Charcoal

the reality

A study of charcoal consumption, trade and production in Malawi

Patrick Kambewa, Bennet Mataya, Killy Sichinga, Todd Johnson

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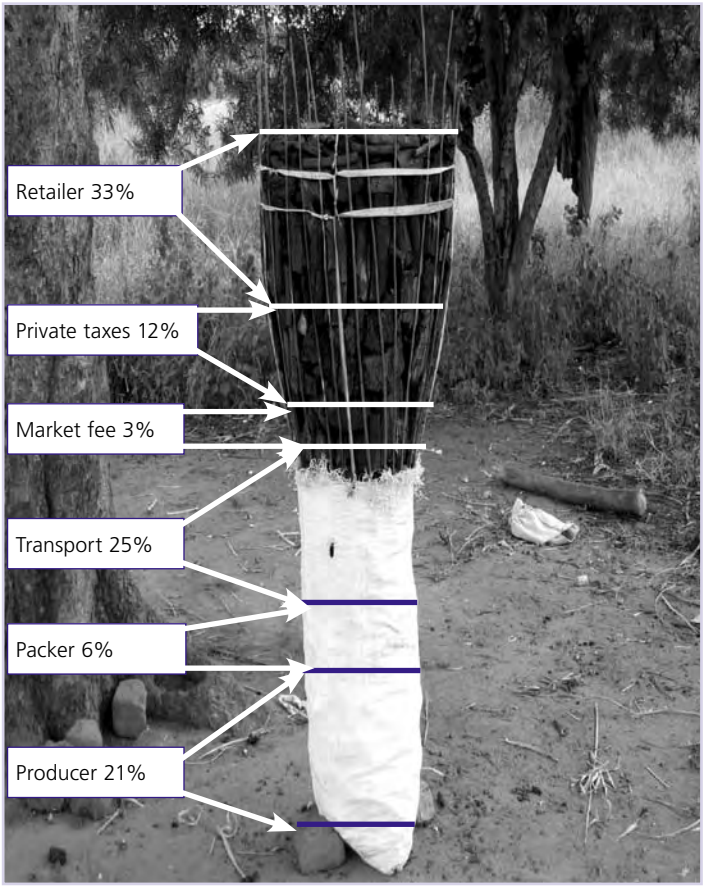

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Acronyms and abbreviations

€	Euro
COMPASS	Community Partnerships for Sustainable Resource Management in Malawi
DFID	Department for International Development (UK)
ESCOM	Electricity Supply Corporation of Malawi
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FGLG	Forest Governance Learning Group
GDP	Gross domestic product
GoM	Government of Malawi
GVH	Group village head
Ha	Hectare
IFMSLP	Improved Forest Management for Sustainable Livelihoods Programme
IIED	International Institute for Environment and Development
Kg.	Kilogramme
Km.	Kilometre
MK	Malawi Kwacha
TA	Traditional authority
UK	United Kingdom
US$	United States dollar
USAID	United States Agency for International Development
VAT	Value added tax
VH	Village head

Preface

The issue of charcoal production and consumption in Malawi seems to be one of those issues that many intelligent and well-intentioned individuals and organizations have tried to resolve at various times over the past several decades. It is perhaps one sign of how complex and challenging an issue charcoal has become to note that none of the previous efforts has succeeded in "solving" the charcoal problem. One reason for these past failures is that technical forestry solutions – or equally unsuccessful National Forest Seasons (i.e., annual tree planting efforts that have not resulted in any noticeable increases in forest cover) – have been used to resolve what fundamentally is not a technical forestry issue at all.

Charcoal is potentially a renewable forest product. But current production methods and distribution modalities in Malawi prevent reinvestment in the next cycle of harvest. Reversing the lack of incentives for reinvestment is a political and economic issue that in a way exemplifies the larger political and economic debates Malawian society is discussing: Do we want to be a market-driven economy governed by a multi-party democracy?

At its core, the "problem" of charcoal is not its existence; it is rather the manner of production. As this study has documented, the charcoal industry is one of the largest in Malawi; if the product was exported, the annual foreign exchange income to the country would fall somewhere between that of tea (Malawi's 2nd-largest export after tobacco) and sugar (3rd-largest in 2006).

As we also document in this study, urban consumers of all socioeconomic strata use charcoal for cooking, heating, and other household needs, including ironing. It is not just a "poor man's fuel" as widely perceived; although the urban poor expend a larger share of total household energy budget on charcoal and would therefore suffer first and hardest if any efforts to control charcoal availability in the urban centres result in price increases.

This is exactly what happened in early 2007 just as this study got underway, when the Department of Forestry collaborated with the Malawi Defence Force to apprehend producers: prices went up and the traders profited more handsomely while the product supply was not noticeably constrained.

The simple fact is that charcoal is a product with a very large domestic market, yet whose production is treated variously as either non-existent or illegal. It was against this backdrop of emotional and very well-intentioned if very poorly-informed arguments for "banning" the 3rd-largest industry in the country that FGLG, COMPASS II, and IFMSLP decided to put solid information on the table so that leaders and the general public could debate the issue openly and vigorously, without the intentional myopia that has stymied the emergence of any real solutions in the past.

In the absence of any genuinely viable alternatives that can operate at commercial scales – despite a variety of interesting hobby-level options supported over the years, ranging from

gelfuel to briquettes of everything from waste paper to rice hulls – charcoal will continue to be produced and consumed in Malawi for many more years. The question that we hope this report stimulates as the core of a lively debate among government officials, parliamentarians, interested parties, and the general public is simple: "*How do we want to produce this product to meet this market demand in a better manner?*"

During the course of this study, many prominent names surfaced of high-level members of the business and political communities in Malawi. We have honoured the request of our respondents by not disclosing these names, and will continue to protect our sources. One reason for doing so is that divulging some of this information could lead to dire consequences for those who spoke openly and honestly. The quality of information gathered could not have been as good if these assurances of anonymity had not been given and were not honoured.

Another reason is that "naming names" is not the mandate of any of the three implementing partners involved in conducting this study. We have no subpoena power or other legal tools with which to conduct proper investigation and evidence gathering that may be used to identify beyond reasonable doubt the large-scale producers and traders who control the charcoal industry, or those in various positions of power who may be protecting them. If we cannot be certain, it would be irresponsible of us to state in this report or any other forum that we think so-and-so is part of the industry.

A third and perhaps most compelling reason is that such a disclosure would divert the purpose of this report – to stimulate an open debate about an economic good whose production system is dysfunctional – toward a personality-driven exercise in character attacks. That kind of discussion would serve no interests other than the narrow ones of a few political opportunists.

It is only when open and honest debate takes place – founded on information rather than supposition and emotion – that real long-term solutions may be found that serve the best interests of the nation. The authors and all involved in conducting this study fervently hope that our efforts lead to just such a productive discussion within the context of an increasingly vibrant market economy within an increasingly mature democracy.

Todd R. Johnson
Senior community based natural resource management specialist and
Chief of Party, COMPASS II

Executive summary

Natural resource management experts, government and its development partners have debated the charcoal trade for some time, but until now, there has been little solid evidence on the scale and scope of the subject. Lacking information on the true value of the charcoal industry, policy makers have had little choice but to develop policies based on impressions rather than facts. Since charcoal has very high potential to be a renewable resource, this study is intended to stimulate and encourage an informed charcoal debate, based on a quantified picture of the industry as a whole.

The study aimed to do the following:

- Determine the scale and economic value of the charcoal industry in Malawi;
- Identify the driving forces behind charcoal production, understand the key players and the value chain, and find out where and how charcoal is produced, marketed and consumed; and
- Provide a sound basis for policy development that reduces the negative impacts of the industry while encouraging the positive attributes.

The purpose of this document is to report on results of a comprehensive study of charcoal in Malawi, consisting of three components:

- a statistically robust household consumption survey to quantify the volume and values of use in main urban centres, stratified by socioeconomic status and population density within these centres;
- a detailed description of the charcoal value chain, including retail and wholesale vendors, traders and transporters, financiers and producers, and the value addition accruing to each link (including value accruing to rent seekers involved in the trade); and
- a detailed description of the current locations, species, methods, and volumes of production.

Key findings from the urban energy survey

The urban energy survey quantifies (for the first time) the volumes and value of charcoal used in the main urban areas of Malawi. The study was not intended to provide national estimates; however, the four largest urban centres do account for roughly 90% of the charcoal used in Malawi[1]. A comprehensive survey of consumer behaviour and energy spending patterns of almost 4,000 urban households in the four largest urban centres of Blantyre, Lilongwe, Mzuzu and Zomba produced the following information:

The estimated *value* of the charcoal industry in the four largest urban areas of Malawi is about **MK5.78 billion** (roughly US $41.3 million or €30.4 million). This figure is slightly less than the value of Malawi's tea industry, and accounts for about 0.5% of the country's GDP.

The estimated total *volume* of charcoal consumed in the four largest urban areas of Malawi is **6.08 million standard bags per year.**[2]

1. The 1998 Malawi Population and Housing Census reports that over 90% of households who use charcoal as the main source of energy live in the four largest urban centres.
2. A standard bag is a 50 kg maize sack. It contains about 38 kg of charcoal, so 6.08 million bags equal about 231,177 metric tons.

Charcoal is a vital energy source for the urban poor. Low-income households have a higher per capita charcoal consumption, and with charcoal and/or fuelwood accounting for three-quarters of their total household energy expenditure.

Electricity is the main source of energy among more affluent households (those in low- and medium-density areas); but these households also use charcoal in significant amounts: the difference in expenditure on charcoal between low-income and high-income households was small.

Low-income households pay a higher price per kilo for charcoal because they buy it in smaller packages priced more appropriately for their spending power.

Key findings from the charcoal value chain analysis

Value chain analysis examines the sequence of productive (i.e., value adding) activities leading to end-use. Unlike other market analysis tools, value chain analysis explores the structure, conduct, and performance of a market including its dynamics. Charcoal is a highly traded commodity produced mainly for urban consumption. The analysis therefore covers who the actors are at various stages, what costs they incur at each transaction node, what the opportunities are at each node, and what services are provided as charcoal moves from production to consumption. Analysing the charcoal value chain provided an understanding of the economics of the industry and how it functions, as follows:

- The charcoal markets are well ordered in spite of it being an unlicensed product. Each urban area had well-defined markets and sources of charcoal.
- The charcoal industry provides significant employment in the various activities outlined above: it is estimated that **92,800 people owe their livelihoods to charcoal**. This figure includes 46,500 producers, 12,500 bicycle transporters, 300 other transporters and 33,500 traders.
- Most of Blantyre's charcoal comes from the Neno/Mwanza area, with smaller amounts from Mulanje, Chikwawa and Zomba. In Lilongwe, the main sources are Thuma and Dzalanyama Forest Reserves. Most of Mzuzu's charcoal comes from Kaning'ina Forest Reserve and Choma. In Zomba, charcoal is sourced primarily from the Malosa/Domasi area and Chingale.
- Charcoal producers can be categorised into small-scale (less than 30 bags per month), medium-scale (30-100 bags per month), and large-scale producers. Many small-scale producers operate at subsistence level and charcoal production provides an opportunity to generate income.
- There are about **338 large-scale producers** who are fully-fledged, well-financed businesses producing up to 500 bags per month, and accounting for 38% of the total charcoal coming onto the market. Small-scale charcoal burners produce 35% and medium-scale 27% of the total charcoal.
- There may be as many as 40,000 kilns operating each year: this means that on any given day, there will be approximately 109 kilns active in Malawi.
- The main value-adding activities in the charcoal industry are production, packaging and transport. The main actors in the chain are producers, wholesalers and retailers. Each urban

area has a number of channels through which charcoal is sold. The simplest are from producers directly to consumers; other channels include an intermediary; and some channels flow through wholesalers to the retail market before reaching consumers. The charcoal market in Blantyre seems to be more sophisticated than in the other areas, with more wholesale markets.

- Values accruing to producers ranged from 20% to 33% of retail price, while transporters earn 20% to 25% of final value. Retailers obtain 25% to 33% of final selling price. City assemblies collect market fees, despite charcoal being an unlicensed product.

- As charcoal is moved from point of production to the markets, traders incur other costs too, some of which amount to **private taxation by public officials**. These officials include people on duty at roadblocks, Traffic Police and the Police 997 Emergency Service, who often demand payments in cash or in kind before they will allow charcoal traders to pass. Amounts range from MK500 to MK10,000 per conveyor, and this study has found that such **bribes account for 12-20% of the final price of charcoal**.

Key findings from the charcoal production analysis

The production analysis examined the impact of the charcoal industry on forests. The study team attempted to estimate, based on field observations and literature reviews, the total volume of wood consumed each year to produce charcoal, as well as the area of land represented by that volume. Finally, an estimate of the changes in forest structure and composition were made, with the following key results:

- The 6.08 million standard bags of charcoal estimated to be used in the four largest urban areas require **1.4 million cubic metres** of wood. This in turn represents a volume equivalent to about **15,000 hectares of forestland** cut per year.

- Nearly **60% of the charcoal is produced in Forest Reserves and National Parks**; almost **40% comes from customary land**; and 2% of charcoal enters Malawi from Mozambique.

- Efforts to protect the forests are failing, as shown by continued charcoal production. In all areas visited, traditional leaders are aware of unlicensed charcoal production in their areas but either participate in or ignore this economic activity.

- Charcoal making is altering the species composition of forests. Species that are preferred for making charcoal are removed, leaving woodlands of lower quality. It is likely that some sites will become other forest types or savannah grasslands, as is happening on the Neno Escarpment and Thuma West Forest Reserve.

- In the sites visited, all charcoal production is done using traditional earth kilns, a technology that is known to be wasteful and inefficient.

Conclusions

- The charcoal industry is a multi-billion kwacha industry, with households spending at least three times as much on charcoal as they spend on electricity. If the charcoal trade was regulated and taxed, Government could raise substantial revenues; using the estimated

industry worth of MK5.78 billion per year, **VAT alone could generate more than MK1 billion annually** in revenues.

- Charcoal is produced mainly for the urban areas, and it is unlikely that urban consumers can manage without charcoal as a source of energy in current conditions. Urban poor, who spend a larger proportion of their household income on charcoal and who have no other affordable energy options, particularly feel fluctuations in the price of charcoal. Thus, solutions to the "charcoal problem" need to target not simply the producer but all agents along the chain. Subsidizing alternative sources of energy such as electricity and paraffin and equipment for cooking with these fuels may help people move away from current heavy reliance on charcoal.

- Charcoal is very widely used by all socioeconomic strata in urban areas. The large urban centres of Blantyre and Lilongwe use more charcoal than Mzuzu and Zomba, due to the larger populations in the former two cities. Although households that are more affluent use electricity as well as charcoal, they nonetheless use charcoal at levels comparable to the low-income households.

- The urban areas studied have well-known and well-ordered charcoal markets, despite charcoal being an unlicensed product. Production sites and charcoal dealers are well known, and the industry provides employment for almost 93,000 people. Unregulated and untaxed charcoal production cannot be managed and instead provides incentives to engage in highly unsustainable production methods to meet the large urban consumer demand.

- There are many bicycle transporters, suggesting that the charcoal business is an important livelihood activity for poor people, especially those in rural and peri-urban areas. However, there is also evidence that many relatively better-off agents also derive their livelihood from charcoal. These include large-scale producers, wholesalers, and large-scale retailers. The rent seeking by public officials also suggests that the charcoal business is an important economic activity, with private taxation of charcoal traders diverting MK1 billion per year from Government.

- At the retail markets, although charcoal is unlicensed, market officials from the Ministry of Local Government charge charcoal sellers the standard market levy. Thus, one ministry of government declares production illegal while another allows traders to sell it within its premises and generates revenue from the trade.

- Current efforts to discourage charcoal making are expensive and ineffective, so charcoal making is likely to continue. However, areas of indigenous woodland could be managed on a coppice system, ensuring sustainability for the charcoal industry. Frameworks for forest management such the Forest Act, the National Forest Policy, and Standards and Guidelines for Participatory Forestry Management are in place, all of which are intended to promote good forest practice throughout Malawi.

- A companion piece of work to this study was the formation of a task force that identified and examined various options. Readers of this document are strongly encouraged also to read Charcoal: The Options.

Background and introduction

One of the most important – and contentious – products in the forest sector in Malawi is charcoal (FGLG, 2006). Recent estimates suggest that 90% of urban families rely on biomass energy, dominated in the main urban centres by charcoal (GoM, 1998). The charcoal trade is perhaps Malawi's most substantial, pro-poor forest industry involving thousands of rural producers, bicycle transporters, and roadside or urban vendors. However, despite this importance, the industry's value is not well understood. The purpose of this study is to provide a comprehensive assessment of charcoal consumption, trade and production in Malawi with the following aims:

- To determine the scale, volume and economic value of the charcoal industry in Malawi;
- To ascertain the driving forces behind charcoal production by characterizing the value chain in order to establish a clear understanding of the key players and also understand where and how charcoal is produced, marketed and consumed;
- To provide a sound basis for reviewing policies, enforcement capabilities and other actions that will reduce the negative impacts of the charcoal industry while encouraging the positive attributes.

