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Energy Expenditure and Fuel Choices among Households in the Sidama Region, Southern Ethiopia

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ABSTRACT

Using the data from an original survey, we analyse energy use patterns and, in particular, energy use for cooking in households from Hawassa City, Southern Ethiopia. Cooking is the main energy-related activity on which households spend money. This expenditure represents 89% of total energy expenditure and a fifth of a household's total budget. Expenditure on modern energy and electricity represents only about a fifth of an energy budget, whilst fuelwood, a potentially health damaging energy, still prevails as the main energy used for cooking in Hawassa. There are, however, large differences in energy use between urban and suburban areas. While fuelwood and charcoal are the main sources for cooking among the poorest households, and fuelwood is the dominant source for cooking in suburban locations, electricity is the energy source used mainly in urban areas and especially among richer households. Our research is also in line with results found for other countries in sub-saharan Africa. Energy expenditure, as well as the use of electricity for cooking, are both sharply increasing with household income. The effect of income on using fuelwood is the opposite. Large families are more likely to prefer fuelwood and less likely to choose charcoal. Female-headed households are more likely to choose charcoal for cooking; however, if females make decisions about household purchases, they prefer to use fuelwood. Formal education increases the likelihood of using cleaner electricity and decreases the usage of fuelwood. Formal education, alongside income, seems to be the key factor in moving from traditional health-damaging energy sources towards modern and clean energy sources.

Keywords: Energy for Cooking, Fuel Choices, Energy Expenditure, Fuelwood, Southern Ethiopia
JEL Classifications: Q2, Q4

1. INTRODUCTION

In developing countries like Ethiopia, energy plays an important role in socio-economic development, poverty reduction, improving the quality of life and technological innovations. Still, the majority of the population in developing countries, and in Africain particular, relies on traditional energy sources (OECD/IEA, 2014) that also contribute to a wide variety of adverse effects, including severe health and safety effects, poisoning from ingestion, burns and deaths from fires, destroyed housing and respiratory diseases resulting from indoor air pollution (Mehlwana, 1999; Qase et al., 2001; Lloyd, 2002; Biggs and Greyling, 2001).

Indoor air pollution due to using conventional biofuel cooking stoves (including traditional three stone cooking stoves widely used in Ethiopia) causes *inter alia* severe respiratory disease. The negative effects of indoor wood fires are more pronounced in rural households with pollutants in the form of smoke being the main culprit (Van Horen, 1996; Spalding-Fecher et al., 2002).

An increasing demand for fuelwood, resultant deforestation spreading outwards from urban consuming centres, and land conversion to agriculture means that fuelwood supplies are constantly diminishing, resulting in increasing fuelwood scarcity in many places in the developing world (Cline-Cole et al., 1990). Increasing energy consumption with fuel scarcity is challenging, especially in the African Sahel region, with vanishing woody forests. In this region, despite the low per capita fuel consumption, the pressure on the existing woody forest resources is mainly due to the increased demand by a large proportion of urban households for charcoal in the cities and towns. High dependency on wood biomass and charcoal has resulted in degradation of the surrounding woodlands and forests in the major cities of sub-Saharan Africa, for example Lusaka in Zambia, Nairobi in Kenya, Dar-es-Salaam in Tanzania and Addis Ababa in Ethiopia. High demand of urban dwellers for biofuels harvested in neighbouring rural areas has strengthened increasing pressure to clear forests and degrade land (Heltberg, 2004; Edwards and Langpag, 2005). According to Gebreegziabher et al. (2010). the gap between a growing demand for fuel sources and supply scarcity has escalated fuelwood prices in urban centres resulting in extensive deforestation in Ethiopia. The dependence of urban households and other economic sectors on rural forestland has resulted in a significant negative effect on the natural environment in general (FAO, 2004; Krämer, 2002), contributing negatively to air and water pollution and greenhouse gas emissions (Malla, 2013). Environmental damage is substantial, especially in highland areas of Sub-Saharan Africa (Karekezi, 2002).

A shift from traditional fuels to renewable energy and electrification may bring environmental benefits, in particular at a micro level. Investment in clean energy technology may ensure improved, reliable, affordable, economically viable, socially acceptable and sustainable environment and development (UN, 2012). Moreover, electrification in rural areas supplied by off-grid renewable energy may provide time to school-children, who are then freed from gathering fuel and tending fires, as found by Karumba and Muchapondwa (2018) in Kenya.

A rising demand with a fast-growing population, weak energy efficiency, a lack of sources for investment, and political disturbances have been recognised as the key challenges for energy transition in sub-Saharan Africa (OECD/IEA, 2014). A more concerning issue, requiring immediate action, is that energy demand is projected to increase up to 80% by 2040 (Africa Progress Panel, 2015). In order to respond to this growing energy demand, policymakers have implemented various measures to increase the adoption of clean energy sources in sub-Saharan Africa. In line with this move, Ethiopia's National energy policy (Ministry of Water and Energy, 2013) framework has also undergone substantial changes over the last two decades and the climate resilient green growth strategy has been implemented to avoid the adverse effects of climate change and build a green economy. Several measures have been introduced to increase the availability of cleaner energy sources such as electricity, biomass, and other renewables, such as solar and biofuels.

