope with stresses and shocks and charcoal production is a male dominated activity.

4.4. Charcoal production and implications on FPES

Despite charcoal production being an important coping strategy, it is one of the major causes of forest deforestation leading to biodiversity loss. Earlier studies (e.g. Chidumayo, 1987, 1988) reported charcoal production in Miombo as selectively targeting trees such as *Julbernardia paniculata* and *Isobertinia angolensis*, while trees which do not carbonise well and fruit trees are left as residual trees. The high demand for charcoal, especially in urban areas, has however led to clear-felling in most charcoal production sites. This diminishes the flow of other FPES such as food, medicines, fodder and construction materials. Although Miombo woodlands are able to recover after charcoal production (Kalaba et al., 2013), forest cover overall is declining due to continuous perturbations, with deforestation rates of 250–300,000 ha annually (Zambia Department of Forestry and FAO, 2008). Woodland conversion through charcoal production produces short-term financial incentives for local communities, while in the long-term has negative implications on biodiversity and livelihoods of local communities. The lack of significance differences in the use of FPES in the two study areas regardless of differences in management system seem to suggest that in both study areas local people have similar access to FPES. Despite statutory regulations restricting forest use on Forest Reserves, illegal collection of forest products was rampant due to weak enforcement agencies and the strong pull of the urban market for charcoal and therefore extensive areas of the forest in both study areas are being depleted rapidly.

5. Conclusion

This study provides empirical evidence on the use of FPES as a natural insurance strategy in the rural livelihoods of residents of Miombo woodland systems. It outlines the nature and types of stresses and shocks that household's face and the influence of wealth of households and gender of household head on coping strategies. The study shows that FPES are the most widely used coping strategy for both idiosyncratic shocks and seasonal food stresses. In relative terms, a higher proportion of poor households rely on FPES as a coping strategy due to limited options. A higher proportion of women used kinship and assistance from faith based organizations to cope with shocks. It is clear from the findings of this study that FPES make an important contribution to livelihoods as a natural insurance against stresses and shocks, and therefore deforestation and forest degradation weakens rural people's coping strategies in the event of shocks. It is vitally important that emerging forest management schemes in Miombo woodlands and other tropical woodlands more widely, develop mechanisms to help rural people cope with household shocks and stresses and consequently reduce pressure on forests.

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