Among natural-resource-degrading activities, charcoal production is prominent. It is a vilified industry, widely blamed for deforestation, loss of biodiversity, reduced water catchment utility, atmospheric pollution, and environmental degradation. Recent advocacy campaigns to ban charcoal production have received media attention and placed charcoal on the political agenda; a few months ago, the Department of Forestry and the Malawi Defence Force signed a memorandum of understanding in which the latter are supposed to enforce such a ban, jailing anyone caught making charcoal.

The scenario in Malawi contrasts with the latest global review of biomass fuels (Arnold *et al.*, 2006), which concludes the following:

- Biomass fuels are seldom a primary source of forest removal;
- Large-scale interventions are seldom needed to maintain biomass sources;
- Rapidly increasing urban demands for charcoal may cause land cover transitions in the vicinity of production sites, usually concentrated along roads and around villages; and
- Land cover transitions are often not caused by total charcoal supply being out of balance with wood stocks; but are rather due to **failures to provide incentives to manage wood production in a manner that allows regeneration in and around charcoal producing areas.**

Within Malawi, surprisingly little accurate information is available upon which decision makers can deliberate and draw conclusions. The charcoal debate, to the extent that there is a debate, appears founded on emotion and supposition rather than solid data.

The discussion of charcoal has, in the absence of accurate and current information, led to three schools of thought. One advocates strict and severe enforcement of law to halt an "illegal"[3] activity that is blamed for environmental degradation countrywide. A second advocates shifting urban energy supply to "alternative" sources which are either untested or too expensive for most urban households. A third quietly advocates maintaining the status quo because the rural poor have no other source of income and the urban poor have no other source of energy.

Against this backdrop, government agencies responsible for forest or environmental management, energy provision, or law enforcement are stymied into inertia and inaction. In effect, the status quo remains in force by default. Charcoal producers continue to endure public frustration with deforestation, yet if trends from other countries hold true in Malawi[4], they actually earn less than others in the value chain do.

The Forest Governance Learning Group (FGLG; an informal alliance of organizations and individuals interested in forest governance issues) approached COMPASS II in April 2006 to develop ways to improve the status quo. FGLG, through its consultations with interested parties, became convinced of the following:

- Too little information is publicly available on the extent of the charcoal trade, who it involves, what financial or legislative incentives and disincentives are involved along the value chain, and what type of incentives might be necessary to shift practice towards a more sustainable model;

- Imposing an unenforceable ban without finding simple ways for communities to comply is counterproductive.

At the same time, the Government of Malawi-European Union Improved Forest Management and Sustainable Livelihoods Programme (IFMSLP), as well as COMPASS II, were searching individually and jointly for ways to encourage a positive, information-based dialogue on charcoal among senior decision-makers. The aim is to transform the charcoal trade from a legally unclear, ecologically unsustainable, and socially disrupting black-market industry into a regulated, managed, and productive contributor to public revenues. A further challenge was for it to be conducted in a more sustainable and pro-poor manner.

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3. The Forest Act of 1996 does not prohibit charcoal production altogether; it prohibits production without a licence. To date, no licences are known to have been issued, so the state currently earns no revenue from a nearly MK6 billion industry.

4. For example, a DFID project in Kenya concluded that "The genesis of cycles of unsustainable production begins with the government proclaiming bans without giving alternatives thereby driving the business underground and making it a nest for corruption as the demand continue (sic) to drive the production. As a result of the restrictions, no long-term investments are made into the industry and therefore it remains unsustainable." Energy for Sustainable Development in Africa. 2006. Completion Report: Enhancement of policy and institutional framework for sustainable charcoal production in Kenya. Project no. KEN/2003/058.

The result of these discussions was an agreement to conduct this study jointly. Each organization agreed to sponsor the portion that best matched its financial and human resources. COMPASS II agreed, with USAID/Malawi approval, to contribute three specialists: in Socioeconomics & Trade, Natural Resources Management, and in Monitoring and Evaluation (a statistician). The last of these had conducted preliminary studies of the charcoal industry in 2005.

The purpose of this assignment was to conduct a comprehensive study of charcoal in Malawi, consisting of:

- a statistically robust household consumption survey to quantify the volume and values of charcoal use in main urban centres, stratified by socioeconomic status and population density within these centres;

- a detailed description of the charcoal value chain, including retail and wholesale vendors, traders and transporters, financiers and producers, and the value addition accruing to each link (including value accruing to rent seekers involved in the trade); and

- a detailed description of the current locations, species, methods, and volumes of production.

2 Methodology, data collection and analysis

The three components of the study were undertaken in sequence: first, the household survey of energy consumption; second the charcoal value chain analysis; and finally the charcoal production survey. In this way, it was possible to follow the charcoal industry upstream from consumers, along the market chain and back to the producers.

All fieldwork was conducted from January to March 2007 in Malawi's major urban areas – Blantyre City, Lilongwe City, Mzuzu City and the Municipality of Zomba – and their surroundings. The study team engaged by COMPASS II worked under the direction of FGLG members and advisors, technical staff and advisors of IFMSLP, with funding from USAID's COMPASS II project, FGLG and the EU. The methodologies used in these three components are described below.

2.1 Urban household energy survey

This survey was led by the statistician, and conducted with the help of a team of research assistants. Each site had its own data collection team, plus a data entry clerk and a supervisor.

At each of the four urban sites, respondents were drawn from five location types chosen to cover all socio-economic strata. A total of 3,945 households were included in the survey; Table 1 below shows the number and percentage of respondents in each site by housing type. (See Annex II for more details.)

Table 1. Strata of respondents by site

	Blantyre City		Lilongwe City		Mzuzu City		Municipality of Zomba	
Residential type	No.	%	No.	%	No.	%	No.	%
Low density	177	12	168	12	69	12	88	18
Medium density	277	19	168	12	101	17	81	17
High density	356	24	286	20	63	11	112	23
Unplanned area	402	28	526	38	244	41	127	26
Shanty area	244	17	253	18	122	20	81	17
Total no. of households	**1,456**	**100%**	**1,401**	**100%**	**599**	**100%**	**489**	**100%**

A detailed questionnaire (see Annex I) was used to collect data from individual households. Questions focused on energy use and expenditure, and covered electricity, charcoal, firewood and other energy sources. The data were analysed in various ways to enable comparisons to be made between sites and location types. Projected population figures were also used to weight the data and thus estimate the energy consumption and expenditure of each site and residential type.

2.2 Charcoal value chain survey

The value chain analysis team was led by the socioeconomist and trade specialist who worked with one selected research assistant per site. Information gathered in the urban energy survey was used to identify the main charcoal markets in the four urban centres. These markets were visited and charcoal traders there were interviewed to trace where the charcoal on sale was produced and how value was added along the entire chain.

The research team visited retail and wholesale markets and production sites. They also looked at how charcoal is transported. At each place, questions focused on prices, value-adding activities at that level, and costs incurred. The data were then analyzed to indicate profitability levels along the chain.

2.3 Charcoal production survey

This final part of the study was led by the natural resource management specialist, with selected research assistants. It was directed by findings from the preceding two surveys, which enabled the team to identify with confidence the main charcoal producing areas for the four urban sites.

The areas examined in this component of the study were producing more than 50% of the charcoal estimated from the urban consumption survey. To determine the scale of charcoal production, the sizes of all observed active kilns were measured. Active kilns were those where wood was stacked ready to cover with earth, or where carbonization was in process. The numbers of old kiln sites were also recorded.

The survey assessed species diversity within each charcoal producing area (or former production area) by identifying all species in a determined compass direction (wandering quarter method) and recording their diameters and distances from each other. The location of area was also recorded using GIS.

Charcoal bags

Charcoal is sold in maize sacks whose capacity is increased by a woven extension. Throughout this study, we refer to 'standard' and 'large' bags.

Standard bag – contains roughly 38*kg of charcoal (50kg maize)

Large bag – contains 50-60*kg of charcoal (70kg or 90kg maize)

*Exact weights depend on species of wood used.

3 Urban energy consumption

In Malawi, the main sources of energy in the urban areas are electricity, firewood and charcoal. This section presents findings from the urban energy survey, in which almost 4,000 households were asked about their energy use. The questionnaire began by asking respondents the main energy sources for cooking and lighting, and went on to find out how much is spent on different types of fuel. It also asked about the proportion of energy derived from different fuel sources.

3.1 Energy consumption

According to Electricity Supply Corporation of Malawi (ESCOM) records, about 93,000 households in the urban areas of Blantyre, Lilongwe, Mzuzu and Zomba are connected to the national grid[5]. This is less than 30% of the estimated 322,000[6] urban households, and implies that more than two-thirds of households have no choice other than to use biomass fuels as their primarily energy source.

For cooking, fuel options other than electricity were said to be mainly charcoal and firewood. 85% of the respondents used charcoal to some extent, showing that charcoal is used by rich and poor alike. Overall, 42% of all respondents said that charcoal was their main source of energy for cooking, with higher figures in unplanned and shanty areas, where more than half of all households (58% and 56%, respectively) used charcoal as the main source of energy. Thus, dependence on charcoal as a cooking fuel is related to poverty.

Overall, 38% said electricity was the main source of energy for cooking, but in the more affluent (low-density) areas 83% of households cooked mainly with electricity, using charcoal as an alternative (for example during power cuts). In medium-density areas, 68% of households said they cooked mainly with electricity. 19% overall said firewood was the main energy source for cooking. Very few cooked on gas or paraffin.

Table 2 shows the average monthly expenditure on electricity, charcoal and firewood in each of the four cities surveyed, by housing type within each city. We should note that averages presented below represent the total reported monthly expenditure by all households in that housing type in that city, divided by the total number of surveyed households in that housing type in that city (cf. Table 1). It is not the average expenditure by only the households reporting usage of a particular fuel. For example, few respondents in low density areas of Blantyre indicated firewood as their fuel source, therefore the average spend is low.

Households in the unplanned and shanty areas use firewood as well, reducing both their electricity (for those connected) and charcoal expenditures. Households in the high-density, unplanned and shanty areas used more charcoal per head than those in the low- and medium-density areas (see Figure 1 below). Added together, the four main urban areas consume a volume of charcoal equivalent to 6.08 million standard bags.

5. This excludes illegal connections, the number of which is unknown.
6. According to the 1998 Malawi Population and Housing Census, which estimated a minimum population growth rate of 2%, the estimated number of urban households in 2007 is 321,956.

Table 2. Average monthly expenditure (MK) on primary forms of energy by site and household type

Housing type	Energy type	Blantyre		Lilongwe		Zomba		Mzuzu		Average across cities
		MK	%	MK	%	MK	%	MK	%	
Low Density	Electricity	5,048	84.88	3,162	71.40	3,042	68.29	1,980	68.67	3,298.58
	Charcoal	805	13.54	720	16.26	654	14.68	773	26.81	719.28
	Firewood	94	1.58	546	12.34	759	17.03	130	4.52	330.73
Subtotal		**5,947**	**100%**	**4,428**	**100%**	**4,455**	**100%**	**2,883**	**100%**	**4,348.59**
Medium Density	Electricity	2,160	64.15	2,776	68.64	1,847	51.62	1,346	50.27	2,012.46
	Charcoal	1,127	33.48	916	22.65	913	25.52	1,013	37.82	979.89
	Firewood	80	2.37	352	8.71	818	22.86	319	11.91	284.75
Subtotal		**3,367**	**100%**	**4,044**	**100%**	**3,578**	**100%**	**2,678**	**100%**	**3,277.10**
High Density	Electricity	1,567	49.15	1,392	35.92	1,278	42.11	1,586	62.23	1,401.97
	Charcoal	1,383	43.38	1,460	37.70	838	27.61	819	32.14	1,125.28
	Firewood	238	7.47	1,022	26.38	919	30.28	143	5.63	532.92
Subtotal		**3,188**	**100%**	**3,874**	**100%**	**3,035**	**100%**	**2,548**	**100%**	**3,060.17**
Unplanned	Electricity	691	31.82	872	27.02	1,079	31.24	673	28.86	763.10
	Charcoal	1,329	61.19	1,402	43.44	1,175	34.01	1,167	50.02	1,254.33
	Firewood	152	6.99	953	29.54	1,200	34.75	493	21.12	603.37
Subtotal		**2,172**	**100%**	**3,227**	**100%**	**3,454**	**100%**	**2,333**	**100%**	**2,620.80**
Shanty	Electricity	395	19.69	312	12.57	381	18.90	657	29.05	410.33
	Charcoal	1,387	69.16	1,028	41.45	850	42.13	1,047	46.27	1,079.12
	Firewood	224	11.15	1,140	45.98	787	38.97	559	24.68	597.78
Subtotal		**2,006**	**100%**	**2,480**	**100%**	**2,018**	**100%**	**2,263**	**100%**	**2,087.23**

3.2 Spending on charcoal

Each household in the survey was asked how much charcoal was used, and its cost, on a daily, weekly and monthly basis. These figures were then converted to monthly values, and then recorded per capita and per household. The monthly per capita or per household values were later converted to annual per capita and household consumption.

When monthly expenditure on charcoal and electricity was extrapolated to overall population for each urban area (Table 3), it emerged that in all the sites, households spend more on charcoal than electricity. Overall, about three-quarters of monthly energy costs are on charcoal. This leads to an estimated annual expenditure of MK5.8 billion, more than 3.5 times the MK 1.6 billion that households pay to ESCOM annually.

Figure 1. Average per capita annual charcoal consumption by residential type

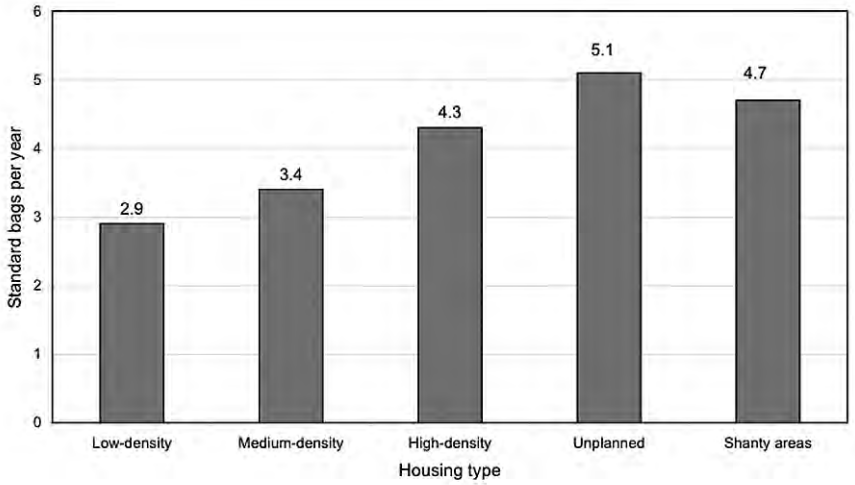


Table 3. Estimated total annual spending on charcoal and electricity by site

Location	Annual expenditure on charcoal (MK)	Annual expenditure on electricity (MK)*
Blantyre	2,330m	713m
Lilongwe	2,789m	717m
Mzuzu	385m	106m
Zomba	292m	86m
Total	5,780m	1,622m

*Source: ESCOM 2007

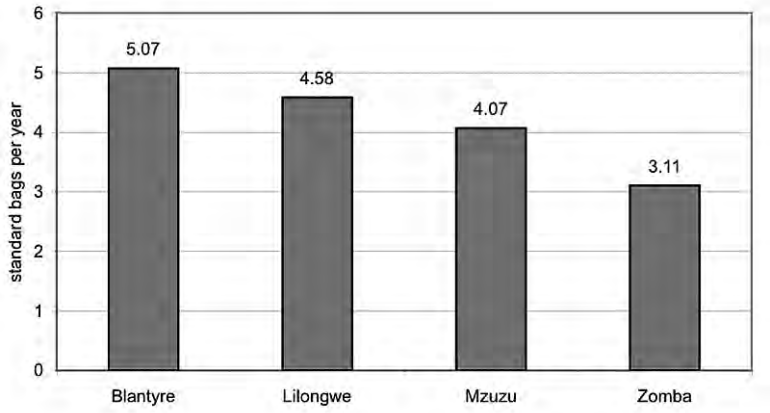
The households in the low- and medium-density areas spent more on electricity than on charcoal compared to less affluent households. However, there is little difference in charcoal expenditure between residential types. Low- and medium-density households, for example, spend an average of MK850 (just over $6) per month on charcoal, while households in high-density, unplanned and shanty areas spend MK1,150 (about $8). The crucial distinction is the proportion of household income that this amount represents (Table 4).