Despite all these efforts, a transition to cleaner fuels has only slowly progressed, and new clean sources have not satisfied the rising demand, making clean energy remain the main challenge for Ethiopia. Asfaw and Demissie (2012) found that between 1995 and 2005 the demand for a modern fuel source increased by 50% in Addis Ababa; however, use of traditional fuel also increased by 10% over the same period. Fuelwood is still used by most of the households in Ethiopia and satisfies more than 80% of households' energy needs, noticeably challenging the natural forest stocks. However, investment in clean energy technology may ensure improved, reliable, affordable, economically viable, socially acceptable and sustainable environment and development (UN, 2012).

Low-income countries are still very dependent on traditional energy sources to meet their energy demand. In Ethiopia and elsewhere in developing countries, traditional and inefficient cooking stoves dominate residential and commercial sectors despite a substantial shift towards improved stoves in urban areas in recent years, with a much slower transition in rural areas (Barnes et al., 2004; Gebreegziabher et al., 2010). On the other hand, limited access, or in some cases a complete absence of clean energy sources, imperfect products and a capital market, have locked households from low-income countries into using traditional fuels. (Bhattacharyya, 2011). The world bank energy access diagnostic report shows that about 64% of households still depend on traditional three stone-cooking stoves, 18% use manufactured improved stoves and only 4% use clean electric stoves (Padam et al., 2018).

This paper contributes to scarce literature on this subject by improving the understanding of the drivers of energy source choices in Ethiopia, which is necessary to consider when designing appropriate policy interventions. Usage of different energy sources, including the explanatory factors for choosing from amongst them, is analysed across urban and suburban households living in the Hawassa City administration. We also examine the relationship between households by income groups and budget share for energy expenditure. We use a survey data, conducted between August and September 2017. The primary cooking energy choice is modelled empirically using a discrete choice framework. Following this, the functional relationships between primary cooking energy decisions and explanatory factors are examined using a multinomial logit procedure.

The findings of this study reveal that electricity and charcoal are primary cooking energy sources in urban areas, while fuelwood is the main source of cooking energy in semi-urban areas. The household budget share of energy expenditure is higher for households in the lowest income quartile than those in the highest income quartile. We also find that a high budget share is directly associated with electricity cooking energy choice, while a low budget share is associated with fuelwood choice for cooking. Finally, we show that income, the relative budget share of energy expenditure, education, geography, gender, family size, and knowledge of alternative fuel sources are significant factors for household primary cooking energy source choice.

The rest of the paper is organized as follows: Section 2 reviews the relevant literature on household energy demand. Section 3 presents the study area and survey sampling method, population and sample size determination, while Section 4 provides a description of the socioeconomic variables in the sample data. Our empirical strategy and model are presented in Section 5 and this section also discusses empirical results. The last section concludes the paper with a summary of findings, and policy implications in line with the findings.

2. LITERATURE REVIEW

The available literature shows that fuel price, budget share on energy and income are the main driving forces behind household energy source decisions (Hou et al., 2018; Zhang and Hassen, 2017; Barnes et al., 2004; Heltberg, 2004;). Other factors associated with energy source decision include socio-economic characteristics of a family, environmental conditions and technological attributes (Karekezi, 2002).

For example, the preference of Chinese households for clean energy sources is mainly driven by income and wealth-indicating assets (Hou et al., 2018). When consumers' income rises, it is more likely that they will move to clean fuel sources. Growth in income or assets makes the preference of rural households stronger for electricity over gas. Again in China, Zhang and Hassen (2017) show that the preference for a specific energy source is determined by the availability of local fuels, particularly in rural areas, whereas urban households' choices are affected more by fuel price, economic status, family size, gender and the education ofthe head of the family.

Similar results are found by Farsi et al. (2007) for India. The choice of urban households of fuel source is strongly influenced by fuel price, the household's income, gender and the education level of the respondent. It was also found that affordability is the main constraint for the low-income households not using modern energy sources. Demand for LPG is also more sensitive to its price. In Guatemala, access to credit determines the level of fuelwood consumption, especially in regions where capital resources are scarce (Edwards and Langpap, 2005). In similarity with the Indian study, the shift from fuelwood consumption to gas stoves and modern energy sources is constrained by financial affordability of households, high start-up costs and a lack of access to financial capital. Fuel price, reliability of LPG supply and household income were also found to be significant factors determining households' decisions to choose cleaner cooking stoves in Ghana (Mensah and Adu, 2015). According to World Bank research on the relationship between energy, poverty and gender in Africa, the double rate population growth in sub-Saharan Africa is the main progressive driving force for energy consumption, whilst increasing income from growing economic performance makes modern energy sources more affordable (Karekezi, 2002).

Moving to Ethiopia, Gebreegziabher et al. (2010) analysed fuel choices of urban households in Northern Ethiopia. Estimating a discrete choice model, they found that highly educated and high-income households have a greater probability of switching to modern fuel sources, thus reducing pressure by urban centres on rural forest resources and improving air quality in cities. Faye (2002) analysed household energy consumption patterns in Ethiopia, estimating multivariate probit. This research suggests price and income are the key determinants of energy demand for all of its forms; charcoal and wood are substituted by kerosene, and the demand for electricity increases with income.In addition, the demand for energy sources varies with household size and urbanization. Another study using a discrete choice model estimated energy demand with the aim of evaluating product specific factors in switching households' preference for fuel and stove types in Addis Ababa (Takama et al., 2012). Again, the authors found that income is a key predictor of cooking stove choice.

