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Charcoal as a diversification strategy: The flexible role of charcoal production in the livelihoods of smallholders in central Mozambique

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Abstract

This paper presents a case study of charcoal producers supplying a small town in central Mozambique, as a contrast to the predominant focus of previous work on charcoal supply to major urban areas. It gives an in-depth account of the situations in which people produce charcoal, linking this to the role it plays in their livelihoods. Charcoal is made for a diverse set of reasons ranging from women wishing for financial autonomy from their husbands, through to gaining supplementary income from field opening. Those making charcoal have a wide range of livelihood strategies and produce in a wide range of situations. The findings counter the idea that charcoal production is a livelihood of last resort. Furthermore, the current de-facto licencing regime facilitates this diversity, but stands in contrast to the law. Enforcing the full requirements of the law would possibly reduce the flexible opportunities for income that charcoal provides for many households within the study area.

Keywords: charcoal, livelihoods, smallholders, woodfuel, Africa

1 Highlights

- First in-depth case study of charcoal producers supplying a small African town
- The situations in which people produce charcoal are highly variable, leading to different roles for charcoal within livelihood strategies.
- The flexibility of charcoal production as an income source is enabled by the informal nature of the local regulation.
- Women make a significant contribution to all stages of the charcoal production process. This contrasts with much of the existing literature on charcoal in sub-Saharan Africa.

2 Introduction

Fuelled by the preferences and demands of increasing urban populations (Girard 2002; Arnold et al. 2006; Maes and Verbist 2012), charcoal production continues to rise in sub-Saharan Africa (Bailis et al. 2005; IEA 2014). Charcoal's clean, even burn makes it popular with urban consumers (Ribot 1993), and it has become the principal energy source in the region's urban areas over the past couple of decades (Sander et al. 2013). In 2012, 36 million tonnes of charcoal with a market value of around \$11 billion was produced to fulfil this growing demand (IEA 2014). Charcoal is a key

contributor to the livelihoods of millions of people across the region. In Mozambique, for example, the number of people participating in the production, trade and sale of charcoal could be as high as 3 million - 15% of the population (Cuvilas et al. 2010). Roughly three-quarters of people employed within woodfuel markets are based rurally (Openshaw 2010) and up to 50% of revenues are retained in rural areas (IEA 2014).

Yet, despite these headline numbers, views about charcoal markets are still primarily shaped by older worries of a woodfuel crisis and (energy) modernisation narratives (Ribot 1999; Mwampamba et al. 2013; Owen et al. 2013). This leads to a negative attitude towards charcoal production as a livelihood. The pervasive caricature of a charcoal producer is that of a man, poor in productive assets and land (Arnold et al. 2006; Mugo and Ong 2006; Ainembabazi et al. 2013; Bekele and Girmany 2013), with less access to agricultural markets and no alternative income (SEI 2002; Arnold et al. 2006; Openshaw 2010; Ainembabazi et al. 2013; Zulu and Richardson 2013). In short, charcoal production is seen as a “last-resort type of livelihood activity” (Cavanagh et al. 2015, p. 77), for those “without much alternative” (Bekele and Girmany 2013, p. 19). Thus, making charcoal is framed as a safety net (Arnold et al. 2006), a shift in strategy as agriculture becomes a less reliable income source (Levy and Kaufman 2014) or a support to income in households with lower agricultural capacity (Luoga et al. 2000). Using this framing, participation in charcoal (and woodfuel markets more generally) is thought to oscillate inversely with agricultural labour demands and fluctuate with urban job opportunities and crop incomes (Gandar 1992; Townson 1995).

However, a nascent cluster of literature on charcoal is beginning to consider the role of charcoal in rural livelihoods from a more optimistic perspective (Arnold et al. 2006; Shively et al. 2010; Mwampamba et al. 2013; Owen et al. 2013, Khundi et al. 2011; Zulu and Richardson 2013; Schure 2014). For these authors, whilst agricultural strategies may be different for charcoal producers, this difference is not necessarily due to varying land availability or agricultural capacity (Khundi et al. 2011). They argue that rather than charcoal production being the preserve of the poor, people make charcoal across a wide range of income levels, leading to higher incomes than comparable non-producing households and lower poverty rates amongst producers (Khundi et al. 2011; Ainembabazi et al. 2013). Charcoal is framed as a livelihood diversification strategy for smallholders rather than simply a “stop-gap”, “safety-net” or “livelihood of last resort” (Chileshe 2005; Zulu and Kalipeni 2009; Ainembabazi et al. 2013; Schure 2014).

Knowledge about charcoal market participation is highly contextual (Ros-Tonen and Wiersum 2005; Schure et al. 2014). Yet, the majority of work on the role of charcoal in rural livelihoods focuses on a specific context: commodity chains and producers supplying principal cities (Ribot 1993; Brouwer and Magane 1999; SEI 2002; Kambewa et al. 2007; Shively et al. 2010; Sander et al. 2013). This focus is fairly unsurprising; large urban areas consume a lot of charcoal. But the preoccupation with large cities and the role of charcoal production in forest loss around them has two major impacts. Firstly, it leaves knowledge about commodity chains to be extrapolated to cover large areas, undermining academic understanding of woodfuel sustainability by overestimating extraction and ignoring regional variation in modes of production (Gao et al. 2011; Bailis et al. 2015). Secondly, it leads to the impression that large commercial producers, working with hired labour, dominate charcoal commodity chains. This is not the case (Leach and Mearns 1988; Kambewa et al. 2007; Schure et al. 2014), but due to the diffuse and intermittent nature of production amongst smaller producers, less

is known about the dynamics of their market participation and the role of charcoal in their livelihoods (Kinyanjui 1987; Kambewa et al. 2007).

Alongside the increasing consumption in major cities, the increasing use of charcoal in small and medium sized urban areas is particularly striking (Girard 2002). A large proportion of Africa's urban growth is projected to be absorbed by settlements with under one million inhabitants (United Nations 2014), and will be accompanied by increasing charcoal consumption in these urban areas (Ibid.). Despite this trend, few data exist on charcoal producing areas supplying such towns and cities (Smith et al. 2015). To counter this, we provide here an in-depth look at charcoal producers supplying a small town of 30,000 people in central Mozambique. The majority of these producers only make charcoal sporadically, on an ad hoc basis. Using a case study approach, we document the diversity of charcoal production through a mixture of qualitative and quantitative methods and explore the roles that charcoal takes within producers' livelihoods. The following questions provide a guiding framework for the case that follows:

- 1) What is the history and livelihood context of charcoal production in the study area?
- 2) In which situations do people produce charcoal, and why?
- 3) How do these situations link to the role that charcoal plays within rural livelihoods?