Households in low-density areas generally pay a lower price per bag (MK820, or just under $6) than those in high-density areas (who pay the equivalent of MK1,070 – more than $7.50 – per bag), mainly because the former can afford to buy in bulk. Less affluent households buy in small packages, which are more expensive for a given volume of charcoal.

Table 4. Percentage of household income spent on different fuels by housing type			
Residential type	Charcoal	Electricity	Firewood
Low-density	1.0	3.6	3.3
Medium-density	2.2	4.4	3.6
High-density	3.8	4.8	6.2
Unplanned	7.4	7.8	8.3
Shanty areas	11.4	1.0	11.3

The amount of charcoal used per month was estimated for each site. Results show that people in Blantyre and Lilongwe use more per capita than Mzuzu and Zomba (Figure 2).

Figure 2. Average annual per capita charcoal consumption by urban area



3.3 Concluding remarks on urban energy use

Charcoal is commonly used in all the four sites, with households spending at more than thrice as much on charcoal as they spend on electricity. The estimated value of the charcoal industry in the four largest urban areas of Malawi is MK5.78 billion (roughly US $41.3 million or €30.4 million). It is also estimated that the four largest urban areas of Malawi consume about 6.08 million standard bags per year.

The urban poor are particularly dependent on charcoal for cooking, and currently have few affordable alternatives. They spend a large proportion of their household budget on charcoal, partly because they buy charcoal in smaller packages and therefore pay a higher price per kilo. Low-income households also use more biomass energy per head, with charcoal and/or fuelwood accounting for 70-80% of total household energy budget.

Although households in the high-income categories spend considerably less on charcoal than they do on electricity, they nonetheless use charcoal at comparable levels to the low-income households. The difference in spending on charcoal between low-income and high-income households was relatively small.

4 The charcoal value chain

Value chain analysis examines the sequence of productive (i.e., value adding) activities leading to end-use. Unlike other market analysis tools, value chain analysis explores the structure, conduct, and performance of a market including its dynamics. Charcoal is a highly traded commodity produced mainly for urban consumption. The analysis therefore covers (1) who the actors are at various stages, (2) what costs they incur at each transaction node, (3) what the opportunities are at each node, and (4) what services are provided as charcoal moves from production to consumption.

The main objective of the value chain analysis was to understand the various channels traders use to move charcoal from production sites to the consumer. Although the research began at household level and moved upstream, the results presented here start at the production sites. Analysing the charcoal value chain provided an understanding of the economics of the industry and how it functions.

4.1 Charcoal production areas

Responses from charcoal traders and others involved in the industry enabled the study team to identify the major production sites for the urban areas under discussion. It emerged that charcoal is being produced long distances from where it is eventually consumed, as improvements to the road network have reduced transport costs.

Table 5. Sources of charcoal for major urban areas

Urban area	Major sources of charcoal	Minor sources of charcoal
Blantyre	Neno and Mwanza districts	Chikwawa, Mulanje and Zomba districts, and Mozambique
Lilongwe	Thuma East Forest Reserve, Nkhoma, Thuma West Forest Reserve, Dzalanyama Forest Reserve	
Mzuzu	Choma customary land, Kaning'ina Forest Reserve, Lusangazi Forest Station	Nkhata Bay district, along the Rumphi road, Chikangawa forest
Zomba	Malosa/Domasi area, Chingale area	Mayaka, Ulumba

In Blantyre, it was estimated that 60% of the charcoal comes from other districts, as the area immediately around the city has already been depleted. Neno and Mwanza districts are northwest of Blantyre, the nearest point being 60km along the M1 highway. The train from Balaka also brings in charcoal, which is off-loaded at Limbe Station. While it was sometimes difficult to identify precise locations where charcoal is produced, Neno and Mwanza districts had well-defined areas, which included the Neno Hills and areas along the Lisungwi River.

Lilongwe's charcoal mainly comes from four major sites, the furthest being about 80km away. Charcoal from Thuma East was transported mainly by vehicle, as the journey is uphill.

From Thuma West, there are more bicycles involved, as this journey is largely downhill. In Dzalanyama, traders use both motor vehicles and bicycles. The charcoal from Dzalanyama was also reported to be coming from the Mozambican side, but aerial reconnaissance of Dzalanyama contradicts this assertion[7].

In Mzuzu, charcoal found in the city is from forest on Choma customary land, Kaning'ina Forest Reserve and Lusangazi Forest Station. Traders on both bicycles and vehicles transport the charcoal to the city. Other important areas in charcoal production for Mzuzu are Nkhata Bay district and along the Rumphi road and Chikangawa forest[8].

Zomba has two main large charcoal producing areas, both on the slopes of Zomba Mountain. Although Chingale is further away from the town (about 25km), it is an easier journey for transporters because the Liwonde-Zomba road (M3) is good tarmac. The road from Malosa/ Domasi is steep.

4.2 Producing charcoal

Charcoal is produced throughout the year, although there are seasonal fluctuations. It is at its highest during the rainy season, for various reasons:

- More people in urban areas need charcoal during the rains, as this is the period when electricity power cuts force people to look for alternative sources of energy. Charcoal is favoured for domestic use, as it is a cleaner source of energy than firewood.
- Households that usually use firewood find it less useful when it is wet, so they turn to charcoal instead.
- The rainy season is followed by colder weather, when charcoal is burned to heat houses.
- During the rains, households may turn to charcoal production as a coping mechanism against food insecurity: demand is high and prices are at their best.

The value-adding activities at the production sites are the conversion of trees and labour into charcoal, and packaging. The packaging is done either by the producers or by buyers themselves. In the production sites serving Blantyre, packaging appeared to be the responsibility of the buyers, who hire their own labour to pack the charcoal. In the other areas, the producer packages the charcoal.

4.3 Adding value from production site to market

The major value-adding activity is transport, as there is little storage of charcoal, perhaps because of its unlicensed status. This sub-section presents the actors and the activities involved here.

7. Bunderson, personal communication
8. There is an area called Malivenji in Chikangawa forest where charcoal is also produced. The researchers suspect that the name is an equivalent of revenge based on history, i.e. after some people were laid off, they set fires on the forest as revenge.

4.3.1 Actors along the value chain

Depending upon the route followed by charcoal from producer to consumer, various actors are involved, including transporters, wholesalers and retailers. Each site has different and sometime complex channels: the Blantyre model is shown in Figure 3 below for illustration.

A simple summary of channels:

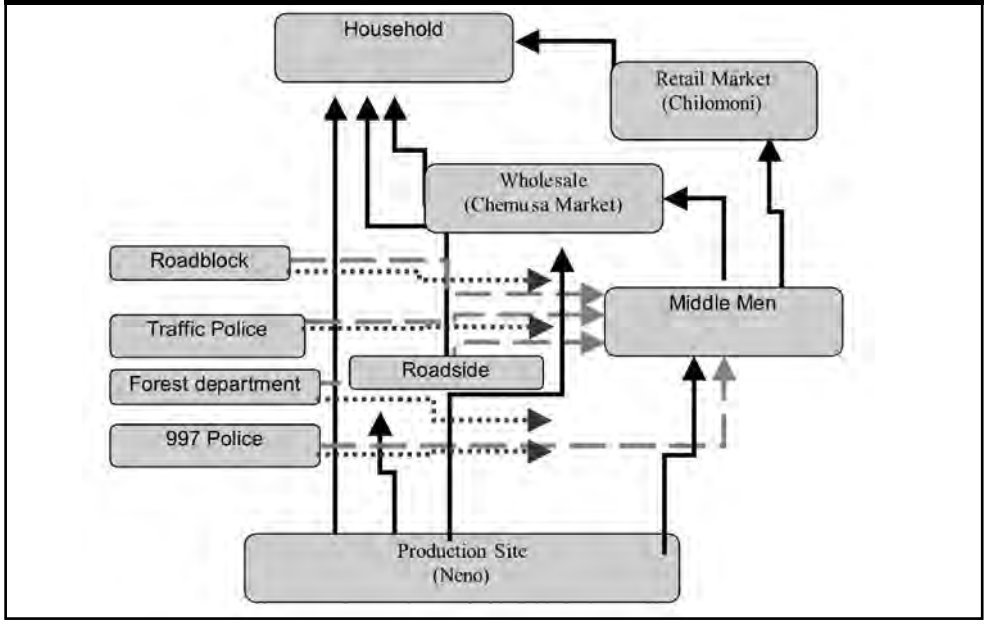
- Producer to consumer: a small-scale producer takes the charcoal directly to the consumer. The producer may have well-established customers or may be an itinerant trader, selling to whoever wishes to buy.

- Producer to buyer to consumer: a buyer purchases the charcoal from the producer and takes it directly to consumers' homes.

- Producer to primary buyer to secondary buyer to consumer: a more complex option in which there are both wholesale and retail markets. This is common in Blantyre and Lilongwe where there were well-established wholesale markets, especially in high-density, shanty and unplanned areas.

Transport channels can be straightforward or more complex, an example of the latter being from Neno to Blantyre City. Charcoal from Neno is transported across the Shire River (where there is a roadblock), through another roadblock near Lirangwe for the Malawi Revenue Authority and, at the Blantyre City boundary, is subject to the threat of the Police 997 Emergency Service before reaching a market.

Figure 3. Marketing channels for charcoal (Blantyre model)



4.3.2 Packaging and transport to primary market

Charcoal trader transporting charcoal from Thuma West Forest Reserve to Lilongwe

Charcoal is packaged in a distinctive way, using second-hand maize sacks and fan palm leaves (Borassus spp) or twine ropes. A standard bag would have contained 50kg of maize; a large bag 70kg or 90kg of maize. The palm leaves or twine is used to increase the capacity of the bag by constructing a woven top known as head of the bag or the mutu. A standard bag will contain about 38kg of charcoal; a large bag from 50kg to 60kg, depending on the species of tree used. The mutu generally contains larger bricks of charcoal than the rest of the bag, in order to attract buyers. In Blantyre, the packing cost is MK30 per bag.

The person who is going to sell at the next stage takes responsibility for transporting the charcoal from the production site. The most common forms of transport observed are bicycles and trucks, but in remote areas ox-carts and head loading are also used. Bicycles are commonly seen during the day, but motorized vehicles transport charcoal mainly by night. Charcoal is transported either directly to the next market or to the roadside to await buyers.

Bicycle transporters are also involved in repacking the charcoal: it was common to find them purchasing two large bags and repacking the charcoal into three standard bags for resale. The number of bags that can be carried on a bicycle depends on the terrain – three bags are common, but on the steep slopes of Chingale, a bicycle can carry only one. In Dzalanyama, cyclists engaged other people to help them cross bridges or surmount very steep slopes, paying them MK100 for the trip.

Traders tend to sell at the nearest port of entry into an urban centre, because there is always the risk that the charcoal will be confiscated en route. In Blantyre, charcoal from Neno and Mwanza goes mainly to Chemusa, Ndirande and Mondoni markets. Charcoal from Mulanje dominates Bangwe and Railways markets. Charcoal from Zomba dominates Kachere and Railways markets. Charcoal from Nkhata Bay is mainly brought into the city by private vehicle owners who buy charcoal for their own use.

In Lilongwe, charcoal from Thuma East is dominant in the northern part of the city such as Area 25 market, Area 18 market, Nchesi market and Chilinde location. Charcoal from Thuma West is found mostly in Area 23 market. Charcoal from Dzalanyama is mostly dominant in Chinsapo area.

In Zomba, charcoal from Malosa and Domasi areas dominates the north of the town (Chinamwali, Chirunga, Naizi and Mulunguzi locations) while charcoal from Chingale is found in the south (Chiyimilire market at the central market, Mpondabwino and Tsazi).

Wholesale market at Nchesi

4.3.3 Packaging at secondary markets

At retail markets, charcoal is sold in small units, the most common unit in all the four sites being a small plastic bag. Traders either repack the charcoal into smaller plastic bags or make small piles (equivalent in volume to the plastic bags). Sellers again put small pieces of charcoal at the bottom and the larger pieces on top to attract buyers.

The selling price depends on the market: in Mzuzu, Zomba and some parts of Lilongwe and Blantyre, the price is MK20, but the same packs cost MK25 each in more affluent areas of Blantyre and Lilongwe. One standard bag was reported to produce from 30 to 90 smaller packs, weighing between 250g and 1kg.

In some markets, the sellers were offering a wide range of pack sizes. For example, in low-income areas (such as Chinsapo and Bangwe), there were seven different pack sizes, varying from MK10 to MK200 per bag. This allows buyers to choose the size they can afford.

4.4 The charcoal value chain

This section looks at who is involved in the value chain, and how the value chain works. People directly involved include producers, transporters, traders, and consumers, while indirect actors are those whose actions either help or hinder the marketing process.

The charcoal market is complex and accurate information on employment is difficult to obtain due to the secrecy required in an unlicensed trade. However, based on interviews, field observations and extrapolation, we estimate that about 92,800 people are regularly involved. This figure includes 12,700 bicycle transporters and 35,500 traders (either based in markets or selling door to door). Forty-six thousand five hundred people are estimated to work in production sites and about 300 individuals perform regular pick-up and truck transport. (Individuals using train, public transport and company vehicles were not included in these estimates.)

4.4.1 Charcoal producers

Producers are a specialized group of people who are usually involved in production and wholesaling only; very few are involved in transporting charcoal further than their homesteads. Charcoal is produced from timber cut when fields are cleared for agriculture, from customary land and from Forest Reserves. Although the Reserves have guards, there are too few to patrol the large areas effectively. However, it also was reported that forest guards sometimes demand bribes to allow people to make charcoal in the Reserves. The customary land forests are under the jurisdiction of traditional leaders, but some of them are charcoal makers themselves. Overall, it was observed that charcoal making proceeds with little control or regulation.

Making charcoal requires minimal financial and human capital, and is therefore attractive to people with few assets. Apart from leased land in Zomba (where charcoal makers were required to pay for the trees), trees can be cut down free of charge. In addition, many charcoal makers said that they have no other way of generating income. However, charcoal making is also attractive to bigger business, because of the high and consistent demand for charcoal.

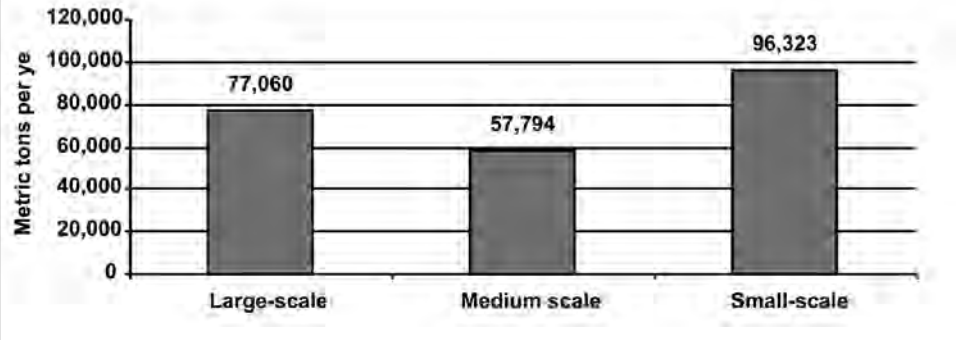
Charcoal producers identified in the study can be categorized according to their level of production:

- There are about **7,041 small-scale producers**, who average less than 30 bags per month, often as a coping mechanism against food shortage or cash needs. Together they produce more than 96,000 metric tons per year, or 42% of the total.

- Approximately **1,950 medium-scale producers** average 30-100 bags per month. They are business-oriented but are not well cash-endowed, and in total, they produce approximately 58,000 tons per year (25% of total production).

- An estimated **338 large-scale producers** (more than 100 bags per month) produce an average of up to 500 bags per month and their total production – at about 77,000 tons per year (33% of total production) – is considerable. These are fully-fledged businesses and have enough financial capital to undertake such large-scale production.

Figure 4. Tons of charcoal produced by the different sizes of producer



Many small- and medium-scale producers reported that they were in fact contract producers for urban-based traders, who would pay their labour costs up-front.

In Choma forest, charcoal is usually made in larger kilns than in the other sites. In some other sites, charcoal making tended to be an individual activity and it was not common to find a group of people working together. (More details on charcoal production appear in section 5 of this study.)

As described above, producers range from small-scale to big businesses. Small-scale producers make charcoal on an ad hoc basis, because they lack either food or cash, and they tended to work in isolation. By contrast, big players produce charcoal at a steady rate.

During the production survey for urban charcoal use (March-April 2007) conducted in Choma forest, Dzalanyama Forest Reserve, Thuma Forest Reserve, Neno customary land forest and the Chingale area in Zomba, more than 40 active kilns and in excess of 1,000 old kilns were observed. Using the prevailing proportion of active kilns in the relation to their total expected production the team estimated the total possible active kilns per day during the survey period. For example, the field team observed 31 active kilns with some 105 old kilns only in the survey area of Dzalanyama Forest Reserve. Extrapolating from the urban and production survey total charcoal figures, we estimated that there are some 40,000 kilns operating each year. This means that on any given day, there will be nearly 109 active kilns in Malawi as a whole.