3. DATA

3.1. Study Area

Hawassa is the capital of the Sidama region of Southern Ethiopia, located on the shores of Lake Hawassa in the Great Rift Valley, 273 km south of the Ethiopian capital Addis Ababa. The population of Hawassa city is 316,842 as at 2016, with an annual growth rate of 4%. The city is broadly divided into urban and suburban districts. The urban districts include seven sub-cities or kebeles: Hayek Dar, Menaharia, Tabor, Misrak, Bahil Adarash, Addis Ketema and Mehal, while Tula is a suburban district, see Figure 1. This study analyses the energy-related behaviour of urban and suburban households living in these eight sub-cities.

3.2. Survey Design and Sampling

The survey was based on a questionnaire that comprised three parts, with questions on socio-demographic information and energy use, including questions on fuel availability, firewood collection and fuelwood scarcity. The survey instrument was comprehensively pre-tested and its final version includes revisions based on feedback in the field.

The survey was conducted by a team of trained data collectors (enumerators) in August and September 2017. The survey respondents were sampled from the seven urban sub-cities and four kebeles from the Tula suburban district in Hawassa, using quota on geographic location, as shown in Table 1, and socio-economic conditions. The final sample is representative with respect to urban and suburban areas and their kebeles.

The enumerators visited each household and filled out the questionnaire at the place and time of interviewing the respondents. The field survey was supported by a global positioning system to map respondent's geographic location.

3.3. Sample Description

In total, 376 people –representatives of households living in Hawassa region– were interviewed. About two thirds were living in urban areas; the remaining third were from suburban locations. The two segments differed in several socio-demographic characteristics. The last column in Table 2 reports the results of the t-test on the equality of the means for given characteristics for the two subsamples.

Descriptive statistics for the whole sample and for the subsample made from respondents living in urban and suburban areas are displayed in Table 2. The T-test of equality of the two means for the urban and suburban sub-samples is also provided there. Looking at the table, there are a number of points of interest. First, the average household income is 4,591 Birr a month, which is about 150 USD, and families living in urban areas are wealthier than families from suburban areas, where on average the monthly income of the former is almost twice large as the income of the latter (5,487 Birr and 2,972 Birr, respectively). Families living in urban areas also spend more on energy; on average they spend 26% of their income on energy compared to a 16% budget share of suburban families.

Second, families from the two areas also differ in their access to natural fuels. Approximately half of the families from both places have access to biomass; however, lifestock is owned by three quarters of suburban families while there are only 14% of such families in urban places.

Third, regarding the socio-economic characteristics, families living in suburban areas are larger, having 6.5 members on average (compared to 5.6 members in urban areas), are slightly younger, with a 33 year old head of the family, (38 years old in urban areas), more often have a malehead of the family , and economic decisions are more frequently made by males.

Lastly, only 34% of respondents have completed a formal education, whilst 13% respondents are unable to read and write and 53% are able to read and write, but do not have a formal education. Respondents from suburban areas are also less educated than respondents from urban areas. While 20% of respondents from suburban areas are not able to read and write and only 24% have a formal education, this proportion is 8%, and 38%, respectively, in urban areas.

4. ENERGY EXPENDITURE AND ENERGY FOR COOKING

4.1. Household Energy Expenditure

Based on our survey, households in the Hawassa region spent on average 504 ETB (approx. 17 USD) a month on energy used for all purposes. This expenditure is higher in urban areas, with a mean of 604 ETB (20 USD), whilst households living in suburban areas spent on average only about a half of this amount, 323 ETB (10.5 USD). We note that the price of supplied electricity and most of the fuels did not differ between the two areas of the Hawassa region. Table 3 provides a breakdown of this expenditure by energy type and fuel source. While households from urban areas spent the most on charcoal, 205 ETB and about 34% of their total expenditure on energy, those from suburban areas spent most on fuelwood, 145 ETB and about 45%, respectively. Households from both urban and suburban areas spent, on average on fuelwood about 150 ETB. In relative terms fuelwood represents a quarter of energy expenditure in urban areas, whilst fuelwood contributes to 45% in suburban areas. Electricity bills represent 20% of all energy expenditure in absolute terms;households from urban areas spent almost

Table 1: Target population and sample by geographical locations

Location	Target population (number of households)	Target population (share of households) (%)	Sample (N=376) (share of respondents) (%)
Urban area			
Mehal	4,324	8.0	8.0
Menaharia	7,236	13.3	13.3
Misrak	6,851	12.6	12.5
Addis ketema	5,264	9.7	9.6
Tabor	12,868	23.7	23.7
Hayek dar	5,132	9.5	9.6
Bahil adarash	4,385	8.1	8.0
Suburban area			
Gemeto gale	2,604	4.8	4.8
Chefe kote jebesa	2,441	4.5	4.5
Dato odahe	1,580	2.9	2.9
Finicahwa	1,573	2.9	2.9
Total	54,258		