A common approach in studies of charcoal producers is to infer "why" charcoal is produced from quantitative household surveys. This approach is powerful when describing who producers are, but weaker for understanding the "why" of charcoal production. Such an approach tends towards inferring post-hoc, that because a household is characterised by certain features (i.e. less agricultural capacity), charcoal must take a certain role within their livelihood strategies. To avoid this, we focus directly on the situations in which charcoal is produced. These production situations are understood through qualitative analysis and linked to information about prevalence through a household survey.

The paper starts with an overview of the case study area, followed by a brief methodology. The results follow the questions outlined above, before the discussion hones in on the role charcoal plays for smallholders, tying this back into overarching debates on the place of woodfuels within rural livelihoods. Particular focus is placed on what this case study of a small town might say about such debates.

3 Study area and communities

Community A¹ lies in Manica Province in central Mozambique. It is around 50 kilometres away from a small market town (Town A) of around 30,000 people (Republico do Moçambique 2005). Community A covers most of a single administrative post which is home to around 16,000 people (Ibid.) and encompasses four chieftaincies.

Like much of the district, the study communities suffered in both the Zimbabwean Liberation Struggle and the Mozambican Civil War. The vast majority of the population fled over the border in

¹ As charcoal production occurs across a full spectrum of formality and legality (Cavanagh et al. 2015), it remains a highly sensitive topic in the area. In agreement with the study communities and stakeholders within the charcoal commodity chain, steps have been taken to anonymise the communities involved, in order to minimise the possibility of identifying research participants.

'80s, returning in the early '90s and this influx has been fairly consistent, but pulses of migration from Zimbabwe as economic strife across the border took hold in the later '00s.

The majority of residents in the study area consider themselves farmers, almost all of whom rely on rain-fed agriculture (see methods section and table 1 for the sources of the information in this section). The warm, wet season spans October/November to March/April, and as a result planting coincides with this pattern; the rest of the year is comparatively cool and dry. Households generally cultivate 1-2 hectares, with their crops and cropping practices diverse. Everyone however, grows some variety of maize. This is often supplemented with a "garden" - a bamboo-fenced, area of naturally wetter land set aside for horticulture. There are varying mixes of commercial focus, ranging from some farmers who regularly sell or plant a cash-crop (typically soya) whilst others sell and trade depending on their needs and yields. There are limited opportunities for wage employment².

Households tend to dwell in scattered *mushas*, or homesteads. Most *mushas* are closely tied to their fields, or *machambas*. Local forms of tenure provided for under Mozambican law dominate, with parcels of land distributed via the chief and in negotiation with neighbours. These forms of tenure, as elsewhere in the province, are complex, multi-faceted and overlapping (Walker 2012) and create a patchwork landscape. Most families have woodland at the edges of their *machambas* and do not have to travel far for firewood³, fruit and most construction materials. A variety of norms regarding the use of forest resources overlap in the woodland areas. The woodlands are a common pool resource for prevalent local fruits, mushrooms and insects, though private usage rights apply to the trees themselves as well as certain foraged foods and materials. The local agricultural department classifies the woodland as "*Uapaca-Parinari*" named after two dominant local species *Uapaca kirkiana* and *Parinari curatellifolia*, though much of flora and fauna is typical of the wider miombo eco-region (Campbell 1996).

4 Methodology

4.1 General approach

This paper draws on nine months of living and researching in Manica Province, Mozambique undertaken in 2013 and 2014. The first author resided in the study area throughout the majority of the fieldwork period. The methodological approach was mixed, consisting of unstructured and semi-structured interviews conducted across the charcoal commodity chain; group interviews with key stakeholders, and; a household survey within Community A. These methods are reinforced and contextualised by ethnographic fieldwork both within Community A and in other areas providing charcoal for Town A. For a table documenting the information provided by each method, see table 1.

4.2 Methods

After an initial period of ethnographic fieldwork in charcoal supplying areas around Town A, in-depth semi-structured interviews were undertaken with charcoal (n= 22) and non charcoal producing households (n = 42). These initial interviews provided a backdrop for characterising Town A's

² Farm labour is still predominantly based on reciprocal exchange, though a small subset of farmers do hire labour for clearing.

³ Despite the prevalence of charcoal making in the area, use in community A is rare (5% of the sample in the last 30 days).

charcoal market and covered livelihoods, agricultural and charcoal producing practices and perceptions about resource access.

Data from interviews along the charcoal commodity chain of Town A informed the selection of Community A. This commodity chain analysis included semi-structured and unstructured interviews with producers, community members, local authorities, transporters and charcoal sellers. It also outlined the commodity chain and determined the differing areas that supplied charcoal to Chimoio and Town A. Interviews with regulatory authorities were conducted at the end of the study. This step was taken in order to minimise potential concern among local producers. A local charcoal trader was also invited to sit in on the interviews at the Department of Agriculture in order to minimise stakeholder concerns regarding our interest in their patterns of trading and to provide transparency to the research process.

The local department of agriculture kindly allowed access to its historical licensing receipts for charcoal. These receipts cover the period from November 2011 to June 2014. Quantity, provenance and date information were recorded for all available license receipts ($n=495$). A random sub-sample of 100 was digitised in their entirety including the gender of licensee and cost of the licence. Further statistical information on charcoal licencing and production at the provincial level was provided by the provincial forestry department.

4.3 Questionnaire survey

A questionnaire survey of 235 households in community A was conducted in July 2014. Due to the dispersed nature of the community, a traditional “village-based” sampling strategy was not possible. Instead, three study areas were defined by drawing ‘catchments’ around three key trading posts. Catchments were defined by the distances that households would likely travel to for basic goods (soap and salt). Once defined, these catchments were subsequently refined in conjunction with a focus group of local leaders to create the final three study areas. The three study areas correspond, in part, to local chieftaincies and all were involved in supplying charcoal exclusively to Town A. During the interview process, households were given the opportunity to self-identify to a geographic area and define which trading post they travelled to. This enabled us to cross-verify our original sampling design.