4.4.2 Charcoal wholesalers

Wholesalers buy charcoal from producers and transport it to wholesale or retail markets in town, by head load, bicycle or motor vehicle. Wholesale markets tend to operate very early in the morning.

The amount of charcoal held by traders varies: some move just a few bags at a time, while large-scale traders can transport up to 500 bags. Smaller traders with only a few bags often hire vehicles with other traders, and share transport costs. There are fewer large traders (estimated at about 300), as they require large financial capital, especially when transporting long distances.

Some traders live close to the wholesale market where they buy from primary assemblers and sell the charcoal on at wholesale prices. Others take charcoal directly from producer to consumer, travelling every day or less often, depending on the distances involved. Some traders repack the charcoal into smaller bags.

Charcoal warehouse at Chilinde, Lilongwe

4.4.3 Charcoal retailers

Retailers include vendors who sell charcoal door-to-door, people who sell charcoal from their homes, and those who sell charcoal at retail markets. In most markets visited, charcoal was sold outside the market confines so that buyers would find it easily; an indication that charcoal selling is a highly competitive business. Retailers reported having an average of three to seven bags at a time, which they would sell during the course of a week. The smaller retailers usually sold other produce (usually beans, rice, sugar and maize flour) as well as charcoal.

Each market will have several retail traders, leading to strong competition between them. Further competition comes from people selling charcoal direct from their homes. Some households buy charcoal directly from producers or wholesalers, if they travel through the charcoal producing areas. This is common among people with personal or official vehicles.

4.4.4 How the charcoal value chain functions

Although transactions in the charcoal value chain are ad hoc and on a cash basis, the market as a whole functions very well. Charcoal is freely available to consumers who wish to buy it, and the market places are established and well known. Charcoal is commonly seen being produced, transported and sold.

Weaknesses in the value chain reflect the unregulated nature of charcoal. For instance, the only evidence of a long-term relationship between the actors is when traders order charcoal from producers and leave behind empty bags to be filled. Some charcoal is sold on a credit basis, (for example in Blantyre along the Chikwawa route), but in this case there is a mark-up on the cash price.

Along the value chain, charcoal is in such high demand that quality appears not to matter. Some charcoal producers know which tree species give the best charcoal, and some traders say they are able to recognize good quality charcoal by its appearance, size and density.

However, as those trees giving good quality charcoal are in short supply, the market treats all qualities alike. Agents will pay a premium for a larger bag but not for other indicators of quality, even though these are well known, and consumers say they are not willing to pay more for better quality charcoal. Some anecdotal evidence indicated that charcoal of species known to be of inferior quality – such as pines – do not have the same market demand or price structure.

4.4.5 Private taxes and the charcoal value chain

Despite the strength of the charcoal market, its shadowy nature means that various officials may demand payment to turn a blind eye when they find charcoal being produced, transported or sold. These payments increase costs and inhibit the smooth functioning of the charcoal market. Sources of these costs include:

- **Department of Forestry.** Sometimes forestry officials conduct patrols, during which anyone caught transporting charcoal risks having their bicycle or vehicle and the charcoal impounded. A bicycle can be redeemed for a MK3,000 fee, while the fee to release a

vehicle varies from MK10,000 to MK30,000. Impounded charcoal is sold by Regional Forestry Offices at a give-away price of MK200 per bag. Vehicle owners in Choma area are said to be unwilling to transport charcoal because the cost of reclaiming a vehicle is so high. No seizure certificate is issued against the confiscated charcoal for small charcoal traders, so disclosure to the office is at the discretion of the official involved. For large-scale traders, seizure certificates are issued. A general receipt is issued when the charcoal is disposed of.

Confiscated charcoal at Zalewa roadblock

- **Security roadblocks.** It was said that officials at the roadblocks demand bribes to allow vehicles with charcoal to pass. They might demand either a flat rate of MK300 to MK500 per vehicle or MK30 per bag. Where a flat rate is charged, owners of charcoal contribute towards the amount. Many bicycle transporters reported that one bag from their load is the standard price for passage. That is, if they have five bags loaded on their bicycle, a "tax" of 20% is assessed; a three-bag load results in a 33% tax by roadblock officials. This conforms to the survey results that showed police and other officials consuming higher rates of charcoal in their households.

- **Traffic Police.** It was reported that police officers might demand bribes from vehicles carrying charcoal, alleging that the vehicle was not roadworthy. In such cases, it was the responsibility of charcoal owners to 'bail out' the vehicle by contributing towards the fine. The officials would normally keep the money paid.

- **Police 997 Emergency Service.** Of the various transactions costs reported, the most expensive bribes were said to be demanded by the Police 997 Emergency Service officials. These were mentioned in Blantyre and Lilongwe especially as the main sources of cost, charging as much as MK3,000 for a three ton truck and MK7,000 for a larger lorry.

4.5 Cost structure of the charcoal value chain

The main sources of cost as charcoal moves from producer to consumer are production, packaging, transport, market fees and private taxes. The data collected reflect the differences between the sites. For instance, in some sites standard bags were most common, while in others large bags were more usual. There were differences in the distances from production site to each urban area, and the mode of transport. Finally, there were different costs depending on the retail market at which the charcoal is sold.

Private taxes paid to public officials were very high in Blantyre and Lilongwe, accounting for about 12% and 20% of the total cost, respectively. Although traders do not meet public officials every time they transport charcoal, it is likely that they factor the risk of having to pay bribes into their prices, thereby making charcoal more expensive.

The other major costs, as shown in Figures 5 and 6, are production, transport, and traders' margins. (Labour for packing does not appear in the costs for Lilongwe City, as in this market the producers do all the packing.) These costs are justified, as they represent value being added, but the private taxes add no value and simply result from charcoal being an unlicensed product. If charcoal was a legal product it could be subject to official taxation. Even a low tax rate from an estimated MK5.8 billion would provide significant revenue to Government and, given the difficulties faced by charcoal traders and transported at present, paying official tax might well be an easier option than the status quo.

Figure 5. Cost structure of charcoal in Blantyre City

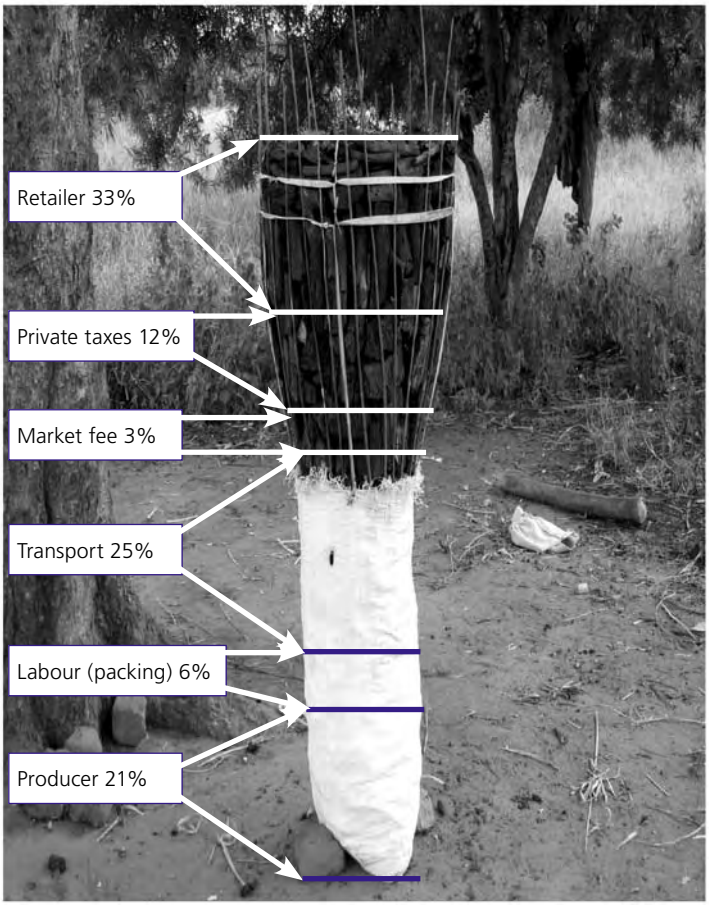
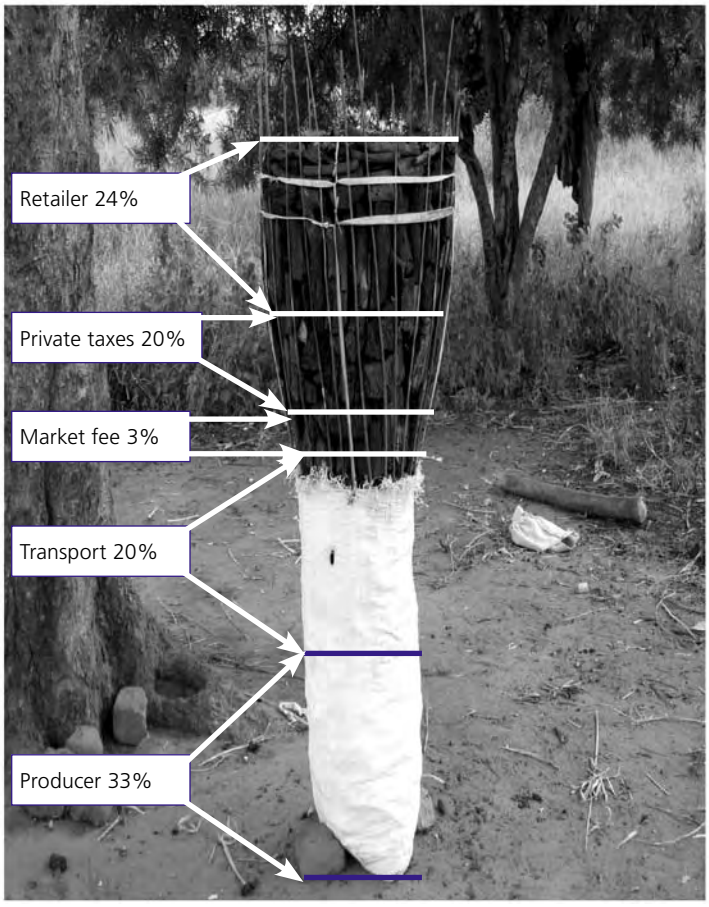


Figure 6. Cost structure of charcoal in Lilongwe City



In Mzuzu and Zomba, cases of rent seeking were not reported, although Forestry Department enforcement activities were mentioned. Market fees are not levied uniformly. In some cases, traders pay daily market fees ranging from MK25 to MK35 per stall. In others, traders paid either MK25 or MK35 per bag brought into the market, plus half the usual daily rate for subsequent days.

4.6 Concluding remarks on the charcoal value chain

The charcoal market systems observed in the various urban locations were well ordered in spite of charcoal being an unlicensed product. Production sites are well known, and there is an established network of transporters, wholesalers and retailers. The main clue that charcoal operates in the shadow economy is that large quantities of charcoal are usually transported at night, although transport by bicycle is done in broad daylight. The value-adding activities involve packing and transport: the findings did not suggest that charcoal is stored in significant amounts.

Most of Blantyre's charcoal comes from the Neno/Mwanza area, with smaller amounts from Mulanje, Chikwawa and Zomba. In Lilongwe, the main sources are Thuma West and Dzalanyama Forest Reserves. Most of Mzuzu's charcoal comes from Choma customary land forest and Kaning'ina Forest Reserve. In Zomba, charcoal is from the Malosa/Domasi area and Chingale.

Producers range from small- to large-scale, with third parties often providing transport. Many small-scale producers operate at subsistence level and charcoal offers a vital opportunity to generate income, but the large-scale producers operate as well financed businesses and they supply about one-third of total production. There may be as many as 40,000 kilns operating each year in Malawi.

The study team estimates that 92,800 people, including 46,500 producers, 12,500 bicycle transporters, 300 other transporters and 33,500 traders owe their livelihoods to the charcoal industry. Values accruing to producers ranged from 20% to 33% of retail price, while transporters earn 20% to 25% of final value. Retailers obtain 25% to 33% of final selling price. City assemblies collect market fees too, despite charcoal being an unlicensed product.

As charcoal is moved from point of production to the markets, traders incur costs, some of which amount to private taxation by public officials. These officials include people on duty at roadblocks, Traffic Police and the Police 997 Emergency Service, and they often demand bribes before they will allow charcoal traders to pass. Amounts range from MK500 to MK10,000 per conveyor, and this study has found that bribes account for 12-20% of the final price.

Consumers preferred to buy large pieces of dark, dense charcoal. However, since species giving this quality are depleted, buyers simply buy what is available. Much as some market agents were aware of quality attributes, these did not translate or lead to any price differentials except for low-quality pine charcoal widely viewed as undesirable.

Charcoal production

The charcoal production survey was driven by information gathered in the earlier parts of the study. Having an understanding of the charcoal value chain enabled the research team to pinpoint which sites were delivering the most charcoal to the urban areas under scrutiny. It emerged that certain sites were particularly important, together providing more than half of the charcoal supplied.

5.1 Charcoal use and implications for deforestation

Data in Table 6 below, gathered from the urban energy survey, show the estimated impact on forest resources. It can be seen that more than 15,000 hectares per year are cut down to make charcoal for the four main urban centres. In 1988 it was estimated that only 8,700 hectares were cleared for charcoal production (Teplitz and Zieroth, 1988).

Table 6. Annual charcoal use in urban areas and implications for forest resources

Urban area	Charcoal use in standard bags	Charcoal use (metric tons)	Wood required (m^3)	Equivalent forest area cleared (ha)
Blantyre	2,788,237	105,953	656,909	6,915
Lilongwe	2,446,237	92,957	576,333	6,067
Mzuzu	483,053	18,356	113,807	1,198
Zomba	366,079	13,911	86,248	908
Total	6,083,605	231,177	1,433,297	15,088

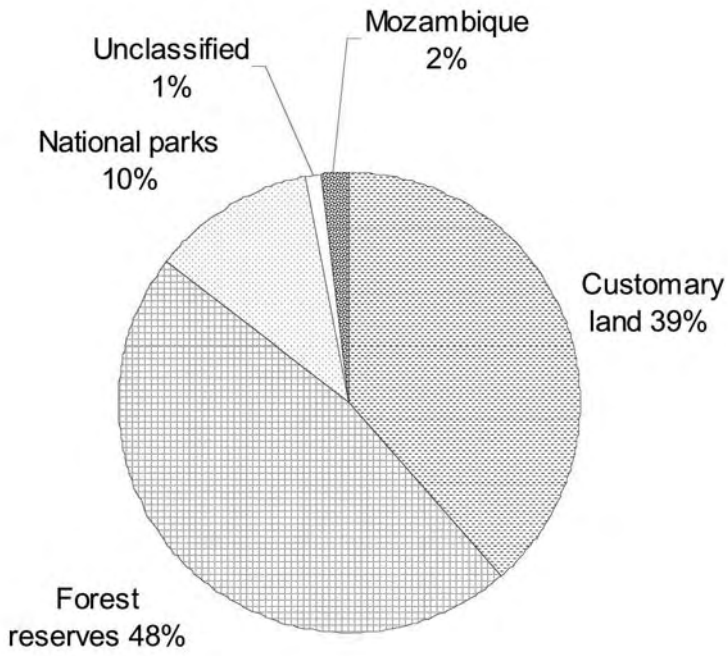
Malawi's annual deforestation rate is estimated to be between 33,000 ha (FAO, 2007) and 71,000 ha (FAO, 2001); an average could of 52,000 ha per year. A slightly higher figure of 53,000 ha per year was given by FAO in 1995 for the deforestation rate between 1980 and 1990, and other sources have quoted 50,000 ha per year. Therefore, even if the 15,000 ha was considered to be total destruction of forests (which is not always the case, as charcoal production is often selective, based on species and tree size), charcoal production would contribute only about one-third of total deforestation. Other deforestation can be attributed to other activities such as agriculture or infrastructure development.

The two more recent FAO studies mentioned above gave estimates of the area under forest cover as 2.6 million ha (in 2000) and 3.4 million ha (in 2005). The Forest Resource Mapping and Biomass Assessment of 1993[9] gave a lower figure (2.05 million ha) for indigenous forest cover, defined as land with more than 20% tree cover. A rough calculation of how long the forest resource will last, if current rates of clearing for charcoal continue, and if charcoal is the only source of forest loss, gives

9. Bunderson (2007), personal communication.

Malawi more than another century of charcoal production[10]. (Conversion factors were based on information from Dr Trent Bunderson[11], Natural Resources Management Specialist for Total Land Care in Malawi, and it was assumed that the average volume of timber per hectare of mature miombo woodland[12] was 95 m^3.)