Table 2: Descriptive statistics

Socio-demographic variable	All (N=376)	Urban (N=242)	Suburban (N=134)	t test (Urban=Suburban)
Living in suburban area, %	35.6%	0.0%	100.0%	
Monthly income, in Birr	4591	5487	2972	4.729***
Budget share on energy	22.5%	26.1%	16.2%	2.312**
Self-collected or home-grown biomass	58.2%	59.9%	55.2%	0.882
Livestock ownership	35%	14%	75%	-14.924***
Family size	5.89	5.57	6.46	-3.627***
Age of family head	35.86	37.68	32.56	3.583***
Family head is male	47.9%	45.0%	53.0%	−1.477
Decision maker is male	82.2%	79.8%	86.6%	−1.655*
Education: unable to read and write	12.5%	8.3%	20.1%	−3.379***
Education: able to read and write	47.3%	50.0%	42.5%	1.388
Education: informal education	5.9%	1.7%	13.4%	−4.789***
Education: formal education	33.8%	39.3%	23.9%	3.048***

*, **, *** represent significance at 10%, 5% and 1% level, respectively

twice as much on electricity as households from suburban areas. Mean expenditure on solar energy was 103 ETB, and 35 ETB, respectively. Expenditure on other energy types, like kerosene and gasoline represented minor sources of energy.

The budget share on energy use, measured as total expenditure on all energy types divided by total household income, is 27.7%, and the corresponding budget shares for the income quartiles are 43%, 25%, 13%, and 8%, respectively. While the budget shares are decreasing across income quartiles, expenditure on energy is increasing with household income in absolute terms; Figure 2 left panel. Households placed in the highest income quartile spent 769 ETB on energy, while families in the lowest income quartile spent 200 ETB. Expenditure of the two middle income quartiles was 452 ETB, and 620 ETB, respectively.

There are, however, a considerable number of households without expenditure on energy, 19 %, and this share sharply declines with household income. There are 41% households with zero expenditure on energy in the lowest income quartile, while there are only 3% of such households in the highest income quartile (there are 16% and 14% of them in the two middle income quartiles). Excluding these households from descriptive statistics provides information about the typical amount of energy expenditure. Naturally, the average expenditure increases when households with zero expenditure are not included.. The average expenditure appears now to be 620 ETB a month, and households appearing in the lowest income quartile spent typically 340 ETB; the average for the two middle quartiles is 537 ETB, and 717 ETB, respectively, and households in the highest quartile spent close to 800 ETB. Figure 2 also displays the average expenditure on electricity, fuelwood, and charcoal for the households with non-zero expenditure.

Table 3: Monthly household energy expenditure, by energy source, including households without expenditure (n=376), in ETB

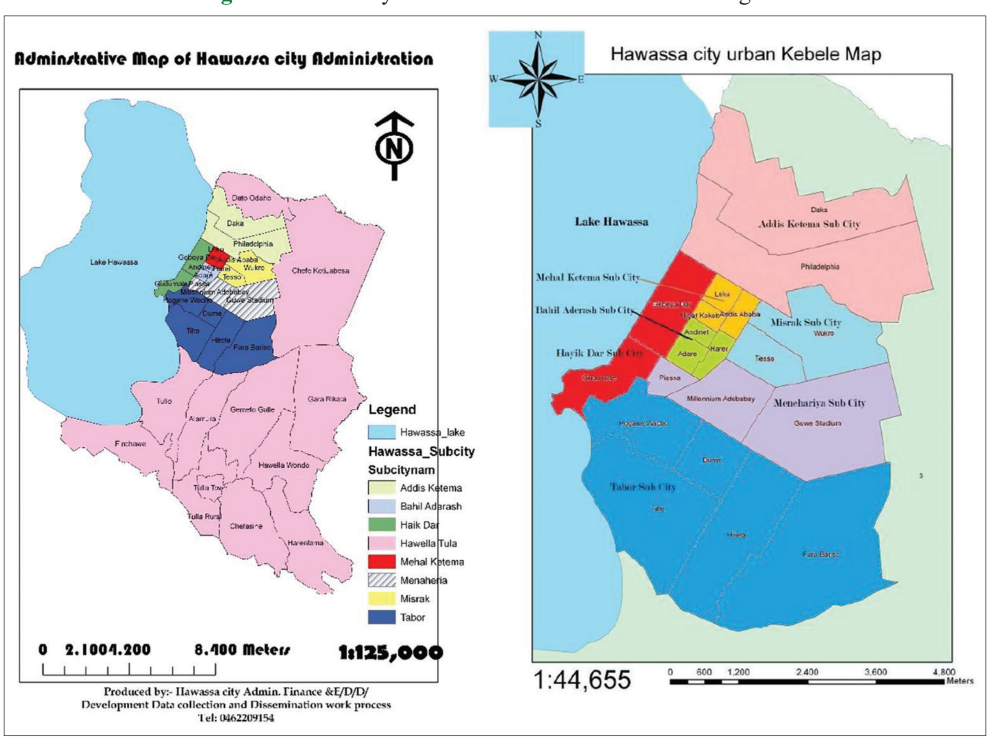
Energy source	All respondents	Respondents from urban areas	Respondents from suburban areas
Electricity	97	117	61
Kerosene	4.0	3.6	4.6
Gasoline	6.5	9.9	0.4
Fuelwood	153	157	145
Charcoal	157	205	70
Solar	79	103	35
Other	7	7	6
Total energy	504	604	323

When it comes to fuel expenditure, since fuel is a basic commodity, expenditure on fuels is not increasing as much as expenditure on all sources of energy, implying that the budget share decreases sharply as income rises. A declining fuel budget share is due to affordability and accessibility.