Using high-resolution satellite imagery, all households were geolocated and 30% from each study area were selected by simple random sampling, creating a sample of 235 households in total. Out of these, 201 households were interviewed. Three refused, in part related to worries regarding the subject matter of the questionnaire and 31 households were other mistakenly tagged buildings or abandoned houses.

The household survey was carried out during July 2014. Interviews were predominantly conducted in chiManyika and Portuguese. The questionnaire sought basic information on family structure, livelihoods, fields and agricultural strategies. More detailed questions concentrated on the opening of new agricultural fields and charcoal production, including ranking exercises about decision making when clearing land. Respondents were asked questions on the situations in which the household made charcoal, derived from categories developed in focus groups within community A. The focus groups developed three, overlapping, non-exclusive situations in which charcoal was produced: “as

part of the process of opening a new field”, “as a key livelihood” and “when the household needs cash”. These situations were later ranked by interviewees within the household questionnaire, in order to best describe their own charcoal production situation. These production situations are used to summarise the quantitative data within the results section. Following the conclusion of the survey a subset of ten charcoal making households were re-visited for in-depth qualitative interviews. This enabled better triangulation between the qualitative and quantitative data.

Quantitative data analysed used SPSS v 22.1 (IBM Corporation, New York). Chi-square tests were used to test for associations amongst categorical variables (e.g. between production situations and gender). T-tests were used for understanding differences between male and female licensees. Standard errors of proportions and standard error of means are indicated via the \pm symbol.

Method	Data used in this paper	Conducted
Ethnography and initial semi-structured interviews	The charcoal production process, land-use patterns and history, historical context, relation between key groups, gendered attitudes towards crops, attitudes towards charcoal as a livelihood	August-December 2013
Commodity chain analysis	Sources of charcoal for Town A, relationship between key stakeholders, governance and access to the charcoal market	May-June 2014, November 2013
Focus groups	Attitudes towards charcoal, types of production situation, gender and charcoal production, seasonal patterns of income	June 2014
Survey	Prevalence information relating to charcoal and charcoal practices, household characteristics	July 2014
Follow up interviews	Gendered aspects of charcoal production, attitudes towards charcoal as a livelihood, charcoal production practices	July 2014
Key stakeholder interviews	Governance and regulation of the charcoal market, historical context of market development, sources and forms of production, licencing data and production statistics	July-August 2014

Table 1 Data types and range categorised by source method

5 Results

5.1 Local charcoal production: The context

Charcoal making is widespread within Community A; 44% \pm 7% of households made charcoal within the past 12 months. Despite the considerable numbers producing charcoal it is an activity that has grown to its current state only over the last 5 years.

Between 2012 and 2014, the administrative post which contains Community A provided around a quarter of the licensed volume of charcoal arriving in Town A. Charcoal is formally regulated under the Mozambican forest law (GOM Forest Law, 1999; Decree No. 12/2002 and subsequent modifications e.g., Decree no. 30/2012), but most producers in this study area operate without licences. Changes in the requirements for an ordinary licence in the 2012 Forest Law (Government of Mozambique 2012) stipulated increased land-use planning and an increase in tax from 10 MZN to 60 MZN per stere⁴ of charcoal (\$0.22-\$1.32). This led to the complete cessation of licenced charcoal entering Town A. The impact is underscored by an 80% reduction in the number of sacks licenced in Manica province the following year. Interviewees at the district department of agriculture and with producers described the situation as untenable, and within months local agricultural departments reverted back to the previous cost structure without any of the 2012 law's other management requirements. Under this de-facto, informal, licencing regime wholesalers in Town A purchase licences for transporting charcoal, removing the tax burden on producers. Thus the licencing process in the district and within the wider Manica Province stands in contrast to Southern Mozambique where the licencing regime is applied as written.

Concern amongst the local traditional authorities about forest loss and a movement away from "traditional" patterns of livelihoods led to the regulation of charcoal by the local chiefs. Within one chieftaincy, production is allowed only as part of opening up of new fields; in others, total bans on production were only lifted in 2013.

5.1.1 The charcoal commodity chain and production process

Charcoal is predominantly made on each household's own smallholding. However, 20% of producers made charcoal on borrowed land, mostly belonging to neighbours. Charcoal producers see the work as hard and risky to their health. "The more you burn the older you grow", according to one producer. Unsurprisingly, given the physical nature of the work, the labour burden is shared; a third (n=29) of producing households enlist help from family, friends or neighbours from outside the household during the charcoal making process. According to group interviews and the survey data, reciprocal labour exchanges amongst friends and family when clearing land or stacking kilns are common, as are profit sharing agreements.

Areas for placing a kiln are selected by weighing up soil fertility (if clearing for a new field), abundance and size of preferred charcoal making species and proximity to existing fields (Jones, In prep.). After an area has been chosen, trees are either selectively harvested around a strategically placed kiln or entire areas are clear felled. A common approach is to combine these methods, clear

⁴ Widely interpreted as one sack of charcoal by forest department officials.

felling a smaller area and supplementing the kiln with higher diameter charcoal making species from around the fringes. This is often done as part of the process of extending an existing field.

Trees are felled by axe. Musasa (*Brachystegia spiciformis*) dominates the charcoal mix and is used by 81% of producers. Mufuti (*Brachystegia boehmii*) is also used (by 21% of producers). If clear felling, a wider species mix is often used, including some species with a lower wood density avoided by better informed producers. Group interviews suggested the use of edible fruit trees such as Muzanje (*Uapaca kirkiana*) is generally frowned upon.

Once felled, trunks are tightly stacked between two sets of supporting poles, sometimes including a tree that has been left standing. The kilns can reach 2 meters high and up to 20 meters in length, though group interviews suggested an average of around 5 meters long. After drying for around 2 weeks, trunks can be covered with small green branches, grass or occasionally horticultural waste. The kiln is then covered in earth, with a hole left in the top to enable ignition. As the smoke changes colour from the kiln, this is then sealed. After what is described by producers as “a good burn”, a 5 m kiln can yield around 25 sacks of approximately 40kg each. This is significantly reduced if the kiln coating develops large breaks. Too quick carbonisation will lead to fine material, not of use for selling. As a result, lit kilns need a lot of attention and most are positioned close to the homestead.