Figure 7. Sources of charcoal by land type



The figure above shows that almost half the charcoal comes from forest reserves and almost 40% from customary land. A small percentage is brought across the border from Mozambique. Forest reserves are the main source of charcoal for Lilongwe and Zomba (Thuma and Dzalanyama, and Malosa / Domasi, respectively). Blantyre and Mzuzu get a reasonable share from customary land because Blantyre and Mzuzu still have some customary forest areas in Neno and Choma.

5.2 Charcoal production and woodland composition

Having established the main charcoal producing sites for the four main urban areas, the study looked at woodland composition in these areas. The aim was to discover whether charcoal production was altering the nature of the forest. Annex VII provides a map of charcoal production sites in Malawi.

10. If 15,000 ha are cleared per year, and assuming that 195,000 ha of forest have been cleared since 1993, charcoal production at current levels would consume the last forest areas of the remaining 1.78 million ha in less than 120 years.
11. 2007, personal communication.
12. Bunderson also reports that Malawi's miombo woodland timber density varies between 80 and 103 m^3, per hectare

From Table 7 it can be seen that in Choma and Dzalanyama Forest Reserves the preferred species for charcoal production are still present as dominant or important species. However, in the other sites different species have assumed dominance and importance. This indicates that the species preferred for charcoal have been removed, and suggests that the composition of the forest may be changing.

Even when the preferred species are no longer present, charcoal production continues. For example, *Uapaca kirkiana* is now being used in Chingale and *Combretum zehyri* on the Neno Escarpment, instead of the preferred *Combretum colinum*. At Thuma West (especially around GVH Mlamba), remnants of preferred species are being salvaged for charcoal production, but *Vernonia amygdalina*, an herbaceous plant, is increasingly being added to raw material for charcoal production.

Table 7. Most common, dominant, important, and preferred species for charcoal

Forest	Area visited	Most common species[a]	Dominant species[b]	Important species[c]	Preferred species for charcoal production
Choma	VH Chibisa / VH Kampeya	*Uapaca kirkiana*	*Brachystegia boehmii*	*Brachystegia boehmii*	*Julbernardia globiflora, Brachystegia manga, B. spiciformis, B. utilis and B. boehmii*
Thuma	GVH Chinkhowe / GVH Mlamba	*Vernonia amygdalina*	*Vernonia amygdalina*	*Acacia polyacantha*	*Combretum colinum, Rauvolfia caffra, Brachystegia manga, B. utilis and Pterocarpus angolensis*
Dzalanyama	Kaundu Hill	*Julbernardia globiflora*	*Julbernardia globiflora*	*Julbernardia globiflora*	*Julbernardia globiflora and Brachystegia spp*
Neno Escarpment	Lisungwi / Malimba GVH Kasamba	*Combretum zehyri*	*Msetanyani*	*Combretum zehyri*	*Brachystegia floribunda and Combretum colinum*
Zomba	Chingale VH Chiganga	*Uapaca kirkiana*	*Uapaca kirkiana*	*Uapaca kirkiana*	*Brachystegia stipulata and B. longifolia*
Zomba	Thondwe	*Diplorhyncus condylocarpon*	*Brachystegia floribunda*	*Mwanankali*	*Brachystegia stipulata and B. longifolia*

a Based on relative density (% of individual species over total number of all species recorded)
b Based on relative dominance (basal area of individual species over the total basal area of all species recorded %)
c Based on a and b (See Annex V)

Although this study represents a snapshot of the situation rather than an examination of change over time, the fact that some of the species preferred for charcoal are no longer present in some sites may be evidence of ecological change. The vegetation of the plateaus and escarpment areas, which has until recently been Zambezian miombo woodland, may be in transition to Zambezian undifferentiated woodland dominated by *Acacia* and *Combretum* species.

5.3 The charcoal production process

Charcoal production begins with cutting down trees, which are then piled up and covered with earth to make a kiln. A fire is lit at one end of the kiln and the wood is turned into charcoal, after which the kiln is dismantled and the charcoal packed into bags.

Depending on the amount of wood and the size of the kiln, this process can take more than a month, although the smallest kilns will produce charcoal in a few days. The study found 19 active kilns, ranging in size from $3m^3$ to $187m^3$. The biggest kiln (observed at VH Limani) took two months to build.

Access to the wood depended on the ownership of the land, but in most cases, the timber can be cut down free of charge or for a token payment. The only exception found in this study was in one area in Zomba, where charcoal makers were paying for trees on private land.

On customary land, people need permission from the village headman to clear trees from land so that crops can be grown. Although no money is supposed to change hands, it was reported that newcomers often pay the village heads a token of appreciation when permission is given. In many cases, especially in Choma forest, trees are removed but the land is not cultivated. Instead, people move on to another site and repeat the process. Some charcoal producers said they were making charcoal using their own trees. In Forest Reserves, people cut down trees without asking for permission from anybody. This process is reported to be facilitated at times by Department field personnel.

Charcoal kiln-making process, TA Symon, Neno

All 19 active kilns observed in the charcoal production sites were traditional earth kilns, which are used throughout Malawi. Studies have indicated that this type of kiln is inefficient, with an efficiency ratio of little more than 20% (Makungwa, 1997; Openshaw, 1997).

5.4 Concluding remarks on charcoal production

The urban energy consumption study estimated that the total volume of charcoal consumed in the four largest urban areas of Malawi is about 6.08 million standard bags (or 231,177) metric tons, which requires more than 1.4 million cubic metres of wood each year. This is the equivalent of clearing just over 15,000 ha of woodland annually. Although this is a significant amount, it should be noted that charcoal is responsible for only about one-third of the annual deforestation in Malawi. A small amount of charcoal is brought in from neighbouring Mozambique (mostly to supply Blantyre).

Where species composition is changing and if conditions are not conducive to natural regeneration, the charcoal production sites may become other forest types (such as undifferentiated woodland) or savannah grasslands. There is also the risk of erosion, siltation of rivers and general environmental degradation. The fact that more charcoal is produced in Forest Reserves than on customary land may indicate that suitable timber is either exhausted or has significantly diminished in the latter sites.

The fact that charcoal production has continued unabated means that past and present policies have been unable to reduce charcoal production. However, the natural regeneration of indigenous trees should not be ignored: with their ability to regrow from coppiced stumps, miombo woodland could be managed on a coppice system, thus ensuring sustainability for the charcoal industry. Frameworks for forest management such the Forest Act, the National Forest Policy, and the Standards and Guidelines for Participatory forestry Management are now in place, all of which are intended to promote good forest practice at local and national level.

Charcoal production using the earth kiln type is inefficient, so better ways of producing charcoal could be promoted. Simple improvements can make a difference. For instance, using dry instead of green wood can increase yield by 15%, and permanent kilns give better recovery rates (Girard, 2002).

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Urban energy consumer questionnaire

Malawi urban energy study: January – February 2007

Confidential

Questionnaire number:

Date:

1.0 IDENTIFICATION

1.1 Enumerator name:

1.2 District:

1.3 Township:

1.4 House type:

Enter number in box below

1. Modern house with servant quarters
2. Modern house with three bedrooms
3. Modern house with two bedrooms
4. Older house with outside water facility
5. Other type of house – please specify

1.5 Type of residential area:

1. Low density
2. Medium density
3. High destiny
4. Unplanned
5. Shanty area

1.6 Is the household connected to electricity and water?

1. Yes, both
2. Yes, electricity only
3. Yes, water only
4. No, neither

1.7 Does the household have the following?

1. Car
2. DSTV/TV
3. Phone
4. Fence or hedge
5. Vegetable garden

DEMOGRAPHICS

1.8 Name of respondent: (optional)

1.9 Year of birth:

1.10 Sex (Male = 1 Female = 2)

1.1 Marital status:
1. Married
2. Single
3. Divorced
4. Widowed
5. Children only

1.12 Type of household:
1. Male-headed
2. Female-headed
3. Child-headed
4. Elderly-headed

1.13 Contact phone (optional)

1.14 Number of people living in the household

1.15 Contact address/work (optional)

1.16 Highest educational level of head of household/spouse
1. University
2. College
3. Secondary
4. Primary
5. None

1.17 Main occupation of head of household:

1.18 Main occupation of spouse:

1.19 Occupations of other members over 18 years old:

2.0 ENERGY USE

2.1 What is your main source of energy for cooking?

2.2 What is your main source of energy for lighting?

For 2.1 and 2.2 use the following codes
Electricity = 1, Charcoal = 2 , Firewood = 3, Gas = 4, 5 = Other (specify)

3.0 Is your household connected to mains electricity?
1. Yes, prepaid
2. Yes, post-paid
3. No

3.1 If pre-paid, what is the average amount you spend, and how often?
Value
Frequency

3.2 If post-paid, what is your average monthly bill?

MK

3.3 Please specify and quantify any other form of payment

4. Do you use electricity for:
1. Cooking and lighting?
2. Lighting only?

5. If not for cooking, why not?
1. Disconnected
2. Landlord does not allow
3. Use gas
4. Cannot afford
5. Use cheaper alternative (specify)
6. Other (specify)

6. What other sources of energy are available to the house?
1. Charcoal
2. Paraffin
3. Candles
4. Gas
5. Firewood
6. Solar power
7. Other (specify)

7. If you use charcoal, estimate the value and quantities per day, week or month, or indicate if free (If no charcoal is used, go to Q8)

Total estimated cost MK

Period	Units (size of package e.g. 5, 10, 20, 50kg)	Unit price	No. of units	Total cost (MK)
Per day				
Per week				
Per month				
Per year				

8. If firewood is used, estimate:
Total value

Specify container/quantity/units used

How long does this quantity last?

9. Estimate the value of paraffin or gas used per month

Item	Amount (units)	Cost (MK)	Period (per day, week or month)
Paraffin			
Gas			
Candles			

10. Please estimate the proportion of energy used

	Proportions			
Charcoal				
	25%	50%	75%	100%
Electricity				
	25%	50%	75%	100%
Firewood				
	25%	50%	75%	100%

11. Please give expenditure per month in kwacha, and the proportion of your energy bill this represents

Fuel	MK	Proportion
Electricity		
Charcoal		
Firewood		
Gas		

12. Discuss and record below where the charcoal comes from

13. Discuss and record below where the household buys charcoal

14. Discuss and record what qualities they look for when buying charcoal

15. Discuss with respondent best tree species for charcoal

a_____

b_____

c_____

16. Are you using more or less charcoal now than in the past?
More = 1, Less = 2, Same = 3, Do not know = 4, Other (specify) = 5 [ ]

16.1 Explain your answer

[ ]

17. Do you expect to use more or less charcoal in future?
More = 1, Less = 2, Same = 3, Do not know = 4, Other (specify) = 5 [ ]

17.1 Explain your answer

[ ]

18. What do you think the government should do to ensure that electricity is made available to every household in Malawi?

[ ]

19. If you want to use electricity for cooking and lighting

How much are you willing to pay per month? MK [ ]

How much are you willing to pay per week? MK [ ]

How much are you willing to pay per day? MK [ ]

20. What is your normal average expenditure on household expenses (MK)?

Item	Day	Week	Month
Food			
Rent			
Water			

21. What is your monthly income range? (Optional)

MK(000)			
0-1		30-49	
2-4		50-79	
5-9		80-99	
10-19		100-199	
20-29		Above 200	

(those with incomes above MK200,000 are assumed not to use charcoal as main energy source

22. What should be done to protect the environment?

END OF QUESTIONNAIRE – thank respondent

Methodology for urban energy study

Three researchers conducted the survey with assistance from team of 36 research assistants. Each site had its own data collection team: 10 in Blantyre, 10 in Lilongwe, and four each in Mzuzu and Zomba. Additionally, there were four data entry clerks and four supervisors. From the four sites, respondents were drawn from five location types: low density, medium density, high density, unplanned areas and shanty areas. Data in Table 8 show the number of respondents in each site by location type.

Table 8. Strata of respondents by site

Residential Type	Urban Area							
	Blantyre City		Lilongwe City		Mzuzu City		Municipality of Zomba	
	No.	%	No.	%	No.	%	No.	%
Low Density	177	12	168	12	69	12	88	18
Medium Density	277	19	168	12	101	17	81	17
High Density	356	24	286	20	63	11	112	23
Unplanned Area	402	28	526	38	244	41	127	26
Shanty Area	244	17	253	18	122	20	81	17
Total	1,456	100%	1,401	100%	599	100%	489	100%

The questionnaire in Annex I was used to collect data. Questions focused on energy use and expenditure (electricity, charcoal, firewood and others). The data were entered into a Microsoft excel spreadsheet from where initial analysis was done. The data were further converted into the Statistical Package for Social Scientists (SPSS) where frequencies, means and cross-tabulations were done to compare various sites and location types. Furthermore, weighting of data using projected population figures by residential type and site were used in estimating site and residential type's energy consumption and expenditure.
The table of parameters below shows variables collected and calculated for the survey and how they are utilized in the charcoal study analysis

Parameters

Key parameters derived from the survey are:

- total kilograms of charcoal consumed per annum per capita;
- expenditure on charcoal per annum per capita.

Total expenditure on charcoal was calculated by determining weighted averages for expenditure by location in each site. The weights were obtained by projecting the urban population by the growth rate given in the 1998 population census of Malawi. Household composition was also drawn from census values.

Using population data by location as weights, the survey results were used to calculate total values for charcoal consumption for the four major urban sites of Malawi. Below are some notes on how variables from the charcoal study were derived and used.

The following data sets and parameters were collected or calculated for every household in the sample:

Table 9. Data Analytical Framework

Variable	Information collected	Comments
District	Name of site	Variables were grouped, weighted within site and later added together to give urban totals.
Township	Name of township	Charcoal, firewood, paraffin, gas and electricity use may be different in different townships or localities. Townships were later grouped by residential type. Calculations for means were then done by residential type and later weighted to give site and urban totals.
House type (verified by household respondent and enumerator)	1. Modern house with servants' quarters 2. Modern house with three bedrooms 3. Modern house with two bedrooms 4. Non-modern house with outside water facility 5. Other type of house	Shanty and unplanned areas had a wide range of household types, so it was important to reinforce classification by location. This allowed modern households in shanty or unplanned areas (which may have different consumption patterns from surrounding houses) to be grouped under different categories. The survey also revealed that medium and low-density households used similar amounts of charcoal, but significantly different amounts of firewood. Therefore, weights for firewood and charcoal had to be different for low density and medium density areas.
Type of residential area (verified by enumerator, supervisor, statistician)	1. Low density 2. Medium density 3. High destiny 4. Unplanned 5. Shanty area	Charcoal use was clearly different among these locations with highest use in unplanned and high-density areas, lowest in low density and shanty areas. Shanty areas use more firewood and low density more electricity.
Is the household connected to electricity and water?	1. Electricity and water 2. Electricity only 3. Water only 4. Neither	Check association in utilization of energy. HH without water and electricity used more firewood. No significant difference in charcoal use between other households.
Does the household have the following?	1. Car 2. DSTV/TV 3. Phone 4. Fence or hedge 5. Vegetable garden	This variable was intended to reflect affluence, using DSTV and brick wall fence as indicators. Unfortunately, the survey planners misunderstood the statistician's intention, so the variable was spoilt by including general TV and hedge fence. No analysis was done on this variable.

Name of respondent	Name	Optional. However, traditionally individuals would like you to know their names, especially in shanty areas. However, in low density and other areas people prefer to be anonymous, so this field was optional. 95% gave their names.
Year of birth	Year	Not used in analysis
Gender	Male or female	Had a bearing in estimation of electricity and charcoal use. Bias noted between genders.
Marital status	1. Married 2. Single 3. Divorced 4. Widowed 5. Children only	Significance in electricity and firewood use. No significance in charcoal use.
Contact phone	Phone number	Data verification. 45% gave number.
Number of people living in household	Number of HH residents	Lowest expenditure on charcoal in household of two people, and second lowest in single-person household. No significant difference in per capita expenditure for households higher than three. Parameter also use for estimating total HH in urban centres since 1998 census only gave general population projections.
Contact address	Box number or physical address (optional)	54% did not give address, and 55% did not give phone number. However if they gave their occupation this was used in analysis of their background in relation to the charcoal value chain. Key people withholding contact details were police, customs, army, transporters and small-scale market sellers. Households using charcoal as alternative cooking energy all gave details.
Highest level of education	1. University 2. College 3. Secondary 4. Primary 5. None	There is significance in charcoal expenditure by education level: it is highest among primary school leavers, followed by secondary school leavers and those with no education. University graduates spend least on charcoal.
Main occupation	Main occupation of HH members	High correlation between expenditure on charcoal (and volume of charcoal use) and occupations of household members.
Main source of energy for cooking and lighting	Main use for cooking Main use for lighting	Comparison with values given for charcoal and electricity use. This variable compared well with responses on expenditure for different energy sources.
Electricity	1. Prepaid 2. Post-paid 3. None	HH with prepaid used less charcoal than HH on post-paid. Prepaid used more electricity than post-paid households. Post-paid metering is cheaper than prepaid metering. 25% of HH have unofficial connections i.e. they have no meters or the meters are not registered by ESCOM. (From the survey, we estimate some 4,000 illegal connections in the four cities, but this has not been checked with ESCOM.)