4.2. Household Expenditure on Energy for Cooking

Cooking is the main activity for which households in Hawassa spent money on energy. On average, the households included in our survey spent 450 ETB (15 USD) a month on energy for cooking, which represents 89% of their total expenditure on energy used for all purposes. If we ignore households with no expenditure on energy, we can see a typical expenditure of 451 ETB a month and a corresponding share of total energy expenditure of 73%. Energy for cooking is the dominant energy, especially in the lowest income quartile, which used 81% of energy expenditure on cooking. These households spent 277 ETB a month on energy for

Figure 1: The study site - location and administrative regions



Source: Hawassa city administration (2016) cooking; the second and the third quartile spent about 400 ETB and 500 ETB, respectively, and in the highest income quartile an average of 569 ETB on expenditure on energy for cooking: see right panel in Figure 2.

Poor households (the lowest quartile) use mainly fuelwood and charcoal, where approximately 40% of them have some expenditure on these two respective cooking fuels. Electricity, which is a cleaner source for cooking compared to fuelwood and charcoal, is used by 5% and 15% of households in the lowest two income quartiles: Figure 3, right panel.

About 63% of households own a traditional electric injera mitad and 50% can use an electric cooking stove, and ownership of these electric appliances increases with income, as shown in Figure 4. Despite this there are 46% and 30% of households, respectively, in the lowest income quartile which own these electric appliances for cooking, which indicates that there are more households even among poorer families that are able to use these electric appliances even without paying for electricity.

4.3. Which Fuel Source is Used for Cooking?

We can now look closely at the energy used for cooking. The right panel in Figure 3 shows that there are 67% of households which use fuelwood for cooking, 65% who use charcoal and 27% that use and pay for electricity for cooking. These shares increase with income. There are about 40% of households with some expenditure on fuelwood and charcoal in the lowest income quartile, while there are 80%, and 87%, of such households respectively in the highest income quartile. Distribution is more uneven in the case of payment for electricity for cooking. There are 5% of households with some expenditure on electricity used for cooking in the lowest income quartile, while there are 56% of such households in the highest quartile.

Electricity is the most frequent energy used for cooking in urban areas, whilst it is fuelwood in suburban areas and there is no difference in this pattern during the wet and rainy season (summer) and the dry season (winter) in Hawassa, as shown in Table 4. We find that fuelwood is the main energy source for cooking in up to 90% of households living in suburban areas in Hawassa, followed by 6% who use mainly charcoal and 4% who use electricity. In contrast, in urban areas, electricity is the main source for cooking used by 54% in the wet summer and 51% in the dry winter, followed by fuelwood (24-26%) and charcoal (21%). Locally available fuelwood stock is becoming scarcer especially in the city and so the demand for charcoal and electricity is higher compared to suburban locations. In urban areas, there is a tendency to favour charcoal when fuelwood becomes hard to find, as alternative fuel sources such as solar panels are relatively expensive (Barnes et al., 2004). Nevertheless, use of biomass (fuelwood and charcoal) as a cooking fuel persists in the urban and especially in suburban areas.

It is quite typical that households in the Hawassa region also use a secondary fuel source for cooking, as an alternative or additional energy source. The percentage of households that use these fuels as the secondary source for cooking is displayed in Table 5. Charcoal and fuelwood are still used as a secondary energy source for cooking in both locations, with about two thirds of urban households using charcoal and almost a half of suburban households using fuelwood. A quarter of households living in suburban locations also use cattle dung as an additional energy source for cooking. Electricity is used as a secondary source for

Figure 2: Household expenditure on energy for all purposes (left panel) and for cooking (right panel) for households with non-zero expenditure, by income quartiles, in ETB

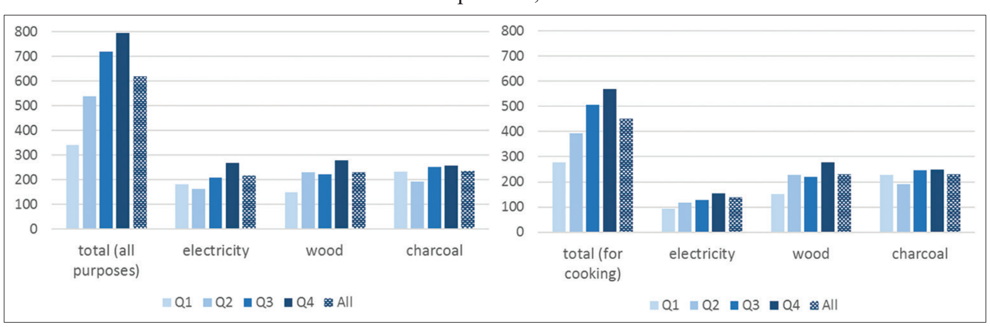


Figure 3: Share of households with non-zero energy expenditure for all purposes (left) and for cooking (right), by energy source and income quartiles