After a few days to a week, depending on the kiln size, the charcoal is then dug out from one end of the kiln. Ideally the finished product should be heavy enough to indicate a good source wood, but not so heavy as to indicate a large amount of moisture. A sheen is also indicative of a good quality. The lumps of charcoal are then stuffed into sacks extended with a combination of bark string and sticks. Sacks produced are bought by traders from locally arranged pick up points or are taken on public transport in small quantities. Traders pay 60-80 MZN (\$1.37-\$1.83) for each sack in Community A, which is 30-40% of the final retail price in the town (200 MZN)⁵. Alternatively, taking charcoal on public transport costs 30 MZN/sack (\$0.69). This relies on a loophole in the Mozambican law, which allows small quantities of charcoal (3-5 sacks) to be produced (and transported) without license for “personal consumption”. Thus charcoal travelling in this manner is unlikely to be taxed and the produce can be sold on for the full retail price in Town A.

5.2 Charcoal production situations

Approximately half of producers (48 ± 10 %) make charcoal as “part of the preparation of a new field”, 32 ± 9 % as a “key livelihood” and 21 ± 8 % “when the household needs cash”. Across the production situations, households are similar in terms of size, age and have similar proportions of principally female decision makers (although non-producing households are slightly more likely to have principally female decision makers) (Table 2). There were differences in some aspects of household agricultural practices (e.g. proportion planting purchased maize varieties, which focus groups suggested as a prosperity indicator) and ownership of high-value cash assets (represented here by percentage ownership of solar panels) (Table 2). Women’s involvement in charcoal production varies across the different production situations. The production situations also show differences in the frequency and quantity of production (Table 2).

⁵ This is in line with findings from elsewhere in the Beira corridor (Siteo et al. 2007) but in contrast to areas supplying Maputo, where retail prices are much higher.

		N=42	N=27		N=19	N=113			
		PRODUCTION SITUATION						NOT PRODUCING	
		Field		Livelihood		Cash			
		Mean	SE	Mean	SE	Mean	SE	Mean	SE
hh structure	Household size (#members)	7.5	0.66	6.7	0.55	9.4	0.85	6.5	0.38
	Age of household (#years since formation) *	15.5	2.3	14.6	2.80	15.6	2.00	14.4	1.42
	Principally female decision makers (% hh)	12.2	9.9	11.1	11.9	10.5	13.8	17.3	7.0
	hhs using purchased maize seeds (%)	26.2	13.3	11.1	11.9	10.5	13.8	30.3	8.50
Wealth indicators	Livestock Units owned (TLU)	3.0	1	3.7	0.93	2.7	0.75	3.3	0.63
	Food poor (% hh) **	9.8	9.0	14.8	13.39	10.5	13.8	17.4	7.0
	Ownership of solar panels (%)	26.8	13.4	38.3	18.3	52.7	22.5	31.3	8.56
Charcoal production	Principally female producers (% hh)	11.9	9.8	14.8	13.39	57.9	22.2		
	Number of months produced	2.2	0.3	4.96	0.93	1.72	0.27		
	Sacks produced (#) ***	42.7	6.3	92.9	22.30	32.7	7.21		
	Most common second ranked production situation	Livelihood		Cash		Livelihood			

* Years since formation defined by time since the primary economic decision maker(s) left their parents home.

** Defined as households who reported that maize yields and incoming expenses had not been sufficient to meet the household's food requirements over the past year.

*** During the last felling event

Table 2 – Household characteristics divided by primary situation in which charcoal is produced: “as part of the process of opening a new field” (field), “as a livelihood” (livelihood) and “when the household needs cash” (cash). Non-producing households are included as a reference. Wealth indicators are based on focus group discussions and interviews.

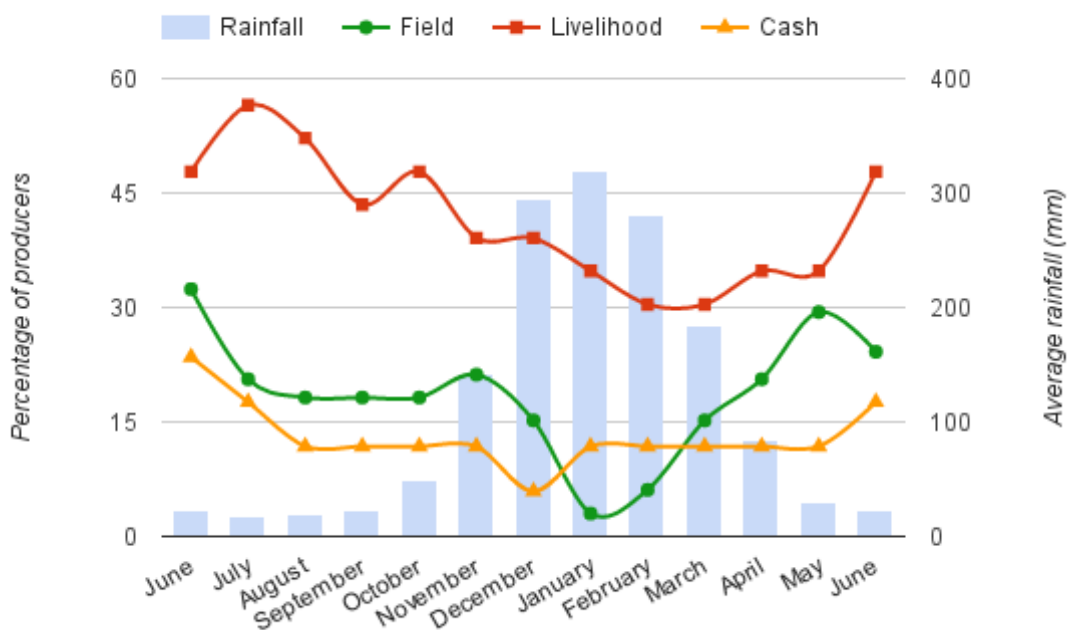


Figure 1: Percentage of producers producing in a given month categorised by primary production situation: “as part of the process of opening a new field” (field), “as a livelihood” (livelihood) and “when the household needs cash” (cash). The graph covers June 2013 to June 2014. Maize harvest is in April/May. Fields are usually opened between late April-July.