If not cooking with electricity why not?	1. Disconnected 2. Landlord won't allow 3. Cannot afford 4. Cheaper alternative 5. Other	Main reasons for not using electricity are 'cannot afford' and 'cheaper alternative'.
Other sources of energy	1. Charcoal 2. Paraffin 3. Candles 4. Gas 5. Firewood 6. Solar	Charcoal is regarded as the main alternative source of energy (84.2%) for households without electricity 7% use candles as alternative for lighting and 65% use paraffin. 2% use firewood as alternative and only 1% use gas as alternative for lighting
Estimate of expenditure on charcoal	1. Daily expenditure 2. Weekly expenditure 3. Monthly expenditure	Best estimate for expenditure on charcoal was derived from this variable. Weighted values by location gave site total expenditure. These were used together with population projections from census and household size data from survey to estimate expenditure by site.
Quantity and value, units used	1. Units 2. Price 3. Value By day, week, month	The key variable for estimating average prices, average charcoal use and average expenditure. Per capita values were derived weighted by location then site totals were derived from this variable. Highest prices were paid by individual households who bought charcoal in small quantities such as 0.5kg.
Firewood	1. Value 2. Quantity 3. Units 4. Period firewood lasts	Commonly used in shanty and unplanned areas. Also alternative to charcoal and electricity in high-density areas.
Paraffin, gas candles	1. Quantity 2. Units 3. Expenditure 4. Unit price 5. Period of use: day week, and month	Expenditure per month was derived from this variable. The expenditure was highly correlated with type of household. Candles were universally used by all residential types and locations.
Proportion of energy used	1. Charcoal 2. Electricity 3. Firewood	Key variable to check on energy use patterns by locality income and site. High association with income and family size.
Expenditure per month: charcoal, electricity, gas and firewood	Total expenditure per item	Extremely important in checking expenditure derived from quantity and volumes used data. Provides double check on derived expenditure variables.
Source of charcoal	Where charcoal came from	Helped to identify sites for production exercise. From this variable, we also calculated the percentage of households using imported charcoal (2%). We also estimated charcoal from production sites. The selected sites for the production survey (Choma, Thuma, Dzalanyama, Neno and Chingale) provided 56% of this variable.

Where household buys charcoal from	Many different responses	There were more than 100 different responses to this question, including roadside, house-to-house vendor, delivered by sales person, confiscated charcoal, truck driver, named market, etc. This provided useful information on trade dynamics.
Qualities look for when buying charcoal	Various responses	Respondents mentioned size, appearance, durability and species. General description was big shiny, dark and long-lasting charcoal.
Tree species best for charcoal	Species list	In order of importance were: Tsanya, Mwanga, Mbawa, Mthethe, Myozi, Mulombwa, Tsamba, Mango.[13]
Future charcoal use	1. More 2. Same 3. Less	Response on future use and past depended on availability of charcoal. All households would like to use less in future if there are alternatives.
Willingness to pay for electricity Current expenditure on electricity	How much are you willing to pay? How much are you paying now?	Average amount respondents are willing to pay per month is MK2,000. For the 1,981 respondents who answered this question, the average bill was MK2,140. This suggests that, if electricity was given a flat rate of MK2,000 per month and made available to all households, people would pay and stop using charcoal.
Average HH expenditure	1. Day 2. Week 3. Month	Good parameter to estimate electricity or energy affordability. Also proxy for income.
Income range	Monthly salary range	Surprisingly, most people provided this information.
What to be done to protect environments (important policy information)	Individual responses	Reduce electricity bills Burn charcoal Plant more trees More law enforcement in protected areas
Population data (from census projections on population and energy use)	1. Urban 2. Locality 3. Total 4. Household	Used to extrapolate data for all sites and for weights for different strata. Used to project energy use and also as a base line on energy use proportions by site and district

13. For botanical names, see back page

The following variables were generated from the survey and are available in the supplemental statistical publication, which includes the tables and methodology for the survey.

- Retail and wholesale charcoal prices;
- Total kg of charcoal consumed per year;
- Total cubic metres of wood consumed per year;
- Income spent on charcoal per year;
- Number of people directly involved in production and marketing of charcoal per year;
- Area of forest cleared per year attributable to charcoal production.

Lists of tree species: observed, expected and preferred

Table 10. Relative dominance of dominant species in selected charcoal production forest areas

Forest	Area visited	Dominant species	Relative dominance (%)
Choma	VH Chibisa	*Brachystegia boehmii* (Chiyombo)	32.8
		Brachystegia speciformis (Mpapa)	26.3
		Julbernardia globiflora (Kamphoni)	10.8
		Uapaca kirkiana (Msuku)	0.3
	VH Kampeya	*Brachystegia boehmii* (Chiyombo)	26.6
		Uapaca kirkiana (Msuku)	21.6
		Parinari curatefolia (Muula)	11.7
		Brachystegia manga (Mufolya)	9.8
		Aguaria salicifolia (Mzyozo)	6.1
		Vitex doniana (Mahuhu)	5.4
		Brachystegia speciformis (Mpapa)	4.7
		Ozoroa insignis (Chifutwe)	3.3
		Faurea saligna (Chiyele)	3.3
Thuma	GVH Chinkhowe	*Acacia polyacantha* (Mthethe)	29.0
		Bauhinia petersiana (Mphando)	20.8
	GVH Mlamba	*Acacia polyacantha* (Mthethe)	32.5
		Vernonia amygdalina (Futsa)	23.5
Dzalanyama	Kaundu Hill	*Julbernardia globiflora* (Kamphoni)	49.1
		Brachystegia boehmii (Mombo)	11.7
		Pseudolachnostylis maprouneifolia (Msolo)	5.9
		Erythrophleum africanum (Kawidzi)	4.6
		Pericopsis angolensis (Muwanga)	4.3
		Faurea intermedia (Chipemphe)	3.1
Neno Escarpment	Lisungwi/Malimba GVH Kasamba	*Sterculia quinqueloba* (Msetanyani)	10.7
		Diplorhynchus condylocarpon (Mthombozi)	10.6
		Combretum zeyhri (Chinama);	9.5
		Pterocarpus rotundifolius (Mbalitsa)	7.5
		Brachystegia floribunda (Tsamba)	6.8
		Mtumbu	6.3

Zomba	Chingale	*Uapaca kirkiana* (Msuku)	62.2
		Monotes africanus (Kakatuku)	9.7
		(Tatalika)	4.5
		Cartunarigum spinosa (Chipembere)	4.3
	Thondwe	*Brachystegia floribunda* (Tsamba)	15.4
		Mwanankali	15.0
		Zikhadabo za mkango	10.8
		Acacia xanthophloea (Chiombamuluzu)	8.0

Table 11. Important species in the charcoal producing areas

Forest	Area visited	Most recorded species	Dominant species	Important species
Choma	VH Chibisa	*Uapaca kirkiana (Msuku)*	*Brachystegia boehmii* (Chiyombo)	*Brachystegia boehmii* (Chiyombo)
	VH Kampeya	*Brachystegia boehmii* (Chiyombo)	*Brachystegia boehmii* (Chiyombo)	*Brachystegia boehmii* (Chiyombo
Thuma	GVH Chinkhowe	*Bauhinia petersiana* (Mphando)	*Acacia polyacantha* (Mthethe)	*Bauhinia petersiana* (Mphando)
	GVH Mlamba	*Vernonia amygdalina* (Futsa)	*Vernonia amygdalina* (Futsa	*Acacia polyacantha* (Mthethe)
Dzalanyama	Kaundu Hill	*Julbernardia globiflora* (Kamphoni)	*Julbernardia globiflora* (Kamphoni)	*Julbernardia globiflora* (Kamphoni)
Neno Escarpment	Lisungwi/ Malimba GVH Kasamba	*Combretum zeyhri* (Chinama)	*Sterculia quinqueloba* (Msetanyani)	*Combretum zeyhri* (Chinama)
Zomba	Chingale VH Chiganga	*Uapaca kirkiana* (Msuku)	*Uapaca kirkiana* (Msuku)	*Uapaca kirkiana* (Msuku)
	Thondwe	*Diplorhynchus condylocarpon* (Mthombozi)	*Brachystegia floribunda* (Tsamba)	Mwanankali

This table should be looked at in conjunction with the lists of expected species (given in the table below and in Annex VI), to check whether the most recorded, dominant or important species are the ones expected to be in that area. If the most recorded, dominant or important species are not the expected species for that area, it is possible that charcoal production has removed the species that were previously common, dominant or important there.

Table 12. Tree species composition in selected charcoal production areas				
Forest	Village/Site	Preferred charcoal species	Expected dominant species in the area, in ranked order	Species observed in assessment area
Choma	VHs Chibisa/ Kampeya	*Julbernardia globiflora* (Kamphoni), *Brachystegia manga* (Mufolya), *B. speciformis* (Mpapa), *B. utilis* (Kavwenji, Mvunje, Nzale) and *B. boehmii* (Chiyombo, Mombo, Msendaluzi)	*Brachystegia boehmii* and *B. speciformis, Julbernardia globiflora* and *B. manga*	*Syzygium owariense* (Chifuwu), *Brachystegia boehmii, Faurea saligna* (Chiyele), *Julbernardia globiflora, Syzygium cordatum* (Katope), *Lannea schimperi* (Kaumbu), *B. utilis, Albizia antunesiana* (Kawizi),*B. manga, Monotes africanus* (Mkalakati), *B. speciformis, Uapaca kirkiana* (Msuku), *Combretum apiculatum* (Mulama), *S. caulescens* (Musimbwi), *Pariari curatellifolia* (Muula), *Erythrina abyssinica* (Mubale), *Dalbergia nitidula* (Mvungwe), *Aguaria salicifolia* (Mzyozo), *Ochna leptoclada* (Phatwe), *Ozoroa insignis* (Chifutwe), *Ximenia caffra* (Mthunduluka) *Protea gaguedi* (Nkhulukulu), *Julbernardia longifolia* (Mtondo), *Vitex doniana* (Mahuhu)
Thuma	GVH Chinkhowe/ Mlamba	*Combretum colinum* (Mkhute), *Lonchocarpus capassa* (Mphakasa), *Brachystegia longifolia* (Chitowe, Mombo), *B. utilis* (Kavwenji, Mvunje, Nzale) and *Pterocarpus angolensis* (Mulombwa)	*Brachystegia boehmii* (Chiyomboa, Mombo, Msendaluzi), *B. floribunda* (Tsamba), *B. utilis, Pterocarpus spp, Faurea spp, Khaya anthotheca* (Mbawa) *and Julbernardia globiflora* (Kamphoni), *Combretum, Diplorhynchus, Diospyros* and *Acacia spp*	*Lonchocarpus capassa* (Chimphakasa), *Bauhinia thonningi* (Chitimbe), *Lannea discolor* (Chiumbu), *Vernonia amygdalina* (Futsa), *Combretum fragrans* (Kadale), *Dichrostachys cinerea* (Kalimphangale), *Zizyphus mucronata* (Kankhande), *Sterospermum kunthianum* (Kavunguti), *Sclerocarya caffra* (Mfula), *Albizia zimmermanii* (Mkolankhanga), *Dalbergia nitidula* (Mkulasinga), *Combretum colinum* (Mkhute), *Pterocarpus angolensis, Brachystegia longifolia, Bauhinia petersiana* (Mphando), *Albizia antunesiana* (Mpepe), *Annona senegalensis* (Mpoza), *Cassia singueana* (Ntanthanyerere) *Acacia polyacantha* (Mthethe), *Diplorhynchus condylocarpon* (Mthombozi), *Vitex mombassae* (Mtonongoli), *Strychnos innocua* (Mzaye), *Markhamia obstusifolia* (Nsewa), *Brachystegia utilis, Pittosporum viridiflorum* (Kakunguni), *Diospyros batocana* (Mdima), *Uapaca nitida* (Mdyambawala), *Parkia filicoidia* (Mkundi), *Ficus capensis* (Mkuyu), *Bridelia micrantha* (Mpasa), *Trichilia emetica* (Msikidzi), *Psorospermum febrifugum* (Mtsiloti), *Kigelia africana* (Mvunguti), *Rauvolfia caffra* (Mwimbi), *Vangueria infausta* (Mzilu), *Flacourtia indica* (Nthudza)

Key to forest abbreviations: Ch = Choma, Th = Thuma, Dz = Dzalanyama, Ne = Neno Escarpment, Zo = Zomba/Chingale

Forest	Village/Site	Preferred charcoal species	Expected dominant species in the area, in ranked order	Species observed in assessment area
Dzalanyama	Kaundu Hill	*Julbernardia globiflora (Kamphoni) and Brachystegia spp (Kaluzi)*	*Julbernardia globiflora, Parinari curatelifolia* (Muula), *Brachystegia speciformis* (Mvukwe), *Terminalia sericea* (Naphini), *B. floribunda* (Tsamba), *Colophospermum mopane* (Tsanya), *Combretum zeyherii* (Mkhute), *Bauhinia thonningii* (Msekese), *Uapaca kirkiana* (Masuku) *and Syzigium guineense* (Katope)	*Faurea intermedia* (Chipemphe), *Combretum molle* (Kadale), *Pittosporum viridiflorum* (Kakunguni), *Julbernardia globiflora, Uapaca nitida* (Kasokolowe), *Erythrophleum africanum* (Kawidzi), *Strychnos innocua* (Mzaye), *Burkea africana* (Mkalati), *Brachystegia longifolia* (Chitowe, Mombo), *B. boehmii* (Chiyomboa, Mombo, Msendaluzi), *Pseudolachnostylis maprouneifolia* (Msolo), *Uapaca kirkiana, Diplorhynchus condylocarpon* (Mthombozi), *Julbernardia paniculata* (Mtondo), *Azanza garkeana* (Mtowo), *Psorospermum febrifugum (Mtsiloti), Bridelia micrantha* (Mtsukamano), *Pterocarpus angolensis* (Mulombwa), *Pericopsis angolensis* (Muwanga), *Flacourtia indica* (Nthudza), *Brachystegia floribunda* (Tsamba)
Neno Escarpment	GVH Kasamba / VH Limani	*Brachystegia floribunda (Tsamba) and Combretum collinum (Mkhute)*	*Combretum fragrans* (Chinama), *Pterocarpus rotundifolius* (Mbalitsa), *Combretum zeyhri* (Chinama), *Bauhinia petersiana* (Phandula), *Diplorhynchus condylocarpon* (Mthombozi), *Dombeya rotundifolia* (Naduwa), *Combretum apiculatum* (Kakunguni), *Mundulea sericea* (Lusyunga), *Diospyros kirkii* (Chitete), *Sterculia appendiculatum* (Njale), *Strychnos spinosa* (Mteme), *Acacia tortilis* (Nsangunsangu), *Commiphora marlothii* (Timbilimbuche), *Catunarigum spinosa* (Chipembere), *Lonchocarpus capassa* (Mphakasa), *Rauvolfia caffra* (Mwimbi), *Terminalia stenostachya* (Chikuliungu), *Dalbergia melanoxylon* (Phingo), *Ormocarpum kirkii* (Msungachuma), *Sterculia quinqueloba* (Msetanyani)	*Lannea stulmanii* (Chilusa), *Combretum zeyhri, Cartunarigum spinosa* (Chipembere), *Brachystegia manga* (Chituwa), *Pittosporum viridiflorum* (Kakunguni), *Markhamia obstusifolia* (Katsongole), *Commiphora africana* (Khobo), *Pterocarpus rotundifolius* (Mbalitsa), *Baphia bequaertii* (Mbawo), *Sclerocarya caffra* (Mfula), *Sterculia africana* (Mgoza), *Pterocarpus angolensis* (Mlombwa), *Xeroderris stuhlmanii* (Mlonde), *Cassia abbreviata* (Mnyoka), *Bauhinia petersiana* (Mphando), *Steganotaenia araliacea* (Mpoloni), *Thilachium africanum* (Mpotolozi), *Pseudolachnostylis maprouneifolia* (Msolo), *Albizia versicolor (Mtangatanga), Diplorhynchus condylocarpon* (Mthombozi), *Vitex doniana* (Mtonongoli), *Kirkia acuminata (Mtumbu), Diospyros senensis* (Mtungamchira), *Albizia harveyi* (Njenjete), *Acacia nigrescens* (Nkunkhu), *Sterculia quinqueloba, Flacourtia indica* (Nthudza), *Lonchocarpus bussei* (Ntswaswa), *Dalbergia melanoxylon* (Phingo), *Brachystegia floribunda* (Tsamba)