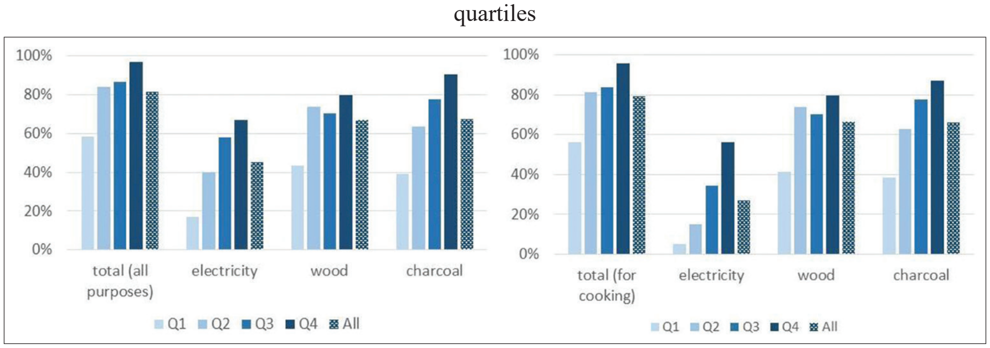


Table 4: Main primary and secondary energy source for cooking, by locations

Energy source	Primary energy source for cooking (%)		Secondary (additional) energy source for cooking (%)	
	Urban locations	Suburban locations	Urban locations	Suburban locations
Summer				
Electricity	54	4	11	3
Charcoal	21	6	67	42
Fuelwood	26	90	19	31
Cattle dung			1	24
Gas cylinder			2	0
Winter				
Electricity	51	4	13	5
Charcoal	22	6	63	46
Fuelwood	24	88	20	25
Cattle dung			0	23
Gas cylinder			4	0

Differences to 100% in the case of primary energy sources are covered by other sources. The two-sample t-test of the mean equality of the primary fuel source for cooking always indicates statistically significant differences in the means at a 1% level between the two locations. Means of electricity and gas cylinders used as secondary sources in winter are different at a 5% level. Gas cylinders and fuelwood used as a secondary source in summer and winter, respectively, are not statistically different at any convenient level

Table 5: Fuelwood collection and its scarcity

Question	Response options	Percent
Who is responsible to avail energy supply in your household?	Wife	65.95
	Husband	20
	Children	12.7
	Other (dependant)	1.35
Where do you collect firewood?	Woodlot	6.69
	Natural forest	9.47
	Buy from market	54.32
	Buy from shop	29.53
How much time does it take to collect firewood in hours?	0.30 h	43.37
	1 h	17.47
	1:00-1 :30 h	26.51
	2 h	8.73
	More than 2 h	3.92
Do you think firewood is scarce?	Yes	64.71
How do you perceive the problem of firewood scarcity in your area?	Highly severe	40.45
	Severe	16.18
	Average	39.48
	Not severe	3.88
What is the best strategy to solve the problem of firewood scarcity?	Planting trees	39
	Charcoal production	5
	Prevent bushfires	12
	Alternative energy	44

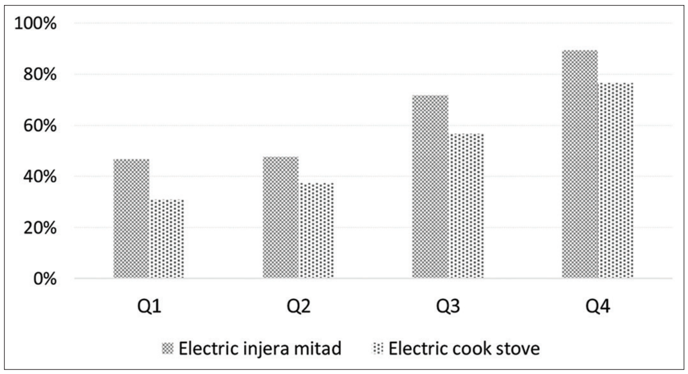
cooking in about 12% of households in urban locations, while there are <5% of such households in suburban locations. As in the case of the primary energy sources, there are no differences in which energy sources are used as secondary sources in the wet summer and dry winter.

4.4. Fuelwood Collection and Fuelwood Availability

Fuelwood is the key source of energy for cooking especially in suburban locations, where almost 90% of households use wood for cooking. Even in urban locations fuelwood is important. A quarter of households use wood for cooking as a primary source, and another fifth use wood as a secondary source of energy for cooking. Where does this wood come from?

In suburban locations fuelwood is mainly collected and, based on our survey, households living there collect or buy fuelwood on average 6 times a month. The responsibility for gathering fuelwood falls mainly to females: in 66 % of cases this responsibility falls to women. Most fuelwood is purchased either from local markets

Figure 4: Ownership of electric appliances for cooking, by income quartile



(55%) or shopping centres (30%), but some respondents collect fuelwood from wood lots (7%) and natural forests (9%), Table 6.

If we turn to time spent on collecting fuelwood, the greatest number of respondents (44%) reported that they spent on average a half an hour on this activity, 17% t spent an hour and 27% spent up to one and a half hours. Despite this, about 65% of respondents believe that fuelwood is scarce and 40% perceive the current situation as very severe, with only 4% of them perceiving the situation as not severe at all. Among the mechanisms available to cope with fuelwood scarcity, the majority would consider using alternative energy (44%) and planting trees (39%). Relatively few think that the scarcity problem can be addressed by preventing bushfires (12%) or by producing more charcoal (5%).