Who participates fluctuates across the year (Figure 2). The percentage of the sample households making charcoal in a given month varied from 13% and 6% across the study year. Lower levels of production coincide with the rainy season and the peaks with field clearing and the agricultural off-season. In $23 \pm 8\%$ of charcoal making households the production was done principally by women and in around $31 \pm 9\%$ of households’ production was principally done by men. Within the rest of the households ($46 \pm 10\%$), participation was a joint activity, with men and women participating equally. Notably, women were the main producers in households that produced within the “cash” production situation (Table 2).

The average number of months in which charcoal was produced was $3 (\pm 3)$. Within the sample $49 \pm 10\%$ of charcoal producers made charcoal in only one month over the past 12 months⁶. This production is fairly evenly spread across the year. $60 \pm 10\%$ of households had a member produce in two consecutive months, a figure which rises to $73 \pm 9\%$ for three consecutive months. This suggests that, for most households, charcoal production is a “one off” occurrence during the year. Drawing lines between regular production, ad-hoc production and the importance of charcoal to the household is difficult. One regular producer framed this distinction as “Our *business* is agriculture; we burn [make] charcoal for pleasure”. This statement hints at the complex attitudes towards charcoal production as a livelihood – discussed further in Jones (In prep.). Succinctly, local attitudes towards regular or full-time charcoal production are predominantly negative, whilst the occasional

⁶ Referring to the period June 2013 to June 2014

production of charcoal as part of agricultural practice is seen as being more financially and ecologically stable.

5.2.1 Producing for a living

Only five out of the 89 charcoal producers within the sample make charcoal all year round, though $27 \pm 9\%$ produced charcoal in more than three months. Interviewees describe involvement in charcoal making as fluctuating with opportunities for cash income. A tobacco-outgrowing scheme collapsed in 2012, removing the only major opportunity for cash income, other than selling surplus maize. This gap in cash cropping opportunities was partially filled by the uptake of soya, though this crop has yet to spread widely in the study area. Other households were left looking for alternative sources of cash income, as selling a maize surplus is a difficult and unreliable form of making money (Hanlon and Smart 2013).

In 2014, the survey year, a forestry company was clearing land and so provided a source of wage labour⁷. Both charcoal producing and non-producing interviewees emphasised that there were fewer “regular” producers in 2014 due to this incoming wage labour and emerging cash cropping opportunities. Our survey, however, displays little flux in the number of producing households – with continuous growth over the past five years. Furthermore, the volume of licenced charcoal flowing to Town A has remained fairly constant over our licencing sample period.

5.2.2 Gaining financial autonomy

The majority ($58 \pm 22\%$) of production within the ‘need cash’ categorisation is undertaken by women ($\chi^2(4, n=89) = 17.61$ $p=.001$, Cramer’s $v = .316$ (moderate association)). Female producers tend to produce charcoal irregularly, pooling labour from outside the household, mainly the labour of other women. The survey data shows $58 \pm 10\%$ of participating women used labour from outside the household compared to $33 \pm 9\%$ in households where production was led by the men or a joint activity.

Three quarters of female producers are based in households where men make the economic decisions. As a comparatively new income source there appears to be few gendered rules surrounding charcoal production. Garden horticulture and ground nuts are sold locally by women, who pass a portion of proceeds back to their husbands. Charcoal, on the other hand, appears to allow women to produce charcoal outside of their husband’s purview, providing an important source of cash. Production takes on a variety of forms. Female producers commonly work together, creating groups of producers across households. For example, one group of women produced charcoal together in order to purchase capulanas⁸ to sell locally, whilst another made charcoal in order to send money to family members in Zimbabwe. Women’s involvement in the charcoal market is further underscored by the fact that almost 50% of the licences issued in Town A were issued to women. The number of sacks each licence was issued for is on average lower (21 ± 16 sacks) than that of men (37 ± 29 sacks).

⁷ Ironically the forestry company is letting locals use the cleared trees to produce charcoal, charging 30 MZN for each bag that leaves the kiln.

⁸ A Mozambican sarong/multi-functional piece of fabric

5.2.3 A quick source of cash

Around 36% of houses purchased a specific good or paid an expense using charcoal finance. These ranged from agricultural inputs and solar panels to cash transfers to a bride's family (lobolo). Those making charcoal to cover a specific expense produced more bags, the last time they produced, than other groups (93 bags vs 41 bags, two tailed t-test $t = 3.09$, $p = 0.01$). One household made 125 sacks in order to fund the purchase of a house in a nearby town.

As observed elsewhere, charcoal is also used as a coping strategy for shocks that interrupt the household's income stream or reduce its asset base (Schure et al. 2014). One family produced charcoal as a one-off to purchase belongings after fire destroyed their home. Those convicted of starting the fire helped the household fell trees for the kiln. A different form of shock response is demonstrated by two women who lost their husbands and made charcoal at a small scale to provide cash income, its returns more reliable than selling a maize surplus. The proportion of food-poor households making charcoal during the hungry season was higher than the non food-poor and this could be seen as a response to this predictable shock – a strategy also seen in other non-charcoal contexts (Dercon and Krishnan 2000).

Charcoal production following the rainy season also serves to generate working capital and facilitate field clearance for the coming agricultural season. If households are opening new fields, the extra labour cost of charcoal production is low. Interviewees framed this as making charcoal production logical and efficient (Jones, In prep.). However, the full extent to which charcoal finance feeds back into other livelihood strategies is unclear. 20% of households bought agricultural inputs or equipment with charcoal finance, but without extensive income data (preferably from panel-based studies), understanding the ripple effects of this cash income source is difficult.

6 Discussion

6.1 The role of charcoal in rural livelihoods

Currently, charcoal production in the study area is dominated by occasional producers, linked to the opening of new fields and fulfilling a need for cash. Because of its flexibility as a cash income source, charcoal is produced by a wide range of people, for a variety of reasons. The scale and timing of production is closely linked to the situation and reasons for producing. This contrasts with the existing literature which suggests that those with predominantly agricultural livelihood strategies who also produce charcoal don't produce in large quantities (Arnold et al. 2006; Kambewa et al. 2007). The scale of charcoal production cannot be divorced from the motivation behind its production; whether that be for subsistence income (Butz 2013), starting a new business (this study) or wanting a bicycle in order to keep up appearances (Serra 2001).