Zomba	VH Chiganga	*Julbernardia globiflora* (Kamphoni, Mchenga) *and Brachystegia boehmii* (Chiyomboa, Mombo, Msendaluzi)	*Combretum fragrans* (Chinama), *Pterocarpus rotundifolius* (Mbalitsa), *Combretum zeyhri* (Chinama), *Bauhinia petersiana* (Phandula), *Diplorhynchus condylocarpon* (Mthombozi), *Dombeya rotundifolia* (Naduwa), *Combretum apiculatum* (Kakunguni), *Mundulea sericea* (Lusyunga), *Diospyros kirkii* (Chitete), *Sterculia appendiculatum* (Njale), *Strychnos spinosa* (Mteme), *Acacia tortilis* (Nsangunsangu), *Commiphora marlothii* (Timbilimbuche), *Catunarigum spinosa* (Chipembere), *Lonchocarpus capassa* (Mphakasa), *Rauvolfia caffra* (Mwimbi), *Terminalia stenostachya* (Chikuliungu), *Dalbergia melanoxylon* (Phingo), *Ormocarpum kirkii* (Msungachuma), *Sterculia quinqueloba* (Msetanyani)	*Bobgunnia madagascariensis* (Chinyenye), *Cartunarigum spinosa* (Chipembere), *Brachystegia longifolia* (Mombo), *Monotes africanus* (Kakatuku), *Ochna arborea* (Kundaguluwe), *Pariari curatellifolia* (Maula), *Burkea africana* (Mkalati), *Pterocarpus angolensis* (Mlombwa), *Uapaca kirkiana* (Msuku), *Brachystegia bussei* (Msumbuti), *Diplorhynchus condylocarpon* (Mthombozi), *Flacourtia indica* (Ndema)
	VH Sande			*Antidesma venosum* (Chidyapumbwa), *Acacia xanthophloea, Parinari curatellifolia* (Maula), *Pterocarpus rotundifolius* (Mbalitsa), *Vangueria infausta, Julbernardia globiflora* (Mchenga), *Dichnostachys cinerea, Vernonia amygdalina* (Mfutsa), *Burkea africana* (Mkalati), *Pterocarpus angolensis* (Mlombwa), *Lecaniodiscus flaxinifolius* (Mbewe), *Brachystegia longifolia* (Mombo), *Annona senegalensis* (Mpoza), *Pseudolachnostylis maprouneifolia* (Msolo), *Diplorhynchus condylocarpon* (Mthombozi), *Erythrina abyssinica* (Mulindimila), *Acacia nigrescens* (Nkunkhu), *Bauhinia petersiana* (Phandula), *Brachystegia floribunda* (Tsamba), *Bridelia micrantha* (Tsukamano)

Annex 4

Lists of expected species

Table 13. Dominant species expected in the Zomba-Malosa Liwonde forests		
Albizia antunesiana	*Faurea saligna*	*Pseudolachynostylis maprouneifolia*
Annona senegalensis	*Faurea speciosa*	*Psorospermum febrifugum*
Antidesma venosum	*Ficus capensis*	*Pterocarpus angolensis*
Bauhinia petersiana	*Ficus natalensis*	*Pterocarpus rotundifolius*
Bauhinia thonningii	*Ficus stumana*	*Rhoicissus revoilii*
Bobgunnia madagascariensis	*Flacourtia indica*	*Rhoicissus tridentate*
Brachystegia boehmii	*Garcinia buchananii*	*Rothmannia englerana*
Brachystegia bussei	*Gardenia manganjae*	*Rourea orientalis*
Brachystegia longifolia	*Hymenocardia acida*	*Securidaca longepedunculata*
Brachystegia speciformis	*Julbernardia globiflora*	*Senna petersiana*
Brachystegia utilis	*Kittia quenzii*	*Sepium ellipticum*
Bridelia cathartica	*Lannea discolor*	*Steganotaenia araliacea*
Burkea africana	*Macaranga capensis*	*Stereospermum kuthianum*
Catunaregam spinosa	*Maytenus heterophylla*	*Strychnos spinosa*
Combretum collinum	*Mononthotaxis chasei*	*Syzygium guineense*
Combretum fragrans	*Mundulia sericea*	*Terminalia stenostachya*
Combretum molle	*Ochna schweinfurthiana*	*Tetradenia riparia*
Cussonia arborea	*Olax dissitifolia*	*Turrea nilotica*
Cussonia stohlzii	*Olax obstusifolia*	*Uapaca kirkiana*
Dalbergia nitidula	*Ozoroa insigns*	*Uapaca nitida*
Dalbergia nyasae	*Parinari curatellifolia*	*Uapaca sansibarica*
Dichrostachys cinerea	*Pavetta schumanniana*	*Vangueria infausta*
Diospyros kirkii	*Pericopsis angolensis*	*Vernonia amygdalina*
Diplorrhynchus condylocarpon	*Phyllanthus discoideus*	*Vitex mombasaei*
Dombeya rotundifolia	*Pittospermum viridiflorum*	*Vitex payos*
Ekebergia benguelensis	*Pleurostylia africana*	*Xemenia caffra*
Elephantorrhiza goetzei	*Protea angolensis*	*Xylopia perviflora*
Erythrina abyssinica	*Protea gaugedii*	*Zanha Africana*
Dominant species expected in and around Neno Escarpment / Zalewa area		
Acacia galpinii	*Combretum imberbe*	*Ormocarpum kirkii*
Acacia goetzei	*Combretum molle*	*Ozoroa insigns*
Acacia nigrescens	*Combretum zeyhri*	*Pavetta schumanniana*
Acacia tortilis	*Commiphora marlothii*	*Pseudolachnostylis maprouneifolia*

Acacia xanthophloea	*Dalbergia melanoxylon*	*Pterocarpus angolensis*
Afzelia quanzensis	*Dalbergia nitidula*	*Pterocarpus rotundifolius*
Albizia antunesiana	*Dalbergiella nyasae*	*Rauvolfia caffra*
Azanza garkeana	*Dichrostachys cinerea*	*Sclerocarya birrea*
Bauhinia thonningi	*Diospyros kirkii*	*Senna singueana*
Bauhinia petersiana	*Diplorhynchus condylocarpon*	*Steganotaenia araliaceae*
Bersama abyssinica	*Dombeya rotundifolia*	*Sterculia appendiculatum*
Brachystegia boehmii	*Erythrina abyssinica*	*Sterculia quinqueloba*
Brachystegia boehmii	*Flacourtia indica*	*Sterospermum kunthianum*
Brachystegia stipulata	*Gridia kraussiana*	*Strychnos pungens*
Bridelia cathartica	*Hymenocardia acida*	*Strychnos spinosa*
Bridelia micrantha	*Ichrostachys cinerea*	*Syzgium cordatum*
Burkea africana	*Julbernardia globiflora*	*Terminalia sericea*
Catunaregam spinosa	*Keitii kenzae*	*Terminalia stenostachya*
Caturegan spinosa	*Lannea discolor*	*Turrea nilotica*
Colophospermum mopane	*Lonchocarpus bussei*	*Vangueria infausta*
Combretum apiculatum	*Lonchocarpus capassa*	*Vitex payos*
Combretum fragrans	*Mundulia sericea*	*Ximenia caffra*
Dominant species expected in and around Dzalanyama Forest Reserve		
Anisophylla pomifera	*Cussonia arborea*	*Parinari guineense*
Brachystegia bussei	*Faurea saligna*	*Pericopsis angolensis*
Brachystegia floribunda	*Faurea speciosa*	*Protea petiolaris*
Brachystegia longifolia	*Julbernardia paniculata*	*Pseudolachynostylis maprouneifolia*
Brachystegia speciformis	*Maprounea africana*	*Strychnos spinosa*
Brachystegia utilis	*Momotes africanus*	*Uapaca nitida*
Burkea africana	*Ochna schweinfurthiana*	*Vitex doniana*
Combretum molle		
Dominant species expected in Thuma Forest – Plateau area		
Brachystegia boehmii	*Combretum spp*	*Khaya anthotheca*
Brachystegia floribunda	*Faurea spp*	*Pterocarpus spp*
Brachystegia utilis	*Julbernardia globiflora*	

Annex 5

Species composition densities

Table 14. Charcoal production study – various species, indices and analysis

Location: Choma VH Chibisa, TA Mtwalo

Botanical name	Local name	No. recorded	Relative density	Basal area m^2 / ha	Relative dominance	Importance value
Brachystegia boehmii	Chiyombo	30	12.50	1.4994	34.95	47.45
Uapaca kirkiana	Msuku	25	10.42	1.2374	28.84	39.26
Julbernardia globiflora	Kamphoni	22	9.17	0.5096	11.88	21.05
Faurea saligna	Chiyele	17	7.08	0.2244	5.23	12.31
Brachystegia utilis	Kavwenje	7	2.92	0.2096	4.89	7.80
Monotes africanus	Mkalakati	37	15.42	0.1386	3.23	18.65
Pariari curatellifolia	Muula	1	0.42	0.0852	1.99	2.40
Aguaria salicifolia	Mzyozo	1	0.42	0.0444	1.03	1.45
Erythrina abyssinica	Mubale	5	2.08	0.0376	0.88	2.96
Lannea schimperi	Kaumbu	3	1.25	0.0336	0.78	2.03
S. coerulescens	Musimbwi	3	1.25	0.0346	0.81	2.06
Ochna leptoclada	Phatwe	4	1.67	0.0186	0.43	2.10
Syzygium cordatum	Katope	5	2.08	0.0154	0.36	2.44
Albizia antunesiana	Kawizi	1	0.42	0.0071	0.17	0.58
Brachystegia manga	Mufolya	1	0.42	0.0078	0.18	0.60
	Unknown	4	1.67	0.0115	0.27	1.93
Syzygium owariense	Chifuwu	1	0.42	0.0044	0.10	0.52
Dalbergia nitidula	Mvungwe	2	0.83	0.0231	0.54	1.37
Brachystegia speciformis	Mpapa	7	2.92	0.1318	3.07	5.99
	Mulama	64	26.67	0.0159	0.37	27.04
Totals		**240**	**100.03**	**4.2900**	**100.00**	

Note: totals may not equal exactly 100 due to rounding

Location: Choma VH Kampeya, TA Mbwana

Botanical name	Local name	No. recorded	Relative density	Basal area m^2 / ha	Relative dominance	Importance value
Brachystegia boehmii	Chiyombo	69	29.74	1.2925	26.63	56.37
Uapaca kirkiana	Msuku	56	24.14	1.0468	21.57	45.71
Pariari curatellifolia	Muula	29	12.50	0.5677	11.70	24.20
Brachystegia manga	Mufolya	18	7.76	0.4760	9.81	17.57
Julbernardia longifolia	Mtondo	9	3.88	0.2629	5.42	9.30
Aguaria salicifolia	Mzyozo	11	4.74	0.2970	6.12	10.86
Brachystegia speciformis	Mpapa	9	3.88	0.2280	4.70	8.58
Faurea saligna	Chiyele	13	5.60	0.1901	3.92	9.52
Vitex doniana	Mahuhu	2	0.86	0.0139	0.29	1.15
	Mnjeyi	3	1.29	0.1363	2.81	4.10
Ozoroa insignis	Chifutwe	6	2.59	0.1582	3.26	5.85
Erythrina abyssinica	Mubale	1	0.43	0.0683	1.41	1.84
Ximenia caffra	Mthunduluka	1	0.43	0.0135	0.28	0.71
Protea gaguedi	Nkhulukulu	1	0.43	0.0133	0.27	0.71
Combretum apiculatum	Mulama	1	0.43	0.0625	1.29	1.72
	Kamphalakasya	1	0.43	0.0075	0.15	0.59
Syzgium cordatum	Katope	1	0.43	0.0099	0.20	0.64
	Mavilinombwa	1	0.43	0.0085	0.20	0.61
Totals		**232**	**99.99**	**4.8529**	**100.03**	

Note: totals may not equal exactly 100 due to rounding

Location: Thuma Forest Reserve GVH Chinkhowe Area

Botanical name	Local name	No. recorded	Relative density	Basal area m^2 / ha	Relative dominance	Importance value
Bauhinia petersiana	Mphando	99	37.36	0.7203	20.81	58.17
Acacia polyacantha	Mthethe	68	25.66	1.0057	29.06	54.72
Combretum fragrans	Kadale	22	8.30	0.2888	8.35	16.65
Combretum colinum	Mkhute	16	6.04	0.1218	3.52	9.56
Cassia singueana	Ntanthanyerere	1	0.38	0.2932	8.47	8.85
Lonchocarpus capassa	Chimphakasa	5	1.89	0.2237	6.46	8.35
Bauhinia thonningi	Chitimbe	3	1.13	0.0862	2.49	3.62
Sclerocarya caffra	Mfula	3	1.13	0.0834	2.41	3.54
Diplorhynchus condylocarpon	Mthombozi	8	3.02	0.0872	2.52	5.54
Zizyphus mucronata	Kankhande	4	1.51	0.0453	1.31	2.82
Strychnos innocua	Mzaye	3	1.13	0.0537	1.55	2.68
Brachystegia utilis	Nzale	5	1.89	0.0279	0.81	2.69
Annona senegalensis	Mpoza	4	1.51	0.0376	1.09	2.60
Vitex mombassae	Mtonongoli	1	0.38	0.0765	2.21	2.59
Lannea discolour	Chiumbu	4	1.51	0.0298	0.86	2.37
Brachystegia longifolia	Mombo	1	0.38	0.0697	2.01	2.39
Albizia zimmermanii	Mkolankhanga	2	0.75	0.0417	1.21	1.96
Sterospermum kunthianum	Kavunguti	2	0.75	0.0333	0.96	1.72
	Mtukunkhuti	2	0.75	0.0291	0.84	1.60
Markhamia obstusifolia	Nsewa	3	1.13	0.0162	0.47	1.60
Pterocarpus angolensis	Mlombwa	1	0.38	0.0338	0.98	1.35
	Mthimbiri	2	0.75	0.0194	0.56	1.32
Dichrostachys cinerea	Kalimphangale	2	0.75	0.0062	0.18	0.93
Albizia antunesiana	Mpepe	1	0.38	0.0131	0.38	0.76
	Mthombozichipeta	1	0.38	0.0108	0.31	0.69
Dalbergia nitidula	Mkulasinga	1	0.38	0.0041	0.12	0.50
Vernonia amygdalina	Futsa	1	0.38	0.0020	0.06	0.44
Totals		**265**	**100.00**	**3.4605**	**100.00**	

Note: totals may not equal exactly 100 due to rounding

Location: Thuma Forest Reserve GVH Mlamba Area

Botanical name	Local name	No. recorded	Relative density	Basal area m^2 / ha	Relative dominance	Importance value
Acacia polyacantha	Mthethe	51	24.29	0.5444	32.47	56.76
Vernonia amygdalina	Futsa	63	30.00	0.3944	23.53	53.53
Bauhinia thonningi	Chitimbe	18	8.57	0.1221	7.28	15.85
Zizyphus mucronata	Kankhande	13	6.19	0.0621	3.70	9.89
	Binu	5	2.38	0.1130	6.74	9.12
Ficus capensis	Mkuyu	3	1.43	0.1052	6.28	7.70
Markhamia obstusifolia	Nsewa	11	5.24	0.0419	2.50	7.74
Psorospermum febrifugum	Mtsiloti	9	4.29	0.0277	1.65	5.94
Trichilia emetica	Msikidzi	7	3.33	0.0280	1.67	5.00
	Mphambe	5	2.38	0.0240	1.43	3.81
Pittosporum viridiflorum	Kakunguni	5	2.38	0.0203	1.21	3.59
Vangueria infausta	Mzilu	4	1.90	0.0285	1.70	3.60
Bridelia micrantha	Mpasa	1	0.48	0.0480	2.86	3.34
Sclerocarya caffra	Mfula	3	1.43	0.0269	1.60	3.03
Rauvolfia caffra	Mwimbi	2	0.95	0.0344	2.05	3.00
Parkia filicoidia	Mkundi	1	0.48	0.0249	1.49	1.96
Diospyros batocana	Mdima	2	0.95	0.0050	0.30	1.25
Flacourtia indica	Nthudza	2	0.95	0.0089	0.53	1.48
	Mnyungo	1	0.48	0.0054	0.32	0.80
	Kapatagwilire (Linguzi)	1	0.48	0.0033	0.20	0.67
Uapaca nitida	Mdyambawala	1	0.48	0.0038	0.23	0.70
Annona senegalensis	Mpoza	1	0.48	0.0021	0.13	0.60
Kigelia Africana	Mvunguti	1	0.48	0.0021	0.13	0.60
Totals		**210**	**100.02**	**1.6764**	**100.00**	