4.5. Using Fuelwood, Charcoal, or Electricity for Cooking?

Next, we analyse the choice of primary energy sources for cooking and as there are three exclusive options to choose from (fuelwood, charcoal, and electricity), multinomial logit is an appropriate model to analyse this choice (Green, 2012; Jumbe and Angelsen, 2011). Results from the maximum likelihood estimate of multinomial logit model are presented in Table 6 Panel A, with fuelwood as the reference category. The marginal effect for each explanatory variable is displayed below, in Panel B.

As expected, the probability of using a cleaner source for cooking —electricity—increases with income; each 1000 Birr

Table 6: MNL estimation results: probability of choosing primary energy source for cooking

Panel A – MNL coefficients		
	Electricity	**Charcoal**
Income (in 1000 Birr)	0.1081***	0.022
	(0.0386)	(0.0474)
Budget share on energy	0.0053	0.0031
	(0.0045)	(0.0049)
Living in suburban area	−3.5323***	−2.3283***
	(0.4753)	(0.4507)
Self-collected or home-grown biomass	−0.4706	−0.8415**
	(0.353)	(0.3877)
Family size	−0.1083	−0.2757***
	(0.0771)	(0.0895)
Age of family head	0.005	0.0321**
	(0.0119)	(0.0137)
Family head is male	−0.6898**	−1.4984***
	(0.345)	(0.4099)
Decision maker is male	0.7118	1.2919***
	(0.4332)	(0.4954)
Able to read and write or without formal education	0.4516	−0.1262
	(0.5678)	(0.5494)
Has formal education	1.5144**	1.0654*
	(0.5981)	(0.587)
Constant	−0.1815	−0.0983
	(0.8689)	(0.9588)
LL	−267.88	
LR chi2	1 223.81	
2 Pseudo R2	3 0.2947	
4 N obs.	5 371	

6 Panel B – Marginal effects			
	7 Electricity	**8 Charcoal**	**9 Fuelwood**
Income (in 1000 Birr)	0.0156***	−0.0052	−0.0104**
	(0.0045)	(0.0045)	(0.005)
Budget share on energy	0.0006	0.000	−0.0006
	(0.0005)	(0.0004)	(0.0006)
Living in suburban area	−0.3916***	−0.0287	0.4203***
	(0.0622)	(0.0508)	(0.0313)
Self-collected or home-grown biomass	−0.0133	−0.0693*	0.0826*
	(0.0464)	(0.0392)	(0.0435)
Family size	0.0029	−0.0261***	0.0231**
	(0.0108)	(0.0096)	(0.0093)
Age of family head	−0.0015	0.0036**	-0.0020
	(0.0016)	(0.0014)	(0.0015)
Family head is male	−0.0001	−0.1343***	0.1344***
	(0.0462)	(0.0422)	(0.0418)
Decision maker is male	0.0187	0.1072**	−0.1259**
	(0.0585)	(0.0516)	(0.0528)
Able to read and write or without formal education	0.0811	−0.0486	−0.0325
	(0.0808)	(0.0618)	(0.0656)
Has formal education	0.1630**	0.0206	−0.1836***
	(0.0812)	(0.0626)	(0.069)

Standard errors in parenthesis, *, **, *** indicate the significance at 10%, 5% and 1% level, respectively

of household monthly income increases the probability of using electricity by 1.6%. The effect of income on using fuelwood is the opposite, and the likelihood is decreased by about 1% for each 1000 Birr. This means that the higher the household income, the more the household is able to afford modern cooking energy sources as opposed to less expensive traditional sources. A large energy budget share does not have any effect on the choice of energy source for cooking, in contrast to Barnes et al. (2004) who found that in low-income countries larger budget shares are associated with using more traditional fuel sources, like fuelwood in Ethiopia.

Using electricity for cooking increases with urbanization; the probability of using electricity increased by 39% in the families living in urban areas. The opposite is true for families from suburban areas, who are more likely to choose fuelwood (+42% compared to two other sources). This may also indicate that in urban areas fuelwood is becoming scarce because of the increasing energy demand due to migration from rural and suburban locations to urban areas. Those families who have access to self-collected or home-grown biomass are more likely to choose fuelwood (+8%) and less likely to choose charcoal as the primary energy source for cooking (-7%), a finding that is consistent with Helberg's 2004 study.

Large families are more likely to choose fuelwood, which costs less or can be collected for free from forests and agricultural residuals. In this case the likelihood increases by 2.3% for each family. These families also use less charcoal, which is a highly commercialized and more costly fuel source, specifically in urban areas. Each person living in a household decreases this likelihood by 2.6%.