The local narrative echoes the literature, explicitly tying charcoal production to a lack of alternative opportunities. Interviews with producers and non-producers emphasised a reduction in charcoal production in 2014, linked to alternate cash generating opportunities. However, there is a disconnect between this qualitative data describing fluctuating production and the quantitative survey and licensing data, which both demonstrate a continuous growth in the number of producers. This disconnect might reflect a reduction in the number of producers focussing their livelihoods on charcoal production - arguably the most visible form of production due to its regularity and volume.

Such a reduction in regular producers could be linked to the actual/perceived availability of wage labour. It however could be equally linked to the local politics of production, which makes sporadic charcoal production linked to field opening more locally acceptable (Jones, In prep.).

It is also difficult to frame a drop in cash-cropping opportunities (e.g. the collapse of the tobacco out-growing scheme in 2012) as the sole force behind an upsurge in charcoal production. Firstly, focus groups stated the number of charcoal producers is much greater than the historical number of tobacco producers, and secondly charcoal's importance and function within household livelihood strategies is more variable than tobacco growing. Such nuances suggest a framing of charcoal that emphasises (negatively) its role as a response to deprivation excludes important parts of the picture.

In contrast to previous studies which have reported little female involvement (SEI 2002; Seidel 2008; Malimbwi et al. 2010), in this area women are widely involved in making charcoal. Likewise, the roles that women play in charcoal production differ in comparison to the literature. In the only study (to the authors' knowledge) using a gendered focus on charcoal, Butz (2013) documents "economically and socially marginalised women" (ibid, p. 143) producing small quantities of pit-charcoal to provide subsistence income. Here we wish to emphasise the positive use of charcoal by female producers, who use it to gain a degree of financial autonomy from their husbands. This could enable them to strengthen their position within the "conjugal contract" (Whitehead 1981; see also Pfeiffer et al. 2001) as well as address personal financial needs or needs that fall outside the household. Income from agriculture is usually controlled by the main economic decision maker within the household, meaning charcoal could lead to more equal forms of cash earning. Similar situations occur in charcoal producing areas providing Zomba, Malawi (Harriet Smith personal communication, 30 May 2015). In a similar vein, focus groups and interviews from this study show some sons get involved with charcoal production to generate cash to start up a life outside of their parents' home and to gain financial autonomy from their parents.

Whilst highlighting the role of charcoal as a proactive form of income generation, the results do also show charcoal production can be used reactively as a response to shocks. Shocks take many forms (Baylies 2002) and households in the area utilise charcoal production to respond to them in different ways, depending on the shock type. The flexibility of charcoal as a cash income source can lead to households producing in bulk to respond to one-off shock events, or turning to charcoal as a longer-term response to deprivation.

Given the wide variation in production situations, describing charcoal production as a last resort would obscure many producers within this study area. Charcoal makers cover a spectrum of different people, with varying constellations of livelihoods, assets and opportunities. For those producing charcoal in Community A income from charcoal is mainly supplementary, seasonal and occasional. Sometimes it is tied into field clearance, sometimes the agricultural off-season. These varying forms of production have also been observed in the commodity chains supplying principal cities (Townson 1995; Levy and Kaufman 2014; Schure et al. 2014), but are rarely emphasised. Within this study area, the flexibility charcoal provides as a cash income source leads to a high level of diversity in production situations. Given this diversity of production situations and close links to existing agricultural practice, charcoal production is primarily being used as a diversification strategy.

6.2 Local regulations engender flexibility

The local regulatory framework, is a key enabling factor within the study area, allowing easy entry into the production sector. Flexible production would become untenable if Mozambique's current licensing regime were enforced, and it is this form of production which is perhaps the most important for vulnerable households. The corollary, is that under this informal system, the rules governing resource management are ill-defined. Local governance via the traditional authorities is playing a role in this regard, as local chiefs are asking charcoal producers to show their licenses (Jones, In prep.). But as the vast majority of charcoal is produced on each household's smallholding (to which they have locally derived usufruct rights) rather than on common land, it is unclear whether the current de jure licensing regime in Mozambique is tenable for individual households. The adoption of a de-facto licensing regime in this study area, shows that in this study area it is clearly untenable. This is because substantial costs are involved in obtaining a license: As written in the law, the cost of a license (69 MZN per sack) represents 35% of the retail price in Town A and 115% of the price paid to producers in Community A. The substitution of a formal licensing arrangement with a de-facto taxing of charcoal transport has been observed elsewhere in Africa (Malimbwi et al. 2010; Shively et al. 2010). However this is often due to a lack of capacity amongst smaller agricultural departments (Malimbwi et al. 2010), rather than an unsuitable pricing structure and unrealistic license requirements.

There is less emphasis on flexible, idiosyncratic or occasional charcoal making in the literature, due to the focus on full-time or regular producers supplying major cities. It is important that the experiences from commodity chains around these large cities do not obscure the wide diversity seen in the periphery. This leads us to a key question: how common is occasional charcoal production within the commodity chains of major cities? The indications are that the majority of producers operate on an occasional basis, producing a substantial proportion of the overall charcoal supply (Kambewa et al. 2007; Schure et al. 2014). Developing our understanding of this is important, as currently policy and development interventions into charcoal markets across sub-Saharan Africa are premised on formalising community based natural resource management. Given the evidence that such processes can have mixed outcomes in terms of resource access (Ribot 1998; Schure et al. 2013; Zulu and Richardson 2013) care needs to be taken that the formalisation and professionalization of charcoal production does not restrict access to those using charcoal as a flexible income source. Ultimately it is this flexibility that makes charcoal such an important livelihood diversification strategy for rural smallholders.