Note: totals may not equal exactly 100 due to rounding

Location: Dzalanyama Forest Reserve, Kaundu Hill

Botanical name	Local name	No. recorded	Relative density	Basal area m^2 / ha	Relative dominance	Importance value
Julbernardia globiflora	Kamphoni	39	40.21	1.5926	58.27	98.48
Brachystegia longifolia	Mombo	9	9.28	0.3803	13.91	23.19
Pseudolachnostylis maprouneifolia	Msolo	12	12.37	0.1907	6.98	19.35
Erythrophleum africanum	Kawidzi	9	9.28	0.1492	5.46	14.74
Faurea intermedia	Chipemphe	7	7.22	0.0991	3.63	10.84
	Mazonozono	5	5.15	0.0784	2.87	8.02
Strychnos innocua	Maye	6	6.19	0.0418	1.53	7.71
Combretum molle	Kadale	2	2.06	0.0452	1.65	3.72
Burkea Africana	Mkalati	1	1.03	0.0560	2.05	3.08
Brachystegia boehmii	Msendaluzi	1	1.03	0.0456	1.67	2.70
Pittosporum viridiflorum	Kakunguni	2	2.06	0.0095	0.35	2.41
Diplorhynchus condylocarpon	Mthombozi	1	1.03	0.0154	0.56	1.59
Uapaca nitida	Kasokolowe	1	1.03	0.0059	0.22	1.25
	Msukwa	1	1.03	0.0080	0.29	1.32
Uapaca kirkiana	Msuku	1	1.03	0.0154	0.56	1.59
Totals		**97**	**100.00**	**2.7331**	**100.00**	

Note: totals may not equal exactly 100 due to rounding

Location: Neno/ Lisungwe/ Malimba Mpinguafisi Area / Lola Hill

Botanical name	Local name	No. recorded	Relative density	Basal area m^2 / ha	Relative dominance	Importance value
Combretum zeyhri	Chinama	44	17.46	0.3922	9.53	27.0
Diplorhynchus condylocarpon	Mthombozi	35	13.89	0.4345	10.56	24.4
Pterocarpus rotundifolius	Mbalitsa	18	7.14	0.3102	7.54	14.7
	Ntchochi	24	9.52	0.1789	4.35	13.9
Acacia nigrescens	Nkunkhu	10	3.97	0.3607	8.76	12.7
Sterculia quinqueloba	Nsetanyani	4	1.59	0.4384	10.65	12.2
Brachystegia floribunda	Tsamba	7	2.78	0.2784	6.76	9.5
Kirkia acuminate	Mtumbu	5	1.98	0.2582	6.27	8.3
Pittosporum viridiflorum	Kakunguni	11	4.37	0.1542	3.75	8.1
Bauhinia petersiana	Mphando	15	5.95	0.0669	1.63	7.6
Cassia abbreviata	Mnyoka	9	3.57	0.1266	3.08	6.6
	Katsachi	6	2.38	0.0783	1.90	4.3
Albizia versicolor	Mtangatanga	3	1.19	0.1287	3.13	4.3
Commiphora africana	Khobo	3	1.19	0.1159	2.82	4.0
	Mthotho	7	2.78	0.0360	0.87	3.7
Albizia harveyi	Njenjete	2	0.79	0.1189	2.89	3.7
	Mthonji	1	0.40	0.0452	1.10	3.5
Pseudolachnostylis maprouneifolia	Msolo	4	1.59	0.0742	1.80	3.4
Lonchocarpus bussei	Ntswaswa	4	1.59	0.0735	1.79	3.4
Lannea stulmanii	Chilusa	2	0.79	0.0669	1.63	2.4
	Sopomtengo	4	1.59	0.0279	0.68	2.3
Markhamia obstusifolia	Katsongole	4	1.59	0.0267	0.65	2.2
Sclerocarya caffra	Mfula	1	0.40	0.0745	1.81	2.2
Vitex doniana	Mtonongoli	2	0.79	0.0584	1.42	2.2
Brachystegia manga	Chituwa	5	1.98	0.0184	0.45	2.0
Xeroderris stuhlmanii	Mlonde	2	0.79	0.0353	0.86	1.7
Cartunarigum spinosa	Chipembere	3	1.19	0.0096	0.23	1.4
	Gangatwa	3	1.19	0.0076	0.18	1.4
Dalbergia melanoxylon	Phingo	2	0.79	0.0205	0.50	1.3
Baphia bequaertii	Mbawo	1	0.40	0.0241	0.59	1.0
Sterculia africana	Mgoza	1	0.40	0.0235	0.57	1.0
Pterocarpus angolensis	Mlombwa	2	0.79	0.0085	0.21	1.0
	Mapirakukutu	1	0.40	0.0097	0.24	0.6
	Mfukuza	1	0.40	0.0090	0.22	0.6
Steganotaenia araliacea	Mpoloni	1	0.40	0.0083	0.20	0.6
Diospyros senensis	Mtungamchira	1	0.40	0.0037	0.09	0.5
Flacourtia indica	Nthudza	1	0.40	0.0049	0.12	0.5
	Thimbiri	1	0.40	0.0053	0.13	0.5
	Mgonetsa	1	0.40	0.0012	0.03	0.4
Thilachium africanum	Mpotolozi	1	0.40	0.0021	0.05	0.4
Totals		**252**	**100.02**	**4.1160**	**100.04**	

Note: totals may not equal exactly 100 due to rounding

Location: Zomba Chingale/ Chimseu VH Chiganga Mandaamodzi Area

Botanical name	Local name	No. recorded	Relative density	Basal area m^2 / ha	Relative dominance	Importance value
Uapaca kirkiana	Msuku	49	44.95	0.8573	62.24	107.19
Monotes africanus	Kakatuku	10	9.17	0.1339	9.72	18.89
	Tatalika	9	8.26	0.0624	4.53	12.79
Ochna arborea	Kundaguluwe	7	6.42	0.0425	3.09	9.51
Diplorhynchus condylocarpon	Mthombozi	6	5.50	0.0445	3.23	8.74
Cartunarigum spinosa	Chipembere	4	3.67	0.0592	4.30	7.97
Pariari curatellifolia	Maula	4	3.67	0.0192	1.39	5.06
Unknown		3	2.75	0.0329	2.39	5.14
Pterocarpus angolensis	Mlombwa	3	2.75	0.0244	1.77	4.52
Flacourtia indica	Ndema	4	3.67	0.0105	0.76	4.43
Brachystegia spp	Ntwana	3	2.75	0.0201	1.46	4.21
Brachystegia bussei	Msumbuti	3	2.75	0.0120	0.87	3.62
Brachystegia longifolia	Jombo (Mombo)	2	1.83	0.0236	1.71	3.55
Burkea Africana	Mkalati	1	0.92	0.0211	1.53	2.45
Bobgunnia madagascarensis	Chinyenye	1	0.92	0.0139	1.01	1.93
Totals		**109**	**99.98**	**1.3775**	**100.00**	

Note: totals may not equal exactly 100 due to rounding

Location: Zomba Thondwe VH Sande Davis Katsonga Forest Area, Leased Land

Botanical name	Local name	No. recorded	Relative density	Basal area m^2 / ha	Relative dominance	Importance value
	Mwanakali	12	10.08	0.1673	15.03	25.1
Diplorhynchus condylocarpon	Mthombozi	16	13.45	0.0905	8.13	21.6
	Zikhadabo za mkango	11	9.24	0.1203	10.81	20.1
Brachystegia floribunda	Tsamba	5	4.20	0.1714	15.40	19.6
Acacia xanthophloea	Chiombamuluzu	5	4.20	0.0895	8.04	12.2
Pterocarpus angolensis	Mlombwa	5	4.20	0.0686	6.16	10.4
Brachystegia stipulata	Mchenga	7	5.88	0.0391	3.51	9.4
	Nachumbu	7	5.88	0.0367	3.30	9.2
Vangueria infausta	Mbulukutuku	7	5.88	0.0332	2.98	8.9
Brachystegia longifolia	Mombo	4	3.36	0.0582	5.23	8.6
Pseudolachnostylis maprouneifolia	Msolo	5	4.20	0.0378	3.40	7.6
Annona senegalensis	Mpoza	6	5.04	0.0256	2.30	7.3
Antidesma venosum	Chidyapumbwa	4	3.36	0.0370	3.32	6.7
Dichnostachys cinerea	Mdulankwangwa	4	3.36	0.0358	3.22	6.6
Bridelia micrantha	Tsukamano	4	3.36	0.0174	1.56	4.9
Vernonia amygdalina	Mfutsa	3	2.52	0.0192	1.72	4.2
Lecaniodiscus fraxinifolius	M'Mbewe	3	2.52	0.0143	1.28	3.8
Acacia nigrescens	Nkunkhu	3	2.52	0.0147	1.32	3.8
Pterocarpus rotundifolius	Mbalitsa	2	1.68	0.0036	0.32	2.0
	Mkulukutu	1	0.84	0.0129	1.16	2.0
Burkea Africana	Mkalati	1	0.84	0.0069	0.62	1.5
Erythrina abyssinica	Mulindimila	1	0.84	0.0061	0.55	1.4
	Kam'mano	1	0.84	0.0032	0.29	1.1
Pariari curatellifolia	Maula	1	0.84	0.0020	0.18	1.0
Bauhinia petersiana	Phandula	1	0.84	0.0020	0.18	1.0
Totals		**119**	**99.97**	**1.1133**	**100.01**	

Note: totals may not equal exactly 100 due to rounding

Annex 6

Malawi urban energy study team

Technical Personnel

- Wellings Simwela, Imprest Administrator/IFMSLP & Convenor FGLG-Ministry of Environment and Natural Resources (Forestry Department)
- Bright Sibale, Environmental Specialist/ Technical Advisor, Forest Governance Learning Group
- Todd Johnson, Chief of Party, COMPASS II

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- Patrick Kambewa, Trade /Marketing Specialist- (Economist), Team Leader
- Bennett Mataya, Natural Resources Management Specialist (Forester)
- Killy Sichinga, Monitoring and Evaluation Specialist-USAID/COMPASS II

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- Iris Chupa

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- Magret Kunje (Field Supervisor)
- Judith Santhe
- Memory Chinyama
- Georgina Allih
- David Hassan
- Jacqueline Somba
- Rabecca Kamwendo
- Jessie Kasenda
- Helen Fatchi
- Susan Munthali
- Tiwonge Nkhonjera

Lilongwe Team

- Lucky Namisengo (Field Supervisor)
- Francis Chinyama
- Mary Sibale
- Precious Khonje
- Benson Mbughi
- Vanessa Isa. Simwela
- Isaac Bulangeti
- Gracious Lwesya
- Constance Pofera
- Estonic Kanyimbo

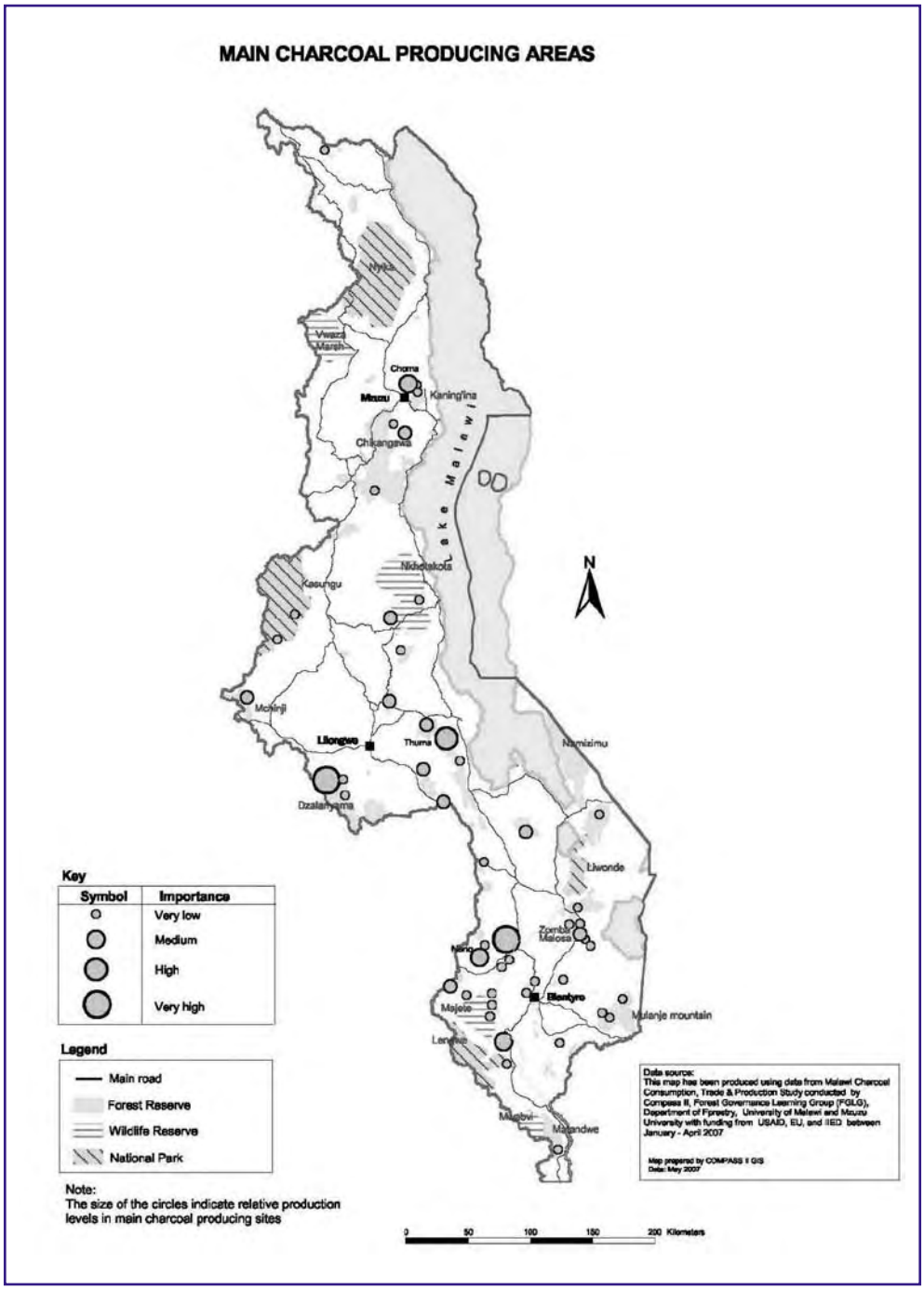
Mzuzu Team

- Ellen Tembo (Field Supervisor)
- Thokozani Chavula
- Annie Massah
- Usher Munthali

Zomba Team

- Harold Kuombola (Field Supervisor)
- Harriet Zammimba
- Praise Chiwambo
- Atupele Matewere

Map of production sites



Some local tree names

Botanical name	Local Name	Botanical name	Local Name
Acacia polyacantha	Mthethe	*Colophospermum mopane*	Tsanya
Brachystegia boehmii	Chiyombo, Mombo, Msendaluzi	*Diplorhynchus condylocarpon*	Mthombozi
Brachystegia floribunda	Tsamba	*Julbernardia globiflora*	Kamphoni
Brachystegia longifolia	Mombo	*Khaya anthotheca*	Mbawa
Brachystegia manga	Chitowe, Mufolya	*Mangifera indica*	Mango
Brachystegia speciformis	Mpapa	*Pterocarpus angolensis*	Mulombwa
Brachystegia sp	Kaluzi	*Rauvolfia caffra*	Mphakasa
Brachystegia stipulata	Mchenga	*Sterculia quinqueloba*	Msetanyani
Brachystegia utilis	Nzale, Kavwenji	*Uapaca kirkiana*	Msuku
Combretum colinum	Mkhute	*Vernonia amygdalina*	Futsa
Combretum zeyhri	Chinama		

Small and medium forestry enterprises for poverty reduction and sustainability

Most international attention in forestry has been given to improving the conditions for either large or micro-scale forestry, and much less to the 'messy middle' – which produces a high proportion of forest products and involves huge numbers of people. Ways need to be found by which small and medium forestry enterprises (SMFEs) can better contribute to sustainability and reducing poverty. IIED, with partners in Africa, Asia, Latin America and the Caribbean have been investigating these issues. Country studies show that the SMFE sector is of major significance for livelihoods – the net effect of these enterprises represents a substantial part of local economies. Yet, these are largely invisible economies, and policy and programme developments almost completely ignore the SMFE sector.

Raising the sector's visibility so that its impacts can be better assessed, and then going on to explore how the positive links to sustainability, livelihoods and poverty-reduction can be enhanced, is a major challenge to which this initiative seeks to rise.

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Series editor: Duncan Macqueen

Charcoal is potentially a renewable forest product. But current production and distribution methods in Malawi prevent reinvestment in the next cycle of harvest. Reversing the lack of incentives for reinvestment is a critical political and economic issue. As this study documents, the charcoal industry is one of the largest in Malawi; if the product was exported, the annual foreign exchange income to the country would fall somewhere between that of tea (Malawi's 2nd-largest export after tobacco in 2006) and sugar (3rd-largest). Charcoal is therefore a product with a very large domestic market, yet whose production is treated variously as either non-existent or illegal. The question that we hope this report stimulates as the core of a lively debate among government officials, parliamentarians, interested parties, and the general public is simple: "How do we want to produce this product to meet this market demand in a better manner?"

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