Older families, measured by the age of thehead of the family , are more likely to choose charcoal compared to electricity and fuelwood – each additional 5 years of the head of the family's age increases the likelihood by 1.8%. We also find that female-headed households are more likely to choose charcoal for cooking, while male-headed households more likely choose fuelwood. However, if we examine who makes decisions about household purchases, we find the opposite behaviour prevails – male decision-makers more often choose charcoal, whilst female decision-makers favour fuelwood as the primary source for cooking. In other words, despite the fact that females as head of families prefer charcoal and do not choose fuelwood, if they are in a position to make economic-related decisions they are more likely to favour fuelwood. This different pattern may be explained by the more limited economic resources of the households where decisions are taken by females, who are also more responsible for providing fuelwood. It seems that female-headed households also tend to choose modern energy sources – for example electricity – than other energy sources that are more labour- and time-intensive toobtain, as has been found in similar studies carried out in Ghana and Tanzania (Barnes et al., 2004). However, in our case, this association is not significant at any convenient level.

Families with a head who is formally educated use electricity for cooking more, at 16%. On the other hand where formal education is associated negatively with using fuelwood, the likelihood decreases by 18%. Although we found a similar tendency for families whose head has an informal education or is able to read and write, their preference for choosing an energy source is not statistically different from the preference of families with an illiterate head. Formal education may therefore be the key factor in moving to cleaner electricity and act as an important trigger of health benefits due to raising awareness about the health risks associated with the use of dirty traditional energy sources.

5. CONCLUSION

Using the original survey conducted among 376 households living in urban and suburban locations in the Sidama region Southern Ethiopia, we analyse energy use in households and, in particular, the use of three energy sources (fuelwood, charcoal, and electricity) for cooking that differ in their potentially adverse health impact. Energy expenditure represents about 28 percent of total household expenditure and the budget share sharply decreases with household income. While households from the two lowest quartiles spend on average 43 and 25% respectively, the highest two income quartiles spend 13 and 8 percent only. Moreover, there are a considerable number of households without expenditure on energy, and this share sharply declines with household income.

Cooking is the main energy-related activity on which households in Hawassa region spend money. They spend about $15 USD a month on energy for cooking and this represents 89 percent of their total energy expenditure, used for all purposes. There are large differences in energy patterns between households living in urban and suburban locations. The former spend on average twice as much as the latter ($10.5). Expenditureon the clean energy source, electricity, represents only about a fifth of total household energy expenditure.

Fuelwood, a potentially health damaging energy source, has been the prevailing dominant form of energy among households in the Hawassa region. Usage of fuelwood, however, differs significantly between urban and suburban areas. While 90% of households from suburban areas still rely on fuelwood, fuelwood is the primary energy source for cooking in only a quarter of urban households. However, fuelwood is also used as a secondary fuel for cooking in another 10% of urban households. Most of the fuelwood is purchased in local markets and shopping centres, and 16% of households still rely on wood collected in wood lots and natural forest. Dependence on fuelwood is not only associated with adverse health effects, but it may escalate the problem of wood scarcity. In fact 65% of households think that fuelwood is scarce and 57% perceive this problem as severe or highly severe. The best mitigation strategy is considered to be planting trees (39%), but also investing in alternative energy (44%), while only 5% consider charcoal production to be a good strategy of coping with the scarcity problem.

Charcoal that is commercialised and more expensive than fuelwood is mainly used as the primary source for cooking in urban areas, by 21% of households, while there are a very small number of suburban households relying on charcoal. Still, 67 percent of households in urban locations and 42% in suburban locations pay at least something for charcoal, used as the secondary energy for cooking.

Electricity is typically the main primary source for cooking in urban locations. There are about 54% of such households, whilst there are only 4% of such consumers in suburban locations. It is worth mentioning that while approximately a third of households in our sample say that electricity is their primary energy source for cooking, only around a quarter of them pay to use it. The limited affordability of the cleaner, more modern energy source of electricity, is also indicated by 47% of households in the lowest income quartile who own an electric injera mitad —the traditional Ethiopian cooking appliance, whilst there are only 5% among them with some expenditure on electricity for cooking.

We find a similar pattern in Hawassa, which is commonly seen in the countries in sub-saharan Africa. Fuelwood and charcoal are the main sources for cooking among the poorest households; fuelwood is the dominant source for cooking in suburban locations, while electricity is mainly used in urban areas and especially by richer households. We find there is no significant difference in this general pattern during the wet and rainy season (summer) and the dry season (winter).

Regarding socio-demographic characteristics, we find that electricity use for cooking increases with income, and each 1000 Birr of household income increases the probability of using electricity by 1.6%. The effect of income on using fuelwood is the opposite. Large families are more likely to prefer fuelwood and are less likely to choose charcoal, which is highly commercialized and more costly, specifically in urban areas.

It is left mostly up to females in Hawassa to gather fuelwood. We also find that female-headed households are more likely to choose charcoal for cooking. However, if females make decisions about household purchases, they tend to choose fuelwood for cooking. This different pattern may be explained by the lower economic resources of households where decisions are made by females who are also more responsible for providing fuelwood. Although our results are largely in line with the results found for other similar countries in sub-Saharan Africa, we do not support the idea that female-headed households are more likely to choose electricity for cooking as shown, for instance, in the study carried out in Ghana and Tanzania by Barnes et al. (2004). Therefore, we find a positive association between formal education and using electricity for cooking, whilst formal education reduces the likelihood of using fuelwood. Formal education is therefore one of the key triggers to move from dirty traditional energy sources like fuelwood to clean modern sources like electricity, through raising awareness about potential health risks associated with using energy in homes.

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