7 Conclusions

Across the study area, a wide range of households and individuals produce charcoal to increase their incomes. They do so in different situations, leading to charcoal taking a varying role within their livelihood strategies. This contrasts with much of the existing literature that characterises charcoal as a livelihood of last resort. The flexible role of charcoal within producers' livelihoods is enabled by the current de-facto licencing scheme, which sits at odds with the current Mozambican law. Changes to this scheme should be careful not to restrict access to the flexible income that charcoal can provide, as it is one of the few cash income sources that can be engaged in on a flexible basis.

In contrast to existing work conducted on charcoal production supplying major urban areas, this study has focussed on occasional charcoal producers supplying a small town and the varied role of production in their livelihoods. Future studies should look towards both studying the commodity chains of small and medium sized urban areas (see also (Smith et al. 2015)) and better documenting the role of diverse types of charcoal production. These processes are not captured by a pervasive focus on commercial and formalised value chains and their environmental impact.

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9 References

- Ainembabazi JH, Shively G, Angelsen A. 2013. Charcoal production and household welfare in Uganda: a quantile regression approach. *Environ. Dev. Econ.* 18:537–558. [accessed 2014 Oct 29]. http://www.journals.cambridge.org/abstract_S1355770X1300017X
- Arnold JEM, Köhlin G, Persson R. 2006. Woodfuels, livelihoods, and policy interventions: Changing Perspectives. *World Dev.* 34:596–611. [accessed 2014 Aug 26]. <http://linkinghub.elsevier.com/retrieve/pii/S0305750X05002263>
- Bailis R, Drigo R, Ghilardi A, Masera O. 2015. The carbon footprint of traditional woodfuels. *Nat. Clim. Chang.* 5.
- Bailis R, Ezzati M, Kammen DM. 2005. Mortality and greenhouse gas impacts of biomass and petroleum energy futures in Africa. *Science* (80-.). 308:98–103. [accessed 2014 Sep 9]. <http://www.ncbi.nlm.nih.gov/pubmed/15802601>
- Baylies C. 2002. The Impact of AIDS on Rural Households in Africa: A Shock Like Any Other? *Dev. Change* 33:611–632.
- Bekele M, Girmay Z. 2013. Reading through the Charcoal Industry in Ethiopia: Production, Marketing, Consumption and Impact. Addis Ababa.
- Brouwer R, Magane DM. 1999. The charcoal commodity chain in Maputo: access and sustainability. *South. African For. J.* 185:27–34.
- Butz RJ. 2013. Changing land management: A case study of charcoal production among a group of pastoral women in northern Tanzania. *Energy Sustain. Dev.* 17:138–145. [accessed 2014 Sep 25]. <http://linkinghub.elsevier.com/retrieve/pii/S0973082612000877>
- Campbell B. 1996. The Miombo in transition: woodlands and welfare in Africa. Bogor, Indonesia: CIFOR. [accessed 2014 Sep 2]. <http://books.google.com/books?hl=en&lr=&id=rpildJJVdU4C&oi=fnd&pg=PR9&dq=The+Miombo+in>

+Transition+:+Woodlands+and+Welfare+in+Africa&ots=FOjtkYh3wd&sig=BsiAYPGLTZjGHb8_2N2e3V
oEW0Y

Cavanagh CJ, Vedeld PO, Trædal LT. 2015. Securitizing REDD+? Problematizing the emerging illegal timber trade and forest carbon interface in East Africa. *Geoforum* 60:72–82.

Chileshe R. 2005. Land tenure and rural livelihoods in Zambia: case studies of Kamena and St. Joseph. University of the Western Cape.

Cuvilas CA, Jirjis R, Lucas C. 2010. Energy situation in Mozambique: A review. *Renew. Sustain. Energy Rev.* 14:2139–2146. [accessed 2014 Sep 2]. <http://dx.doi.org/10.1016/j.rser.2010.02.002>

Dercon S, Krishnan P. 2000. Vulnerability, seasonality and poverty in Ethiopia. *J. Dev. Stud.* 36:25–53.

Gandar M V. 1992. An investigation of prices, pricing criteria and distribution networks for fuelwood in selected areas of South Africa. A report for the Biomass Initiative. Pretoria, South Africa.

Gao Y, Skutsch M, Drigo R, Pacheco P, Masera O. 2011. Assessing deforestation from biofuels: Methodological challenges. *Appl. Geogr.* 31:508–518. [accessed 2014 Aug 1]. <http://linkinghub.elsevier.com/retrieve/pii/S0143622810001220>

Girard P. 2002. Charcoal production and use in Africa: What future? *Unasyuva* 53:30–34. [accessed 2014 Sep 12]. <http://www.cabdirect.org/abstracts/20033047982.html>

Government of Mozambique. 1999. Lei de Florestas e Fauna Bravia. Mozambique.

Government of Mozambique. 2012. Decreto n. 30/2012 de 1 de Agosto. Mozambique: Boletim da República, I Série, No. 31.

Hanlon J, Smart T. 2013. Small farmers or big investors ? The choice for Mozambique Making money farming in Manica. :1–11.

IEA. 2014. Africa Energy Outlook. Paris.

Kambewa P, Mataya B, Sichinga K, Johnson T. 2007. Charcoal-the reality: A case study of Charcoal consumption, trade and production in Malawi.

Khundi F, Jagger P, Shively G, Sserunkuuma D. 2011. Income, poverty and charcoal production in Uganda. *For. Policy Econ.* 13:199–205. [accessed 2014 Jul 23]. <http://linkinghub.elsevier.com/retrieve/pii/S1389934110001498>

Kinyanjui M. 1987. Fuelling Nairobi: the importance of the small scale charcoal enterprise. *Unasyuva* 39:17–28.

Leach G, Mearns R. 1988. Beyond the woodfuel crisis: people, land and trees in Africa. London: Earthscan.

Levy C, Kaufman B. 2014. Charcoal for food. Livelihood diversification in two peasant communities in Mozambique. In: Fakier K, Ehmke E, editors. *Socio-Economic Insecurity in Emerging Economies: Building Social Spaces*. Abingdon: Routledge.

Luoga EJ, Witkowski ETF, Balkwill K. 2000. Economics of charcoal production in miombo woodlands of eastern Tanzania: Some hidden costs associated with commercialization of the resources. *Ecol. Econ.* 35:243–257.

Maes WH, Verbist B. 2012. Increasing the sustainability of household cooking in developing countries: Policy implications. *Renew. Sustain. Energy Rev.* 16:4204–4221. [accessed 2014 Aug 5]. <http://linkinghub.elsevier.com/retrieve/pii/S1364032112002146>

Malimbwi R, Chidumayo E, Zahabu E, Kingazi S, Salome Misana EL, Nduwamungu J. 2010. Woodfuel. In: Chidumayo EN, Gumbo DJ, editors. *The Dry Forests and Woodlands of Africa: Managing for*

Products and Services. 1st ed. London: Earthscan. p. 155–177.

Mugo F, Ong C. 2006. Lessons from eastern Africa's unsustainable charcoal business. Nairobi, Kenya ICRAF Working Paper Report No.: 20. [accessed 2014 Sep 2].
<http://erepository.uonbi.ac.ke/handle/11295/54949>

Mwampamba TH, Owen M, Pigaht M. 2013. Opportunities, challenges and way forward for the charcoal briquette industry in Sub-Saharan Africa. *Energy Sustain. Dev.* 17:158–170. [accessed 2014 Sep 17]. <http://linkinghub.elsevier.com/retrieve/pii/S0973082612000750>

Openshaw K. 2010. Can biomass power development? London Gatekeeper series Report No.: 144.

Owen M, der Plas R Van, Sepp S, van der Plas RJ, Sepp S. 2013. Can there be energy policy in Sub-Saharan Africa without biomass? *Energy Sustain. Dev.* 17:146–152. [accessed 2014 Sep 15].
<http://linkinghub.elsevier.com/retrieve/pii/S0973082612000749>

Pfeiffer J, Gloyd S, Li LR. 2001. Intrahousehold resource allocation and child growth in Mozambique: An ethnographic case-control study. *Soc. Sci. Med.* 53:83–97.

Republico do Moçambique. 2005. Perfil do distrito de Manica, província de Moçambique. Maputo, Moçambique.

Ribot JC. 1993. Forestry policy and charcoal production in Senegal. *Energy Policy* 21:559–585.

Ribot JC. 1998. Theorizing Access: Forest Profits along Senegal's Charcoal Commodity Chain. *Dev. Change* 29:307–341. [accessed 2014 Sep 9]. <http://doi.wiley.com/10.1111/1467-7660.00080>

Ribot JC. 1999. A history of fear: imagining deforestation in the West African dryland forests. *Glob. Ecol. Biogeogr.* 8:291–300.

Ros-Tonen MAF, Wiersum KF. 2005. THE SCOPE FOR IMPROVING RURAL LIVELIHOODS THROUGH NON-TIMBER FOREST PRODUCTS: AN EVOLVING RESEARCH AGENDA. *For. Trees Livelihoods* 15:129–148.

Sander K, Gros C, Peter C. 2013. Enabling reforms: Analyzing the political economy of the charcoal sector in Tanzania. *Energy Sustain. Dev.* 17:116–126. [accessed 2014 Sep 2].
<http://linkinghub.elsevier.com/retrieve/pii/S0973082612000932>

Schure J. 2014. Woodfuel for Urban Markets in the Congo Basin A Livelihood Perspective. Wageningen University.

Schure J, Ingram V, Sakho-jimbira MS, Levang P, Wiersum KF. 2013. Formalisation of charcoal value chains and livelihood outcomes in Central- and West Africa. *Energy Sustain. Dev.* 17:95–105. [accessed 2014 Sep 2]. <http://linkinghub.elsevier.com/retrieve/pii/S0973082612000452>

Schure J, Levang P, Wiersum KF. 2014. Producing Woodfuel for Urban Centers in the Democratic Republic of Congo: A Path Out of Poverty for Rural Households? *World Dev.* 64:S80–S90. [accessed 2015 Jan 15]. <http://linkinghub.elsevier.com/retrieve/pii/S0305750X14000795>

SEI. 2002. Charcoal Potential in Southern Africa CHAPOS. Stockholm.

Seidel A. 2008. Charcoal in Africa: Importance, problems and possible solution strategies. Eschborn, Germany: GTZ.

Serra A. 2001. Legitimacy of Local Institutions for Natural Resource Management - The case of M'Punga, Mozambique. MARENA RESEARCH PROJECT: WORKING PAPER Report No.: 3.

Shively G, Jagger P, Sserunkuuma D, Arinaitwe a, Chibwana C. 2010. Profits and margins along Uganda's charcoal value chain. *Int. For. Rev.* 12:270–283.

Sitoe AA, Argola J, Tchaúque F. 2007. Modelling fuel wood demand availability in northern Sofala

province, Mozambique. In: Chidong Z, editor. Proceedings of the international conference on long-term ecological research. Beijing, China: Chinese Ecosystem Research Network. p. 205–206.

Smith HE, Eigenbrod F, Kafumbata D, Hudson MD, Schreckenberg K. 2015. Criminals by necessity: the risky life of charcoal transporters in Malawi. *For. Trees Livelihoods*:1–16.

Townson IM. 1995. Patterns of non-timber forest products enterprise activity in the forest zone of southern Ghana: Main report. London.

United Nations. 2014. *World Urbanization Prospects: The 2014 Revision*. New York.

Walker MM. 2012. A Spatio-Temporal Mosaic of Land Use and Access in Central Mozambique. *J. South. Afr. Stud.* 38:699–715.

Whitehead A. 1981. “I’m Hungry, mum’: The Politics of Domestic Budgeting. In: Young K, Wolkowitz C, McCullagh R, editors. *Of Marriage and the Market: Women’s Subordination Internationally and Its Lessons*. London and New York: Routledge.

Zulu L, Kalipeni E. 2009. Land cover change, forest condition and community based forest management in the Blantyre City Fuelwood Project (BCFP) Area. In: Kalipeni E, Kakoma I, Sanogo Y, Fawcett K, Warner R, editors. *Turning science into action: Biodiversity Conservation and Natural Resources Management in Africa*. Trenton, NJ: Africa World Press. p. 251–98.

Zulu LC, Richardson RB. 2013. Charcoal, livelihoods, and poverty reduction: Evidence from sub-Saharan Africa. *Energy Sustain. Dev.* 17:127–137. [accessed 2014 Sep 2].
<http://www.sciencedirect.com/science/article/pii/S0973082612000506>